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Evaluation of a Multicomponent Oral Health Education Intervention in a Vulnerable Infant Population: A Mixed Methods Study

Thomas, Nicole

UNIVERSITY OF PLYMOUTH

Evaluation of a Multicomponent Oral Health Education Intervention in a Vulnerable Infant Population: A Mixed Methods Study

by

NICOLE THOMAS

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Author's Declaration

I hereby declare that I am the sole author of this thesis. This thesis is entirely my own work, in my own words. To the best of my knowledge this thesis contains no material previously published by any other person except where due acknowledgement has been made.

At no time during the registration for the degree of Doctor of Philosophy has the author been registered for any other University award without prior agreement of the Doctoral College Quality Sub-Committee.

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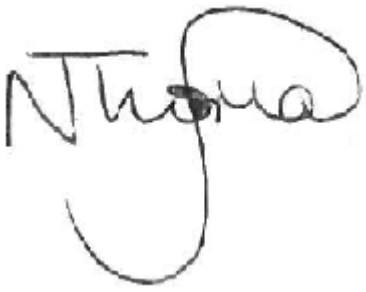
Signed:  **Dated: 11th November 2022**

Abstract

Policy makers and researchers have recommended that oral health initiatives should target primary caregivers in the first year of life to reduce the risk of early childhood caries. Approaches using mobile technologies for oral health are now being endorsed by the World Health Organisation.

This mixed methods exploratory study examined the feasibility, acceptability and effectiveness of engaging and delivering a multicomponent oral health education intervention to vulnerable caregivers in the first year of their infant's life. The study explored three engagement approaches: in-person (IP), a social messaging platform (two-way text messaging and/or a social messaging group) (SMP), or both (IP-SMP). The intervention supported a caregiver's self-efficacy in the uptake and maintenance of key oral health behaviours. A survey and analytical framework were used for data collection and analysis of acceptability. The validated general self-efficacy scale was used to measure self-efficacy. In addition, a methodological study explored the feasibility of using full arch digital images as a dental caries examination method for its potential use at the end of the study intervention.

Forty-four mothers were recruited and randomised into the three engagement approaches and a control group. The IP-SMP intervention delivery method was shown to be the most acceptable (P=0.03) with the optimal start of delivery being when infants are four months old. Peer-to-peer support, flexibility in how to access expertise and trust in expertise impacted acceptability. How mothers coped with infant temperament and teething

impacted the uptake and maintenance of oral health practices. Reassurance and guidance on how to facilitate toothbrushing, especially during periods of teething, was highly valued by the mothers. Trust was lost in early years services when compassion for the challenges associated with infant temperament and teething wasn't shown. Educating early years and family support services on the impact of infant temperament and teething on oral health behaviours may have value in encouraging caregivers with their infant's oral health. Two-way text messaging could be a flexible and low-resource way of early years services supporting caregivers in this way and should be investigated. In addition, early years services themselves may benefit from text message support to aid the delivery of oral health education which could be a further valuable avenue of study.

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Glossary of Terms

Dental disease: Tooth decay, developmental defects of enamel, dental erosion and periodontal (gum) disease form dental disease, predominantly caused by poor oral hygiene habits

Early Childhood Caries: rapidly progressive tooth decay, with a distinguishing appearance**,** in one or more teeth, which arises in children under the age of 6 years old

Early Years Services: Services which provide children and their family access to high quality early education and support to achieve the best outcomes in life

Familial Self-efficacy: accumulative self-efficacy of the family to carry out behaviours which has a positive overall effect on being able to deal with issues and overcome them

Intervention: any program, service, policy or product that is intended to ultimately influence or change peoples' social, environmental, and organisational conditions as well as their choices, attitudes, beliefs and behaviours.

Oral Health Literacy: ability to obtain, process, and understand basic oral health information and have an awareness of the services available to them, to make appropriate oral health choices

Oral Health Behaviour: the complex outcome on individual oral health from oral hygiene habits, nutritional preferences and how often a person utilises dental services

Parental Self-efficacy: parents' beliefs about being able to influence their child in a way that fosters his or her positive development and adjustment

Perinatal: the period of time just prior to giving birth and up to a year after

Self-efficacy: confidence in ability to carry out tasks needed to achieve necessary behaviours

Oral Health Vulnerability: The attributes of vulnerability which are closely related to family and community factors and identified as limited parental income, lack of access to community-based services, Index of Multiple Deprivation decile and being in receipt of family support services.

Introduction

Since the formation of the World Health Organisation (WHO) in 1948, the WHO has carried out extensive research into improving global child oral health over the past 70 years (Peterson 2010). Despite this, childhood dental caries still affects 60-90% of school children around the world (World Health Organisation 2019). Early childhood caries (ECC) refers to one or more decayed teeth, which arises in children under the age of 6 years old. ECC has a distinguishing appearance, is rapidly progressive and is said to have a profound impact on a child's life, especially if left untreated (Drury et al., 1999). Life-long implications reported in the literature range from poor weight gain, sleep deprivation, poor school attendance, and/or increased risk of future dental caries (Sheiham 2006, Jackson et al., 2011, Seirawan et al., 2012, Public Health England 2017, Mansoori et al., 2019).

Treatment of ECC is challenging. It can often lead to the need for invasive dental procedures under general anaesthetic, missed school days and increased risk of dental anxieties and avoidance of treatment in later life (Haworth et al., 2017, Public Health England 2018). The numerous factors involved in the provision and uptake of dental general anaesthetics (DGA) is complex and discussed in the literature (Robertson et al., 2012, Broomhead et al., 2020). However, there is a considerable number of children undergoing the procedure in the UK which carries a 1:400,000 risk of life-threatening problems (The Royal College of Anaesthetists 2008). Data published in 2017 showed 9,206 children under five years old, underwent a DGA in the year 2014/15 (Royal College of Surgeons 2017) with a cost burden of £7.8 million to the NHS.

The link between social deprivation and ECC is well established in the literature (Locker 2000, Vadiakas 2008), with dental caries experience being more unequally distributed between

deprived and wealthy populations in highly developed countries (Schwendicke et al., 2014). The impact of social deprivation is thought to start during pregnancy with stress and poor living conditions experienced by the mother disrupting the healthy development of teeth in utero (Caufield et al., 2012). The National Institute for Health and Care Excellence (2020) reported findings which suggest children living in areas of deprivation in the UK can have an eightfold increase in risk of ECC compared to their wealthier counterparts. This increased risk of ECC is also demonstrated in the Public Health England (2018) oral health data, which reported approximately double the prevalence of five-year-old children experiencing ECC in the Northwest (~34%) compared to the Southeast (~17%). These large variations in ECC prevalence also occur locally. In Devon UK, the least deprived areas show the lowest percentage (~13%) of ECC experience compared to the most deprived regions with approximately 35% of five-year olds experiencing ECC (Public Health England 2018). Vadiakas (2008) reports socially deprived infants may be further impacted if they belong to ethnic minority groups.

Despite the well-established link between social deprivation and ECC, the literature has shifted away from simplistic relationships to include other multiple complex contributors to an infant's vulnerability to ECC (Children's Commissioner for England 2017). These contributing factors include socio-behavioural, economic, environmental and societal factors, known as the social determinants of health (World Health Organisation 2008, Hooley et al., 2012). Reisine and Douglass (1998) describe the importance of considering a caregiver's mental wellbeing and their subsequent attitudes and beliefs towards their infant's oral health as an influencing factor on ECC. In addition, Horowitz and Kleinman (2008) discuss how the ability of a caregiver to turn oral health knowledge into oral health behaviours (oral health literacy) is a major contributing factor to infant oral health. Although not specific to infant

oral health, Wamala et al., (2007) suggests those who experience frequent discrimination, even in the absence of social deprivation, were associated with three to nine-fold increased odds for refraining from seeking medical treatment. Reluctance to engage with healthcare services may also be not recognising and accepting vulnerability to disease in the first place and may be rooted in feelings of shame (Brown 2006).

The WHO recommend population-based prevention of ECC, and health promotion initiatives should target pregnant women, new mothers and primary caregivers with the aim of educating and disseminating knowledge (Phantumvanit et al., 2018). The literature similarly advocates that caregivers and their infants should be enrolled in an oral health education programme in the first year of life (Leong et al., 2013, Lemos et al., 2014, Chen et al., 2019). This is to address the reported habits which can significantly increase an infant's risk of ECC (Feldens et al., 2010a, Leong et al., 2013). Some of these habits may seem perfectly natural to a caregiver, such as habitually kissing on the lips or pretesting food and sharing the infant's utensils. However, this could potentially expose the infant to higher levels of bacterial transfer, particularly the bacteria responsible for ECC, if the caregiver themselves has poor levels of oral health (Wan et al., 2003). Introducing sugary foods and liquids earlier than is recommended, having poor dental attendance and insufficient toothbrushing habits have all been shown to increase risk of ECC (Huebner and Riedy 2010, Mattheus 2010, Herman et al., 2012, Leong et al., 2013, Duijster et al., 2015). In addition, caregiver confidence in their ability to carry out the necessary oral health habits and the number of children a family has, are both said to increase vulnerability to ECC (Christensen et al., 2010, Silva-Sanigorski et al., 2013, Wilson et al., 2017).

Certain mediating factors identified in the literature may be out of the family's control, such as using childcare for more than ten hours a week, the mother's education and family income (Wan et al., 2003). The consumption of sugary foods and drinks have been shown to be influenced by factors external to the family, including the school, the social environment, commercials and television, supermarkets and affordability of foods (Duijster et al., 2015). This can be alongside cultural beliefs about the limited function and low importance of primary teeth which may hinder access to early preventative oral health care for their young children (Hilton et al., 2007). Non-natives to a country of residence may find barriers with navigating the country's bureaucracy and health systems, particularly where language and educational barriers co-exist (Christensen et al., 2010). Negative mind-sets and avoidance of oral healthcare services may have been passed down by older generations with fatalistic attitudes to oral health (Roden 2003, Smith and Freeman 2010). These parental variables are important mediating factors in the development of ECC. However, Hooley et al. (2012) suggests this area of oral health research is still not well understood. More focus needs to be drawn on what it is parents do, given the constraints they behave within, that determine their child's health outcomes.

The two distinct pathways said to be used to develop oral healthcare interventions are either, a top-down approach using a well-established theory which underpins the development of the intervention, or a bottom-up approach using clinical experience as the driver of the intervention (Vansteenkiste and Sheldon 2006). However, integrating both psychosocial theories to conceptualise new behaviour change models whilst still being guided by clinical expertise is thought to be the most ideal approach to oral health intervention design (Watt 2002, Cathain et al., 2019). Adopting this ideal design approach, the overarching aim of this PhD was to support the confidence and emotional wellbeing of a vulnerable population of

primary caregivers with infant oral health practices. An intervention, underpinned by Bandura's self-efficacy theory, was developed to increase the caregivers' oral health knowledge and encourage positive infant-focussed oral health behaviours in the first year of the infants' life. Vulnerability was defined as primary caregivers with a limited income and/or a lack of access to community-based health services and/or being in receipt of family support from community-based health services (Mattheus 2010).

This thesis therefore describes a randomised controlled feasibility study, "Filling the Gap" (FtG), along with a nested methodological study, "Open Wide" (OW). The FtG study used mixed methods to examine acceptability, feasibility and effectiveness of different engagement approaches used in a multicomponent oral health education intervention. Whether these approaches impacted the general self-efficacy of the primary caregivers, and behaviour uptake and maintenance of oral health behaviours for their infants, were explored. There was also focus drawn on the feasibility of the processes of the study, such as the methods used for recruitment and the methods used for evaluating the intervention. This included:

- The development of acceptability measurements used in an intervention survey
- The preliminary testing of a dental caries measurement tool using digital images to collect child oral health data (OW study).

Revisions to the original protocol

Prior to this PhD, an earlier intervention development study was carried out, in which I was involved but was not leading. Being involved in the end stage analysis of the pre-PhD study formed part of my qualitative research methods training. This included summarising and theorising on the findings. This raised questions which were used as a focus when critically

reviewing the literature and led to the PhD being carried out in two parts; the FtG study and the OW study (see Figure 1).

The OW study was a methodological study. It explored the use of full arch digital images to measure dental caries in primary teeth as a more resource efficient way to evaluate child oral health in research trials and to add to the literature regarding the validity of digital epidemiology. If found to be feasible and accurate, it was also to be used to evaluate infant oral health at the end of the main FtG intervention study. However, due to revisions to the original protocol, an endpoint child oral health evaluation tool was no longer required for the FtG study. As the revisions occurred after the OW study had been completed, the OW study is still reported and discussed within this thesis.

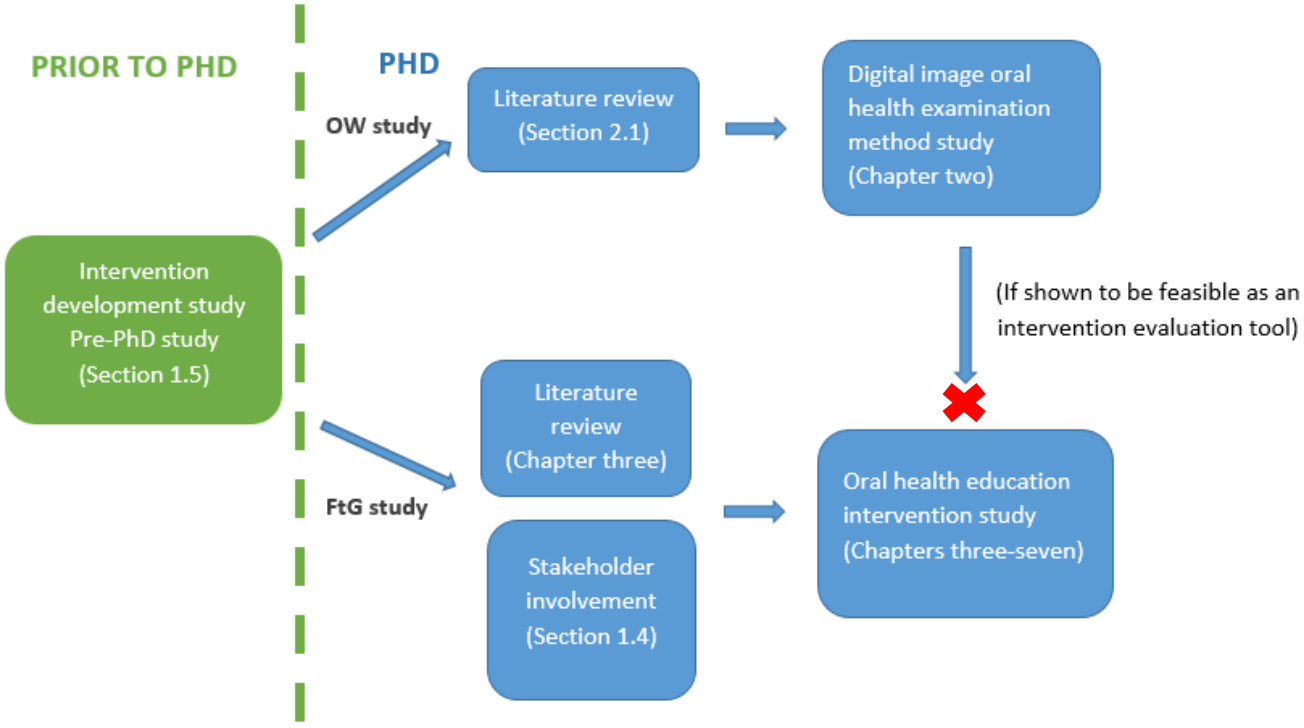


Figure 1: *Diagram to show the main components of the PhD and where they are discussed in the thesis. The red cross represents where the "Open Wide" (OW) study no longer contributed to the "Filling the Gap" (FtG) study.*

Appendix A provides the original protocol and revisions to the protocol. The revisions to the original protocol have been included to provide insight on the logistical and social challenges in conducting health services research, which can be used to inform future intervention development studies.

Organisation of the thesis

Chapter One addresses the influences of the PhD, which shaped and informed the critical review of the literature for the OW study and the FtG study. This includes the earlier pre-PhD intervention development study, stakeholder involvement and my own personal experiences. The chapter also provides an explanation to the philosophical approach of critical realism used in the design and evaluation of the main oral health education intervention study of this PhD (FtG study).

Chapter two begins with the critical review of the literature for the OW methodological study. The chapter then describes the methods and findings of the study and concludes with the feasibility of full arch digital images as an intervention evaluation tool in child oral health dental studies and digital epidemiology.

Chapter Three critically reviews the literature for the FtG study. The literature review focuses on the complex nature of early childhood caries including the mediating factors which are thought to increase risk. Interventions which used behavioural theories versus those which used educational practice are then discussed. A conceptualised model is provided to show how the critical review of the literature will inform the delivery of the intervention.

Chapter Four discusses the methodology and methods used to explore the main theories and research questions for the FtG study. It describes how the different deductive inquiry components, both quantitative and qualitative, will be used to find the best possible explanation from the study findings and answer the research questions.

Chapter Five describes both the quantitative and qualitative findings which answer the feasibility and acceptability research questions of the intervention. This includes the outcomes of the recruitment approaches and the impact these approaches had on the participant profile. Engagement outcomes from the intervention engagement approaches are described, along with other factors found to impact engagement. The two key themes found to impact acceptability are also described.

Chapter Six completes the findings of the FtG study. It describes which engagement components were effective in supporting self-efficacy in the uptake and maintenance of the target oral health behaviours. This chapter also introduces a new oral health behaviour which impacted the ability of mothers to carry out oral health behaviours, and which was identified when supporting mothers on the social messaging group. This chapter also discusses the environmental factors found to influence the mothers' self-efficacy and ability to carry out the oral health goals they had set out for their infants.

Chapter Seven explains the findings from Chapter Five and Six, evaluating the design of the FtG study and possible causal mechanisms which may have influenced the outcomes. How the key findings contribute to the existing literature, along with the limitations of this study and possible avenues for future research are discussed. This includes introducing an emerging theory regarding the affective (emotional) states of the mothers, and other key people involved in the infant's care, and the possible impact on oral health decision-making.

Chapter Eight concludes the findings of both the OW study and the FtG study. It expands on the emerging theory of affective states on oral health decision-making and provides conceptual models on how the findings of this PhD can be used to improve future dental health studies. It also discusses possible implications for early years services including improvements to oral health education training.

1.0 Chapter one: Methodologies of the PhD

The research questions and methods of this PhD were predominantly informed and shaped by a critical review of the literature. However, other contributors motivated the research questions and methods for the "Filling the Gap" (FtG) intervention study and the "Open Wide" (OW) methodological study. This included an earlier intervention development study which took place prior to the PhD (pre-PhD study), and stakeholder involvement.

These influences will be discussed in this detail in this chapter. However, first I will address the influence my own values had on the philosophical approach used in the research design for main oral health intervention study of this PhD (FtG study).

1.1 Author Position and Philosophical Approach

The main purpose of an exploratory study is said to be to understand how intervention components interact and impact the final outcomes of the intervention (Bowen et al., 2009, Halligburg et al., 2018). As the person delivering and evaluating the intervention, I felt it important to regularly reflect on how my own interactions may be impacting the study outcomes. Therefore, parts of this thesis will be written reflexively. In addition, my own reflections on the research methods and the engagement approaches used in the intervention are included within the analytical framework and reported within the findings.

Being influenced by our own values to research issues close to our own experience, has to be done so with caution, as Letherby discusses in the book, Objectivity and Subjectivity in Social Research (Letherby et al., 2012, pages 2-3). However, not acknowledging, at some level, the influence of life experiences on our researcher identity would be more problematic, as this identity impacts the work that we do (Letherby et al., 2012). Despite being unorthodox, I

include in this thesis a description of two key life experiences which I suggest influenced my focus on emotional wellbeing when reviewing the findings of the pre-PhD study. This focus of emotional wellbeing was also used when critically reviewing the literature for the main intervention study of this PhD and motivated how I delivered and evaluated the study. By being aware of this focus, I strived to reduce bias by actively seeking constructive criticisms from my peers and supervisors and by reflecting my observations with those who may have differing viewpoints and clinical backgrounds to me.

1.1.1 Infant feeding peer-to-peer support

Following the birth of my first child, the pressure I had felt to pursue 'best practice' with my infant feeding journey had a profound impact on my wellbeing, particularly when expectation did not meet reality. I was therefore compelled to take on a volunteering role as a peer-to-peer infant feeding support worker, supporting mothers in the vulnerable first few weeks and months of their infant's life.

The aim of an infant feeding support worker was to encourage breastfeeding as the ideal behavioural outcome, and to not discuss alternative practices. This included teaching only breastfeeding practice at the ante-natal level with the education containing the latest evidence-based information about the health benefits of breastfeeding. Despite the breastfeeding health promotion and support, breastfeeding rates remained low with 99% of mothers not reaching the recommended guideline of breastfeeding to six months. I wanted to find possible explanations for this as I personally did not believe the rhetoric that formula feeding mothers were 'selfish' 'lazy' or 'gave up too easily', and so carried out an infant feeding survey. The rudimentary survey was shared on various infant feeding Facebook support groups, for both breastfeeding and formula feeding mothers. There were an

astonishing 565 responses from mothers, internationally, all sharing very similar experiences of shame and guilt which had a profound impact on their emotional wellbeing. This was due to not being able to reach their pre-determined infant feeding goals. Mothers wanted their experience of trying their hardest to be believed; if they had only been provided information on the alternatives, the pressure might not have caused a decline in emotional wellbeing which in turn was instrumental in the failure of their infant feeding journey. Reading these mothers' accounts of their experiences led me to believe the statistical research driving the infant feeding health promotion material was only telling one side of the story. It appeared what mothers needed help with the uptake and maintenance of breastfeeding was not being paid attention to and could not be expressed using quantitative language alone. In addition, I observed that the statistical breastfeeding evidence was being weaponised against mothers by mothers, with internet forums arguing correlation and causation with eloquent and well-researched arguments. This was to the detriment of the lived human experience. This made me consider the importance and value of both qualitative and quantitative methods in research to tell a more complete story, as well as thinking differently about how supporting emotional wellbeing may favour behaviour change, instead of knowledge dissemination alone.

1.1.2 Emotional regulation and behaviour uptake

Having a child with severe learning disability was another major life learning experience. Having a non-verbal child who also lacked the ability to understand language meant I had to develop skills in understanding and recognising non-verbal communication. I had to learn a whole new way of communicating and unlearn behaviours of 'atypical parenting' to be able to connect with my child in order to overcome challenges, even ones as simple as toothbrushing. This required constant self-reflection and trying to put my own perceptions of

reality to one side. In order to help him, I had to see things from his point of view and understand his experience of the world, which was clearly very different to mine. Bridging the gap between my world and my child's meant having to find the middle ground and make reconstructive changes in an incremental way, to cause the least distress. It meant that I became adept at exploring and testing multiple theories on why meltdowns were occurring, in order to avoid the triggers which were causing the greatest difficulties. I had to become acutely aware of motivators to behaviour and nourish emotional wellbeing in order for my son to thrive. One of the major parts of this journey was attending a clinical psychology-led course on positive behaviour strategies. The premise of these courses was to recognise the emotional triggers which were manifesting physically in behaviours, particularly during the early stages of distress. Being able to recognise the early warning signs meant my child didn't have to reach 'the red zone' before the problem was recognised. Rather than having a negative version of himself being continually reinforced, he was able to be his best self, enhancing his emotional wellbeing and in turn, encouraging positive behaviours including self-care. This reinforced my learning and understanding about how we think and feel about ourselves as a key component to our behaviours, decision-making and our ability to practice self-care, including habits associated with oral health.

Despite infant feeding practices and strategies to help children with additional needs not being directly related to oral health practices, I could see an overlap, especially when viewed through the lens of emotional wellbeing. Understanding how our internal emotional world impacts our external social world, and therefore our interactions and behaviours within it, including oral health practices, was the energy I channelled into this PhD project. This was a good fit with the philosophical approach of Critical Realism as described by Roy Bhaskar

(1978), due to its concern with exploring relationships which interlink and overlap in the possible causation of a particular phenomenon.

1.2 Critical Realism

Critical Realism (CR) is first and foremost a philosophy concerned with ontology – the philosophical nature of being – and how statements about the world (ontology) cannot be reduced to statements about our knowledge of the world (epistemology) (Bhaskar 1978, Bhaskar 1998). CR defines an objective reality as one that exists independently of an individual's perception, but also recognizes the role that an individual's subjective interpretation plays in defining that reality (Bhaskar 1978, Bhaskar 1998). Within social sciences, CR is concerned with the interconnectedness of where people are placed within society, how people interact and live within the stable institutions of society, how people interact with each other, and the material transaction with nature (Bhaskar 1978, Bhaskar 1998). According to Bhaskar (1978, p48), social structure (for example, the World Health Organisation) is one such example of subjective interpretation as the structure only exists in 'virtue of the activities they govern and cannot be empirically identified independently of them'. This makes social structures activity-dependant (Bhaskar 1978) and observable. Mechanisms in society, such as how people interact with a social structure, can hinder or facilitate how effective a social structure is at achieving its goals, which results in an observable impact (Fletcher 2017). For example, how the public interpret and act on oral health messages from the World Health Organisation may result in an increase or decrease in dental disease. This infers causal mechanisms can be social products making these phenomena possible to investigate through scientific inquiry (Fletcher 2017).

Like many other disciplines, critical realists typically begin with a particular problem or question, which has been guided by theory (Bhaskar 1978, Danermark et al., 2002, Fletcher 2017). However, it is a continual theoretical process in the search for causation to help researchers to explain social events and suggest practical policy recommendations to address social problems (Fletcher 2017, Reid 2019). Although CR has been applied to studies exploring health inequalities (Harwood and Clark 2012, Fletcher 2017, Eastwood et al., 2019, Reid 2019), CR has not been explicitly used to explore *oral* health inequalities. As CR is concerned with the depth of investigation (Bhaskar 1978, Bhaskar 1998, Danermark et al., 2002, Ritz 2020), it is well positioned as an appropriate and ideal scientific approach to investigating the multiple complex contributors to child oral health. In addition, CR matches a mixed methods exploratory design.

1.3 Mixed Methods Research

Mixed methods research uses different methods for different inquiry components to gain divergent views and provide a more complete picture of the phenomena being investigated (Greene et al., 1989, Carey 1993, Sale et al., 2002, Biesta 2010, Maxwell and Mittapalli 2010, Creswell and Clark 2011, Zachariadis et al., 2013). As described by Creswell and Clark (2011), mixed methods is not simply the gathering of quantitative and qualitative data to provide a formative and summative evaluation of the research problem. Mixed methods is an approach which integrates the combined strengths of both stories and experiences with statistical trends to provide a better understanding of the research problem, than either form of data alone (Creswell and Clark 2011). For this PhD, a mixed methods approach was used to gather and integrate both closed-ended (quantitative) and open-ended (qualitative) data with a CR lens to guide the critical reflections and interpretations of the findings.

1.4 Stakeholder Involvement

Stakeholder involvement in research can develop the research design by seeking feedback from those who may be most affected by the study outcomes (Boaz et al., 2018, Concannon et al., 2019). Involving stakeholders enriches the researcher's understanding of the topic area, adding credibility to the research by creating meaningful partners distinct from the research participants (Entwistle et al., 1998, Absolom et al., 2015, Concannon et al., 2019). In this PhD, stakeholder involvement was used to inform the main intervention study (FtG study). Stakeholder involvement refers to informal conversations which took place with parents, children's service providers, a digital media manager based at a university, and a local authority lead for a Southwest city during the research design phase. This was alongside a working group of five mothers who were more heavily involved in the research design. Although falling under the stakeholder terminology, this advisory group will be referred to as a Patient/Public Involvement (PPI) group as they represent the population the oral health education intervention is aimed at and deserve more specific recognition for their involvement. This includes providing feedback on the development of acceptability measurements used in an intervention survey, and on the engagement approaches used to deliver the intervention. The PPI group's involvement will be detailed within the methods which are described in Chapter Four.

1.5 Pre-PhD Study

In 2016, an oral health education intervention development study was undertaken in the Southwest UK. The aim was to create new knowledge about how best to recruit and motivate a target vulnerable population whom very little was known about how best to support behaviours conducive to their infant's oral health (Kay et al., 2019). My role in the pre-PhD

study was assisting end stage analysis by summarising the qualitative findings and reflecting and theorising on these findings with the principal investigator.

The reason for giving an overview and key findings of the pre-PhD study within the thesis is because of the role it had in influencing and informing my PhD, along with the stakeholder involvement, including:

- Testing a full arch digital photographic method as a resource efficient way to measure dental caries in a vulnerable child population (OW study)
- Reviewing the evidence for using the behavioural theory of self-efficacy to underpin the FtG study
- Piloting the same gatekeeper referral recruitment approach which was used in the Pre-PhD study; using early years services to refer vulnerable families to the FtG study
- Reviewing the use of two-way text messaging in healthcare interventions, and piloting it as an oral health education intervention engagement approach in the FtG study
- Reviewing the evidence on the role of compassion in enhancing oral health support, and exploring it as an oral health education intervention delivery approach in the FtG study

The pre-PhD study considered beliefs, attitudes, and oral health knowledge of vulnerable mothers, and was sensitive to the attributes needed by people delivering such an intervention. It was uniquely integrated into a current public health system which is accessed by and is supportive of first-time teenage mothers. This population was known to be difficult to engage with, generally recognised as being at high risk to many chronic diseases and social problems and were served by the Family Nurse Partnership (FNP). The pre-PhD study used the FNP nurses to introduce the oral health educator delivering the intervention to their

teenage clients to encourage engagement with the study. The intervention used the FNP client-driven methodology underpinned by Bandura's self-efficacy theory (Bandura 1977). It delivered the intervention using a motivational interviewing, non-directive style, to disseminated knowledge and support fifteen young mothers. The pre-PhD study consisted of up to three visits by an oral health educator, delivered from around the time of the infant getting their primary teeth.

1.5.1 Key Findings

Kay et al. (2019) concluded that research methods used in the pre-PhD study were effective in recruiting and engaging with the young mothers, and the intervention delivery was acceptable. Several factors were attributed to the effectiveness and acceptability:

- Oral health guidance provided as and when the participant requested it, rather than it being imposed by the oral health educator, meant participants were more receptive to information.
- The initial introduction of the project by the family nurses, who the participants trusted, was vital. The best form of initial contact was found to be when the oral health educator visited with the family nurse.
- Being able to concentrate on the specifics of oral health rather than the wider issues that they discussed with their family nurses was highly valued.
- Participants reported being visited in their own homes was very important to them and made them much more likely to take part.
- Participants valued flexibility in ongoing contact with some feeling that they had all the information they needed after the first visit.

- Participants facing more challenging social situations, required several visits and ongoing text messaging support.

1.5.1.1 Influence on the FtG study

Although applying evidence-based interventions that have worked elsewhere directly to a new population can prove efficient, this may not always be successful. Differing social norms within a population, resources available, and local adaptations needed may compromise important intervention delivery functions (Evans et al., 2019, Movsisyan et al., 2019). Therefore, the FtG study was to determine whether an intervention underpinned by the same behavioural theories, using the same gatekeeper recruitment approach, aimed at a similar population of vulnerable caregivers living across the Southwest UK, would be feasible and acceptable.

There is good evidence to support the use of incorporating technology in health promotion strategies, particularly those who are attempting to promote or maintain behaviour change (Webb et al., 2010). Smartphones now have the capacity of a hand-held computer and have been shown to be widely used across all socioeconomic groups (Mosa et al., 2012). This potentially positions them as an excellent resource for health promotion messaging (Mosa et al., 2012, Casey et al., 2014). As some mothers in the pre-PhD study required ongoing text messaging support, the use of text messaging as an engagement approach in oral health education interventions was explored in the literature.

1.5.1.2 Influence on the OW study

Primary caregivers involved in the FtG intervention study would need to travel to the dental clinic based in Plymouth with their infants or a calibrated examiner would need to travel to them. Both have considerable implications for resource and opportunity costs. As part of our

initial informal consultation with stakeholders, we were aware of the challenges of availability and time for vulnerable families. This was further evidenced by the vulnerable caregivers in the pre-PhD study being more likely to engage with the project if it took place in their home. Therefore, we conducted a literature review to determine other options.

We identified digital images as a potential alternative. Using digital images for measuring dental caries has the advantage of significantly reducing resource costs, burden on participants and their families, and additionally strengthens blinding in research trials with remote access. However, further research was needed to test the feasibility of a more time-efficient method to identify childhood dental caries which would be acceptable to young children. A methodological study comparing full arch digital images to the established visual examination approach was conducted as part of this PhD. This study will be reported in the next chapter.

To conclude this chapter, Figure 2 provides an overview of all the key areas of the main study of the PhD (FtG study) which were predominantly shaped either by stakeholder involvement or the pre-PhD study. The area which led to the OW study is highlighted by a red asterix.

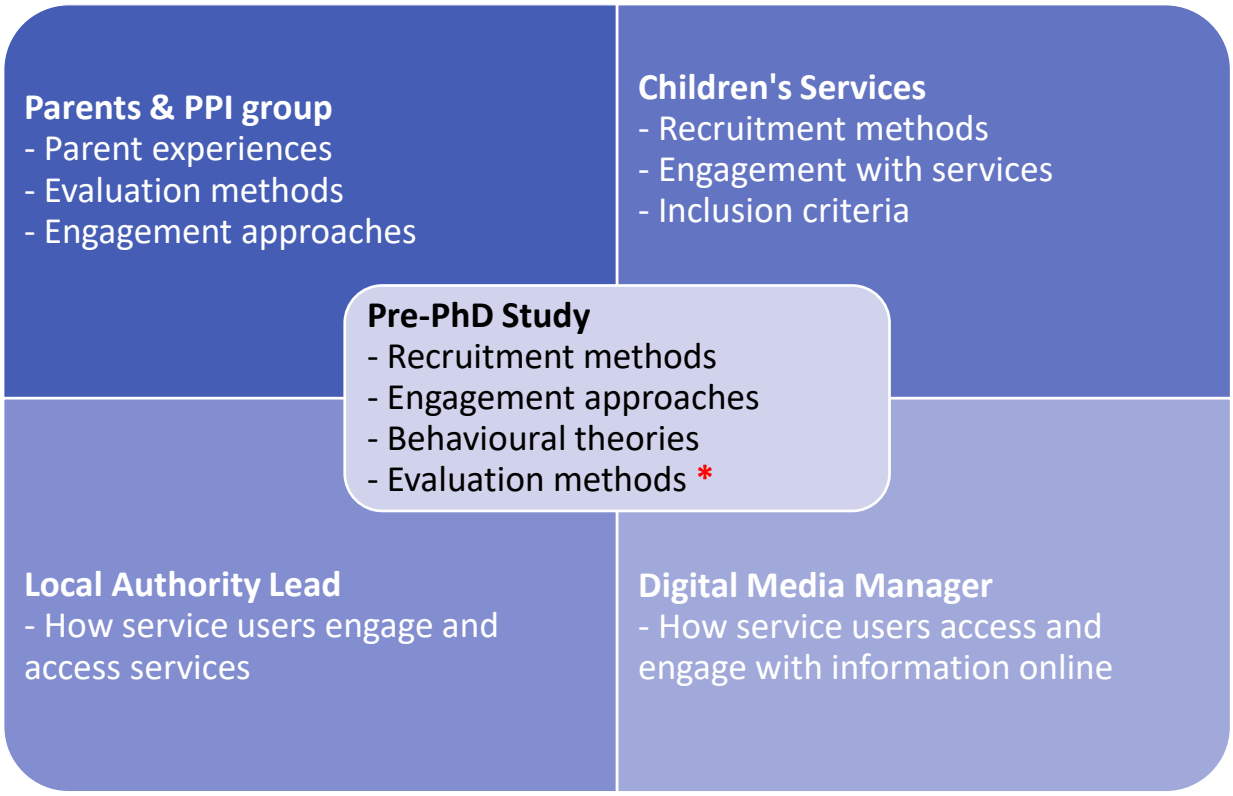


Figure 2. Origins of influence on the research design for The "Filling the Gap" (FtG) study and the areas they contributed

**Influenced the literature review for the "Open Wide" (OW) study only*

2.0 Chapter two: "Open Wide" study - Investigation into full arch digital images as feasible and accurate method to identify early childhood caries

Currently, there are a variety of dental caries assessment methods used in epidemiological studies to assess levels of dental disease in populations (Ismail 2004, Jablonski-Momeni et al., 2008, Kuhnisch et al., 2009). However, with changes in technology, the use of digital photography as a valid methodology has become a possibility (Forgie et al., 2003, Hogen et al., 2018). In the few studies that have been published, the use of digital photography has been reported as equivalent to a benchmark method for the detection of caries (Boye et al., 2012a, Boye et al., 2013a, Boye et al., 2013b, Bottenburg et al., 2016). In addition, it has been shown to be acceptable to both examiners and young children (Boye et al., 2012, Boye et al., 2013).

As a dental disease measurement tool in epidemiology, or for data collection in oral health intervention research trials, a digital method could offer considerable advantages over the standard visual examination. Benefit examples are, reducing resource costs, reducing opportunity costs, strengthening the blinding of examinations and remote accessing and archiving (Forgie et al., 2003, Boye et al., 2012a, Boye et al, 2013a, Boye et al., 2013b, Estai at al., 2016, Hogan et al., 2018). The evidence therefore suggests using a digital method could be a resource efficient way of measuring childhood dental caries in research trials.

Images could be remotely assessed and scored to avoid the barriers of those who are dentally avoidant, and/or living in rural areas, negating the need to visit a dental clinic. However, issues with food and debris obstructing diagnostic accuracy, and it being a time-intensive method, in comparison to the standard visual examination, was also reported (Boye et al., 2013a).

If a research trial needed to identify early childhood caries in a young child population, such as those taking part in the FtG study, a more time-efficient method would be needed. The diagnostic accuracy of using full arch images of the primary teeth as a more time-efficient method to measure early childhood caries had not yet been tested. It was therefore decided to carry out a methodological study using full arch images to answer the research question:

RQ1: Are full arch digital images a feasible and accurate way to measure dental caries in a child population?

If shown to be feasible and accurate then it would be used at the end of the FtG intervention study.

This chapter will firstly review the literature on digital dental disease measurement methods which was available at the time (up to 2018), and which helped inform the rationale. The chapter will then report the methods, including the rationale for chosen methodologies, and findings from The OW study of this PhD. The literature (post 2018) were consistent with the findings from this study and will be included within the discussion in Chapter Eight, section 8.2.

2.1 Literature Review

Oral health epidemiology surveys began being used in the UK in 1973 to determine the prevalence of dental disease in child and adult populations. The findings of oral health surveys informs policy decisions in the oral health service. It can guide the design and implementation of new intervention or adapting current ones in the health service. For example, where oral health services should be expanded or reduced (World Health Organization 2013). They can

contribute to the evaluation of oral health promotion interventions - this can be targeted or population-based interventions.

The WHO endorse epidemiological surveys being carried out every five to six years with the recommended basic methods for collecting oral health data remaining largely unchanged over the last fifty years (World Health Organization 2013). Whereas there are a variety of dental caries assessment methods developed and used in epidemiological research trials to evaluate the levels of dental disease in populations (Ismail 2004, Kuhnisch et al., 2009).

There are different challenges in translating clinical observations into quantitative data to inform policy decisions. This includes validity, reliability and applicability of the methodology but also whether it is possible to manage the risk of bias in the process of collecting data. The literature argues that currently examiners cannot be blinded in the data collection process for dental research trials due to the nature of disease detection (Hogan et al., 2018). To minimise the risk of performance bias, some strategies have been attempted. These include transporting study participants to a central location, as well as removing or masking identifiers on participant clothing (Stephen et al., 2002). These strategies can be undermined should a participant disclose any personal information to the examiner, or through the examiner's conscious or unconscious evaluation of a subject's accent, vocabulary, dress, or mannerism (Hogan et al., 2018). When planning dental research trials, inadequate blinding can cause significant differences in treatment effect size estimates based on lack of patient and assessor blinding (Karanicolas et al., 2010, Fleming et al., 2014, Saltaji et al., 2018). Although every care is taken to reduce the possibility of bias in disease measurement and reporting in dental research trials, changes in technology could provide an opportunity to use digital photography as a valid methodology for strengthening the blinding process (Forgie et al., 2003).

A digital dental caries examination method could reduce the cost and resources involved in measuring dental disease in dental research trials and epidemiological screening programmes (Boye et al., 2013, Alan et al., 2018) particularly when using other oral health professionals to assess digital photographs remotely (Estai et al., 2016, Davies et al., 2020). However, the feasibility of using non-dental professionals to assess digital images has not yet been tested. If lay examiners could be used in mass screening programmes, this would greatly reduce the resource implications of large scale and national dental studies.

Although the photographic method should not be used to replace visual examinations for diagnosis of dental disease for individual treatment planning (Inês Meurer et al., 2015), the literature currently supports the use of digital images as an acceptable alternative assessment method in the detection of dental caries (Elfrink et al., 2009, Boye et al., 2012a, Boye et al., 2013a, Boye et al., 2013b, Bottenberg et al., 2016, Estai et al., 2016). In addition to the advantages of blinding examiners and resource costs, digital examination methods have implications for opportunity costs, remote access and archiving (Hogan et al., 2018).

A gold standard test is the diagnostic test or benchmark that is the best available under reasonable conditions (Versi 1992). Two UK studies conducted by Boye et al. (2012a, 2013a), reports the use of digital photography as being equivalent to a gold standard visual examination method for the detection of caries. These studies used a well-documented clinical examination method developed by the British Association for the Study of Community Dentistry (BASCD), which is considered the caries surveillance method of choice (Pitts et al., 1997). The method by Boye et al. (2012a, 2013a) was reported as being acceptable to both young children and the examiners, and therefore could translate to improving compliance with end point data collection in oral health interventions (Boye et al., 2012, Boye et al.,

2013). Additional literature, outside of the UK, supporting digital photographs for measuring dental disease, used the International Caries Detection and Assessment System (Bottenberg et al., 2016) and adapted Molar Incisor Hypomineralization criteria as the benchmark methods to compare digital photographs assessment scores (Elfrink et al., 2009). Smartphone camera images assessed by different oral health professionals, in comparison to a gold standard visual examination is also supported in the literature (Estai et al., 2016, Estai et al., 2016a).

Although the concurrent validity of a digital photographic method as an alternative to the direct visual examination method is promising, three of the published studies reported on the technical challenges of using this method (Boye et al., 2012a, Boye et al., 2013a, Bottenberg et al., 2016). Boye et al. (2012a, 2013a) attempted to address the issue of time by capturing images of 'index teeth' thought to be at the most risk of early childhood caries: all first and second primary molars, the upper central and lateral primary incisors, and the lower primary canines. However, this was still reported as time intensive. Other technical challenges identified were the need for adequate drying and debris removal prior to images being taken (Boye et al., 2013a).

2.2 Aims & Objectives

The primary aim of this study was to test the feasibility and accuracy of full arch digital images to identify dental caries in children. The study would compare data derived from measuring dental caries in a cross-sectional population of at least thirty 4- to 5-year-old children using a gold standard examination method and compare it with data derived from a digital image method.

One of the main challenges found in similar previous method comparison studies was the time it took to take the images (Boye et al., 2013a, Boye et al., 2013b). In The OW study of this PhD, we aimed to address the issue of time by testing the accuracy of measuring dental caries using three images: an upper full arch image, a lower full arch image, and a single anterior image.

In addition, these studies used the same examiners to score both visually and assess the photographs and analysed intra-examiner agreement using weighted kappa. Using the same examiners for both visual and digital photographic assessment may increase the risk of observation bias. How the weights for a weighted kappa are decided is a subjective issue; this may be prone to disagreements between experts, particularly in measuring dental caries – either the dental caries is present or not (Viera and Garrett 2005). The use of these methods for data collection may have caused an increase in treatment effect size, bringing the reliability of the findings into question. In the OW study, we aimed to address observation bias by using different examiners for assessing the digital images. In addition, we included untrained (not specifically trained to recognise and diagnose dental caries from an image) dental and non-dental professionals to further test the diagnostic accuracy of the digital images. Non-weighted kappa was used to increase the reliability of the results.

The previous studies used the well-documented clinical examination method developed by the British Association for the Study of Community Dentistry (BASCD), which applies the WHO caries scoring criteria, as the comparison method of choice. However, an International Caries Detection and Assessment System (ICDAS) also exists and so it was important to look at both diagnostic methods before deciding on the gold standard method for this comparison study.

2.2.1 DMFT (decayed, missing, filled teeth)

The DMFT index, is one of the simplest and most commonly used indices in epidemiological studies. The capitalisation of the letters 'DMFT' relates to the adult teeth and lowercase letters 'dmft' relates to primary teeth. The WHO first published dental caries surveillance data in 1969 showing a global map of DMFT levels among 12-year-olds (World Health Organisation 2020). It has since been consistently used as a measure of oral health status among varying populations, or in the same group, at different times by scoring dental health status on the number of decayed, missing, and filled teeth found. When reporting caries surveillance data, DMFT and dmft scores are calculated to a mean number of decayed, missing and filled teeth by taking the sum of individual scores and dividing by the sum of the population. This provides an estimate of the burden of disease within a representative population.

There are some reported disadvantages to this scoring method, however (see Figure 3). According to the criteria recommended by WHO (Armitage 1972), because each tooth is counted only once, caries takes priority over fillings. Therefore, if both caries and a filling are present on the same tooth, only the caries will be scored. Thus, it may not correctly reflect the true scope of restorative work an individual may have undergone or determine the causes of decay, which may have not been from individual factors but due to poor quality restorative care.

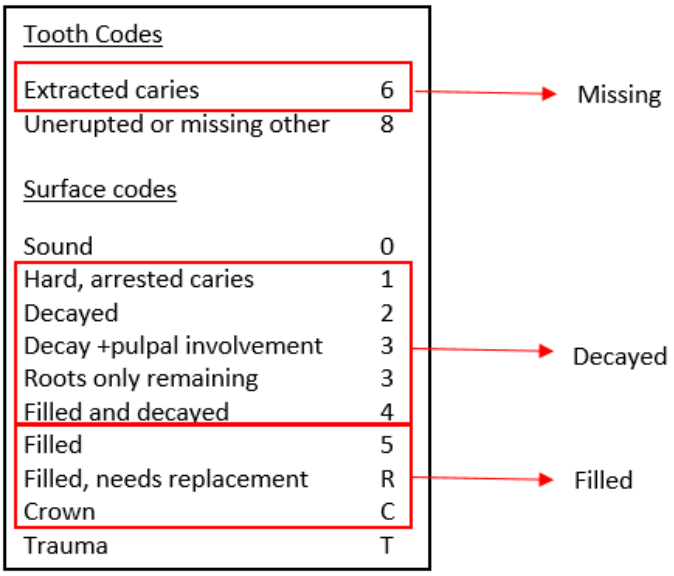


Figure 3. DMFT/dmft scoring criteria

The index also does not indicate the severity of disease or treatment needs, as a severely decayed tooth due for extraction or root canal treatment, will be coded the same as a tooth with minor decay.

2.2.2 The British Association for the Study of Community Dentistry (BASCD)

BASCD guidance and standards have underpinned NHS school dental surveys of the primary teeth and permanent teeth for over three decades, starting in 1985/86 in England and Wales (Pitts et al., 1997). Using the WHO DMFT/dmft scoring criteria, the BASCD method has set the quality standards for epidemiology studies, starting with the BASCD Trainers' Pack published in 1992 (Mitropoulos 1992), and revised in 1997 (Pine et al., 1997, Pitts et al., 1997) to support both trainers and examiners. Simple monitoring of disease does not require perfect information as it is not being used for the purpose of treatment planning. By its own admission, the BASCD caries criteria underestimates true caries burden within a sampled population, as it only identifies visually obvious caries into dentine, missing caries into dentine which is not obvious to the eye. However, because of its ease of use and strict calibration of examiners, provided the method is used consistently over time, it will reflect a true trend of dental caries prevalence. This can then be interpreted by policy makers in order to take action, or not.

2.2.3 The International Caries Detection and Assessment System (ICDAS)

In 2002, an international group of cariologists and epidemiologists developed an International Caries Detection and Assessment System (ICDAS) based on a systematic review of clinical caries detection systems. The aim was to provide clinicians, epidemiologists, and researchers with an evidence-based system for caries detection to gain better quality diagnostic and prognostic information, so decisions about the appropriate clinical management of dental

disease could be made, at both the individual and public health levels (Pitts and Stamm 2004). By 2005, this method had been further developed to include an exchange of codes to ensure the system reflected increased severity. This system is now recognised as ICDAS II for caries surveillance (Ismail et al., 2007). Many studies have found ICDAS II and the WHO DMFT/dmft criteria give similar results for detection of occlusal caries. An advantage of ICDAS II is the ability to evaluate very early signs of decay and provide information on disease severity and progression over time (See Figure 4). However, the disadvantage to ICDAS II is the longer application time when compared to the WHO criteria (Braga et al., 2009) as the system relies on prolonged air drying of the tooth surface (5 seconds) for each tooth.

ICDAS II CODE	**CLINICAL CRITERIA DESCRIPTION**
0	Sound tooth surface: no evidence of caries after prolonged air drying (5s)
1	First visual change in enamel: opacity or discolouration (white or brown) is visible at the entrance to the pit or fissure after prolonged air drying, which is not or hardly seen on a wet surface
2	Distinct visual change in enamel: opacity or discolouration distinctly visible at the entrance to the pit and fissure when wet, lesion must be visible when dry
3	Localised enamel breakdown due to caries with no visible dentin or underlying shadow: opacity or discolouration wider than the natural fissure/fossa when wet and after prolonged air drying
4	Underlying dark shadow from dentin ± localised enamel breakdown
5	Distinct cavity with visible dentin: visual evidence of demineralisation and dentin exposed
6	Extensive distinct cavity with visible dentin and more than half the surface involved

Figure 4: showing clinical diagnostic criteria for ICDAS II. Table taken from paper by Shoaib et al. (2009)

2.3 Rationale for Comparison Method of Choice

The aim of investigating the digital images for measuring dental caries was not for treatment planning, nor to measure the severity of disease, but to test the diagnostic accuracy of detecting the presence of disease or not tooth by tooth. The BASCD epidemiology method for measuring dental disease in a population is used in national oral health surveys, and in child oral health dental studies, as the benchmark for population level caries diagnosis. The BASCD method was also the gold standard method of choice for previous digital image comparison studies (Boye et al., 2013a, Boye et al., 2013b). Therefore, the rationale for comparing the concurrent validity of a digital examination method with the calibrated BASCD visual examination method as the method of choice, is appropriate.

2.4 Methods

2.4.1 Ethical Approval

Recruitment began immediately after ethical and regulatory approval. Ethical and regulatory approval was obtained from the University of Plymouth Faculty Research Ethics and Integrity Committee (FREIC) for Health and Human Sciences (17/18-863).

2.4.2 Setting

The setting for data collection was a primary school in Plymouth, UK. The school was identified by the high uptake of free school meals which corresponded with high rates of dental extractions under general anaesthetic as reported by the Office of the Director of Public Health, Plymouth City Council (Office of the Director of Public Health Updated August 2019).

2.4.3 Sample and sample size

The population of interest were at risk reception-aged (4-5-years-old) children. The purpose of using a child population known to have high caries rates was to guarantee the presence of caries for the digital images. No demographic information was collected.

Due to this being a method comparison study which did not have a known effect size, a reliable power calculation was difficult to determine. Sample size varied between n=25 (α = .05, power =.90, effect =0.6) and n=262 (α = .05, power =.90, effect =0.2) depending on the effect size using a single proportion test. Koo and Li (2016) recommend a sample size of 30 heterogeneous samples which involve at least three examiners whenever possible, for testing reliability. A single reception class contains 30 children with a potential total of ~600 observations being scored (~20 observations (1 observation per tooth) per child), therefore we aimed to recruit a class of 30 children.

2.4.4 Project Webpage

A project webpage, hosted on the University of Plymouth website, was used in the recruitment process. This has been shown to be a cost-effective adjunct to traditional methods of study dissemination and recruitment (Khatri et al., 2015). The project webpage contained a video animation describing the project in a visually engaging format. The webpage also included downloadable study information in the traditional written format, and links to information on the research team. The study was called the 'Open Wide!' project. Should the school have a social media page, parent/teacher texting or newsletter emailing service, the webpage could be shared electronically.

I created the video animation using VideoScribe™. Videoscribe™ is whiteboard animation software, predominantly used as an educational tool to make information more visual and

engaging (Sparkol 2020). The video was just over a minute long and contained information on the purpose of the study, explaining who was carrying out the study, and described how to make contact for further information. See Appendix B for a screengrab of the project webpage.

2.4.5 Recruitment

Primary schools were contacted sequentially to arrange an in-person meeting or telephone call with the school Principal to discuss the research. The project webpage was emailed to each school once further information was requested. When a school consented to take part, no further schools were contacted. The reception class teacher become the key contact for gaining parental consent. The project webpage was provided as a short link to send via email or text to parents and written study information sheets and consent forms were handed out to parents two weeks prior to data collection by the class teacher. Consent forms were collected on the morning of data collection by the teacher, with additional forms being available should a parent forget to return their form. A copy to the study information leaflet is available in Appendix C.

2.5 Data Collection

Prior to any visual or digital image examinations, each child recruited into the study was assigned a unique identification (ID) number. These corresponded with unique ID numbers previously created on the Caresteam Health Inc. dental imaging software, which accompanied the digital camera (CS1500 Carestream Dental). This number was written on a paper data collection form to ensure the correct visual examination scores were matched with the digital image scores. No demographic information was collected.

To address the issue of debris hindering the image quality, as reported in the study by Boye et al., (2013a), all children received a toothbrushing lesson using the dry brushing protocol (Public Health England 2016). Toothbrushing instruction was given first by me (a qualified dental hygienist) prior to the visual and digital image examinations. A named goody bag containing the toothbrush and toothpaste was given to each child along with the disposable inspection mirrors used for the examinations.

2.5.1 Visual Examination

The examiner had been trained and calibrated to the BASCD caries examination protocol as a member of the UK National Epidemiological Survey team (Mitropoulos et al., 1990). All recommended BASCD procedures were followed using the recommended instrumentation and equipment (Mitropoulos 1992), including a portable dental chair and Daray™ light which attached directly to the portable dental chair. Disposable hand mirrors and cotton wool rolls for drying the teeth were used for inspection. Latex-free gloves were worn and replaced for every child. Protective darks glasses were worn by the children during the visual examinations.

Children were laid supine. Caries was diagnosed visually at the 'caries into dentine' level as per the BASCD protocol (Pitts et al., 1997). Only primary teeth were scored, with exfoliated teeth charted as unerupted/missing.

The BASCD examiner, for the remainder of this chapter, will be referred to as the gold standard (GS).

2.5.2 Digital image Examination

One of the digital image assessors was also a BASCD calibrated examiner (BCE). The five remaining assessors were me as the principal investigator (PI), a general dental practitioner (GDP), a dental therapist (DT), a dental nurse (DN) and a lay person (LP). Apart from the BCE, no other assessors had received formal training to recognise dental caries from a photographic image.

2.5.6 Equipment

A Carestream™ 1500 digital camera was used due to ease of use and ability to be connect to a tablet device via a USB 2.0 highspeed interface. A tablet device was chosen for being lightweight with a 12-inch screen the children could hold during the digital examination procedure and see their teeth on the screen, for added compliance.

The camera came with its own imaging software which was installed remotely by an engineer onto the Surface Pro 4, fourth-generation 2-in-1 detachable laptop/tablet. The software allowed for the safe storage and management of the images which were saved into electronic folders identified by the unique ID numbers previously created, eradicating the need for any personal information to be stored. The digital camera and dental imaging software was tested for suitability prior to data collection.

2.5.7 Image Capture

Although the camera was designed for intraoral use, the camera was used extra-orally in order to be able to capture a full arch image. The intraoral camera was connected directly to the tablet and children were able to view as the images were being taken. Images were repeated until satisfactory images had been captured or the child had was no longer able to sit still enough for quality images to be taken. The software automatically saved the images

into the corresponding unique ID folder, which guaranteed no data could be accidentally lost during the data collection process.

As opposed to the supine position of the visual examination method, children sitting upright with two mouth mirrors to retract the cheeks was optimal for the digital examination method (see Figure 5).

Figure 5. Poor image quality using cotton wool rolls and fingers to retract in comparison to disposable mouth mirrors

2.6 Data Processing and Statistical Methods

2.6.1 Assessing Images

Three best quality images for each child were chosen: a full upper arch, a full lower arch and an anterior view. These images were added to a document with the same visual examination data collection entry points (See Appendix D). Any identifying facial features were cropped from the images.

Files for each digital image assessor was saved onto a USB flash drive. Each assessor was given the same criteria to follow for scoring the images. The criterion were as follows:

- Only score primary teeth
- Try to score all surfaces, if possible

- If not possible, mark the tooth surface with the 'assessment cannot be made' code, ordinarily used for the plaque score (Mitropoulos 1992). (This was an arbitrary number for the purpose of recording no-scores for this study only)
- Leave sound surfaces blank (to save time)

Missing primary central and lateral incisors were pre-scored as 'missing', in accordance with the BASCD reporting assumptions, which states, *"5-year-olds may not all accurately remember why the teeth were lost. As a result, all missing deciduous* [primary] *first and second incisors are presumed naturally exfoliated, even though we know some will have been lost to decay."*

The image assessors scored the images at a place and time convenient to them, with me (PI) assisting with data input if necessary. However, no assistance was given to the actual scoring of the images. I then assessed the photographs leaving a time gap between data collection and scoring to reduce observation bias. The other assessors were asked to give feedback on the time taken to assess and score the digital images and any challenges they encountered.

2.6.2 Statistical Analyses

Statistical methods to test agreement between image assessors are used to assess the degree of similarity between two (or more) sets of measurements, termed inter-examiner agreement. This decides whether one technique for measuring a variable can substitute another. There are a number of methods which can be used for measuring agreement (Ranganathan et al., 2017). Results and the interpretation of those results may differ depending on the analytical strategies chosen (Silberzahn et al., 2018). For this study, agreement between the digital image assessors and the gold standard assessment scores,

was analysed using similar methods to Boye et al., (Boye et al., 2013a, Boye et al., 2013b) and recommended by BASCD (Pine et al., 1997).

2.6.2.1 Sensitivity and Specificity

Using the WHO DMFT/dmft scoring criteria (Pitts et al., 1997), the BASCD visual examination scores were converted into dmft scores and collated into IBM SPSS Statistics 24 and termed as the gold standard (GS). Sensitivity measures the proportion of positive scores that are correctly identified (the proportion of those who have dental disease and are correctly identified as having it). Specificity measures the proportion of negative scores that are correctly identified (the proportion of those who do not have dental disease and are correctly identified as not having it). The BASCD guidance on the statistical aspects of training and calibration of examiners for surveys of child dental health states benchmark levels of true positive (presence of disease) results should be 75% or higher and true negatives (no disease) should be 90% or higher (Pine et al., 1997).

2.6.2.2 Cohen's Kappa

Cohen's Kappa calculates inter-examiner agreement taking into account the expected agreement by chance (Cohen 1960). For ordinal data, where there are more than two categories, it is useful to know if the ratings by different assessors varied by a small degree or by a large amount. This would be applicable if we were testing the photographic method against the ICDAS II system, measuring severity of dental disease. For this study, we were only concerned with if disease is present, or not and therefore standard Kappa agreement was used. The values suggesting agreement are defined by Landis et al. (Landis and Koch 1977). The BASCD kappa benchmark value is 0.75 (Pitts et al., 1997).

2.6.2.3 Intra-class correlation coefficient

Intra-class correlation coefficient (ICC) is a statistical method applied for the assessment of consistency or reproducibility of the same measurements when made by different observers (Koch 1982). This will also be used to evaluate inter-examiner agreement. ICC values of less than 0.5 are indicative of poor reliability, values between 0.5 and 0.75 indicate moderate reliability, values between 0.75 and 0.9 indicate good reliability, and values greater than 0.90 indicate excellent reliability (Koo and Li 2016).

2.6.2.4 Bland-Altman Plots

When two instruments or techniques are used to measure the same variable, Bland–Altman plots can be used to estimate reliability with 95% limits of agreement (Altman and Bland 1983). This allows identification of any systematic difference between the examiners or possible outliers. Usually, this plot shows the difference between the two measurements (Y-axis) against the average of the two measurements (X-axis). This is particularly useful for calibration exercises. However, for this method comparison study, the plots were calculated using the mean difference between the digital images assessor scores (Y-axis) against the GS scores (X-axis) (Krouwer 2008).

2.6.2.5 Independent Sample T-Test

An independent sample T Test is frequently used when comparing the means between two groups (Karl 1894). This is to show whether there is any statistical difference between the GS mean and the digital image assessor mean scores, which would infer poor agreement.

2.6.2.6 Feasibility

The feasibility of the digital examination method was explored by examining the number of refusals, the % unusable/unreadable images, the examiners' time and satisfaction, and its real-world applicability.

2.7 Results

2.7.1 Descriptive statistics

Two schools were recruited to this study due to not reaching the target sample size with the first school. A total of 43 children took part (School A: n=17. School B: n=26). Of these, three children refused to have the visual and digital examinations (these children were classed as special education needs children and although their parents consented, the class teacher had been advised their compliance was unlikely). A total of 294 images were taken, an average of seven images per child. Visual examinations and digital images collectively took two to three minutes per child. All photographs used for assessment (n=120) were scored with a total of 3,470 tooth surface comparisons being analysed. However, both the BCE and GDP felt not all tooth surfaces could be assessed from the images. The BCE classed 515 (14.8%) tooth surfaces as 'assessment could not be made', whilst the GDP classed 621 (17.9%) as 'assessment cannot be made'. The PI (myself) did not score 5 surfaces, the DT did not score 23 surfaces and the DN did not score 2 surfaces. The LP scored all tooth surfaces.

Untreated dental disease was detected in twelve children, six from school A and six from school B. Of those twelve children, two also had previous experience of restorations and extractions. Due to only two children presenting with extracted or filled teeth, mt and ft were not individually analysed.

2.7.2 Sensitivity, Specificity and Kappa

A dichotomous scoring of 'sound' or 'unsound' per tooth (total number of teeth n=788) was used to measure agreement with the gold standard (GS). However, due to the use of 'assessment cannot be made' on certain tooth surfaces using the photographic method, four separate rules were applied. The dmft scores for each rule were individually analysed in comparison with the GS (see Figure 6). These rules were as follows:

1. Any tooth surface scored with 'assessment cannot be made' was replaced with a 'sound' score
2. Any tooth with a surface that had been scored with 'assessment cannot be made' was removed from analysis.
3. Only teeth with all surfaces scored with an 'assessment cannot be made' score was removed from analysis.
4. Tooth surfaces most like to be affected by dental caries (Elfrink et al., 2009) and with an 'assessment cannot be made' score was removed from analysis.

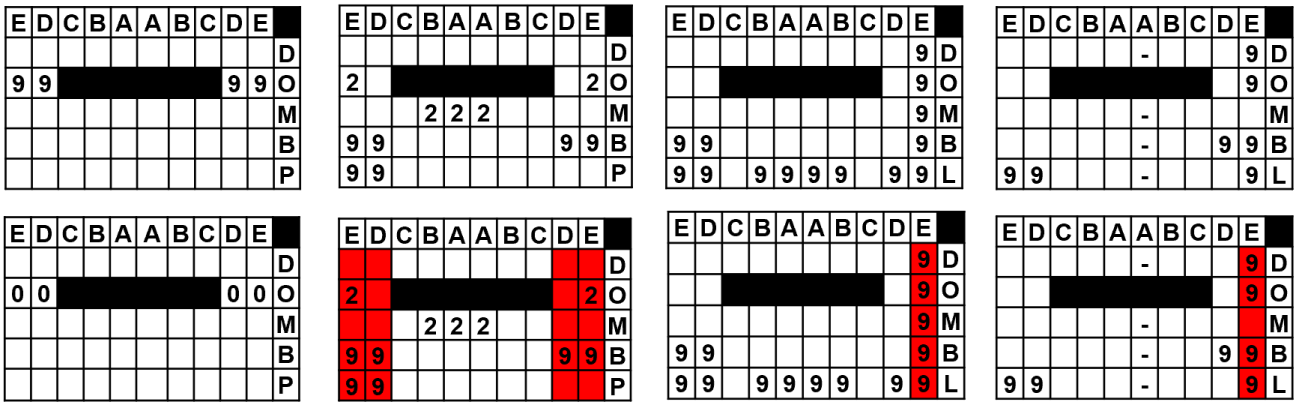


Figure 6. Data entry '9' represents 'assessment cannot be made'. This figure shows how each rule affects teeth included and excluded from analysis

The sensitivity scores, for all four rules, ranged between 32.7% (DN) to 62.3% (PI), with a mean value of 48.0% (see Table 1). These fall below the BASCD recommended 75% level as outlined in BASCD guidance on the statistical aspects of training and calibration of examiners for surveys of child dental health (Pine et al., 1997). Specificity scores, for all four rules ranged between 98.1% (BCE) to 99.6% (PI) with a mean value of 99.1% (See Table 1). These fall above the BASCD recommended 90% level. The kappa values ranged between 0.43 (GDP) and 0.74 (PI), with a mean of 0.57 (See Table 1), showing moderate to substantial agreement between the photographic assessors and the GS (Landis and Koch 1977). However, this falls below the 0.75 benchmark recommended by BASCD (Pine et al., 1997).

2.7.3 Independent Sample T-Tests

Independent samples T-tests showed all photographic assessors' mean dt and dmft scores fell below that of the GS. No statistically significant difference was seen between photographic assessors compared to the GS, except for the DN dmft score with an almost significant difference (P=0.09). The dt and dmft mean, standard deviation, mean difference, 95% confidence intervals (CI) and P values are shown in Table 2.

2.7.4 Intraclass correlation coefficient

Using intraclass correlation coefficient (ICC) as a measure of inter-examiner reliability to calculate agreement with 'assessment cannot be made' scores showed low agreement (Koo and Li 2016) between the BCE and GDP (0.37). The ICC showed good agreement between the photographic assessors for decayed teeth scores (PI 0.85, GDP 0.88, DT 0.80, LP 0.82), apart from the moderate level of agreement between the GS and BCE (0.63) and DN (0.71). The mean ICC value for decayed teeth was 0.78 (good agreement). The PI and BCE showed good agreement with the GS (PI 0.89, BCE 0.77) for dmft scores with the remaining photographic

assessors showing moderate agreement (GDP 0.72, DT 0.70, DN 0.61, LP 0.71) (See Table 3). The mean ICC value for all photographic assessor dmft scores was 0.73 (moderate agreement).

	Rule 1: all 'assessment cannot be made' scores replaced with 'sound'				**Rule 2**: teeth with an 'assessment cannot be made' score removed from analysis				**Rule 3**: only teeth with all surfaces scored as 'assessment cannot be made' removed from analysis				**Rule 4:** only teeth with surfaces most likely to be affected by caries scored 'assessment cannot be made' removed from analysis			
	N=	**Sens %**	**Spec %**	**Kappa**	**N=**	**Sens %**	**Spec %**	**Kappa**	**N=**	**Sens %**	**Spec %**	**Kappa**	**N=**	**Sens %**	**Spec %**	**Kappa**
PI	788	62.3	99.7	0.74	786	62.3	99.7	0.74	788	62.3	99.7	0.74	787	62.3	99.7	0.74
BCE	788	49.1	99.0	0.58	621	55.3	99.3	0.66	713	53.1	98.9	0.61	693	53.1	98.9	0.62
GDP	788	50.9	98.5	0.57	299	33.3	98.9	0.43	785	50.9	98.5	0.57	716	54.2	98.5	0.60
DT	788	47.2	98.4	0.53	765	47.2	98.5	0.54	788	47.2	98.4	0.53	783	47.2	98.4	0.53
DN	788	35.8	99.7	0.49	786	36.5	99.7	0.50	788	35.8	99.7	0.49	787	35.8	99.7	0.49
LP	788	41.5	99.2	0.52	788	41.5	99.2	0.52	788	41.5	99.2	0.52	788	41.5	99.2	0.52

Table 1: Photographic assessor sensitivity, specificity and kappa scores for each rule, in comparison to the gold standard

	Mean (dt)	Std Dev (dt)	Mean diff	*P<0.05* vs GS (dt)	95% CI		Mean (dmft)	Std Dev (dmft)	Mean diff	*P<0.05* vs GS (dmft)	95% CI	
GS	1.05	2.17					1.33	2.71				
PI	0.65	1.50	0.4	0.34	-0.4	1.2	0.88	1.96	0.5	0.40	-0.6	1.5
BCE	0.58	1.36	0.5	0.24	-0.3	1.3	0.83	1.85	0.5	0.34	-0.5	1.5
GDP	0.85	1.99	0.2	0.67	-0.7	1.1	0.95	2.08	0.4	0.49	-0.7	1.4
HYG	0.88	1.40	0.2	0.67	-0.6	1.0	0.93	1.54	0.4	0.42	-0.6	1.4
DN	0.53	1.22	0.5	0.19	-0.3	1.3	0.53	1.22	0.8	0.09	-0.1	1.7
LP	0.70	1.62	0.4	0.42	-0.5	1.2	0.70	1.62	0.6	0.21	-0.4	1.6

Table 2: Results from independent sample T-Tests

	PI	BCE	GDP	DT	DN	LP
DT	0.85	0.63	0.88	0.80	0.71	0.82
DMFT	0.89	0.77	0.72	0.70	0.61	0.71

Table 3: Results of Intraclass correlation co-efficient scores to show agreement with the gold standard

2.7.5 Bland Altman Plots

The 95% limits of agreement (LOA), which show the under and overestimation of decayed teeth by each photographic assessor, in comparison to the GS were -2.6 to 1.8 (PI), -3.8 to 2.8 (BCE), -2.2 to 1.8 (GDP), -2.8 to 2.5 (DT), -3.6 to 2.6 (DN), and -2.8 to 2.1 (LP). The 95% LOA which show the under and overestimation of dmft scores by each photographic assessor, in comparison to the GS were -2.7 to 1.8 (PI), -3.9 to 2.9 (BCE), -4.0 to 3.3 (GDP), -4.2 to 3.4 (DT), -5.0 to 3.4 (DN), and -4.4 to 3.1 (LP). There were seven sets of dental images that showed divergent results, however, only two cases consistently fell outside of the 95% LOA. These were identified by plotting the mean scores and LOA onto Bland-Altman graphs. All Bland-Altman plots are available in Appendix E.

2.7.6 Digital Assessor feedback

Boye et al., (2013) published examiner feedback on the digital caries assessment method. This reported saliva and debris visible on the digital images impacting their ability to correctly assess the photographs. The extended time needed to assess the images was also discussed along with training to recognise tooth-coloured fillings on images (Boye et al., 2013).

Assessor feedback from this study reported similar findings with regards to the time needed to assess the photographs. The BCE, GDP and DT all felt it was more time consuming to score a photograph in comparison the time it takes for them to make a visual diagnostic decision.

The BCE reported that she used the BASCD protocol which states to under-estimate disease if an assessment cannot be made. This may also explain the high use of the 'assessment cannot be made' scores for certain surfaces of the teeth.

The GDP expressed a cynicism for the digital assessment method from the outset and took the longest to access the photographs (four weeks). The GDP expressed a difficulty in assessing the photographs due to using loupes in clinical practice and therefore found viewing dental disease which wasn't under magnification challenging. The GDP also used the 'assessment cannot be made' score the most, which may have impacted the time taken to score each photo. Despite this, the GDP still showed moderate (Cohen's Kappa: 0.72) to good (Cohen's Kappa: 0.88) agreement with the GS.

The laptop/tablet worked well with the children engaging with the digital examination method. However, the dental imaging software was very difficult to use in tablet mode and therefore, the type cover had to be left on, hindering the versatility of the screen. This, alongside the length of the wire connecting the digital camera to the laptop, made manoeuvring the laptop and camera very cumbersome. The CS1500 camera also comes as in a wireless option with video software, which although increases the resource cost significantly, may need to be a consideration to streamline the digital image examination method.

2.8 Discussion

This study tested the diagnostic accuracy of using full arch digital images as a way of measuring dental caries in children, addressing the technical issues found in previous studies relating to time and image quality (Boye et al., 2013a, Boye et al., 2013b). This was with the aim of investigating using full arch images as a suitable and feasible way to measure child oral

health at the end of the main intervention study of this PhD. This study also tested the diagnostic accuracy of the full arch digital images by using six independent examiners, including a lay person, which to date has not yet been reported. The aim of this was to further demonstrate the feasibility of the digital method, and to eliminate observation bias which may have been present in previous studies which used the same examiner to visually examine the children and score the images.

Digital photographs are already used for the training and calibration of dental epidemiologists (Pitts et al., 1997). Using digital images for measuring dental caries has the advantage of significantly reducing resource costs and strengthening blinding in research trials as digital images can be assessed remotely. Digital screening for dental disease as a data collection method may also increase compliance among a fearful or vulnerable population where uptake with end point data collection may be poor (Hallas et al., 2015).

Digital images also have the potential to reduce resource costs for epidemiological surveys. Alongside the advantages of being able to remotely access a digital archive, having a digital record of epidemiological surveys would also provide an opportunity to retrospectively extract further data by rescoring for other oral conditions increasing the epidemiological yield in the process (Hogan et al., 2018). Creating a digital archive for open-source data would allow single databases to be used more widely, with data being shared and combined with other data (Huston et al., 2019). Sharing of information in this way would assist scientific collaboration, enrich research and advance analytical capacity to inform decisions (Huston et al., 2019). In addition, a digital archive can be used to track population changes over time.

An important finding in this study relates to the lay image assessment scores. It may have been predicted that due to having no prior dental training, the lay person would have showed

low agreement with the gold standard. However, no statistical difference was found between the lay person photographic assessment score and GS for dt (p=0.42. 95% CI [-0.5 1.2]) and dmft (p=0.21 95% CI [-0.4 1.6]) respectively. The lay mean Kappa values showed moderate agreement, which was consistent with the GDP, DT and DN. The lay intraclass correlation coefficient (ICC) showed moderate to good reliability often scoring similar or better than the BCE, GDP, DT and DN. These findings indicate the feasibility of non-dental professionals being recruited to carry out digital epidemiology for the oral health surveillance of children which could reduce resource costs further.

All photographic assessors fell above the BASCD specificity benchmark (90%) for correctly recognising teeth free from dental disease (99.1%). However, all photographic assessors fell below the BASCD sensitivity benchmark (75%) for correctly recognising dental disease (57%). The PI (myself) was the closest to reaching the BASCD kappa benchmark (0.75) with a mean of 0.74. However, all other assessors fell below this value. Underestimation of disease was also found in previous studies (Boye et al., 2013a, Boye et al., 2013b). Although the BASCD criteria err on the side of caution by recommending examiners underestimate dental disease if any uncertainly is felt (Pine et al., 1997), benchmark values are necessary. Overestimation, or false negative decisions, can be problematic as they may lead to unnecessary and irreversible dental treatment (Dowell et al., 1983). Equally, if oral health surveys are used to monitor the need for oral care services, under/over-estimation of disease could possibly impact the provision of resources (World Health Organization 2013). For research trials, under/over-estimation of dental disease may cause incorrect reporting of intervention effects. However, if digital examinations are found to consistently show systematic error in a particular direction, a correction factor can be applied to minimise bias (Kirkwood 2003).

Causes of underestimation of dental disease in this and previous studies was due to tooth-coloured fillings being more difficult to identify, and transcription errors (Boye et al., 2013a). In addition, the image viewpoints used in this study underestimated disease distally of the upper lateral incisors, mesially of the canines and distally of upper second primary molars. The rationale for using full arch images with a single anterior view was to address the issues of time reported in the previous studies (Boye et al., 2013a, Boye et al., 2013b). However, it may be more appropriate to return to using the methods described by Boye et al., (2013a), capturing images of 'index teeth'. Additionally, more advanced technologies are becoming available, including handheld digital high-definition video devices. To date, the use of full mouth video technology for epidemiology is unexplored. Research into the accuracy of video technology compared to digital images may address the underestimation of disease found in this and previous studies (Hogan et al., 2018).

In this study, the digital image assessors were independent to the visual examination process, except for myself. This meant observation bias could be minimised. I purposefully did not score the images until all data collection and photographic assessments had been made by the other independent assessors. This left a time gap of six months between assessing the photographs from School A and three months assessing the photographs from School B. Despite this, I still had difficulty in remaining objective when scoring the images. This bias may be reflected in the results, where I show consistently higher agreement with the GS in comparison the other independent image assessors.

Despite meeting the sample size reliability criteria (Koo and Li 2016), the sample size in this was considerably less than those tested in by Boye et al., (2013a). Intra-rater reliability was not calculated due to the small sample size. A further limitation to this study was the use of

one calibrated examiner for the visual examinations and one assessor from each category scoring the images. A combination of multiple visual examiners and multiple independent assessors would be optimal to reduce observational bias and validate inter-examiner reliability.

2.9 Conclusion

The findings of this study suggest that using digital images shows promise as a feasible dental disease measurement tool. However, a full arch digital image examination method may not be appropriate, with the method described by Boye et al., (2013a) being a more accurate digital assessment method.

Using digital images as a dental disease assessment method significantly reduces resource and opportunity costs, and has advantages such as, being remotely accessed, archiving, and strengthening blinding in research trials. Also, with the additional feasibility of using trained non-dental professionals to assess the digital images, costs could be reduced further. Therefore, continued research into a digital examination method is worthy of investigation despite the underestimation of disease found in this study. If the underestimation of dental caries is considered a barrier to the use of a digital examination method, at the very least, this study has demonstrated that there is potential for using the digital method for epidemiological screening dental disease negatively or positively. This could be undertaken by lay people to refer children who may need a fuller dental examination. However, the testing of more advanced video technology using independent assessors to score digital records to minimise observation bias should be considered.

As per the original protocol, if the results of this study were being used to determine the data collection method being used at the end of the main intervention study of this PhD, a digital

dental examination would not have been chosen. This is due to the OW study method not providing high quality images of the posterior teeth and the canines. The digital methods described by previous studies were not time-efficient which may have been a barrier with the child population of the main intervention study of this PhD.

3.0 Chapter Three: “Filling the Gap” study - literature review

This chapter provides a critical review of the literature for the main intervention study of this PhD and explains how the study will address the knowledge gaps within the literature. The areas of the critical review influenced by the pre-PhD study will be reported first. This is followed by behavioural models and theories used in oral health research. The chapter finishes with oral health interventions carried out in the first year of life, comparing interventions which used behavioural theories to interventions which focused on education.

The first year of life is known as the perinatal period. Using search terms such as ‘perinatal’ ‘early childhood caries’ and ‘first year of life’ focused the review to interventions taking place with caregivers of children under the age of two years old. Cited reference searching from systematic reviews, including oral health educational interventions integrated into existing health services, targeted relevant research for this review (Leong et al., 2013, Abou El Fadl et al., 2016, Menegaz et al., 2018, Riggs et al., 2019).

3.1 Compassion in oral health interventions

The pre-PhD study adopted the same person-centred, compassionate approach as the FNP practitioners to deliver the intervention and was mindful of the characteristics needed by the intervention deliverer (Kay et al., 2019). The rationale for this approach was therefore explored within the literature to determine its value in the main intervention study of this PhD.

The literature suggests that an important aspect often overlooked when evaluating health interventions is the fidelity and characteristics of the facilitator which may have impacted the acceptability of the intervention (Bowen et al., 2009, Jagosh et al., 2011, Jelalian et al., 2014).

Regardless of the treatment outcomes, if fidelity has not been carefully considered, incorrect conclusions may be drawn about the effectiveness of an intervention (Moncher and Prinz 1991, Weiner 2003, Green and Glasgow 2006). Facilitator characteristics such as expressing warmth, genuineness, and enthusiasm are often associated with positive outcomes in the psychotherapy literature (Weiner 2003). The mastery of technical skills by facilitators of interventions, such as motivational interviewing, are said to improve competence (Wilson et al., 2018), but may only work alongside the ability to establish a valuable rapport which engenders collaboration and empathy (Moyers et al., 2016). A lack of rapport may severely hinder engagement with oral health services and dental visiting, especially in the absence of a friendly, supportive environment (Tamanna et al., 2017, Thomas et al., 2018). In contrast, the experience of receiving genuine support and empathy can assist autonomy and empowerment which has been shown to lead to positive oral health outcomes (Sbaraini et al., 2012).

Compassion for others has been widely recognized as an integral part of patient-centred care (Perez-Bret et al., 2016, Cetrano et al., 2017, Sinclair et al., 2017) with increasing evidence for the effectiveness of using compassion-focused approaches in health (Gilbert 2015). Compassion is a multi-dimensional process, comprising of empathy, sympathy, wanting to relieve the problem the person is experiencing, and a willingness and readiness to try (Jazaieri et al., 2013, Gilbert 2015). Although compassion has been directly discussed and recommended in the literature as an approach for improving oral health (Pla 1994, Freeman 2008), the reporting of such an approach in oral health interventions is scarce. This may be due to a lack of research or due to a lack of consistent definitions and nomenclature (Jackson et al., 2013). ‘Parent-centred’, ‘family-centred’ and ‘child-centred’ are synonymous with

empathy and understanding, and therefore may be interchangeable with a compassionate approach.

It is thought that the opposite of compassion is not believing a person's experience, which can alter the motivation and desire to help that person (Gilbert 2015). It has been argued that the negative attitudes of oral health professionals can alter the support they're willing to provide (Threlfall et al., 2007, Aljafari et al., 2015). Mouradian (2007) suggests that how dentists respond to children's oral health disparities is influenced by deeply held, but rarely challenged, philosophical views. If the practice of conditional support is a real phenomenon, only providing support to parents displaying receptive or 'good parent' characteristics could put high dental disease risk children at even further disadvantage (Threlfall et al., 2007, Malcom 2019). It may also be plausible that this lack of compassion creates a perpetual cycle between dental professionals unwilling to provide support and patients who avoid seeking support due to a loss of trust in their dental service providers (Malcom 2019), and in the wider health care system (Goold 2002).

Avoidance behaviour is often related to feelings of shame (how a person feels about themselves) or being shamed (how a person has been made to feel about themselves) (Frank 2002). It is thought that by giving autonomy to a person to seek the information on improvement they need when they need, can reduce feelings of shame and avoidance behaviours (Frank 2002, Rollnick et al., 2010, Miller and Rollnick 2012, Sbaraini et al., 2012). Like compassion, it has been argued that shame is an important subject for public health, and the health of the public, and deserves serious assessment and discussion (Brown 2006, Dolezal and Lyons 2017). Although shame is associated with morally bound behaviours, it is experienced in 'non-moral' situations, such as failure in performance which impairs health,

interferes with health relationships and impacts on service provision (Frank 2002, Dolezal and Lyons 2017). It is therefore possible that shame is also attached to oral health beliefs and attitudes and impacts the outcome of oral health behaviours.

More specifically, Brown (2006) discusses how women struggle the most with feelings of shame, in particular around 'unwanted identities' relating to family, motherhood and parenting, and what people think of them as a result. It has been reported in the literature that mothers labelled as 'formula feeders' or 'bottle feeders' feel shamed by healthcare professionals whereas 'breast feeders' feel shamed by peers and family members (Thomson et al., 2015, Jackson et al., 2021). Another example within the literature relates to the use of dummies or pacifiers; the practice being associated as working-class mothering within the medical literature, which Whitmarsh (2008) argues has become embedded within the negative self-perceptions of mothers who use pacifiers with their infants. It could therefore be inferred that these pervasive feelings of 'shame if you do – shame if you don't' felt by mothers, as described by Thomson et al. (2015) and Brown (2006), permeate into oral health behaviours impacting confidence and self-belief. Therefore, using a compassionate approach to reduce feelings of shame associated with key oral health behaviours may be a valuable and important approach when delivering oral health education interventions.

3.2 Self-efficacy theory

The intervention behaviour change techniques used in the pre-PhD study (Kay et al., 2019) emphasised the importance of respecting a person's frames of reference and helping chart a pathway to applying positive health behaviours for themselves, which is an approach supported in the literature (Bandura 1977, Miller and Rollnick 2012, Owen-Jones et al., 2013). By being specifically guided by Bandura's (1977) self-efficacy theory, the mother's intentions

and confidence to carry out oral health behaviours were supported alongside direct assisting with the behaviours. The theory of self-efficacy and the evidence for its use in oral health education interventions was therefore explored within the literature.

Self-efficacy was first introduced as a behavioural theory in 1977 by Albert Bandura and is now thought of as an accurate predictor of health-promoting lifestyles (Bandura 1977, Grzywacz and Keyes 2004). Lee and Bobko (1994) report that such individuals with high levels of self-efficacy are less inclined to have fatalistic attitudes as failing in tasks is related to effort and not external forces. Bandura has since expanded his self-efficacy theory to the role of parenting, describing that a parents' beliefs about being able to influence their child can foster their child's positive development and adjustment (Bandura 1977, Bandura et al., 1999).

In the context of oral health, increased parental self-efficacy is suggested to be associated with effective routine setting and being able to overcome barriers which hinder oral health practices, such as toothbrushing and dental visiting (Huebner and Riedy 2010). In addition to parental self-efficacy, oral health practices also rely on parental knowledge and perceived importance, to establish the adequate routines and habits (Divaris et al., 2011, Lee et al., 2012). Parental self-efficacy has been identified as complex due to the many factors which can impact the caregiver's ability to carry out oral health behaviours for their children, such as being on a low income, fatigue, anxiety and depression (Zayas et al., 2005). Within the literature, lack of time and an uncooperative child has been reported as making the task of brushing a child's teeth particularly challenging (Huebner and Riedy 2010). Factors shown to impact positive intentions, even in the presence of oral health knowledge, is being nagged for certain foods, being undermined by other family members and having feelings of guilt, making healthier food choices difficult (Herman et al., 2012). Fatigue, which naturally accompanies

becoming a parent, has been shown to significantly impact parental self-efficacy, negatively influencing the behaviours important for their children's well-being and development (Chau and Giallo 2015). Spitz et al. (2006), and Hooley et al. (2012), argue that this complex relationship between a child's environment created by their parents which directly influence the child, and the temperament of the child which influences parental behaviour is an undervalued area of research.

Oral health interventions often focus educating the primary carer, with the WHO recommending interventions being aimed at new mothers (Phantumvanit et al., 2018). With mothers acting as 'guardians of health' (Milne et al., 2017), the many aggravating factors associated with early childhood caries risk, both internal and external to the family environment, may cause the mother to feel overwhelmed. By mediating self-efficacy levels in oral health interventions, as opposed to increasing knowledge alone, Silva-Sanigorski et al. (2013) suggests it may help improve the likelihood of families fostering positive oral health behaviours.

Evidence also suggests a synergistic relationship may be present between self-efficacy and oral health literacy, which influences oral health practices (Lee et al., 2012). Oral health literacy (OHL) refers to how a person is able to obtain, process, and understand basic oral health information and have an awareness of the services available to them, to make appropriate oral health choices (Horowitz and Kleinman 2008). Horowitz and Kleinman (2008) describe the characteristics needed for OHL are proficiency at listening, understanding and good communication skills. However, in a later paper, Horowitz and Kleinman (2013) discuss that this is regardless of a person's social and educational status, as the complex demands of

understanding the information from health service providers and healthcare systems can impact anyone's OHL.

Wan et al. (2003) reports the oral health practices of a caregiver with low OHL may be, providing snacks more than four times a day, consuming sweetened beverages in bottles and brushing their infants' teeth less than twice a day, increasing risk of early childhood caries. The literature also reports caregivers introducing foods and liquids, other than first milk, earlier than is recommended, and not introducing toothbrushing with appropriately fluoridated toothpaste after the emergence of primary teeth is associated with low OHL (Huebner and Riedy 2010, Herman et al., 2012, Duijster et al., 2015, Hallas et al., 2015). Caregivers may not place importance on supervising toothbrushing, due to seeing it as an autonomous exercise, similar to getting dressed and toileting (Huebner and Riedy 2010). Despite the recommendations made by Horowitz and Kleinman (2013), increasing OHL has been shown to only alter some of the high-risk oral health practices, and not all caregivers' behaviour (Leong et al., 2013). Some behaviours remained unchanged despite the risk they posed to their child's oral health. Kok et al. (2018) suggests increasing OHL and knowledge about risk and consequences of early childhood caries may only cause preventive behaviour changes in individuals with increased self-efficacy (Kok et al., 2018). It could therefore be argued that a primary caregiver's levels of self-efficacy is of increased importance when determining vulnerability to infant oral health, compared to other factors such as OHL levels alone.

Vicarious experience, modelling and peer learning are classed as powerful educational tools for increasing self-efficacy (Eysenbach et al., 2004, Gavriel 2016). Bandura (1977) describes that if an individual is able to identify with their fellow learner, whom themselves is

succeeding, they are more likely to grow confidence in their own abilities. Oral health education usually takes place with individuals and therefore rarely includes peer learning and support. With the exponential growth of social messaging platforms, Timimi (2012) argues direct face-to-face patient-provider moments are becoming scarcer across the spectrum of health care, increasing the opportunity for creating peer learning environments. In contrast to traditional forms of healthcare engagement, education and promotion, it has been reported that messaging platforms have the advantage to expand the potential reach, availability, and accessibility for patient education, disease self-management, and remote monitoring of patients (Mosa et al., 2012).

3.3 Text messaging in oral health education interventions

A key finding of the pre-PhD study was the need for certain individuals facing stressful social situations to receive ongoing support via text messaging (Kay et al., 2019). Webb at al. (2010) argues that there is good evidence to support the use of incorporating technology in health promotion strategies, particularly when attempting to promote or maintain behaviour change. Willcox et al. (2019) report how text messaging has taught researchers substantial lessons about tailored interactive health communication such as, reach and engagement, particularly in low-resource settings. Willcox et al., (2019) further discuss how text messaging can support behaviour change techniques such as reinforcement, prompts and cues, goal setting, feedback on performance, support, and progress review. This was demonstrated by Endicott and Clarke (2014) who developed ChatHealth, a text messaging service for 11–19-year-olds being served by Leicestershire Partnership NHS Trust.

After being successfully used for several years by the school nurses for young people, ChatHealth was tested in a pilot study involving the whole population of 0–19-year-olds in Leicester,

including health visitors for parents of newborns and under-fives (Palmer 2019). The pilot study provided parents and carers of approximately 140,000 babies and children access to support. Between November 2016 and December 2017, the service received 1,448 enquiries and handled 5,124 messages (Palmer 2019). Health visitors responded to a wide range of issues raised by parents and carers which included questions and concerns about breastfeeding, general health, constipation, immunisations, sleep and feeding. Several fathers also engaged with the service. Health visitors requested feedback from parents and carers after every contact by text message. Almost all feedback from 460 respondents was very positive, with 97% stating that they were satisfied or very satisfied with the care provided. They specifically reported gratitude at being able to text at any time and their enquiry would get picked up within 24 hours during the working week.

The ChatHealth facilitators were also surveyed (n=183) and reported it was quick and easy for them to respond to queries, it improved job satisfaction as they could see an immediate effect, it was time efficient, and they felt safe and supported when using it. It is noticeable, however, that in the breakdown of message content, there is a lack of oral health related queries, although these may be hidden among generalised subject titles (See Figure 7).

Using text messaging to enhance engagement and efficacy of oral health education interventions among primary care givers is an emerging area of research, with studies having statistically underpowered samples (Hashemian et al., 2015, Borrelli et al., 2019). However, using messaging platforms shows promise as a feasible and acceptable way to engage with, and increase oral health knowledge, amongst new mothers to reduce risk factors of early childhood caries (Hashemian et al., 2015, Borrelli et al., 2019). In addition, social messaging group platforms could allow multiple members to engage in conversation, share images and

videos as well as signposting via hyperlinks to relevant healthcare websites. This would provide a virtual peer-to-peer environment thought to increase self-efficacy and confidence with oral health behaviour uptake.

Messaging contacts by type

Messaging contacts by type	Percentage of messages
General health	27%
Administration	14%
Formula feeding	13%
Constipation/stool	10%
Breastfeeding	9%
Parenting advice or support	9%
Sleep	6%
Dietary/nutritional/health/lifestyle	4%
Vitamins	2%
Immunisations	2%
Emotional health and well-being	2%
Signposting	0.60%
Smoking cessation	0.60%
Child development	0.50%
Sexual health	0.30%

Figure 7. Breakdown of the ChatHealth message contacts by type. Taken from paper by Palmer (2019)

3.4 Behaviour models and theories in oral health research

Oral health behaviour is defined as the 'complex outcome on individual oral health from oral hygiene habits, nutritional preferences and how often a person utilises dental services' (Kirch 2008). There are a number of health behaviour models, all with their own strengths, used in oral health behaviour modification (Schou and Blinkhorn 1993). These models provide useful

frameworks which have been guided by sound behavioural theories to help understand the pathways of oral health behaviours, with specific emphasis on behaviour change (McGrath 2019). Patey et al. (2018) argues that failure to consider underlying behavioural theories that may have influenced behaviour, when reviewing the literature could lead to a misinterpretation of the effectiveness of the intervention methods. Therefore, the main behavioural models used in oral health research were reviewed to inform the main intervention of this PhD, and either adopt an already established model, or conceptualise a new model for the intervention.

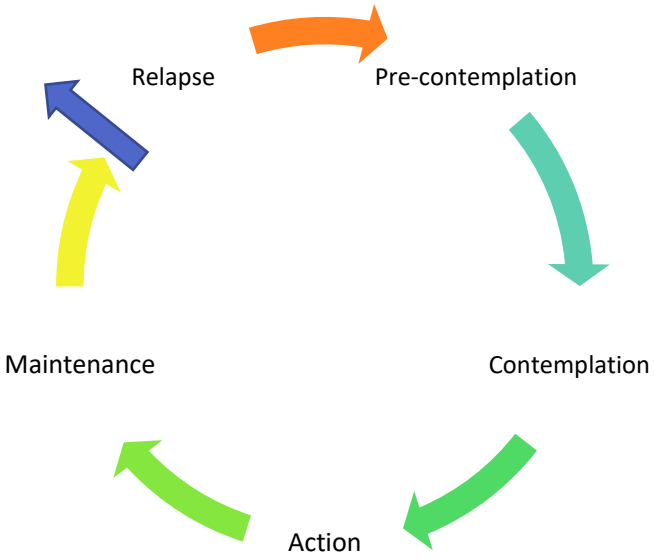
3.4.1 Health Belief Model

Initially developed in the 1950s to explain and address the widespread lack of participation in health programs in the United States, the Health Belief Model was used to study a person's response to symptoms and diagnosed illness (Rosenstock 1974). When directly applying this theory to early childhood caries, a caregiver must believe their child is at risk of dental disease, understand the severity of the problem, believe it can be prevented and willing to carry out the necessary behaviours to prevent it. The constructs of the Health Belief Model have benefited oral health research by identifying maternal education as a key predictor of oral health beliefs (Wilson et al., 2017) alongside the importance the caregivers place on their own oral health (Vanagas et al., 2009, Hiratsuka et al., 2019). Although identifying these beliefs has merit in recognising possible barriers and debunking myths which may be hindering oral health behaviours, Hollister and Anema (2004) argue that the Health Belief Model's value in behaviour change is questionable.

3.4.2 Stages of Change Model

The Stages of Change Model (Figure 8) is represented as a wheel with five key stages used to measure readiness to adopt a new, or alter an old behaviour (Prochaska et al., 1985). The wheel consists of a predictable continuum with each step having distinct characteristics, which make it popular with addiction interventions, such as smoking cessation.

Figure 8. Stage of Change Model by Prochaska et al., (1985)



Those in the pre-contemplation stage have no intention of changing behaviour. This moves onto contemplating a change of behaviour in the near future, followed by taking action, and then maintaining the behaviour and exiting the wheel. The wheel also includes the possibility of relapsing back into old behaviour patterns and beginning the cycle again. It has been suggested that a limitation to this theory is, categorising intentions in this way may lead to effective interventions not being offered to people who would have otherwise responded, such as those in the pre-contemplation stage (Stewart et al., 1996, West 2005).

The Stages of Change Model has strengths in being able to provide patient-centred oral health education, based on where they are in their intentions to change (Wade 2013). However, there is a noticeable paucity of literature using the Stages of Change methodology in perinatal

oral health intervention design, suggesting the model may not easily translate to changing behaviours of caregivers with their infants in the prevention of early childhood caries.

3.4.3 Theory of Planned Behaviour

According to this theory, the most important determinant of behaviour is intention (Ajzen and Madden 1986). The theory is based on the individual's belief and attitudes towards the behaviour and how this corresponds with the attitudes and beliefs of their social networks and the subsequent willingness to comply with these social norms. Like the Health Belief Model, the Theory of Planned Behaviour also relies on whether the person perceives the threat to oral health being significant and their confidence to carry out the necessary behaviours to prevent it.

This theory of intention is said to be a key predictor of oral health behaviours in children, with the mother's perceived behaviour control being responsible for a ~30% variance in brushing frequency (Van den Branden et al., 2015, Soltani et al., 2018). A mother's infant feeding practices have also been suggested to be associated with the Theory of Planned Behaviour, due to needing social acceptance amongst peers (Zhang et al., 2009). However, Faries (2016), argues intention alone is a poor predictor of behaviour as data suggests those with intentions do not automatically follow through with the behaviour.

3.4.4 Intention-behaviour gap theory

In addition to Faries (2016), Webb and Sheeran (2006) also describe how having a strong intention to carry out a behaviour does not always translate into action. This may be due to a phenomenon known as the intention-behaviour gap, which Webb and Sheeran (2006) suggest educational interventions alone do not resolve. Even in the presence of a cleft palate, which increased intention and motivation due to the complications to their child's

oral health, some parents still did not maintain adequate toothbrushing for their child (Lin et al., 2017). Faries (2016) suggests five factors impact the intention-behaviour gap: (1) the motivation, (2) the trigger, (3) the response, (4) the capacity, and (4) the process. Bridging the intention-behaviour gap by addressing additional factors, such as motivation, planning and self-efficacy, has been shown to be a good predictor of a parental toothbrushing habit (Smith et al., 2021).

3.5 Educational versus behavioural oral health interventions

The goal of oral health education, as set out by the WHO, is to improve knowledge, which aims for the adoption of favourable oral health behaviours contributing to better oral health (World Health Organisation 2019). However, there is an acknowledgement of the limitations of educational interventions in improving oral health and reducing health inequalities (Watt 2002, Yevlahova and Satur 2009). Stewart et al., (1996) suggests knowledge dissemination as the primary goal of an oral health intervention may not be effective, as it does not impact those in the pre-contemplation or contemplation stages of change. Instead, by supporting change-seeking intentions as the primary aim, oral health behaviour change interventions may be enhanced with an increase in knowledge occurring indirectly (Stewart et al., 1996).

Although Stewart et al.'s (1996) study was carried out over 25 years ago, the value of educational interventions versus behavioural is still being argued within the literature and so it is worthy of attention in this review. Stewart et al. (1996) came to their conclusion following investigating two intervention groups: educational and psychological. The educational group aimed to increase participant knowledge about the causes of periodontal disease and the measures they could take to prevent it. Whilst the psychological group aimed to help participants improve oral health self-efficacy. Using motivational interviewing, which

previously had only been used to treat addictions, the psychological intervention placed importance on behaviour intentions and removed obstructions to change avoidance by providing alternatives and possibilities. As well as having the greatest pre-post-test mean difference in self-efficacy flossing scores, the Stewart et al. (1996) study found the psychological group had acquired the same amount of dental knowledge as the educational group. This was despite direct imparting of knowledge *not* being part of the psychological intervention. Facts relating to dental disease were only revealed on request or when offering guidance to an expressed belief regarding dental disease which may have otherwise been incorrect. In comparison, the educational group had received 160 minutes of detailed information regarding the causes of dental disease and the necessary measures needed to prevent it.

Notwithstanding, the importance of these findings, the study participants were all male veterans (n=123) and therefore cannot be generalised to the population of interest for this PhD. The study also does not investigate how the increased self-efficacy scores translate to the uptake of oral health habits and the presence of any potential intention-behaviour gap. However, there is overlap with the findings from the pre-PhD study by Kay et al., (2019); by establishing a supportive relationship, delivering advice as and when the participant requested it, or as part of a reasoned explanation for a desired behaviour, an oral health education intervention may be enhanced.

Oral health education interventions often show short term improvements to oral health but there is a lack of evidence of effectiveness and long term sustained change of behaviour (Kay & Locker, 1998, Gao et al., 2014). Plutzer and Keirse (2014) however, report providing mothers with anticipatory advice can improve oral health and reduce the use of dental

services to deal with problems in their preschool children, up to seven years of age. Plutzer and Keirse (2014) report, by giving mothers oral health education material before the birth of their first child, when their infants were six months and again at twelve months old, children were less likely to need to use dental services for pain or treatment compared to the control groups. From the intervention group (n=117), 3.4% used dental services more than five times from birth to 7 years of age. From the control group (n=113), 10.6% used dental services more than five times from birth to 7 years of age. However, despite demonstrating a positive intervention effect, it was reported some of the mothers still felt the information they received was not enough and needed more support and guidance throughout the first year.

While most knowledge may be retained, there has been shown to be attrition in the oral health information retained by parents over an 18-month time period, emphasising the importance of repeated reinforcement of the same information over a shorter space of time (Gajanan 2013). Mothers in a high-risk population, who received four or more motivational interviewing style, oral health counselling sessions in the first two years of their infant's life resulted in significantly less prevalence of untreated dental disease (35% test group n=110 vs 60% control n= 131) (Harrison et al., 2012).

Counter to this, Kowash et al. (2000) found no significant difference in dental caries when mothers were visited every three months compared to every twelve months from birth to three years of age. Kowash et al. (2000) instead found that in the first three years of life, dental caries prevalence was most impacted when the dental health education focused on oral hygiene instruction, including fluoridated toothpaste. This was compared to dietary advice alone. When compared to the control group, all dental health education groups positively influenced infant oral health with only two children presenting with tooth decay at

three years of age, compared to eighteen in the control group. Feedback from the mothers was not reported so it is unclear, despite the positive intervention effect, whether the participants felt a preference to the differing intervention delivery methods. The study also neglected to report behavioural theories which may have underpinned the way the oral health information was delivered.

Feldens et al. (2010) found that dietary counselling, concentrating on feeding guidance and introducing first foods positively impacted oral health of the study infants. Home counselling, aimed at a high-risk population of mothers, every month from birth, increasing to every two months from 6 months to 12 months old, reduced early childhood caries incidence at 4 years old by 22% and severe caries by 32% (Intervention group n=141; Control group n=199) (Feldens et al., 2010a). The findings suggest the emphasis of oral health education interventions should be sensitive to supporting self-efficacy alongside the content of information primary caregivers receive. Although the optimal time in the first year, and/or how often support should be given was said to be difficult to determine. It could be further speculated that the location of receiving oral health counselling has importance, with some interventions occurring within the community whilst others taking place in the home (Kowash et al., 2000, Feldens et al., 2010, Harrison et al., 2012).

The evidence demonstrates the complexities of oral health interventions with it being difficult to determine which design components were key to the reported intervention effectiveness (regularity of information dissemination vs content of information vs delivery of information). Without the possible behavioural mechanisms which may have influenced behaviour being reported, it is difficult to interpret the effectiveness of these methodologies. Additionally, very few interventions collect data on acceptability outside of statistical trends such as

attrition rates. With interventions using multiple oral health educators and counsellors to reach large test groups, it is difficult to determine whether individual characteristics of certain intervention facilitators influenced the intervention effects.

3.6 Conceptualised behavioural model

The following figure (Figure 9) conceptualises the essential factors highlighted in the literature review. It shows how the wheel of change *could* be used for a perinatal oral health intervention. Knowledge dissemination underpinned by the self-efficacy theory are represented in the central circle ("Why should I? How can I?"), which requires reinforcement at every stage. The potential intention-behaviour gap is highlighted as an important factor during the pre-contemplation and contemplation stages, with motivations, confidence, oral health literacy and actualisation of the oral health practices being addressed by the questions in the central circle. How often support occurs and the location, are also important considerations for the oral health education intervention of this PhD.

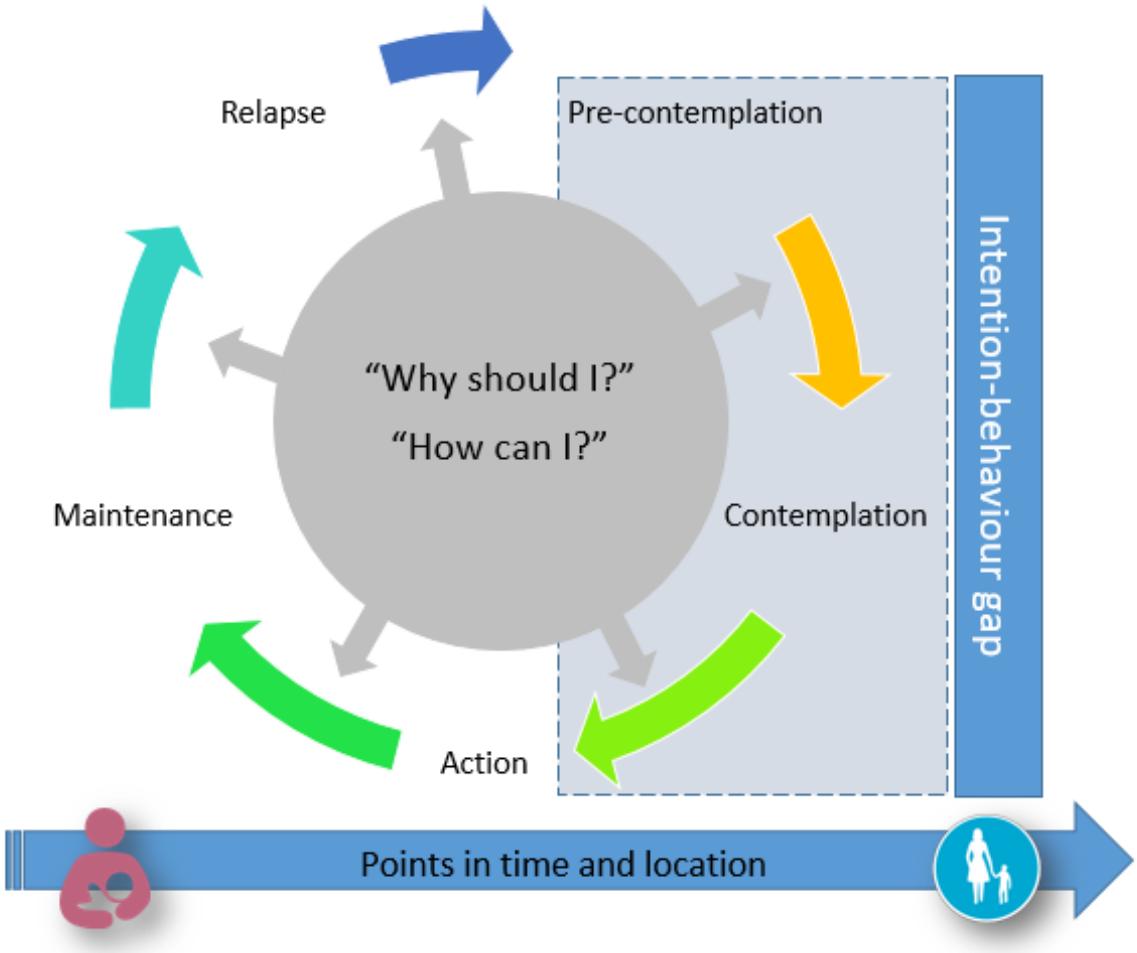


Figure 9. Conceptual model incorporating Bandura's self-efficacy theory with the Stages of Change theory and potential barriers and facilitators to behaviour change/uptake

3.7 Contribution to knowledge

As discussed in section 1.5.1.1, barriers exist with recruiting vulnerable populations to health interventions. Kay et al. (2019) used a gatekeeper approach which was adopted for the main intervention of this PhD. The feasibility of directly applying this recruitment and engagement method with a similar but larger population of vulnerable mothers was investigated. Self-efficacy as a mediating factor in oral health behaviours is well described in the literature. However, no studies to my knowledge have reported investigations of the direct supporting and facilitating of maternal self-efficacy as a major component in an oral

health education intervention. In addition, no studies to my knowledge, have tested two-way text messaging and social messaging group platforms as an engagement approach in an oral health education intervention in the first year of life.

Therefore, the research questions for the FtG study were:

RQ2: Are the recruitment and engagement approaches used in this multi-component oral health education intervention, feasible and acceptable?

RQ3: Did different engagement approaches enhance the self-efficacy of the caregivers and uptake of the five infant-focused oral health behaviours?

The five target oral health behaviours are those recommended in Delivering Better Oral Health (England 2017):

1. Brushing primary teeth with an appropriately fluoridated toothpaste especially last thing at night
2. Encouraging positive attitudes to oral health and dental visiting
3. Not putting to bed with a bottle
4. No sugared drinks in bottles
5. Early progression from bottle to cup

4.0 Chapter Four: Research Design

The aim of this chapter is to describe how mixed methods were used in a convergent design to answer the research questions, RQ2 and RQ3, of this PhD. This chapter also pays particular attention to how the methods were influenced by stakeholder involvement. This includes the development of an intervention survey and the different engagement approaches used to deliver the oral health education intervention. The methods used for participant recruitment, intervention delivery, data collection and data analysis are all given within this chapter.

4.1 Mixed Methods Design

The FtG study was designed using an advanced convergent mixed methods model (See Appendix F) to answer the research questions set out in section 3.7, examining the feasibility, acceptability and effectiveness of a multicomponent oral health intervention. A convergent mixed methods design was used as both qualitative and quantitative data was collected during similar timeframes. The qualitative and quantitative data were not being used to inform one another, as is the case for exploratory and explanatory mixed methods designs, but rather to converge both the qualitative and quantitative data once it had been analysed, and to attempt to validate the results with one another.

The intervention had three areas of focus:

1) Recruitment using gatekeeper referrals from community-based family support services

2) Building parent confidence in carrying out the target behaviours and evaluating how supporting self-efficacy, using a compassion-focused approach, may hinder or facilitate the uptake of these behaviours

3) The use of social text messaging as an intervention engagement approach

4.2 PPI group involvement

As discussed briefly in section 1.4 of this thesis, a working group of mothers with experience of receiving additional support from their local community-based family support service, were included in the stakeholder involvement to feedback on:

- Optimal ways to engage with a population of primary caregivers in receipt of support from community-based family support services
- The design of an acceptability measurement tool

The mothers were selected by a Children's Centre manager, who invited Children's Centre service users to be a member of the PPI group by emailing details about the study. Two separate meetings were held at the Children's Centre, organised by the Children Centre manager to keep the mothers' personal contact details confidential. Both meetings lasted no longer than one hour at the request of the mothers as infants and children were also in attendance. Financial acknowledgement of their time was offered (£10 love-to-shop voucher per person, per attendance), and travel expenses reimbursed. The precise contributions to the research design from the PPI group are discussed throughout this chapter. Minutes from the meetings are provided in Appendix G.

4.3 Methods

4.3.1 Ethical Considerations

Ethical approval was obtained from the University of Plymouth Faculty Research Ethics and Integrity Committee (FREIC) for Health and Human Sciences (17/18-863). Signed consent was gained prior to baseline data collection and checked verbally at the midway point, with non-engaging caregivers being given the option to stop being contacted with the opportunity to

offer feedback. Data was held in a password protected secure folder in a cloud location hosted by University of Plymouth.

Participants were given a unique ID which was used for data collection and analysis. Participants were saved in a mobile telephone device using their first name, assigned unique study identifier and the intervention engagement identifier (e.g., <first name> P38 IP-SMP). The mobile device was password and biometrically protected.

Social messaging data was saved with identifying information, such as child or partner's name being redacted. Transcriptions of the interviews also had identifying information, including geographical locations, redacted.

A lone-working policy was used for visits to participant homes and a protocol was in place to respond to any safeguarding concerns (University of Plymouth 2020).

4.3.2 Participation

As this was an exploratory study, the sample size was decided based on the feasibility to recruit and deliver the intervention effectively within a strict timeframe.

This study therefore aimed to recruit forty vulnerable primary caregivers of babies 0-12 months old, from six satellite health services (SHS) in the Southwest of England, over a four-month period. The SHS were located in areas of increased rates of dental disease and social deprivation as rated by levels of dental disease and dental general anaesthesia data (NHS Digital 2017, Public Health England 2018) and Index of Multiple Deprivation (IMD) data (Ministry of Housing 2015). These services included Family Nurse Partnership (FNP) nurses, or family support workers from Children Centres, who both work to support new parents to ensure the future wellbeing of vulnerable infants (Lewis et al., 2011, Wu et al., 2017). The

time period was based on estimates provided by each health service which suggested they were directly supporting 10-15 eligible families each. Additional eligible vulnerable families not in direct receipt of family support but known to the SHS could also be referred. Both primiparous (one child) and multiparous (more than one child) primary caregivers were included. Infants with life-limiting medical conditions and non-English speaking primary caregivers were excluded. It was assumed that the primary caregiver for a baby under the age of 12 months would be the mother, but paternal primary caregivers were also invited to participate in the study.

Deviations from the original protocol were needed (see Appendix A), as mentioned in the introduction to this thesis, resulting in recruitment being conducted over two phases.

4.3.2.1 Phase I

Phase I recruitment ran from November 2017 to May 2018, following the gatekeeper referrals recruitment approach as used by the pre-PhD study intervention developers (Kay et al., 2019). Feedback from the PPI group supported using a project webpage to aid recruitment, in addition to traditional written study information formats. The idea was that eligible primary caregivers could be sent a link to the webpage via text or email by the family support workers. This would be part of a generic introduction to the study, removing the potential stigma associated with being directly 'targeted'. The project webpage was entitled 'Filling the Gap' and included an animated video explaining the purpose of the intervention (see Appendix H). The caregivers could then directly contact myself to participate. Downloadable and printable information was available on the webpage. Printed information was also available to be handed out in person (See Appendix I).

In addition, the gatekeeper organisations agreed for me to attend baby well-being clinics held at the Children's Centres, with a view to being introduced to vulnerable parents by staff members known to the families. Direct recruitment without introductions from staff was also deployed by myself when attending the baby well-being clinics.

4.3.2.2 Phase II

After a deadline for Phase I was reached, Children's Centres advertised the project webpage on their Facebook page over three weeks in May 2018. The advert highlighted the topic, the benefits of participating and contact information for participation as shown in Figure 10.

Figure 10. Facebook Recruitment Advert

4.3.3 Intervention Delivery

The intervention ran between December 2017 and May 2019, with primary caregivers receiving support for twelve months. The intervention was delivered by myself, a dental hygienist and mother with experience of providing infant feeding peer-to-peer support, as previously reported. A record was kept of the contact efforts and outcomes in order to keep in monthly contact with caregivers and signpost to approved oral health websites and to the Public Health England Sugar Smart app (Public Health England 2009). Caregivers were given an infant's toothbrush and toothpaste at the beginning, middle (if requested) and at the end of the study.

Three intervention arms were explored as engagement approaches for delivery of the oral health education intervention to support caregivers' self-efficacy in the first year of their infant's life. A control group was used to compare the self-efficacy of the intervention caregivers with the control arm caregivers, and the acceptability of the standard level of support open to everyone through existing health services (e.g., health visitors, Children's Centres, and dental care professionals). This follows guidance that control conditions should be comparable to real-world settings, i.e., current standards of care, instead of 'no treatment' or 'placebo' (Tunis et al., 2003, Russell et al., 2005, Zwarenstein 2009).

The decision to explore three differing intervention engagement approaches followed stakeholder feedback, including the PPI group and the local authority lead (LAL) for a Southwest UK city (as introduced in Section 1.4). The LAL provided their views on the ideal engagement approaches following focus groups, which the LAL conducted with the local authority service users. The results of these focus groups identified three types of service users, which the LAL defined as 'support me', 'enable me' and 'inform me'. The stakeholder

feedback will be described in more detail within each intervention engagement approach next.

4.3.4 Intervention Engagement Approaches

The intervention engagement approaches used to deliver the oral health education intervention were as follows:

*1. Face-to-Face Oral Health Education (In person arm (**IP**))*

I visited primary caregivers in person, at a location decided by them, every three months. Primary caregivers were also informed of times when I would be available at the baby wellbeing drop-in clinics held at Children's Centres.

This engagement approach was influenced by the PPI group, who advised home visits or making appointments would be a barrier to engagement, preferring opportunities for engagement during weekly drop-in health clinics at their local health centres. In addition, this engagement approach aligned with the 'support me' service users described by the LAL, who preferred face-to-face contact.

*2. Direct and Group Messaging Oral Health Education (Social messaging platform arm (**SMP**))*

A casual style, as used by NetMums Online Drop-in health service (NetMums 2017), was adopted. Primary caregivers could contact myself between 7.30am to 9.30pm, Monday to Friday, via their preferred multi-media text messaging platform (SMS, Messenger or Whatsapp), or in a dedicated social messaging group hosted by Whatsapp, as often as needed.

Feedback from the PPI group advocated for an 'online expert-led group', which they felt would be a helpful and useful way to engage with vulnerable caregivers, more so than face-to-face contact. Interacting with mothers in a similar situation would be an incentive to

engage with an online group. Facebook was mentioned as the ideal platform to deliver this engagement approach by the PPI group. However, during recruitment it became clear that Whatsapp was a better fit for the social messaging group delivery.

This engagement approach aligned with the 'inform me' service users described by the LAL who tended to avoid face-to-face contact and preferred to seek out information online.

*3. Face-to-Face and Social Messaging Platform Oral Health Education (**IP-SMP**)*

Primary caregivers in this arm, received both in-person delivery at least every three months and could access the social messaging group and direct messaging as often as needed.

This engagement approach aligned with the 'enable me' service users who liked to have the choice of both face-to-face support as well as being able to seek information online.

4.3.5 Randomisation

Caregivers were randomly assigned to one of the four trial arms (IP, SMP, IP-SMP and Control). A random sequence of the trial arms was created using an online block randomisation tool (Atkins et al., 2004) and opaque envelopes were sequentially numbered by a fellow PhD student. Randomisation occurred after the aim of the intervention and the different engagement approaches had been described to the eligible caregivers and consent had taken place.

4.3.6 Data collection: quantitative methods

Data for this study was collected at baseline, midway (six months from the start of receiving the intervention) and at the end of the intervention (twelve months from the start of receiving the intervention) as recommended by (Sehkon et al., 2017). This was to explore the

acceptability of the intervention and engagement approaches, and the impact on levels of general self-efficacy over time.

4.3.6.1 General Self-efficacy (GSE) Scale

This study used the validated psychometric GSE scale (Schwarzer 1995) to explore general levels of self-efficacy between intervention arms and in comparison to the control group.

The GSE scale is a measurement tool, correlated to emotion, optimism, work satisfaction, consisting of ten items being scored: 1 = Not at all true, 2 = Hardly true, 3 = Moderately true, and 4 = Exactly true. The total score is calculated by finding the sum of all ten items, ranging between 10 and 40, with a higher score indicating more self-efficacy (Schwarzer 1995, Scholz et al., 2002, Luszczynska et al., 2005).

The GSE scale was replicated and hosted via a cloud-based software company (Qualtrics^{TM}) and sent to all trial arm caregivers at baseline (IP, SMP, IP-SMP & C), and to the intervention arm caregivers (IP, SMP & IP-SMP) via an intervention survey (described in the upcoming section 3.3.6.3) at the midway point and at the end of the intervention. GSE data was collected from the control group at the midway point and at the end of the intervention either via email or social messaging platforms (Facebook messenger, Whatsapp or SMS). Three prompts were used to encourage completion of the GSE scale.

4.3.6.2 Development of acceptability measurement questions

To expand the analysis and reporting of acceptability in this intervention, constructs outlined by Sekhon et al., (2017) were used to design acceptability data collection measurement questions. Feedback from an expert panel of researchers and the PPI group was used to develop the acceptability measurement questions. These were used in an intervention survey.

Acceptability in healthcare interventions is usually synonymous with feasibility, however, it is still considered a poorly defined term (Bowen et al., 2009, Sehkon et al., 2017, Hallingberg et al., 2018). Reporting acceptability most commonly includes operational definitions such as, number of dropouts, treatment discontinuation and other measurable variables such as side effects, satisfaction and uptake rates (Sehkon et al., 2017, Hallingberg et al., 2018). Whilst the use of measures of observed behaviour does give an indication of how many primary caregivers initially agree to participate in a trial versus how many actually complete the intervention, often reasons for discontinuation or withdrawal are not explored (Sehkon et al., 2017).

An expert panel of researchers were initially consulted on developing the questions from the seven domains of the Theoretical Framework of Acceptability (TFA) (Sehkon et al., 2017). These included:

- Affective attitude – how participants feel about the intervention
- Burden – how much effort it takes to participate
- Ethicality – how much the intervention fits with a participant's value systems
- Coherence – how much participants understand the intervention
- Opportunity Costs – what values, benefits or profits are given up by participating
- Effectiveness – how much participants feel the intervention will achieve its purpose
- Self-efficacy – how much participants feel confident in being able to perform behaviour(s) required to participate.

The measurement questions were then tested with the PPI group, along with getting their feedback on ways to improve engagement with an intervention survey, and ways to ensure honesty when completing.

The feedback from the PPI group suggested a number of factors may put participants off completing surveys, or even disengaging with the study entirely (See Appendix G for meeting minutes). Having the time and how relevant surveys felt to them was suggested as key to engaging with the data collection process. One parent reported having dyslexia and said surveys often made her "feel stupid" as she does not always understand the meanings of words or struggled answering if there were too many questions.

The PPI group felt a 0-100 sliding scale (negative to positive) was the most acceptable way to measure the acceptability questions, although the group advised about being mindful of those answering with a neutral score of 50. The PPI group reflected that when they do not understand a question, they often place the answer in the middle, and this may also be indicative of neutral answers given by the caregivers in this study.

The PPI group recommended three revisions to the measurement questions. 'Affective Attitude' or 'feelings' were deemed to be too ambiguous, instead proposing the question be related to how interesting/uninteresting, or how good/bad the intervention is. The PPI group suggested 'Ethicality' should be removed, as they did not feel that a person would have values which go against wanting to carry out behaviours to improve their infant's oral health. They also felt it was a confusing construct; trying to quantify a person's values and relate it to an oral health intervention. Finally, the PPI group recommended changing 'Opportunity Costs' (what values, benefits or profits are given up by participating) to 'Opportunity' (how much a

participant feels they will benefit from the intervention), as they felt the benefits from taking part in the study greatly outweighed any hypothetical opportunity costs.

It was agreed by the expert panel that 'Ethicality' should be removed, with values instead being explored in the qualitative interview data. The expert panel also agreed to change 'Opportunity Costs' to 'Opportunity', again being considerate to both in the qualitative interview data. However, it was decided to stay true to the original 'Affective Attitude' measurement construct; a more specific question may not elicit the same kind of data as the broader construct, but the number of neutral scores given to the measurement question would be explored in the evaluation of the survey.

The final acceptability measurement questions were:

- How would you describe your feelings towards this baby dental health study? (Negative to Positive)
- How much effort do you feel is required to take part in this baby dental health study? (Excessive effort to No effort)
- How understandable is the purpose of this baby dental health study to you? (Not at all understandable to Very understandable)
- How much do you feel you will benefit from taking part in this baby dental health study? (No benefit to Benefit a great deal)
- How likely is it that this baby dental health study is going to improve child dental health? (Extremely unlikely to Extremely likely)
- How confident are you that you will be able to carry out the necessary tasks to take part in this baby dental health study? (Not very confident to Very confident)

A preview of the acceptability measurement questions as they would appear on a laptop or mobile device is available in Appendix J.

The self-efficacy question needed to be amended for endpoint data collection so that it referred to behaviour going forward rather than taking part in the study. For the final questionnaire, it was changed to:

- How confident are you that you will be able to continue to carry out the necessary tasks to look after your baby's teeth after the end of this baby dental health study?

4.3.6.3 The Intervention Survey

The acceptability measurement questions were merged with the general self-efficacy scale (section 3.3.6.1) to create a single intervention survey.

The intervention survey was hosted via the same cloud-based software company (Qualtrics^{TM}). At baseline, the intervention survey was collected electronically in person during the recruitment meeting, via a handheld device, after consent but prior to the previously described randomisation process. This was so the caregivers answered before knowing which trial arm they had been assigned to, to avoid biasing their opinion of the intervention.

At the midway point, the intervention survey was sent electronically, either via email or social messaging platforms (Facebook messenger, Whatsapp or SMS) to intervention arm caregivers (IP, IP-SMP and SMP). The midway intervention survey also included open questions asking the caregivers how they felt they were coping with parenthood in general, how they felt they were coping with their infant's oral health, and an 'opt out' option with a box to provide feedback. Three prompts were used to encourage completion of the intervention survey.

At the endpoint, the intervention survey was either collected electronically in-person via the same handheld device prior to the semi-structured interviews or sent electronically via email or social messaging platform. Three prompts were used to encourage completion of the intervention survey by those who were not taking part in a semi-structured interview.

Figure 11 gives an overview of data being collected at baseline, midway and at the end of the intervention.

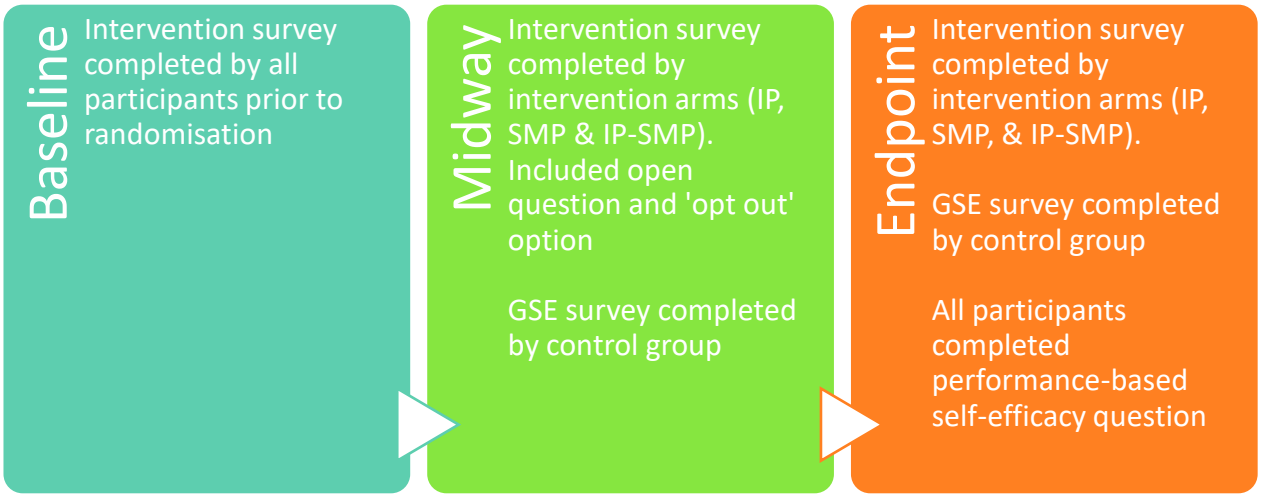


Figure 11: Overview of data collection at baseline, midway (6 months from the start of receiving the intervention) and at the end of the intervention (after twelve months from the start of receiving the intervention).

4.3.6.4 Contextual Information

Contextual information was collected to explore relationships between GSE and engagement with demographic data of the caregiver or infant. This included infant age and parental status (primi/multiparous), which was collected at the start of the intervention, and primary caregiver age, average household income and an Index of Multiple Deprivation (IMD) which was collected at the end of the intervention.

Infant age was categorised into 0-3, 3-6, 6-9 and 9-12 months old. Any infant whose age straddled between two groups were assigned to the older of the two categories. Primary

caregiver age was collected in incremental groups, starting at 18-24 years old and ending at 45-54 years old. Average household income was collected in incremental groups, starting at 0-19k and ending with over 100k. It was expected to recruit low-income families using the Phase I recruitment strategy and so this cut off point was deemed appropriate. Household size measurements were not considered. The limitations of this are discussed in section 4.3.6.4.

The IMD data was collected using the Ministry of Housing, Communities and Local Government postcode mapping tool (Ministry of Housing 2015). This ranks postcodes into deciles of least deprivation (decile 1) and deciles of most deprivation (10). If the postcode of caregiver's home address was not known, the postcode of the Children's Centre the caregiver was recruited at was used instead.

Access to services was explored during recruitment with caregivers who were not recruited by a satellite heath service or in a satellite health service setting. This was self-reported access to early years services.

4.3.6.5 Engagement

Engagement was defined by at least one two-way text messaging exchange and at least one in-person meeting over the 12-month period which led to support and advice being given relating to the five target behaviours (see section 3.7). Primary caregivers were categorised into 'yes' or 'no' at the midway and end point of the intervention which ascertained whether they had engaged with the intervention or not. This was added to the SPSS datasheet.

4.3.6.6 Text message engagement

For the caregivers receiving a social text messaging engagement component of the intervention (IP-SMP and SMP), the number of one-way messages (from me to the caregiver)

was collected alongside the number of two-way messages. Text message exchanges unrelated to the purpose of the intervention were not included in the data collection.

4.3.7 Data collection: qualitative methods

A word document with each caregivers' unique ID and intervention engagement identifier (e.g., P38 IP-SMP) was saved onto a password protected secure folder in a cloud location hosted by University of Plymouth. Facilitator reflections, content of two-way text message exchanges and interview transcriptions were saved to each caregivers' individual word document and then imported into NVivo12 software.

4.3.7.1 Facilitator Reflections

Facilitator reflections were kept throughout the recruitment, intervention delivery and data collection process, which were audio recorded and transcribed verbatim either onto the caregiver's personal word document or onto a general word document.

Reflections included what I felt did or didn't work well with recruitment and the intervention engagement approaches, and nuances to engagement patterns that I noticed throughout the intervention. Reflections following face-to-face meetings included thoughts on rapport and how the meeting went, and the content of the oral health discussions, and any attitudes and beliefs relating to carrying out oral health behaviours. Reflections were also collected after each semi-structured interview on how I felt the interview went, and any stand-out caregiver responses relating to self-efficacy, the acceptability of the intervention or areas of improvement.

4.3.7.2 Content of two-way text message exchanges and social messaging group chat

The content of two-way text message exchanges were copied and pasted onto the corresponding caregivers' individual word document. The entire social messaging group chat

was exported (minus group media such as photographs) from the social messaging platform and imported into a separate word document and uploaded into the Nvivo12 software.

4.3.7.3 Semi-Structured Interviews

Towards the end of the intervention, all caregivers from all trial arms, excluding caregivers who had left the study, were contacted to enquire about their interest in taking part in an interview following completion of the intervention. An incentive of receiving a £10 love-to-shop voucher was given. The caregivers who agreed to take part were contacted again at the end of the intervention.

The interviews lasted up to an hour and took place in person, at the caregiver's home at a time convenient to them. The interviews were all audio recorded using the same password and biometrically protected mobile telephone device and uploaded onto a password protected cloud location hosted by University of Plymouth.

Open questions based on the Theoretical Domains Framework (Michie et al., 2005, Cane et al., 2012), which is a framework used in behavioural change and implementation research, and the Theoretical Framework of Acceptability (Sehkon et al., 2017) were asked. These questions related to their experience of oral health support, within the intervention and with other healthcare providers, and the caregivers' oral health behaviours, beliefs, and knowledge. The caregivers' opinion on their ideal infant dental health support service was also sought, including the most acceptable engagement approach and acceptable time of intervention delivery, aimed at people like themselves.

The effectiveness of the interview questions to elicit the required data was reviewed after the first three interviews, with topics of interest apparent in the data being paid attention to and added to the interview guide if appropriate.

4.3.8 Data analysis: quantitative data

Due to the small sample size, both parametric and non-parametric tests were conducted to explore the data. Parametric tests are appropriate where normal distribution is observed. Non-parametric tests are useful to reduce possible bias when analysing data from small samples (Field 2013). If normal distribution was found, a parametric test was conducted. However, because of the small sample size, a non-parametric test was also conducted on the same data and used to interrogate any significant findings. If both tests showed significance, then the findings were deemed appropriate to report alongside the qualitative findings. However, the validity of these findings are not reported but rather used as possible areas of interest for future research.

Due to the three levels of data collection (baseline, midway and end), where applicable, a Bonferroni Correction was applied to the parametric model. This is used when multiple comparisons are being tested to reduce the Type I error rate, so findings do not show statistical significance where there is none.

Questions were asked of the data to explore statistical trends in acceptability, feasibility and GSE. These statistical trends were then integrated with the qualitative data to look for similarities and differences in both data. These questions were:

- What factors, if any, affect engagement? (Control groups were not included in the engagement analyses.)
- What differences, if any, were seen in acceptability scores over time, between the intervention arms?
- What differences, if any, were seen between all trials arms in their confidence to carry out future oral health behaviours, after the end of the intervention?

- How did the GSE scores compare between all trial arms over time?

4.3.8.1 Repeated Measures Analysis of Variance (ANOVA)

Repeated measures ANOVA with the Bonferroni correction was used on both GSE data and acceptability data. The repeated measures ANOVA compares means across one or more variables that are based on repeated observations, which in this study occurred at baseline, midway and at the end of the intervention. This was to explore whether there were any statistical trends over time in the acceptability data and GSE scores between the intervention arms (IP, IP-SMP and SMP).

4.3.8.2 Univariate ANOVA

A general linear univariate model was used to analyse the performance-based self-efficacy question asked at the end of the intervention (section 3.3.5.1**,** p74**)**. This question determined the confidence of all trial arms in carrying out oral health behaviours for their children after the end of the intervention. This analysis explored any statistical trends between intervention arms as well as in comparison to the control group.

4.3.8.3 Univariate Binary Logistic Regression

The dependent variable of engagement was a binary 'yes' or 'no' (section 3.3.5.6) and therefore a univariate logistic regression was used to explore the relationship between the categorical independent variables, namely:

- The intervention arm (IP, IP-SMP, SMP)
- Baby's age at the start of the intervention
- The phase they were recruited (Phase I or Phase II)
- Parent status (primiparous/multiparous)

- IMD decile scores
- Acceptability measurement scores
- Average household income

4.3.8.4 Kruskal-Wallis Test

If the Repeated Measures ANOVA tests showed significance when exploring acceptability and GSE scores over time, a Kruskal-Wallis test was used as the non-parametric model, to question the findings of Repeated Measures ANOVA by looking at where the significance may be. For example, between total and individual acceptability measurement scores and engagement, when modelled with the independent variables listed in section 4.3.8.3.

4.3.8.5 Mann-Whitney test

A Mann-Whitney test was used as a non-parametric model to question the findings of the Repeated Measures ANOVA when looking at acceptability scores, by exploring the significant differences between intervention arm acceptability measurement scores, taken at the end of the intervention.

4.3.8.6 Social messaging data – Descriptive Statistics, Text Network Analysis and Power BI

One-way and two-way text message descriptive statistics were analysed for patterns in the data.

Text network visualization can be used to identify the main keywords and topics within a document or a corpus of documents (Paranyushkin 2011). A text network analysis tool, using the social messaging data relating specifically to the Whatsapp group, was used for topic modelling, to identify what distinct topics the text comprised of, and the most influential elements discussed within the data (https://infranodus.com/).

The data was exported from Whatsapp into a Word document. The data was cleaned by removing unwanted characters (e.g., :o), !, ?), replacing any acronyms, removing stop words (e.g., of, are, the, it, is), removing identifiable data, time stamps and checking spelling. The cleaned data was then uploaded to the text network analysis software. The text network analysis tool was applied to detect communities of closely related concepts or topical clusters (topic modelling) and identify the most influential nodes (top keywords). A network graph is automatically generated from the data.

Further insights into the social messaging group data was gained from using an additional Excel function, known as PowerBI™. The social messaging group transcript with message time stamps was imported into an excel spreadsheet. Analytics were run to explore descriptive findings such as frequencies of messages per user, the time of day users interacted with the social messaging group, and the frequency of engagement with the social messaging group over the twelve-month period.

4.3.9 Data analysis: qualitative data

4.3.9.1 Framework analysis

After being uploaded to Nvivo12, the data were analysed using framework analysis (Richie and Spencer 2004, Gale et al., 2013). There are five key stages of qualitative analysis when using a framework approach, described by Richie and Spencer (2004) which was expanded on to include the additional two stages described by Gale et al., (2013). These stages are:

1. Transcription
2. Familiarisation with the interview
3. Coding
4. Developing an analytical framework

5. Applying the analytical framework
6. Charting data into the framework matrix
7. Interpreting the data.

Stage 1: I transcribed the audio recordings of the interviews verbatim (word for word). This facilitated my immersion in the data. Three transcripts were checked against the audio recording for accuracy by another experienced qualitative researcher (SB).

Stage 2: Interview reflections were added to the transcripts. The transcripts were read several times, with further reflective or contextual notes annotated onto the transcript.

Stage 3: Codes were drawn from the Theoretical Framework of Acceptability (TFA) (Sekhon et al., 2017) to explore thoughts, opinions and experiences of the intervention, and the Theoretical Domains Framework (TDF) validated for behaviour change (Michie et al., 2005, Cane et al., 2012), to look at influences which may have impacted infant-focused oral health behaviours. These were used as deductive column headings for the framework and added to a codebook with a definition for each code.

Stage 4: SB and I independently coded the first four transcripts, one from each of the four trial arms (IP, SMP, IP-SMP & C), using the codebook Discrepancies in coding were discussed and differences were explored. An additional inductive code “compliance” was added at this stage to capture data relating to behaviours that were impacted by the temperament of the child. In addition, a “miscellaneous” column was added to ensure data which still did not fit did not get lost and could be discussed. Insights and decisions made in relation to remits of new codes were recorded in a reflective journal and discussed with MN, CQ and SB before finalising the analytical framework.

Stage 5: The remaining transcripts were coded by me using the analytical framework.

Stage 6: The data were then charted into a matrix by code (column) and primary caregiver/facilitator (rows). This enabled overall summaries to be written in respect of the data by each code, to identity patterns across columns and rows, and homogeneity or lack of. This provided an overview of the feasibility, acceptability and effectiveness of the intervention as a whole. In a separate matrix using the same codes (columns) and primary caregiver/facilitator (rows), the data was charted into the different trial arm groups and summarised again to see whether there were any differences in the patterns specific to the trial arm. This identified the differences in self-efficacy and the factors which impacted it more clearly. The data were finally viewed to summarise findings relating to the intervention as a whole, comparative findings per trial arm, and per individual primary caregiver. This provided insight into particular characteristics of each individual which may have influenced their attitude towards the intervention and their uptake of infant-focused oral health behaviours.

Stage 7: The quantitative findings were added into the respective columns of the qualitative framework matrix to look for patterns or discrepancies and see whether the quantitative data confirmed the qualitative data and vice versa. An example of this is shown in Appendix K. In particular, attention was paid to the outliers in relation to their engagement, intervention survey scores and the coded data to explore potential reasons for lack of homogeneity. A research journal was kept to record ideas, early interpretations and potential themes of the data. Silences within framework matrix were reflected upon as to whether they were due to an unnecessary code or due to the interview questions not eliciting the data. An example of this was the code “reinforcement”. Incentivising and rewarding infants as young as four

months old may not have been applicable with distraction as opposed to reinforcement being discussed more often. This was discussed within the oral health behaviours.

Once, cross cutting themes were identified by highlighting themes which appeared across some or all of the matrix summaries, using the codes as headings, all deductive and inductive themes were written into a draft report along with associated quotes. These were further interrogated by SB, MN and CQ for repetition and coherence before finalising the key themes.

One of the challenges of deriving themes was due to the interconnectedness of the data. Key themes were either derived from collapsing themes together or from the cross-cutting themes. An example of this was “Attitude” and “Expertise”. Attitude was a collapsed theme which included emotions, ethicality, motivations, intentions and benefits. Expertise was a cross cutting theme which was found to impact acceptability of the intervention.

The relationships and connections between the key themes were mapped onto a diagram and inferences being made on emerging theories were recorded in the research journal.

5.0 Chapter Five: study findings to answer RQ2

In order to answer RQ2, which focused on the feasibility and acceptability of the recruitment and engagement approaches of the oral health education intervention, analysis of the data focused on:

- Phase I and Phase II recruitment approaches
- Engagement approaches used for intervention delivery
- Acceptability data

Differences and similarities per intervention arm are described, with control group comparisons where appropriate. Quotes from interviews with participants are set out in italics with quote marks, and with identifiers to show the data source. My reflections are set out in a different type font in italics to make the different sources of data easily identifiable.

Participants are referred to as 'mothers' unless referring to both maternal and paternal primary caregivers, then the term 'caregivers' is used.

5.1 Recruitment Approaches

5.1.1 Phase I

As set out in section 4.3.2.1 in the previous chapter, a webpage was used as an adjunct to traditional recruitment methods in the first phase of recruitment (Ph1). Webpage analytics showed that there were no views of the webpage and/or the recruitment video by the satellite health services (SHS). This suggested the text/email link designed to help key healthcare workers refer eligible caregivers was not utilised.

In February 2018 (three months after Ph1 recruitment began), one of the gatekeeper referral SHS decided to withdraw from the project after not being successful in referring any families

they were supporting. This was due to the support workers not deeming it appropriate to discuss the intervention study with the eligible caregivers they supported, because the families were often in crisis. This left five SHS to refer eligible caregivers to the intervention.

Out of twelve potential Family Nurse Partnership (FNP) mothers, the family nurses felt it appropriate to only provide five mothers with information about the study. This was due to the acute challenges the other families were facing or not meeting the inclusion criteria (infants were over 12 months old). In addition to the FNP family nurses directly referring eligible mothers, I was invited to a baby group being trialled by the FNP for the first time in February 2018 with a view to being introduced to mothers from this group. It was held in social services run accommodation which served as a respite for the mothers during the process of finding permanent accommodation. I found it very difficult to engage with the mothers at this particular location and no mothers were recruited from this group. A family nurse suggested the reason for lack of engagement may be due to the mothers viewing me similarly to staff working at a Children's Centre service which they avoid. Negative experiences with oral health was also reported as a reluctance to engage:

> *Attended FNP baby group – very difficult to engage with the mums. <Family Nurse> reported that the mums very rarely engage with the children's centres so likely view me in the same vein. <Family Nurse> introduced me to a mum; she seemed very reluctant to take part. She told me her son had bitten some bristles off a toothbrush and so she avoided brushing his teeth for two months.* ***NT reflection February 2018***

Out of the potential forty to sixty eligible families receiving support through the remaining SHS, no families were directly referred by key early years support workers.

Both the FNP and the Children's Centres underwent a process of recommissioning in April 2018, with Children's Centre services returning to a targeted family support service, as opposed to a universal service. This reduced the number of potential baby wellbeing clinics for recruitment to take place at. In addition, the amount of effort required for myself to maintain engagement with the gatekeepers in order to attend baby wellbeing clinics for recruitment was considerable. There were times I was not given consent to attend at all:

> *Getting permission to attend groups often took several emails and follow up telephone calls if there had been no response. Some weeks had to be prioritised for the health teams, so I was not able to attend.* ***NT reflection April 2018.***

Due to understaffing at baby wellbeing clinics, and staff not being informed of the study, caregivers were all approached directly by myself, as opposed to the original plan to be introduced by the SHS workers. Recruiting in this way was difficult and made building an initial rapport with the caregivers a challenge:

> *Drop-in health clinics often only had one staff member with a fast turnover of mothers attending to weigh their babies. At one point I mucked in with helping the mothers weigh their babies as the Children's Centre worker was overwhelmed and the room was very crowded. Starting a conversation and building rapport was therefore difficult.* ***NT reflection April 2018****.*

Selecting caregivers based on infant age, as well as the discomfort of purposively selecting 'vulnerable' caregivers without having knowledge of their personal circumstances caused me concern:

I think, because I am shorter on time, I am having a selection bias towards mums with six months and older babies as I feel they will get the most benefit from me over the next twelve months. ***NT reflection February 2018.***

Attended <Children's Centre> today but did not recruit any mums. Felt that it wasn't targeted enough which leaves me incredibly uncomfortable having to judge mothers in this way. ***NT reflection February 2018.***

5.1.2 Phase II

As the Ph1 recruitment strategy was taking much longer than anticipated, as described in section 4.3.2.2 of the previous chapter, a second phase (Ph2) was introduced which ran for three weeks in May 2018. The project webpage was shared by one of the engaged SHS on their social media (Facebook) page. This had a snowball effect with the advert being shared by other baby group pages. Vulnerability was therefore dropped as a requirement. University of Plymouth webpage analytics showed that there were a total of 115 unique page views of which 46% (n=53) enquired about the study.

Those who were recruited in the second phase had a longer initial meeting with me to discuss the study and participation, with the meeting held at a space and time decided by them. This was in direct contrast to Ph1 and paved the way for me to engage and build rapport due to feeling less discomfort which was associated with the direct recruitment approach:

It was far easier for me to be engaging as I was relinquished of the discomfort at having to 'target' mums based on my perception of what a 'vulnerable' mum might look like, and the appropriate age of the baby for the intervention. ***NT reflection May 2018.***

5.2 Participant Profile

Out of the five mothers given information by the FNP, three consented to take part. From the twenty-three mothers approached directly by myself at baby wellbeing clinics and given information, seventeen consented to take part. Out of the fifty-three caregivers who enquired from the social media advert, twenty-six replied to arrange an initial meeting to sign up to the study. Two did not meet the inclusion criteria due to their infants being over 12 months old. The remaining twenty-four consented to take part in the study. Therefore, a total of forty-four mothers were recruited; twenty recruited from Ph1 and twenty-four recruited from Ph2 with eleven per research arm (See Appendix L for participant information table). The mothers were all located in mixed rural and urban areas in the Southwest of England.

All four children centres used for recruitment were within districts of Southwest England known to have high rates of child dental general anaesthetics (NHS Digital 2017, Public Health England 2018). These areas corresponded with Southwest districts considered most deprived according to the Index of Multiple Deprivation (Ministry of Housing 2015). These Children's Centres were also identified by the area managers of the Children's Centres as areas of high need.

Of the thirty-three mothers who were assigned to an intervention group (IP, IP-SMP or SMP), primiparous (first-time) mothers made up 70% (n=23) of the sample and multiparous (more than one child) 30% (n=10). Two first-time mothers had twins. Of the thirty-five babies included in the intervention, 69% were aged 0-6 months (n=24) and 31% were 6-12 months (n=11).

Only six mothers recruited from Ph1 provided details on their household income which showed two mothers would be considered low income (0-19k). One of these mothers was not considered to be living in an area of deprivation, according to their postcode, despite being in receipt of family support by the FNP. The remaining four mothers recruited from Ph1 had an average household income of 20 to 59k, despite living in areas considered most deprived according to their postcodes. Three mothers (13%) would be considered living in an area of deprivation (IMD decile 1-4) according to their postcode IMD decile. There were eight Ph1 recruited mothers who disclosed their age range; four were aged 18-24, three mothers aged 25-34 and one mother aged 35-44. Of the twenty-three mothers recruited from Ph2 who provided average household income, only one mother would be considered as being a low-income household (0-19k). However, this mother would not be recognised as living in an area of deprivation according to their postcode (IMD decile 7) despite living in local authority housing. Only three mothers recruited from Ph2 could be considered living in an area of relative deprivation (all from IMD decile 4). The Ph2 recruited mothers' age ranges were, one mother aged 18-24, seven mothers aged 25-34 and sixteen mothers aged 35-44.

Looking at the vulnerability criteria used for this study (access to services, in receipt of family support services, low income and IMD decile), four mothers (Ph1 = 3, Ph2 = 1) were known to be using targeted services for additional support (FNP and social services). There were nine mothers who lived in remote areas of the Southwest UK, with barriers to access to services (Ph1 =1, Ph2 = 8). There were twenty-two mothers who met the criteria for deprivation using the IMD index, from either their postcode or the Children's Centre they were recruited from (Ph1 = 19, Ph2 = 3). Out of the twenty-nine mothers who provided household income, three would be considered on a low income (0-19k, Ph1 = 2, Ph2 = 1). Although all mothers were English-speaking, two mothers were not born in the UK. Appendix M provides a detailed table

showing which mothers fulfilled each vulnerability criteria. Table 4 below provides an overview of the number of mothers fulfilling each criterion and the number who fulfilled none of the criteria.

Vulnerability Criteria	Total of Ph1 mothers	Total of Ph2 mothers	Total mothers
Access to services	n=1	n=8	n=9
IMD decile	n=19	n=3	n=22
Household income*	n=2	n=1	n=3
In receipt of family services**	n=3	n=0	n=3
Mothers who met no criteria	n=0	n=14	n=14

*Table 4: Overview of the number of mothers fulfilling the vulnerability criteria. *n=13 Ph1 mothers did not provide income details. **n=12 Ph1 mothers did not provide details about family support services*

5.3 Engagement

By the midway point (six months after recruitment into the study), one mother had not engaged with the intervention at all. This mother was from the in-person intervention arm, was multiparous (the mother disclosed she had five children) and recruited from Ph1. Contact was attempted via Whatsapp, which showed the mother never received the message (one tick)[1]. Several attempts were also made via Short Messaging Service (SMS), but these were not responded to. This mother was not seen at further Children's Centre visits.

[1] Whatsapp uses a tick system to identify delivery success of messages. A single tick shows the message is undelivered or has been blocked, two white ticks shows the message is delivered and two blue ticks means message has been delivered and read by the recipient.

A further mother in the IP-SMP intervention arm, and recruited in Ph1 by a FNP nurse, used the 'opt out' option which was at the end of the midway survey. This mother felt she was not benefiting from the intervention and withdrew. This mother had only been contactable via email as she did not respond to text messages and had also declined an in-person meeting. Prior to the mother opting out, it had been discussed with her family nurse how best to try and engage with the mother more, with the FNP nurse describing the mother as 'very shy'.

A further nine mothers did not engage at various stages after the midway point (stopped responding to messages, unable to arrange a convenient time for intervention delivery or reported no problems which required facilitator support). This took the total number of mothers who did not engage or stopped engaging with the intervention to eleven (33%) by the end of the twelve months (see Figure 12 for engagement flow diagram).

The control arm attrition was not included in the engagement attrition rate as their engagement was not key to the acceptability of the intervention. However, there were eleven control mothers at the start of the intervention, seven completed the midway survey reducing to five mothers completing the survey and taking part in an interview at the end of the intervention (comparative attrition rate of 45%).

Factors tested against intervention engagement were the intervention arm, mother's age, baby's age at the start of the intervention, their parental status (primiparous or multiparous), baseline and total general self-efficacy scores, their Index of Multiple Deprivation (IMD) scores, their average household income, their acceptability questionnaire scores and whether they were recruited via gatekeepers (Ph1) or self-selected to participate (Ph2). For an effect to be detected in the data being analysed, there should be a sample of at least 15

per group or data range (Field 2013). The mother's age, IMD decile scores and household income data did not have a big enough sample size within each data range to detect an effect between engagement and these variables. All the other factors tested did not show statistical significance to engagement, aside from recruitment strategy. Parental status showed a statistical trend to being significant.

The majority of mothers not engaging with the intervention were recruited from Ph1 (40%) in comparison to Ph2 (13%). This corresponded with the univariate binary regression (UBR) and Kruskal-Wallis (KW) test. When testing the independent variable of recruitment phase (Ph1 or Ph2) against the dependant variable of engagement (yes or no), the phase mothers were recruited from was statistically significant to their engagement (UBR P=0.01. KW P=0.01). Mothers recruited from Ph2 were 7.5 times more likely to engage than mothers recruited from Ph1 [Exp(B) 7.50 95% confidence interval (CI) 1.49-37.66]. The large CI range suggests the model may be unreliable, however, this finding was further reflected in the analysis of engagement with one-way and two-way direct text messaging.

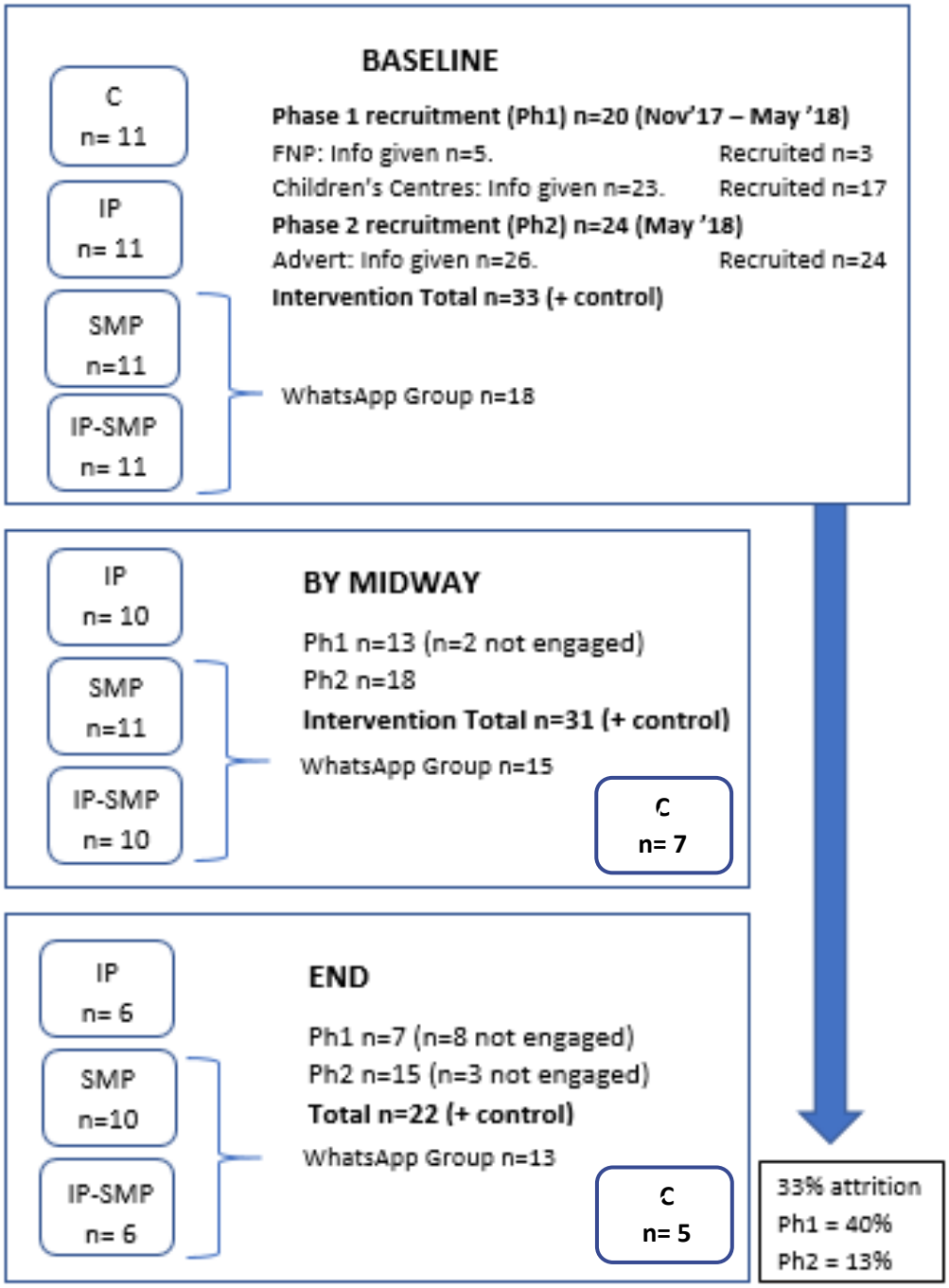


Figure 12: Engagement flow diagram showing recruitment per phase and attrition per intervention arm and phase.

Being multiparous (independent variable: primiparous or multiparous) also showed a statistical trend to being less likely to engage with the intervention (UBR P=0.07 [95% CI 0.05-1.13] and KW P=0.07).

All mothers recruited in Ph2 watched the animated video describing the study and intervention on the project webpage as part of the recruitment and consent process. When looking specifically at the baselines questions of the acceptability questionnaire as independent variables, question three ("how understandable is the purpose of this baby dental health study to you?") and the phase mothers were recruited (dependant variable) showed a statistical difference between recruitment phases (univariate ANOVA P=0.00 /KW P=0.02). Mothers recruited from Ph1 had a mean score of 77.50 (standard deviation (SD) 22.2) with the mothers recruited from Ph2 having a mean score of 95.89 (SD 6.66).

There was also a three-month lag in being able to fully engage with Ph1 recruited mothers due to the issues with recruitment. Having to attend baby wellbeing clinics weekly across the Southwest UK, to directly approach mothers, took time away from being able to arrange in-person meetings and engage with mothers using social messaging:

> *It's been difficult building up a rapport with mothers whilst still directing vast amounts of effort recruiting. Approaching mothers directly from baby groups is arduous.* ***NT reflection April 2018.***

Mothers recruited from Ph2 received more knowledge dissemination and engaged conversation from the very start. This was due to there being less time constraints and other stressors associated with recruiting from a busy baby wellbeing clinic. The initial meeting for Ph2 recruited mothers was at a time and place of their choosing:

Participants are already more engaged. I was able to build a rapport from the first meet as it was on their terms as opposed to being approached at a baby group. ***NT reflection May 2018.***

5.4 Engagement by engagement approach

5.4.1 In-Person

Maintaining positive connections with the mothers outside of the social messaging group was more of a challenge and arranging in-person meetings usually took several attempts. Not all mothers in the IP intervention arm kept to the engagement approach, with three mothers (one recruited from Ph1, two recruited from Ph2) asking oral health questions via text. The mothers were encouraged to meet in person with the mothers recruited from Ph2 agreeing to an in-person meeting, whereas the Ph1 recruited mother did not. Table 5 gives an example of a conversation which occurred with an IP engagement approach mother via social messaging.

Table 5. Example of two-way text message conversation between NT and a Ph2 primiparous mother.

Message	***Date/time***
P41 IP: I'm after a little advice for <Baby's> teeth. We've been maintaining a fairly good teeth brushing routine, brushing every evening before bed. Mornings I struggle remembering to do it first thing so often brush his teeth after breakfast. I'm noticing plaque build-up on the bottom front teeth, nothing noticeable on the other teeth. What's the best way to deal with this? Dentist? Or is there something I can do?	07/04/2019, 20:13
NT: Plaque is the soft white stuff that builds up which then hardens to a more yellowy colour. The advice I'm sure the dentist would give is just to keep brushing the teeth as best as you can. This isn't always easy when they push the brush away with their tongue!	07/04/2019, 20:44
P41 IP: Would brushing get rid of it if I focus more on the front teeth?	07/04/2019, 21:19
NT: It's definitely worth giving it a go, if you can!	07/04/2019, 21:21
P41 IP: Thank you. Fingers crossed it helps!	07/04/2019, 21:23

Two mothers did not wish to meet up and reported not having any problems but were happy to remain in the intervention (both recruited from Ph2). One mother was unable to arrange a time to meet up due to a number of competing events such as illness or hectic schedules with multiple children (recruited from Ph1). However, where possible mothers were given the opportunity to ask questions after they had been allocated to an intervention arm. These initial conversations often covered all five target behaviours. The Ph1 recruited mother who had been unable to meet up expressed how this had been enough to make a difference.

> *"We have only been able to meet once but it was an impactful meet. When we met my little boy was a few months old now he is 1 and loves to brush his teeth."* ***P7 IP***

By the end of the intervention, six mothers had arranged an in-person meeting: four mothers having a single meeting, and two mothers seeing me twice. These meetings either occurred at the mother's local Children's Centre, at a baby group chosen by the mother, at the mothers' home or at a local café. Table 6 below shows the demographic information regarding these mothers, along with the mileage I travelled for each meeting. Mileage is included as a measure of feasibility when comparing the engagement approaches.

ID	Ph1/Ph2	Age	Infant age	IMD decile	Household income	P/M	# of meetings	Miles travelled
P9	Ph1	-	-	3	-	M	1	20
P15	Ph1	25-34	3-6 mo	3	40-59k	P	2	88
P22	Ph2	35-44	3-6 mo	5	40-59k	M	2	60
P33	Ph2	35-44	6-9 mo	8	40-59k	M	1	2
P40	Ph2	35-44	0-3 mo	4	40-59k	P	1	20
P41	Ph2	35-44	9-12 mo	5	40-59k	P	1	26

Table 6: Demographic information of mothers and total miles I travelled for meetings. IMD decile 1 = most deprived, 10 = least deprived, P = primiparous, M = multiparous

Five out of the six in person meetings went well with meetings lasting 60-90 minutes, discussing all five target behaviours. However, one meeting, which took place at the local Children's Centre, was difficult due to the mother seeming reluctant to talk, despite agreeing to meet up. This meeting only lasted 15 minutes.

> *I got the impression from mum's message that there were specific things she wished to chat about but seems reluctant to approach me. Very difficult to tell whether mum found the information useful. Didn't have any particular questions.* ***NT reflection re P9. April 2018.***

This mother reported in the midway survey that her infant still did not have any primary teeth. However, messages were not responded to after the midway point, with the final message showing that it had been blocked (one tick).

Suggestions to improve the intervention by IP intervention arm mothers were having flexibility of choice in ways to interact with infant dental health support, either via social messaging or in-person.

> *"I do think like a combination would be the best option. …Whatsapp group that you mentioned before sounds like it would be really useful if you're all grouped together. Because loads of people quite often have the same questions, um, so I think it would be good to be a part of that. But then I guess it is nice to see someone more face-to-face."* ***P22 IP***

5.4.2 In-Person and Social Messaging

Although all IP-SMP intervention arm mothers had the option of meeting in person, this engagement approach was not taken up by any of the mothers. This was due to feeling that

the social messaging group was giving them enough, or not being able to think of questions that would be make a meeting worthwhile.

> *"I would love to take advantage of the 'in-person' meet up but I can't think of any questions to discuss."* ***P38 IP-SMP***
>
> *"I think, meeting someone in person, sometimes you have to wait a bit and either you worry until you wait, until whilst you wait, or by the time you meet up the problem has resolved itself."* ***P36 IP-SMP***

All Ph2 recruited mothers with this engagement approach joined the social messaging group and remained throughout the length of the intervention. The social messaging group engagement will be discussed further in section 5.4.4. Three out of the five Ph1 recruited mothers who joined the social messaging group, left almost immediately, with one mother staying for two months.

One Ph1 recruited primiparous mother, who did not respond to SMS messages and was not on standard social messaging platforms (Whatsapp or Facebook Messenger), was seen during an unarranged meeting (I had not been able to give notice of my planned attendance) at their local children's centre. Although this in-person meeting went well, they continued to be unresponsive to further SMS messages. In addition, the Children's Centre group was discontinued after services were reduced. This meant contact with this mother was lost. Another Ph1 recruited multiparous mother was seen twice during Children's Centre visits. Although the mother had seen the messages advising of my planned attendance (two blue ticks), the mother had not responded with an agreement to meet. The mother was reluctant to engage during both meetings. After the second meeting, a two-way message exchange occurred but then the mother blocked contact prior to the end of the intervention (one tick).

The Ph1 recruited multiparous mother who remained in the social messaging group for two months, witnessed conversations around all five target behaviours. After leaving the group, contact was made via direct social messaging signposting to links to useful NHS websites and information videos about brushing and toothpaste. These were shown as being read (two blue ticks). Invitations to meet up were also read but not responded to. After nine months, messages were being shown as blocked (one tick).

5.4.3 Social Messaging Only

Mothers with just a social messaging engagement approach communicated through SMS, Whatsapp or Facebook Messenger. Ten out of the eleven mothers joined the social messaging group, with seven mothers staying throughout the intervention. These mothers will be discussed in the next section. No mothers with the social messaging engagement approach, who communicated outside of the social messaging group, remained engaged for the full twelve months.

Only one Ph2 recruited primiparous mother who left the social messaging group, and who did not engage with the intervention to the end, provided feedback. This mother stated that she felt her baby's age was a factor in not engaging with the intervention. The infant was close to being a year old at the start of the intervention.

> *"I'm not sure I have much to add to it as after sign up I wasn't really involved so much as I took myself off the Whatsapp group as my boy was so much older than the others it felt irrelevant to us at that stage."* ***P31 SMP***

One-way text messages (where a message was sent but response was not received) were higher among the Ph1 recruited mothers (92%) compared to the Ph2 recruited mothers. Two-way text messages were higher among Ph2 recruited mothers (79%) compared to Ph1

recruited mothers, as shown in Figure 13. Table 7 provides another example of a two-way text conversation.

Table 7. Example of two-way text message conversation with a Ph2 primiparous mother

Message	***Date/time***
P37 SMP: <Baby> has her two lower teeth now. I have introduced the banana silicone toothbrush, firstly with teething gel and now with Colgate Smiles baby toothpaste. I brush my teeth with her twice daily, to mirror but she is starting to become more interested in my toothbrush. Do I need to get a brush with bristles? Is the toothpaste I'm using ok? The next query is about dried fruit – I haven't offered dried raisins, prunes or apricots yet. But wondering if they are too sticky/sugar loaded for baby teeth? Should I avoid them? Thank you.	17/08/2018, 09:50
NT: It might be worth having a replica brush like yours so she can feel included when you're using yours?! For effectiveness, the silicone brush is great and you're getting toothpaste on the teeth which is fab! Re the dried fruit – definitely avoid, if poss, especially as a snack. It is very sugary and sticky. Occasionally with a meal will be ok, but to be honest, dried fruit is also expensive!	17/08/2018, 10:12
P37 SMP: It's amazing how quickly she picks up on things. <Baby> try's to brush her teeth first then I go over them. I shall commence the twinning toothbrushes ASAP. Thanks for the dried fruit advice, I haven't given any so far but have a feeling a convo will come up soon (husband and grandparents).	17/08/2018, 15:19

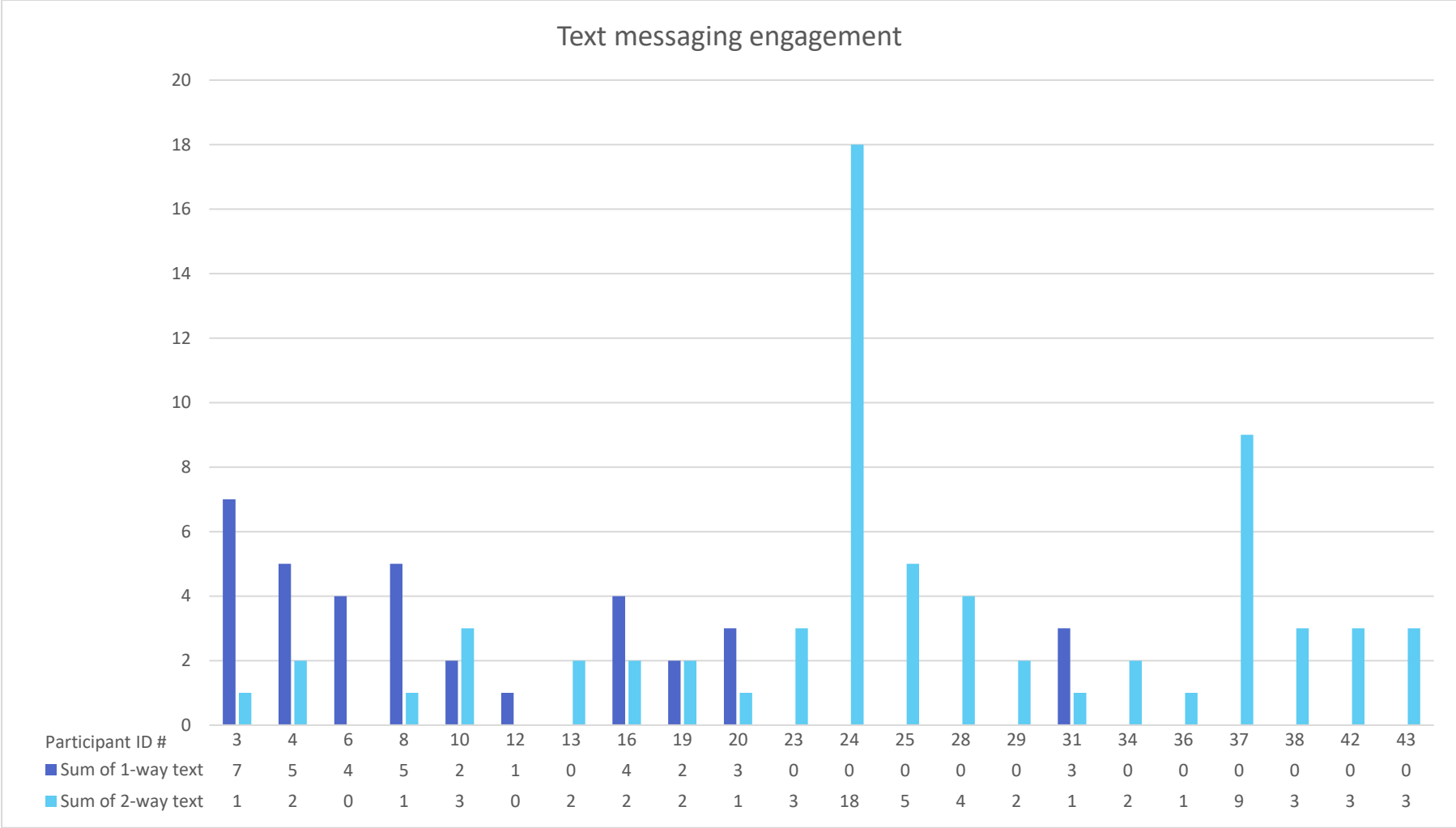


Figure 13: Graph showing one-way and two-way text message engagement between participants with a social messaging component (IP-SMP and SMP). Participant ID numbers 3-20 identify Ph1 mothers. Participant ID numbers 23-43 identify Ph2 mothers.

Another Ph1 recruited multiparous mother who had left the social messaging group within the first month and did not respond to direct messages, with messages seemingly being blocked (one tick), was seen two months later at the Children's Centre visit. Although this mother did not engage with me in-person, the mother directly messaged shortly after asking for advice about toothpaste and brushing for all three of her children and engaged in a two-way text message conversation.

Another Ph1 recruited multiparous mother who had left the social messaging group but remained in contact using direct text messaging, was seen in-person at the Children's Centre. This mother read (two ticks) but rarely responded to messages. However, one two-way conversation was engaged with, apologising at the start for the lack of contact:

> *"Sorry I haven't been in touch summer holidays are a nightmare. I do have a question how many teeth are they meant to have <baby> only has 8 teeth and is now 15 months."* ***P8 SMP***

The one Ph1 recruited primiparous mother who did not join the social messaging group was only contactable via Facebook Messenger. This mother engaged with two-way conversations but stopped responding to messages after the midway point. This mother was not native to the UK and, although was English-speaking, appeared to struggle with the written language.

During the interviews, a few mothers reflected on how the social messaging intervention could have been improved by having the reassurance of someone check their brushing in person, or issues with appearance of their infant's teeth. Although, this would have been possible on the social messaging platform, either by a videocall or videos/pictures.

"There are probably a couple of times in the year when I would have liked to have been able to say, 'Nicole, can you just have a look and see in the actual mouth and tell me, is this good, bad or whatever?'" ***P13 SMP***

5.4.4 Social Messaging Group

Out of twenty-two mothers who were randomised to the social messaging engagement approach (SMP n=11 & IP-SMP n=11), eighteen agreed to be added to a Whatsapp social messaging group. Three mothers left the social messaging group by the midway point (all recruited from Ph1). At the end of the intervention, two more mothers (one recruited from Ph1 and one from Ph2) left the social messaging group. Table 8 provides demographic information and message counts for the remaining thirteen social messaging group mothers.

ID	Ph1/Ph2 & intervention arm	Age	Infant age	IMD decile	Household income	P/M	Message counts
P13	Ph1 SMP	35-44	0-3 mo	4	40-59k	P	27
P19	Ph1 SMP	18-24	3-6 mo	1	0-19k	P	5
P23	Ph2 SMP	35-44	6-9 mo	7	Over 100k	P	149
P24	Ph2 IP-SMP	25-34	3-6 mo	7	0-19k	M	90
P25	Ph2 SMP	35-44	3-6 mo	10	60-79k	P	73
P28	Ph2 IP-SMP	35-44	9-12 mo	7	60-79k	P	55
P29	Ph2 IP-SMP	25-34	6-9 mo	5	40-59k	P	74
P34	Ph2 SMP	35-44	3-6 mo	7	Over 100k	P	82
P36	Ph2 IP-SMP	25-34	0-3 mo	6	60-79k	P	4
P37	Ph2 SMP	35-44	3-6 mo	7	40-59k	P	44
P38	Ph2 IP-SMP	35-44	3-6 mo	4	20-39k	P	39
P42	Ph2 IP-SMP	35-44	9-12 mo	6	80-99k	P	27
P43	Ph2 SMP	35-44	3-6 mo	8	20-39k	P	18

Table 8: demographic information and message counts for active social messaging group mothers. IMD decile 1 = most deprived, 10 = least deprived, P = primiparous, M = multiparous

Using a social messaging group made it easier to facilitate conversations around the target behaviours, compared to all other social messaging engagement platforms. This made the

social messaging group engagement approach the most acceptable to me, as the deliverer of the intervention.

> *I therefore must reflect on the difficulties in having mothers on different messaging platforms - it was far easier for me to keep in touch with those on the group compared to those that wanted to stay off the group.*
> ***NT reflection September 2018***

For the mothers who felt the social messaging group required more effort, they associated it with their general attitude towards and engagement with social messaging; not being very responsive to messages in general or not enjoying the aspect of virtual communities.

> *"Even with friends, I'll look at a message then I'll forget to reply then they'll message again and I'll look at it...I'm really rubbish at stuff like that. Whereas, if it's in person, you can kind of engage."* ***P19 SMP***

This same mother who remained in the social messaging group, but did not engage in the conversations, also attributed it to not encountering problems which required the same level of support as the other mothers in the social messaging group.

> *"I did dip in and out of it. But I just didn't really have much input because I didn't really go through the problems that they did."* ***P19 SMP***

One mother with an older infant (in the 9–12-month age bracket) in comparison to the other mothers in the social messaging group reported how this helped her remain engaged due to feeling useful within the group.

> *"It became very evident to me very early on that <child> was the oldest so they were asking questions and I'd already done that so […] that kind of made me feel like almost I know what I'm talking about."* ***P28 IP-SMP***

When looking specifically at the engagement of the social messaging group, mothers were most active between the hours of 6pm and 11pm (See Figure 14). Most mothers had returned to work or were busy with their baby during the day and therefore, the evenings were when most questions were asked.

Over the twelve months, mothers on the social messaging group were most active during the first four months of the intervention. However, the level of communication in the group remained active throughout the year (see Figure 15).

Figure 14. Count of messages per 15 minute interval in a 24 hour period.

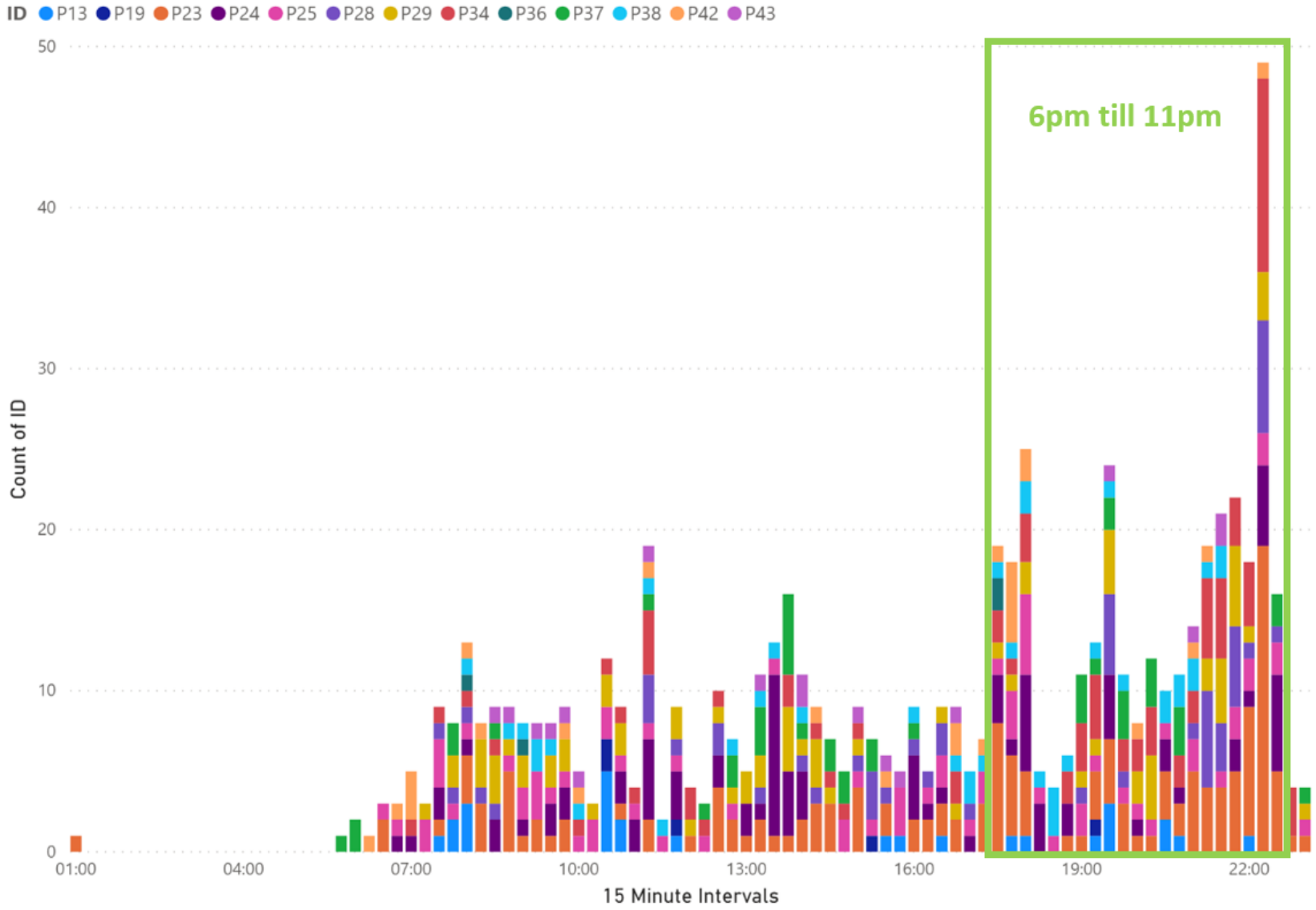
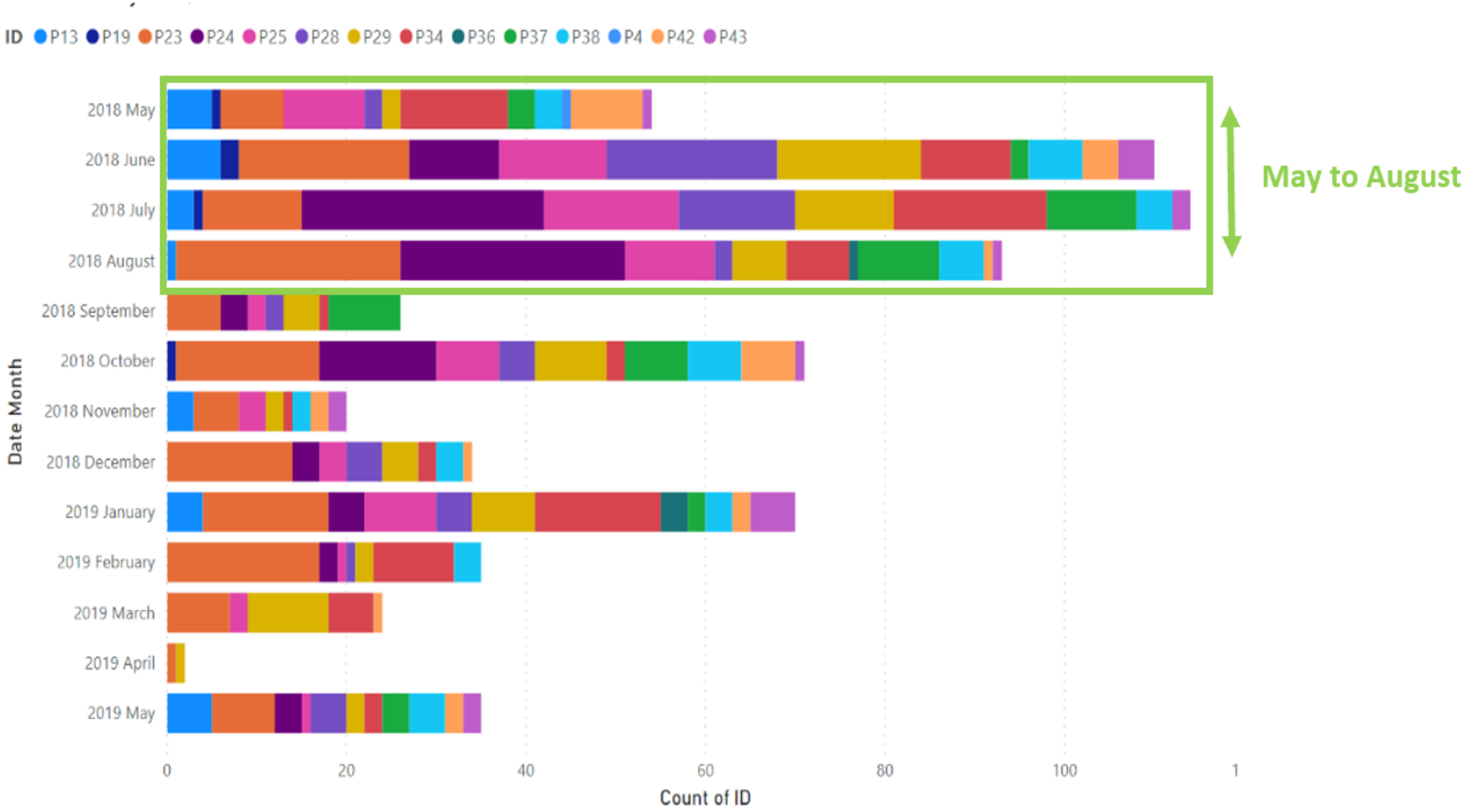


Figure 15. Count of messages per month from May 2018 to May 2019



5.4.5 Control Arm

When and how mothers in the control arm would engage with an oral health intervention was also discussed during the interviews. This was to add to the findings from the intervention arm mothers to make recommendations for future interventions. Flexibility of choice on how to access infant oral health support was described, with additional importance being placed on the timing of the intervention around the infant age of 4-6 months.

> *"Having like a teeth person at the weigh in […] I think that would be really useful. But then also having something […] like a confidential text service […] that you could just message and say, you know, 'my baby's teeth still haven't come out yet, is that ok?'"* ***P39 C***
>
> *"Maybe around the weaning talk. That would be a sort of a time to, at least talk about; I know they talk about finger food like carrot sticks and all that and having all good healthy stuff um, but something then about cleaning teeth. Are you using the right toothpaste with the right amount of fluoride and stuff in?"* ***P27 C***
>
> *"Definitely around teething because it's such a big thing for everybody, for like two years of like...I don't even know when it, kind of, typically stops either."* ***P5 C***

5.5 Acceptability

This section now moves onto the findings from framework analysis using the qualitative interviews, my reflections from in-person meetings, and the social messaging data. As described in the previous chapter, sections 4.3.6.2 and 4.3.7.3, acceptability was measured using a bespoke intervention survey developed for this study, and through semi-structured interviews at the end of the intervention. First, the results of the survey and overall views of the intervention will be set out before describing two key themes which appeared to

influence the acceptability of the intervention: Attitude and Expertise. A network diagram showing the interlinking key topics within these themes are shown in Figure 16.

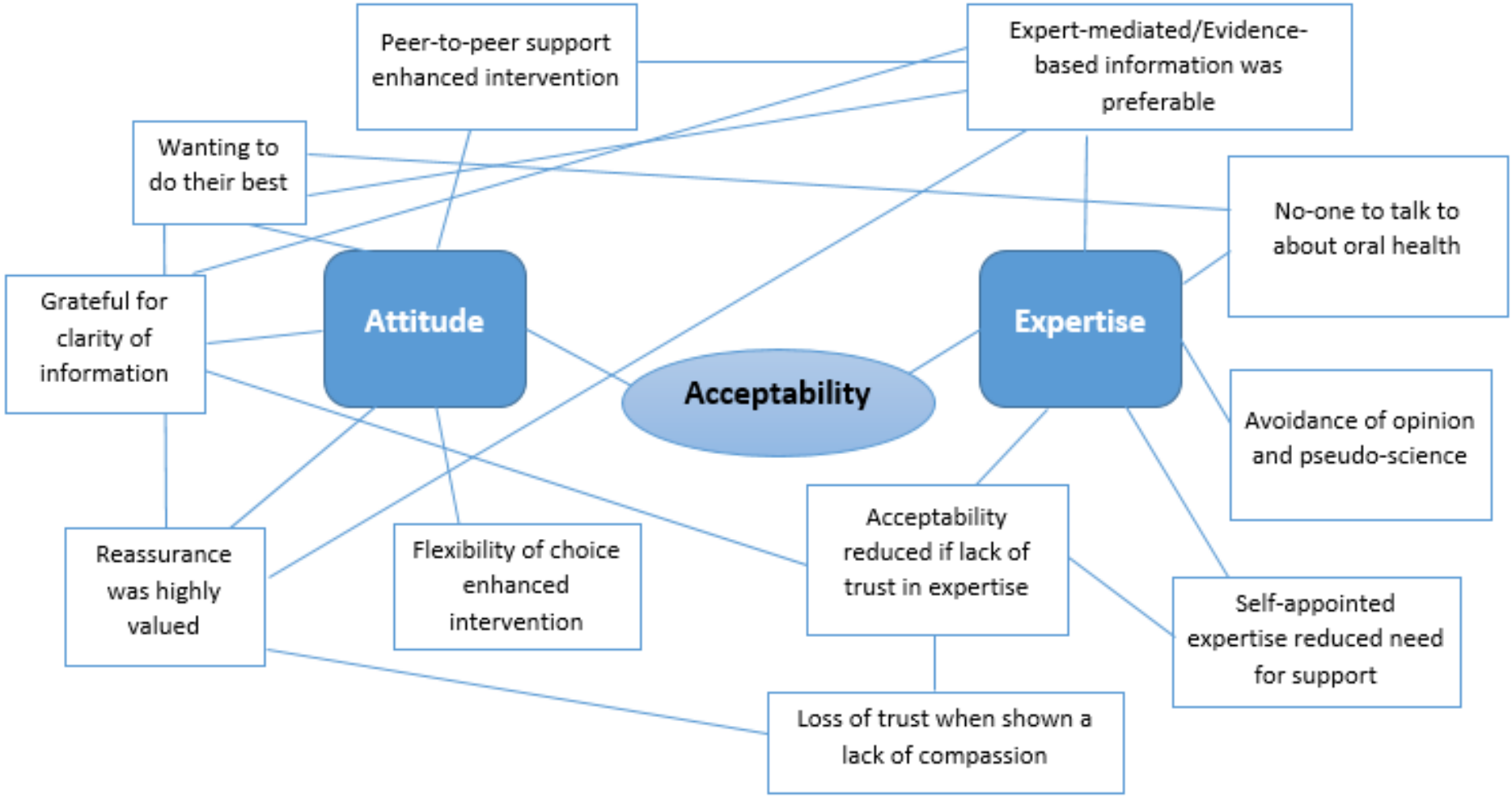


Figure 16. Network diagram showing the main themes from the acceptability data with interlinking key topics from each theme

5.5.1 Acceptability measurement findings

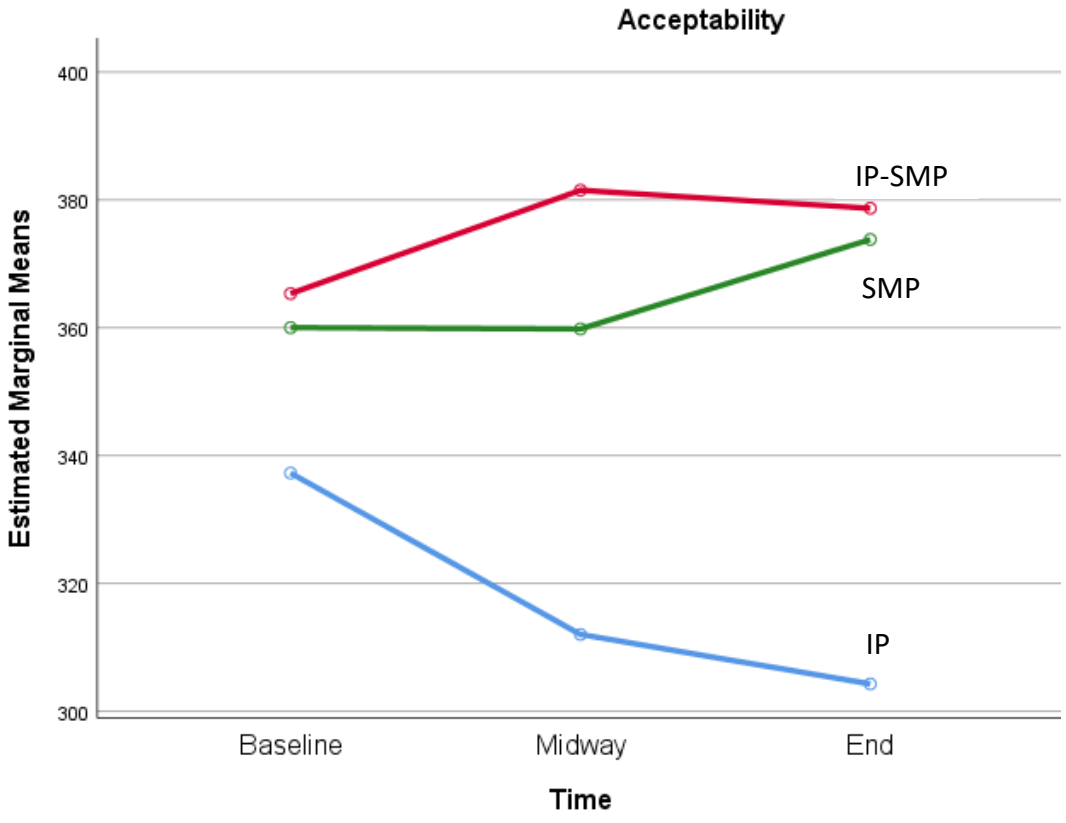
The baseline survey was completed by the mothers after consent and prior to being randomised. Nine mothers did not complete the baseline survey. These mothers were all recruited from Ph1 and requested that they be sent the links to complete at a later time due to not wishing to neglect their children at the baby group. However, despite prompting up to three times, these mothers still did not complete the questionnaire.

A homogeneity test was carried out on the separate constructs of the acceptability questions (affective attitude, burden, coherence, opportunity and effectiveness) to check reliability of the data. "Burden" failed this test, with the standard deviation of marginal homogeneity being 87.5 (P=0.04). This meant that the responses to this question lacked homogeneity and were therefore not reliable. This construct was consequently taken out of the overall acceptability totals prior to analyses. Acceptability survey data therefore relates to four constructs: how mothers felt about the intervention, their understanding of the intervention, how much they benefited and how effective they felt the intervention will be in improving child oral health.

The maximum score for acceptability was 400. The mean acceptability score at baseline was 342.4 (SD 54.9). There was no statistical difference between trial arms. After baseline data collection, the control arm mothers were not required to complete the acceptability survey questions.

At the midway data collection point, twenty mothers (61%) completed the survey with the mean score being 349.3 (SD 47.1). A total of twenty-two (67%) mothers completed the acceptability survey question at the end of the intervention. The mean score was 327.4 (SD 67.5). At each stage mothers were prompted up to three times to complete the survey.

At the end of the intervention, a general linear model with Bonferroni correction was used to test for any statistical difference between acceptability and the intervention arms. The total acceptability scores (total of all four constructs) at baseline, midway and at the end were used as the independent variables tested against the intervention arms (dependant variable). There was a significant difference between the intervention arms over time (P=0.03) (see Figure 17). Using the Mann-Whitney (MW) test this significance was specifically between the IP group and the IP-SMP group (P=0.03). Therefore, according to these analyses, the IP-SMP group was more acceptable than the IP only group. Although the very small sample size makes this analysis unreliable, it was kept within the thesis due to the findings within the qualitative data providing an indication of why this might have been the case for this particular group of mothers.



When

Figure 17. Plot of estimated marginal means (the predicted mean per arm) using ANOVA of acceptability over time per intervention arm

looking to see if there were statistical difference between the individual end acceptability question scores and the intervention arms, there was a statistical trend of how much participants felt they benefited from the intervention and the intervention arm delivery method they received. Using a univariate ANOVA model, each individual end point acceptability question score was used as the independent variable against the dependant variable of intervention arm. This showed that question four, "how much do you feel you benefited from this intervention?" showed an almost statistical difference (P=0.06). Using the Kruskal-Wallace test, this same question showed statistical significance (P=0.04). Using the Mann-Whitney test, this was identified as being between the IP and IP-SMP group (P=0.02).

5.5.2 Attitude

This theme describes how specific components of the mothers' attitude (what they felt about the intervention, how the intervention fit with their personal values including their motivations for taking part and views on the benefits from taking part) influenced acceptability.

Explicit motivations for taking part in the study were 'wanting to do the best they could' with a desire to avoid problems with teeth due to their own negative experiences with dentists, shame over having fillings themselves or older children having dental disease. In particular, the lifelong repercussions of getting it wrong, including financial implications rectifying damage caused by poor oral health, was a strong motivator.

> *"I think my motivation was, especially as a new mum, wanting to do anything I can to be the best I can be. So, if I can learn something that I don't know about teeth, then I want to do that because then, I don't know…we, I might pick something that might be better."* ***P23 SMP***

"We were going to <place> this year and we couldn't go because he had to spend £850 on his teeth, so that was our…that was like half our money that we had saved up to go so it's um…it sucks not looking after them. I find it really annoying that, that his, that his parents didn't value it very much when he was little and um…yeah, the sort of legacy." ***P13 SMP***

"I was really freaked out by the dentist, when I was younger […] it's quite scary. And so I don't want him to be the same." ***P41 IP***

"That's why I joined this project as <child> ended up needing teeth removed because he had a bottle for many years and I made mistakes. Thankfully he has perfect adult teeth but my anxiety about <baby> having to do the same is through the roof." ***P24 IP-SMP***

The majority of the mothers expressed gratitude and described the intervention as "really useful" and "helpful". This was attributed to the support they received about their infant's oral health due to it being ever changing or finding it "all a bit confusing".

"It was nice to have somebody there just to go, 'this is happening, is this alright?' or just to see somebody else say something and I'd be 'I'm glad somebody has asked that question.'" ***P28 IP-SMP***

"It's like changing a nappy…You don't ever have to be told how to do it again, whereas, teeth, there's always something that happens." ***P41 IP***

Receiving general encouragement about their infant's oral health was valued highly by the mothers, with it being key to their confidence in carrying out oral health behaviours and increasing the acceptability of the intervention.

"Just generally having the reassurance was actually, really important, I think. And probably means that I've been more confident about, you know, brushing his teeth and what he should and shouldn't be eating and we also talked about um, what cups they drink from." ***P25 SMP***

"I think it was really good because early on I met you, when I thought her teeth were coming really early, but it wasn't, it was just like a little bud? Um, whatever it was. So it was good to be reassured." ***P22 IP***

For the mothers in the social messaging group, it was the peer-to-peer support environment that specifically increased the acceptability of the intervention by being "a little safe place to ask questions". This was alongside flexibility in how and when mothers interacted with the social messaging group, with the ease in being able ask a question when it was most convenient to them, and "leave if you want to" if they no longer felt they were benefiting.

"Life's busy as a new mum and you tend to, like WhatsApp is great because you've got two seconds you can throw a question out there [...] You probably won't be like at a toddler group having an issue of teething, but it'll be at home when you're in a dark room somewhere going, 'oh my god!'" ***P23 SMP***

"You're not pressured or anything like that. So, no, I thought that really worked for us and to be honest that's how loads of stuff is done now anyway, isn't it?" [social messaging] ***P42 IP-SMP***

This flexibility extended to being able to choose the level of participation in the social messaging group. They could read what others had said and learn from others without having to message themselves. One mother specifically described how it saved time when someone else had already asked a question which was now pertinent to her.

"I think the Whatsapp group worked well. Um, I'm never, on big groups like that, I'm never the most verbal. But I quite like to just sit and read it." ***P36 IP-SMP***

> *"We're all going through the same things and when people were asking questions that, sometimes, I was a couple of months behind and so I would be like, 'I'm sure that was covered?' and I'd go back through the chat and read back through it and be like, 'ah, yeah. Ok.'"* ***P25 SMP***

The social messaging group was described as 'healthy' due to its size feeling more personal, and how conversations around oral health behaviours were had in a supportive way due to the commonality of milestones the mothers were experiencing at similar times to each other.

> *"So, I think it was a good number of people. I think if you had too wider group, it becomes…I felt like, almost, we got to know each other."* ***P23 SMP***

> *"So it's quite a healthy sort of forum rather than perhaps people who either kids are way older telling you what to do, so it's good to have it like, people are, at the same time are um, yeah so, going through it so."* ***P42 IP-SMP***

However, an in-person intervention arm mother expressed how she also benefited from hearing about these conversations vicariously instead of needing to think of questions herself.

> *"I haven't spouted out loads of questions but in our last, um, meeting up at the café, you mentioned, 'oh somebody has done this' 'somebody was talking about this', so actually, it was like, 'oh yeah, actually, I was overly thinking about that', but it's good to know so it's just all that shared knowledge and the shared questions and that kind of thing."* ***P41 IP***

5.5.3 Expertise

Linked to the finding that participant attitude had a bearing on the acceptability of the intervention were perceptions as to the need and desire for expert input. For some, having access to an oral health expert increased acceptability, for others it hindered engagement.

In particular was the reporting from all intervention arm mothers that outside of the intervention, there was no-one to talk to about their child's oral health. This gap in oral health expertise increased the acceptability of the intervention. Mothers reported a general lack of oral health-related conversations, expressing that they felt oral health was a low priority compared to other pressing issues of a newborn usually saved for discussions with health teams. This meant they did not feel it appropriate to discuss the oral health of their infant with their health visitor, dentist or GP.

> *"Otherwise, I think I wouldn't have known who to ask about it? Because there isn't really a role for anybody and it's probably not something that would be, you know, important enough to take to your GP or something like that."* ***P22 IP***
>
> *"Because I had no idea. I think I would just, I would have been a lot more confused and felt a lot more, um, in the dark really, because there isn't anything is there?"* ***P29 IP-SMP***

The reasons given for feeling infant oral health was not a priority for services was due to them being too stretched to deal with the oral health issues the mothers may be encountering.

> *"Because you feel like all those resources are kind of stretched and sometimes they're not actually all that interested."* ***P36 IP-SMP***
>
> *"I think everyone is so stretched that things go by the by, and I think it is and in a sense it is a shame."* ***P33 IP***

This feeling of not having anyone to talk to about oral health was also found amongst the control group mothers and formed their motivation for wanting to be part of the intervention study.

> *"I just thought that it would be a really good thing to do. Um, and interesting, just to get more knowledge really and it's good to have that sort of support, isn't it, with um, with something that isn't spoken about a lot."* ***P21 C***

> *"That's why I was interested because yeah, no one else really talked about it at all, other than 'brush your children's teeth'. That was it."* ***P5 C***

For the mothers who found the intervention acceptable, a great deal of value was placed on the expert advice and reassurance in order to avoid opinion, particularly when accessing information online or gaining information from other mothers.

> *"You can have a look online but you have to be careful what you look at because some of it is just people's opinion, not um, researched or evidence-based."* ***P37 SMP***

> *"If you speak to twenty mums, they'll probably all say different things or they've been told different things so it's you know, it's having that…it's good to have a bit of solid, solid advice from somebody that knows."* ***P41 IP***

One in-person intervention arm mother expressed how expertise of the person delivering the intervention was more important than the engagement approach itself.

> *"What's important for me, I think to a certain point is to have a specialist point of view. That's the most important."* ***P40 IP***

Having an expert in the background of the social messaging group to monitor the peer-to-peer support and advice being shared on the group, and ensure the information was correct, was seen to increase satisfaction, especially when the support was compassion-based.

"Even if you weren't saying anything, you know in the back of your mind that if someone said something that was completely wrong, you know, I'm not saying you would wade in and say, 'no, don't be ridiculous!' but you would temperate it." ***P25 SMP***

"Knowing that you were there to moderate so there wasn't any false information […] it's not like an internet forum where people could say anything that's clearly not correct. We knew that you were checking. I had more confidence in it than a forum." ***P43 SMP***

The importance of evidence-based knowledge, getting rid of 'pseudoscience' with a compassionate approach was also mirrored by the mothers in the control group.

"And it's things like that, that I think could be an awful lot better and same with the weaning side of it, more informed of, 'actually, you can do that. Also, you can do this way and…' you know. I think it can be a bit backwards." ***P35 C***

"I think just more getting rid of the pseudoscience and just knowing what really is factual about whether it is bad to wear, to use dummies or not and things like that. That sort of stuff." ***P5 C***

One mother, with a nursing background, acknowledged her lack of expertise, which alongside having experience of the consequences of poor oral health in her working life, was a motivating factor to taking part.

"Because of my lack of knowledge, as with regards to children's teeth and also being aware of um, of um, nursing… um, nursing young children who have full dental clearances, so that for me is a big driver. I didn't want that to happen to her." ***P37 SMP***

However, other mothers with a medical background reported not feeling they benefited as much from the intervention due to their existing professional knowledge. For example,

looking at the individual acceptability question scores, two mothers were identified as outliers (P26 and P30) (See Figure 18). Both mothers had an in-person engagement approach and either worked in the medical profession or had close family members who worked in the medical profession. In addition, a third mother, also with a medical background, who didn't return all surveys so doesn't appear in the data but did have an endpoint interview, felt similarly to the other medically trained mothers. These three mothers were recruited in Ph2 so self-selected to take part.

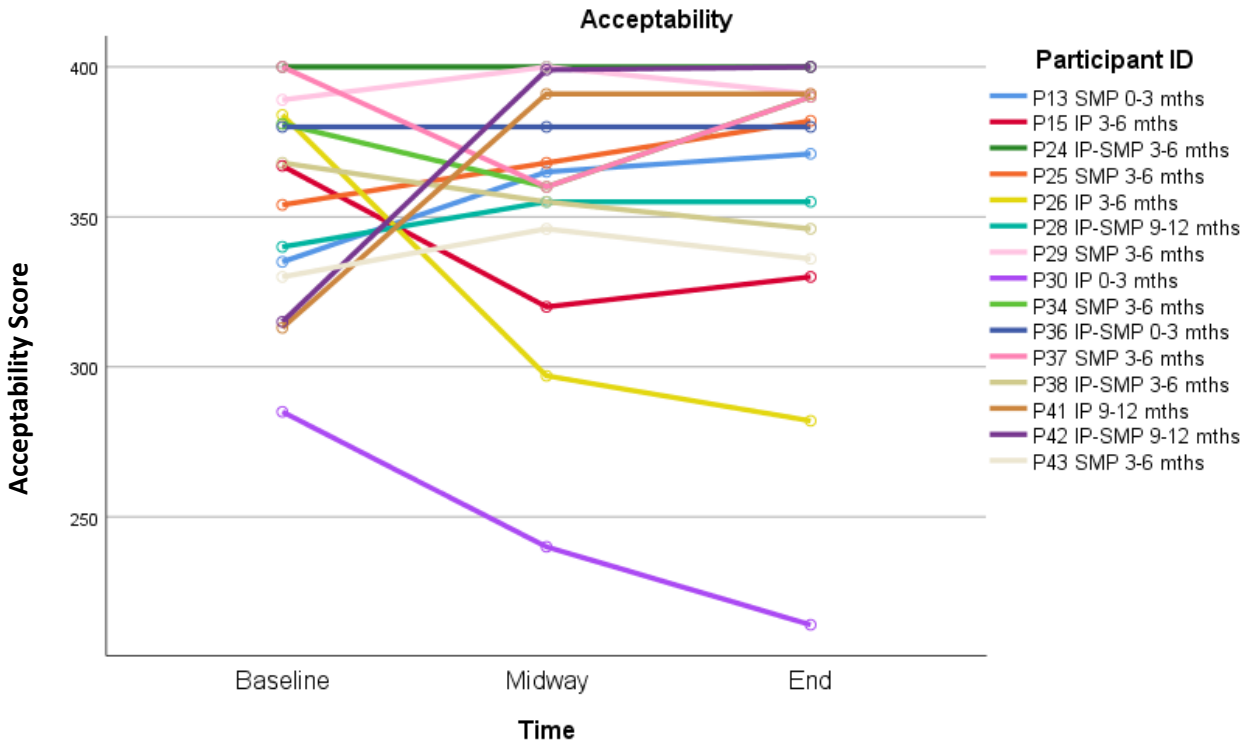


Figure 18. Acceptability scores (out of 400) per participant over time showing P26 and P30 outliers.

All three mothers did not require reassurance about their oral health decisions and did not consider themselves part of the demographic the intervention was designed for. They could

see how the intervention would still be useful, but for mothers who may be less educated or from a lower social group.

> *"It's probably not something I've benefited from, but I definitely think there is scope to improve with a lot of people that perhaps aren't so educated."* ***P33 IP***

> *"And you've got NHS stuff but I don't think they tend to…because it's too government [...] some people just don't care and it's there's, you know, to make that change in behaviour takes quite a lot of work."* ***P26 IP***

This increased parental confidence also extended to other parenting practices and engagement with other health services, such as the health visitors and dentists which were on the mothers' terms and generally felt as not needed.

> *"I was quite, like, quite confident with stuff and then they don't feel they need to, do they. You go in and say, 'no, I'm happy…with him. And here he is!'"* [health visitor appointment] ***P30 IP***

> *"Without meaning to sound horrible, it's different social classes as well, isn't it? Different lifestyles. Whereas, I limit the amount of sugar my children have. Whereas some people, it's an easy way to, 'let's give you some sweets because it keeps you quiet.'"* ***P33 IP***

A control arm mother also expressed a similar attitude when discussing her own experience of engaging with health services; although she reported the services not being supportive, she would not have engaged with them anyway. This mother also had a close friend who was a GP.

> *"Um, we don't go, there's no health visitor clinics really. And even if there was we don't bother going to them. If I want to weigh him, I'll take him and weigh him. So I don't need to go and see them, so."* ***P27 C***

Another key factor in expertise was being able to trust the source of information which appeared to influence acceptability. Two mothers recruited in Ph1 (IP-SMP and SMP) from the same SHS were both seen at their local Children's Centre during a visit to the baby wellbeing clinic. Both mothers did not engage directly with me, preferring to talk through the Children's Centre worker.

> *Only spoke through a Children's Centre worker and other mums and would not directly converse with me. There was a big sense of mistrust. I offered her toothpaste/brushes. Refused but then took some when another mum helped herself.*
> ***NT reflection re P4 SMP. July 2018***

The mother receiving the IP-SMP engagement approach reported her mistrust for health professionals whilst describing an issue she was having with her son's oral health. Advice was given with consent being given for me to follow up via direct messaging. It was hoped that this positive encounter was enough the build a valuable rapport but despite the mother responding with a positive message of gratitude, all further messages were ignored.

> *She was discussing with the children centre worker her deep distrust for health teams […] she feels that she gets judged because of her appearance, and she has been accused of mistreating her children. Her deep distrust for health workers has been putting her off seeking help and advice for her son […] I'll go away do a bit of research and I'll get back to her. It might build a little trust, because I found it really hard to engage with this particular lady. She never replies to my messages so this might actually be a bit of a way into to help her gain her trust.*
> ***NT reflection re P3 IP-SMP. July 2018****.*

Trust was lost when the expert delivering the advice was not able to offer authority on the foundations of why and how, particularly when it came to changing behaviours that may impact them or their child's routine.

> *"I think if somebody had said that but didn't actually give me the background on it, like why, then it wouldn't have made sense and then I would probably well, "I've finished eating so you're going to brush all the…" actually, it's better to do it before. And I, I now brush my teeth before, so I've got to change my habit."* ***P41 IP***

> *"I think the health visitors should be a bit more informed as in, so when you ask questions, they know the answer or why they're saying things! But I did think that was surprising to say something but actually not be able to back up why you're saying it!"* [Referring to health visitor saying electric toothbrushes are not suitable for infants] ***P35 C***

Trust was also lost instantly when the expert assigned to support them did not show empathy or compassion for a situation they were experiencing. Therefore, mothers avoided seeking oral health advice from these healthcare professionals.

> *"My health visitor, I don't necessarily value her opinion […] Shortly after <baby> arrived, I lost my dad and so it was a horrendous time. Absolutely horrendous because he wasn't sleeping, I didn't know what was up or what was down. Maybe two months after he'd passed away, my health visitor said, 'are you feeling better now?' It was probably a slip of the tongue, but I just stared at the phone and thought, 'That was really ill-judged!'"* ***P38 IP-SMP***

> *"I don't remember, to be honest, you don't see health visitors. I probably saw one that gave me some really dodgy advice which I ignored."* ***P25 SMP***

"Her advice was, 'how would you feel if he died? Don't put him on his front.' […] No 'I wonder why he's screaming constantly?' 'I wonder why he's not slept for months?' 'I wonder why this?' 'Perhaps we could look at some solutions.' 'No, you shouldn't do that. He just wants a cuddle.' So, I was like, 'well…I wasn't going to do it anyway but thanks very much, that's really helpful.' I then, I turned to the internet." ***P23 SMP***

5.6 Findings Summary

Using gatekeeper referrals from family support services and directly recruiting from Children's Centres (Ph1) required more effort and time compared to the social media advert (Ph2). However, this had implications for the vulnerability criteria and engagement with the intervention. Mothers recruited in Ph2 were 7.5 times more likely to engage with the intervention. In addition, there was a significant difference in how much the mothers recruited in Ph2 understood the purpose of the dental study compared to mothers recruited in Ph1 (univariate ANOVA P=0.00 /KW P=0.02). All mothers recruited in Ph2 watched an animated video hosted on a University of Plymouth webpage prior to recruitment compared to mothers recruited in Ph1 who received written information. There was also a statistical trend for first time mothers to engage with the intervention more compared to mothers with more than one child.

The in-person and social messaging engagement approach was the most acceptable (p=0.03) due to being more flexible for mothers to access support and information. This was also shown by mothers with the in-person engagement approach not adhering to the method, often sending messages requesting advice and not engaging with in-person meetings. The social messaging group enhanced the acceptability of the social messaging engagement approach by providing peer-to-peer support, real-time responses to queries and providing a reference tool for information. In particular, acceptability of the social

messaging group was attributed to the size of the group, the users all going through similar experiences and trust in the authoritative expertise mediating the conversations. Mothers engaged most with the social messaging group between the hours of 6pm and 11pm.

Trust was lost in healthcare professionals when a lack of compassion was shown or they felt judged leading to avoidance of engaging with healthcare services, such as health visitors. Mothers felt there was no-one to talk to about oral health outside of the intervention. This was also reflected by the mothers in the control group. However, self-appointed expertise and mothers with increased confidence were less engaged with the intervention and had lower acceptability scores. These mothers were also less engaged with other healthcare services.

6.0 Chapter Six: Intervention findings - Effectiveness and Self-efficacy

In this chapter, the effectiveness of the engagement approaches in encouraging the uptake of five infant-focused oral health behaviours (also referred to as target behaviours), with emphasis on self-efficacy, is reported. Findings concerned with self-efficacy and the timing of the intervention are reported first. The findings from social messaging data, interviews and my reflections, with attention being paid to mothers' motivations, intentions, attitudes and beliefs in relation to the five target behaviours are reported second.

This chapter will also identify a further oral health behaviour found, which did not form part of the existing model, but was of key importance for the participating mothers: Teething Response. In addition, a key theme found to impact the self-efficacy of the mothers to carry out oral health behaviours is described: External Affects.

A mapping diagram of the key findings from the qualitative data relating to a mother's self-efficacy is shown in Figure 19. This diagram maps the five target behaviours with the addition of the extra oral health behaviour supported (Teething Response) showing how self-efficacy was either hindered or facilitated in the uptake of target oral health behaviours.

Quotes from interviews and individual quotes from social messaging data are set out in italics, as per the previous chapter. My reflections will be set out in a different italicised font, as per the previous chapter. The social messaging conversations are displayed in a similar speech bubble social messaging format, with date and time stamps, to make it distinguishable from the interview and facilitator reflection data.

Figure 19. Mapping of key findings from qualitative data relating to self-efficacy which impacted oral health behaviours.

6.1 Self-efficacy and Timing of the Intervention

Due to the low sample size, the self-efficacy findings are unreliable. However, they are included within the thesis due to similar trends found elsewhere and therefore may be of interest for future exploration.

Using a univariate ANOVA model, the intervention survey question as the independent variable, "How confident are you in being able to carry out all the tasks needed to maintain your baby's dental health?" was tested against all trial arms. This showed no statistical difference across all trial arms (P=0.15). However, when looking at pairwise comparisons, the IP-SMP arm was significantly different to the control arm (P=0.03) meaning those in the IP-SMP may have felt more confident in being able to maintain their infant's oral health compared to the control arm. This was also mirrored by the Kruskal-Wallace test which showed no statistical significance across all trial arms (P=0.14) but did show a statistically significant difference between the IP-SMP arm and the control (P=0.02).

As described in the previous chapter, the IP-SMP intervention arm scored significantly higher in the acceptability survey in comparison to the control group. This was due to the flexibility of choice in how to access the intervention support, even though none of the IP-SMP mothers took up the opportunity for an in-person meeting.

When plotting the estimated means of the mothers' general self-efficacy scores against the baby's age at the start of the intervention, there was an interesting trend. Self-efficacy decreased between baseline and midway for mothers joining the intervention with infants aged 3-6 months. This age is known for a number of milestones such as weaning, teething, crawling and sleep regression (a period when a baby who has been sleeping well enough suddenly experiences poor sleep).

Again, great caution has to be taken when inferring the occurrence of real phenomena from a very small dataset. However, it is worthy of note that this mirrors the findings described in the previous chapter which suggested the time mothers would be receptive to the delivery of an oral health education intervention was around the time of the emergence of primary teeth and weaning, usually around 4-6 months of age. Also described further in the chapter, are the findings which suggest delivery of this intervention was most effective at supporting a mothers' self-efficacy around the emergence of primary teeth, typically from 4 months, due to the pain some infants suffered during teething.

> *"The nights have been horrific! I think, um, I mean the dental study has been absolutely brilliant, to be able to have the Whatsapp group and go, 'oh. My. God. Is this normal?'"* ***P38 IP-SMP***

Whereas the control arm mothers did not receive intervention support to maintain oral health behaviours during periods of difficulty.

> *"I knew it was going to be bad [returning to studies when infant was three months old] but I didn't realise how up and down that first bit would be and, not just the lack of sleep, how hard that just makes making a cup of tea, or getting dressed, or whatever else. I totally underestimated how difficult it makes doing anything else."* ***P5 C***

Mothers who did not take part in the final interview but left feedback on the final survey, expressed a similar attitude to the interviewees regarding increased self-efficacy in carrying out oral health behaviours. These mothers were from differing intervention arms but joined prior to weaning and the emergence of primary teeth and both remained in the social messaging group throughout the intervention.

"Thank you to Nicole for allowing me to be part of the group. I have picked up some useful information and tips which will help me manage my little ones dental health." ***P34 SMP***

"Thank you so much. Feel so much more confident in brushing and other aspects of dental care." ***P24 IP-SMP***

A total of twenty-one mothers completed all three GSE surveys. Looking at the general self-efficacy (GSE) survey data using a repeated measures general linear model with Bonferroni correction, there was no statistically significant difference between trials arms over time (P=0.44). The Kruskal-Wallace test also showed no statistical significance between trial arms over time.

There are a total of twenty-eight mothers who completed baseline and end GSE surveys. Using a repeated measures univariate model, no statistical difference can be seen between trial arms. Using ANOVA to examine variables such as receiving the intervention (combining control arm and non-engaging mothers), average household income, parental status and baby age at the start of the intervention, there was no statistical difference between baseline and end GSE scores.

Looking at patterns in the overall increase or decrease of mothers' baseline and end general self-efficacy scores, Figure 20 shows the majority of mothers who engaged with the intervention having an overall increase in self-efficacy. However, there are also two mothers who show a large decrease in self-efficacy despite their engagement with the intervention (P22 IP and P37 SMP).

Additionally, there is a control arm mother and a mother who did not engage with the intervention both with large increases in self-efficacy scores (P30 IP and P35 C). This corresponds with the repeated measures general linear model with Bonferroni correction that the intervention did not have an impact on the mothers' general self-efficacy over time.

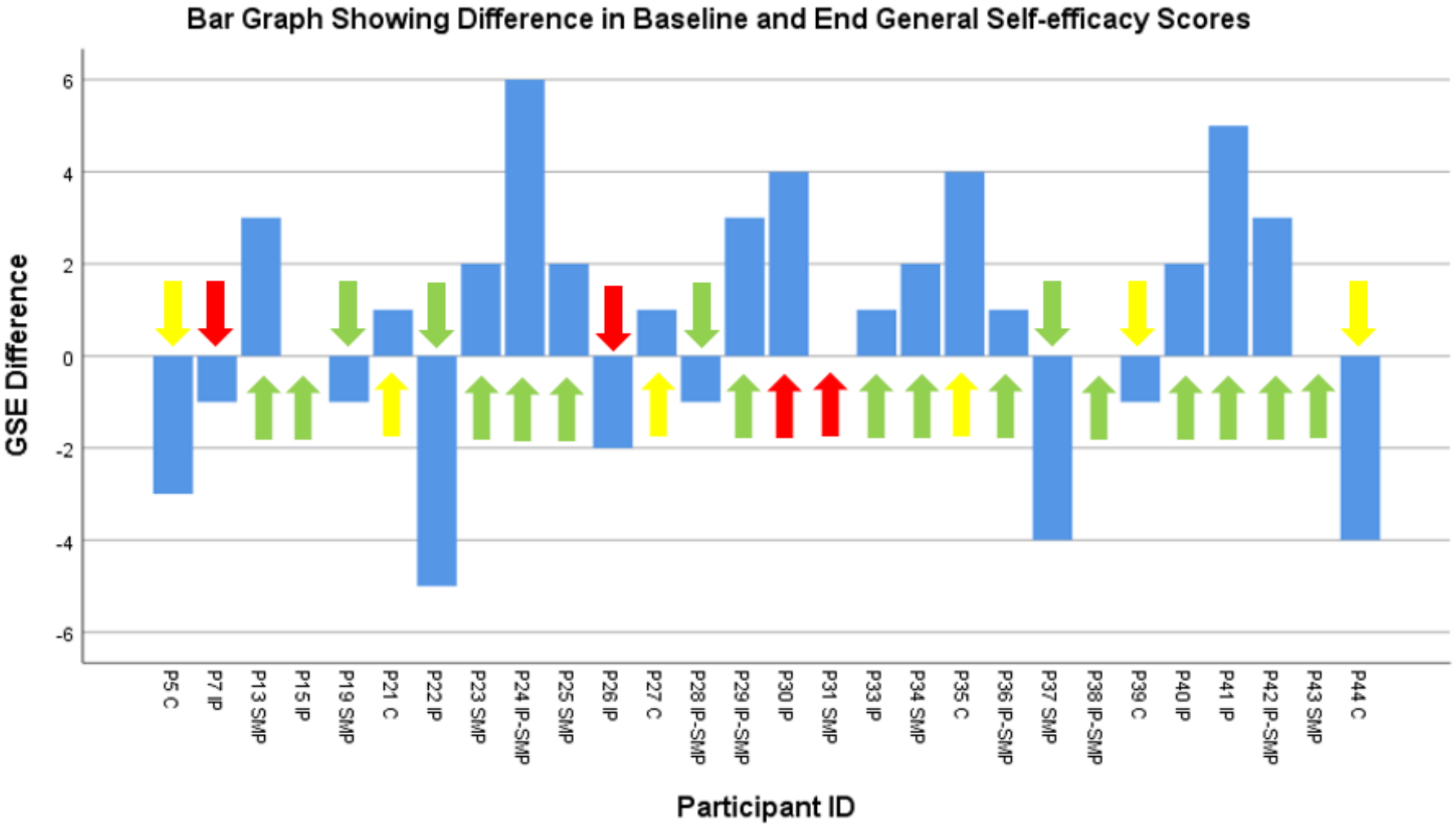


Figure 20. General Self-efficacy score overall increases or decreases per participant. Yellow arrows = control arm. Green arrows = intervention arms. Red arrows = intervention arm mothers who did not engage

6.2 Effectiveness of the support of five infant-focused oral health behaviours

Findings on how the intervention overall supported these oral health behaviours will be outlined, with the effectiveness of individual engagement approaches being described. Some target oral health behaviours required much less support within the intervention, with a sixth behaviour being described within these findings: Teething Response. In addition, interview data gave an insight into why some of these oral health behaviours weren't taken up, despite support, which will be summarised within the oral health behaviour sections.

6.2.1 Toothbrushing with appropriately fluoridated toothpaste

The findings from the interview data suggest the intervention was effective in increasing confidence, knowledge and changing behaviour around brushing primary teeth. For those mothers who joined and engaged with the intervention prior to the appearance of their infant's primary teeth, the intervention supported establishing brushing routines for when primary teeth emerged.

> *"It gave me the confidence earlier on, about what to do when he had teeth and I was really on it as soon as they appeared with the toothbrush and the toothpaste and, making sure that he had…his teeth were, his tooth was brushed after milk."* ***P36 IP-SMP***
>
> *"Like, I had no idea when to start brushing his teeth. Um, and, you know, you obviously gave us the toothbrush and things to start with so actually I started doing that quite early on, as soon as his teeth started appearing."* ***P25 SMP***

For mothers who joined with older infants, who did not engage with the intervention straight away, or who were not part of the social messaging group, brushing primary teeth with an

appropriately fluoridated toothpaste, did not always occur immediately due to a lack of awareness.

> *"It's not the end of the world that he missed three weeks, but it hadn't been pointed out to me and it sounds silly because, I brush my teeth so why didn't I brush my son's!"* ***P28 IP-SMP***
>
> *Baby has 4 teeth now but mum doesn't go near them.* ***NT reflection after meeting P8 SMP***

However, the intervention supported mothers to adapt to new behaviours with some mothers showing motivation to change.

> *"Thanks Nicole. I've started doing this* [brushing after last feed] *after speaking to you. We do it last thing at night between feed and bedtime story. He loves it and I have to have to prise the toothbrush from his hand!!"* ***P23 SMP***

As highlighted in the previous chapter, the social messaging group increased the regularity of discussions on oral health and provided peer support. Mothers were honest about their difficulties with toothbrushing as a shared experience. Support and advice was therefore reinforced on a more regular basis in comparison to the other intervention delivery methods.

27/03/2019, 16:15 NT: *Just checking in… How is everyone feeling about looking after their LO's* [little one's] *teeth? Ok or complete nightmare?*

27/03/2019, 16:40 P29 IP-SMP*: It's not going too badly this end, he's so much better than he was, especially after I realised I didn't have to put the toothbrush quite so far into his mouth!*

27/03/2019, 16:47 P42 IP-SMP*: Ups and downs! I have to admit I bribe him with iPad but then this means that he then drinks his bed time milk after brushing teeth, is this going to cause damage to teeth?*

27/03/2019, 16:47 P23 SMP*: Bit of a battle here still but we persist...in sure once his second molars are through we'll be ok again (she says, hopefully) x*

27/03/2019, 16:48 P34 SMP*: Bit hit and miss here, some days are good, some days she's not interested at all. I must admit I also give <Baby> her milk feed after brushing in the evenings x*

27/03/2019, 16:50 P23 SMP*: Yes here too - always milk after brushing I'm afraid x*

27/03/2019, 17:27 P25 SMP*: All ok here thanks. <Baby> has days he loves*

Although mentioned in the previous chapter, mothers with the IP engagement approach often used social messaging to get additional reassurance about toothbrushing, especially if challenges were being experienced. Due to being linked with self-efficacy, it is worthy of mention again, as it provided an opportunity to support confidence, accessible at a time mothers' most needed it.

14/07/2018, 19:32 P41 IP: *Hi Nicole, it's <Name>. We have a pretty poor and broken bedtime routine lately with <Baby> being ill with one thing after another. Teeth cleaning has been a bit sporadic with sometimes finishing last feed upstairs and <Baby> having a strop and throwing toothbrush behind the bath where I can't get it! […] Is it OK rubbing the toothpaste on? […] We're halfway back to normal routine but he has injections next week. Blow it all up in the air again! Sorry to text on a Saturday I've been meaning to text for last week and kept forgetting.*

14/07/2018, 20:01 NT: *It's absolutely fine! Rubbing a bit of toothpaste is perfect. The toothbrush is merely an applicator at this stage. Don't panic! Just get through this phase and the routine will come back again. I promise!*

The Delivering Better Oral Health: Evidence-based Toolkit (Public Health England 2021) advises that parents should brush primary teeth last thing at night. This guidance was interpreted by the pre-PhD study (Kay et al., 2019) as after the last feed at night. This same advice was given to the mothers in this intervention. The mothers who had already established feeding to sleep routines were reluctant to change this habit.

I recommended after the last feed at night; even just putting toothpaste on teeth with finger. Mum feeds to sleep so, although she's willing to try it, she probably won't fully commit if it wakes her baby up. She will use toothpaste when she brushes during baththime from now on though. ***NT Reflections after meeting P40 IP***

"Nicole - you have talked about the most important time to brush being last thing at night but little man is usually sparko after his last feed and I'm loathed to wake him. Am I ruining his prospect of good teeth? When is the next best time to brush?" ***P25 SMP***

"Thank you, Nicole. We are already using a brush to get him used to it even though he doesn't have any teeth just so he is used to it." ***P24 IP-SMP***

For the few mothers with infants who didn't feed to sleep, this behaviour was taken up, even before emergence of primary teeth.

Although there was reluctance over brushing after the last feed, mothers were able to see the value in brushing last thing at night in order to establish future intentions and motivations to set goals for when their infants stopped feeding to sleep.

> *"Well, what we're going to do, because we're going to stop breastfeeding soon, so when I stop breastfeeding, we'll do milk and then teeth but at the minute, it works quite well...so when we swap to, just a cup of milk before bed, then he can, we'll do his teeth afterwards."* ***P30 IP***

Feeding to sleep was not the only explanation for infants missing having their teeth brushed last thing at night. During the interviews, mothers talked about establishing brushing at bath time to help promote the habit as more fun and playful. This bath time brushing habit was more attuned to the natural bedtime routine which helped mothers remember. When bath time was missed, sometimes so was brushing.

> *"I quite often let him brush in the bath because he loves baths. He has a bath with <husband> mostly. […] at least he's enjoying it and it's a nice thing for him and, so yeah, I'm trying to keep it fun, rather than a, *authoritative* 'let's brush your teeth.'"* ***P25 SMP***

> *"So, the evening is a lot easier, if we have a bath, the difference is when we don't have baths because it's not a natural routine to go in there and occasionally I've put him to bed and gone, 'dammit! I didn't clean his teeth!'"* ***P40 IP***

When exploring the control group mothers' experience of brushing their infant's teeth with an appropriately fluoridated toothpaste within the interview data, one mother had some confusion around fluoride levels in toothpaste, one mother described a more relaxed

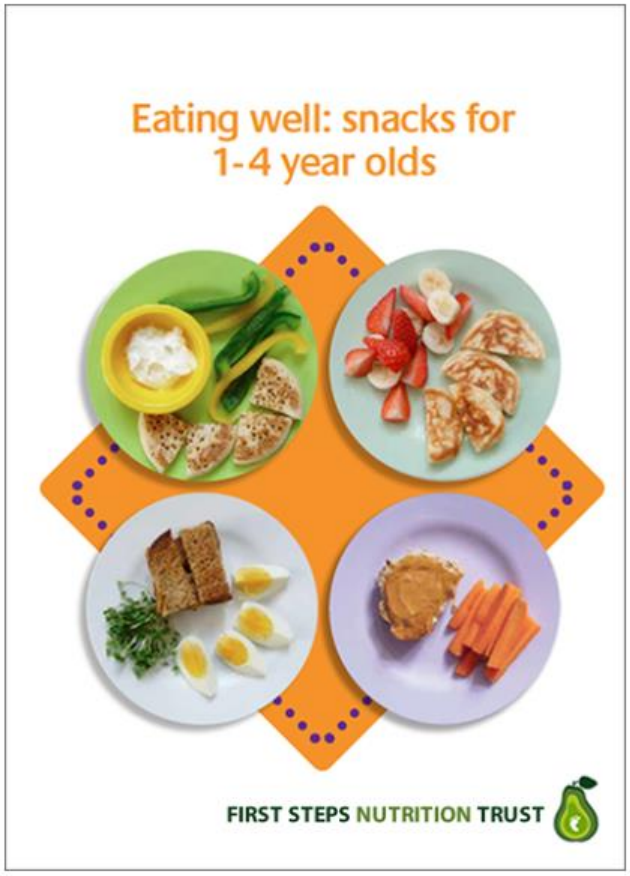
approach to ensuring their child had their teeth brushed and another mother discussed a lack of confidence in knowing she was brushing correctly.

> *"I just buy the one from the supermarket that says it's the right age for him but they just seem so sweet […] but I don't know if it's to do with fluoride level in the toothpaste or what it is to why there is different ones of the ages or if it's just a marketing thing?"* ***P5 C***
>
> *"He's fine having his teeth brushed and if you try to clean them, I'm sure he'd be ok but, especially at the moment, I'm not bothering. I'm just letting him chew the toothbrush and eat the toothpaste."* ***P27 C***
>
> *"But I do always say, have you got it enough, I think that's it, is there enough brushing? You know, have you brushed it for long enough before she gets fed up?"* ***P35 C***

6.2.2 Positive attitudes to oral health and dental visiting

Demonstrating positive attitudes to oral health encompassed habits outside of tooth brushing such as, not introducing foods before the recommended age of six months (or before the baby is able to sit unaided), not adding sugar to weaning foods, keeping sugary foods and drinks to a minimum, and discouraging use of pacifiers, as per the government guidelines (Public Health England 2021). Intervention arm mothers were sent a link to the Public Health England Change4Life Sugar Smart app (see Figure 21), to either follow up on conversations regarding sugar and make recommendations for healthy alternatives, to try and prompt conversation, or to initiate a meet up.

Figure 21. Advert for Change4Life Sugar Smart app. Image used from https://www.bjpcn.com/browse/have-you-heard/item/1887-sugar-smart-app-aims-to-reduce-obesity.html



Mothers with a social messaging engagement approach were also sent a link to firststepsnutrition.org, a website with information, downloadable posters and booklets on child nutrition, including information regarding foods which are better for infant oral health (see Figure 22).

Figure 22. Example of downloadable booklet. Image taken from https://www.firststepsnutrition.org/eating-well-infants-new-mums

A social messaging group conversation captured one mother's conflicted decision whether to start introducing food prior to the recommended age. Querying the motivation behind wanting to start early weaning led to the mother waiting until the recommended time, with the help of peer support. This was without the mother receiving information on the evidence-based oral health implications of weaning too early.

***23/05/2018, 17:43 P34 SMP**: Hi all. I have a question about weaning. My little girl is coming up 5 months and weighs 22lbs, so she's a big girl! […] I have received conflicting advice about waiting until she's 6 months so her digestive system has developed or on the other hand starting now because of her size.*

***23/05/2018, 18:59 NT**: I generally say look at the motivation for weaning. If sleep is the driving factor, then be prepared that it might not work! If you're happy to take your baby's lead and see how it goes, then your mental health is far more likely to stay intact.*

***23/05/2018, 19:04 P34 SMP**: You make a good point! I guess the main motivation is the fact she's so big and me wondering if she's getting enough milk, but lack of sleep is definitely a factor especially when it's like having a newborn again at the moment!*

***23/05/2018, 19:34 P28 IP-SMP**: My little boy had a sleep regression at 5 months, went from sleeping for 10 hours to up every 2 hours. When I started weaning a month later I started with an evening meal in the hopes it would help his sleep ... it didn't!!!!*

***23/05/2018, 20:11 P34 SMP**: It's the same here - she used to sleep pretty much right through, now we're lucky if we get 3hrs in a row! Thanks for the advice about weaning not helping though - it'll stop me introducing solids unnecessarily too quickly.*

When questioned directly during in-person meetings, mothers did not feel that discussions around sugar or weaning foods was something they needed help with due to feeling like they had good knowledge and followed a healthy diet.

Feeding, diet wise, mum says she's really happy with everything she's eating. She's eating a varied diet and very healthy. ***NT reflections after meeting P33 IP***

Diet - he doesn't have any refined sugar, he doesn't have anything other than milk or water. ***NT reflections after meeting P41 IP***

Sugar was more freely discussed in the social messaging group with mothers admitting to the sugar being consumed by their infants. This made it easier to have open conversations about sugar and to reinforce healthy behaviours, such as keeping treats to mealtimes and using a smear of family fluoride toothpaste (1,350-1,500 parts per million fluoride – ppmF) for days when there had been a high sugar intake. The social messaging group conversations also provided evidence for oral health messages being taken on board.

22/08/2018, 09:39 P38 IP-SMP: Can I raise the S question? Sugar. I'm having real struggles with when to introduce <Baby> to sugar. His granny is dying to feed him 'naughty' treats. Are there any guidelines Nicole? How are you all tackling it?

22/08/2018, 09:42 P29 IP-SMP: I'm clearly not as restrained! <Baby> has had some ice cream and some other treats as well (bitbut of cake etc). There's also a surprising amount of sugar in baby food - check out the packets of puree and you'll see what I mean. In my view as long as its a balanced diet, a little every now and then is OK but happy to take advice on that! X

22/08/2018, 09:43 P24 IP-SMP: Sugar is allowed here but only with meals... So if my eldest wants chocolate it's at meal times only. <Baby> has had a few treats mainly because of grandma but again meal times only

During the course of the intervention, three of the infants had to be taken into hospital. One infant was being investigated for type I diabetes and therefore the mother had been advised to put the infant on a 'full-fat' diet to avoid a hypoglycaemic attack until they had confirmed the diagnosis. The mother was on a low income and was concerned at the cost of 'full-fat' drinks, such as Ribena. Advice on how to counter the risks of such a diet by using family fluoridated toothpaste was delivered in person, with follow up advice on interpreting what a 'full-fat' diet meant being delivered via direct messaging.

20/07/2018, 15:26 NT: I've just spoken to the paediatric diabetic team at the <hospital>. They have said, as long as it's not "sugar free" drinks, anything with sugar in is completely fine, including "no added sugar" (as it won't be completely sugar free). So, for example, a large carton of Aldi apple juice is 69p and is high in fruit sugar which will increase <Baby's> sugar levels if needed.

The app I showed you is also great for checking the amount of sugar in drinks so as long as it's not sugar free, it'll be fine to get less expensive drinks or juices.

It might be good to keep the Ribena for an emergency such as if you think he's starting to get low blood sugars again as that contains around 6 teaspoons of sugar per serving.

20/07/2018, 15:33 P3 IP-SMP: Thank you very much that's a great help x

Two infants were hospitalised after becoming very unwell with infections. As standard, the nursing staff had given the infants sugary drinks or food to raise their blood sugar levels. This was in conflict with the low sugar diets they had been trying to maintain for their children and therefore caused some anxiety and confusion.

"But then when <child> was ill, the first thing they did in hospital was give him jelly because he needed salts and he needed the sugar. So we then had, put him on a sugary diet to try and get his energy up. That was a bit strange, to try and slowly wean him off the sugary stuff again. But that was just a…yeah, we would never have done that - never thought to have given them jelly!" ***P43 SMP***

"Hi Nicole, <Baby> was admitted to hospital this week... But they gave him juice in a bottle will that be OK? Just once." ***P24 IP-SMP***

Using social messaging made disseminating information and reinforcing positive attitudes towards healthy eating choices easier. However, overall, the findings from the interviews suggest the intervention may not have been effective at changing mothers' motivations, intentions, attitudes, and beliefs towards sugary foods with their infants.

Although all mothers expressed positive intentions and attitudes to keeping their infant's teeth healthy, interview data on attitudes towards dietary sugar remained conflicted. It was discussed in terms of 'trying' to limit sugar as much as possible, with a sense of inevitability of sugar being introduced at some point. There was also great conflict in the justifications for giving their child sugar.

"Sometimes my husband was like, "it would be great if she couldn't have sweet before one year or two years," and I say, "yeah but…" it's like pretending that the world is not existing and when she will be two, she will just rush on it." ***P40 IP***

"She does have it in moderation, I mean, on a Monday after nursery, we go to the shop and pick some penny sweets. Um...I mean she does have juice with us but in nursery, they only give her water." ***P19 SMP***

There was also the concern that not introducing sugar would mean that their child might not have a healthy relationship with it later in life.

"You try and find a balance, because I don't want him going to school or going to a party and then suddenly going nuts about, 'oh my god, sugar!'" ***P23 SMP***

"I'm a bit of a sugar addict, so I want him to have a better relationship with it than me. But I feel a complete ban is unrealistic. I don't want him to be the boy at the party bouncing off the walls because he's had his 1st jammy dodger!" ***P38 IP-SMP***

There were a number of mothers discussing 'mummy and daddy' foods and drinks in comparison to their children's diet, reinforcing less sugar for their children but still often consuming sugary drinks and foods in front of them.

"I have hot chocolate and I give him the odd spoonful, but in general terms, it is 'No. That is <child's name>. This is mummy's, or daddy's. End of story.'" ***P25 SMP***

"I'll have to make sure I've got the banana bread or something for <child> on the side, so he knows we're all having cake, but he's just not allowed a chocolate muffin. " ***P38 IP-SMP***

"Hidden sugars", "fruit sugars" and "good energy" all seemed to be a personal interpretation of the health messages. Several mothers were concerned about their infants eating too much fruit because of it being bad for their teeth and ruling out fruit as a snack. In contrast, there were discussions around foods such as children's yoghurts and biscuits being ok for teeth, as long they weren't chocolate-covered, or fruit flavoured.

"He does eat a lot of bananas and so I'm kind of, I've stopped buying them just because, I know they're quite high in sugar so I'm conscious of that." ***P41 IP***

"Obviously doesn't have sugar in his cereals or even yoghurts, he tends to have more like the vanilla flavoured ones so they haven't got, you know, lots of fruit-flavoured things like that." ***P42 IP-SMP***

Attitudes to sugar were mirrored in the control group with most of the mothers trying to limit as much as possible. However, one mother described how she felt her child's nursery were too strict with not allowing sugar, whilst another mother described her lack of confidence in limiting sugar, due to her own habits when she is feeling fatigued.

"You can take in fruit but then they already have fruit so why would you, send even more in because then, you can only eat so much fruit. So, yeah, you can't even take in cake." ***P27 C***

"When I am tired, I'll eat sugary stuff. Loads and he does coz [sic] he sees me doing it so he probably eats more cake and biscuits than he should I'd say." ***P5 C***

Another control group mother described how they put a small fridge in the living room for their child to help herself to food when she wants, not understanding the implications of regular snacking on oral health.

"This is our new thing because food gets left around and the dog eats it, so this is, we only did this this week! Because it was upstairs, unused, this fridge, so I thought actually, then she can keep all her bits in there and help herself when she wants it as well!" ***P35 C***

Pacifiers were rarely used among the mothers assigned to the intervention arms. One mother described how this habit developed out of perceived 'selfishness' and the associated shame led her to not leaving the house during nap times whilst her infant used one to sleep.

Very unsure of herself. Feels very guilty about 'selfish decisions' such as using a dummy for nap times. Doesn't use it in public because feels ashamed. ***NT reflections after meeting P34 SMP***

Attitudes to dental visiting were supported in the intervention, by ensuring the mothers knew about the Dental Check by One initiative (British Society Paediatric Dentistry 2017) and encouraging engagement with dental services early on. This was an initiative established by the British Society of Paediatric Dentistry in partnership with the Office of the Chief Dental Officer for England to ensure children began dental visiting after the emergence of primary teeth, or by their first birthday, at the latest.

Most mothers reported they had visited or intended to visit the dentist with their infants at some point during the intervention. Helping mothers register to local dentists or advising them on how to register their infants with their own dentists was provided in all intervention delivery methods.

The social messaging group conversations highlighted misinformation that may have been given to the mothers regarding taking their infants for their first visits.

21/01/2019, 21:08 P34 SMP*: I've tried to register <Baby> at mydentist, but she's now on the waiting list and I asked about having a check-up and they said that she wouldn't been seen until she is at least 2 years old.*

21/01/2019, 21:09 P29 SMP*: <Twins> had an informal checkup (after our appointments) at 12 months and next appointment is at 24 months.*

21/01/2019, 21:11 P23 SMP*: <Baby> is registered but they said not to worry about taking him until my next appointment (he'll be 27 months). To be honest I don't think they'd have any chance of looking in his mouth anyway x*

This misinformation could be easily addressed within the social messaging group, ensuring mothers did not wait too long for the first visit, or between dental visits.

> ***21/01/2019, 22:18 NT**: Mydentist's own guidelines – Bring baby along from first tooth appearance! NHS guidelines - from first appearance of teeth and no longer than 12 months between check-ups.*

> ***22/01/2019, 12:05 P34 SMP**: Hi Nicole. I've just rang Mydentist and they registered and booked in <Baby> for when I have my next appointment. The lady apologised for the false advice that I was given before.*

A finding highlighted during an in-person meeting, was that the positive attitudes towards oral health and dental visiting were not always reflected back to the mothers by the dental professionals.

> *The dentist had asked if he has any teeth and at that time he just had two teeth and the dentist didn't offer any advice or to see whether mum wanted any advice. Mum took that it was just part of a conversation, but in hindsight thinks the dentist was not interested in what was happening with <Baby's> oral hygiene regime at this early stage.* ***NT reflection after meeting P41 IP***

Interview data from this same mother showed how the attitudes of the dental team had also affected her attitude to dental visiting, despite reinforcing the importance during intervention meeting.

> *"They said they won't see him until two, so, um, so…I kind of, I thought, he's two next week, um, but I thought, well I'm going in for this and, they were one of those that, 'yeah, we don't generally as a routine see them until two, but we will see him if you're concerned.'"* ***P41 IP***

This finding was also discovered during recruitment. When Children's Centre workers were advising primary carers about the Dental Check by One initiative, as per the guidance, primary carers responded that they had received different advice from their dental service provider.

> *Feb 9th – attended health drop-in session today at <Children's Centre>. Spoke to three members of the health team who discussed the barriers they come up against with regards to oral health. They find the advice given is very conflicting from dentists as they have had mums being told by their local dental service that children don't need to have a check up till they're 2-3 whereas, they're trying to encourage mums at the 10-month review to register and get their babies checked by a dentist.* ***NT reflection during recruitment***

This misinformation given to mothers by dental practices was also found amongst a control group mother who as a result, still had not taken her nearly two-year old to the dentist.

> *"I asked her about when would she, you know, when would be a good age to bring her for the first time and they said after one so, to wait till after one and that was the only question I asked, I think and then never got round to taking her!"* ***P35 C***

During an interview, a control group mother reflected on dental visiting, suggesting that taking children from a very young age was still not a regular occurrence, particularly among her friends.

> *"Also a lot of people don't think children of their age are able to go to the dentist. Because of lot of my friends who have children around that age, all say, "oh can they go to the dentist already?" So, a lot of people are unaware that they can go to the dentist under five."* ***P21 C***

Another control group mother had recently had a negative dental experience which was putting her off from visiting the dentist with her infant.

> *"I don't know how you know who's a good dentist […] I know that they have to be on a registered scheme and everything but it's, there's less quality control and things like that around NHS."* ***P5 C***

Interview data from a mother who did not engage with the intervention, highlighted a barrier to dental visiting which was concerned with about their infant's non-compliance. It was discussed as being a factor putting them off from taking their infant to the dentist due to possibly inconveniencing the dentist.

> *"I need to go to the dentist soon. But I just thought, if I take him, is that not going to be a pain for the dentist? Because, he will not just sit on my lap. He will want to claw at my face and take all his tools and, and touch the light."* ***P30 IP***

Upon reflection, being able to reinforce the purpose of familiarising infants and young children to the dental environment, as well as having their teeth checked if the infant allows, was a way of supporting the confidence to persist with dental visiting. This was most effective in the social messaging group due to the regularity of being able to reinforce this behaviour, in comparison to the in-person engagement approach.

One mother reported how their infant not letting the dentist check the infant's teeth did not put them off from trying, due to the knowledge and reassurance they received from the social messaging group. The mother felt confident in looking after their infant's oral health between visits and felt that the habit would develop in time.

"But I feel I've had the reassurance [from the intervention] that I know, I mean, he only has milk and water anyway. […] So, I figure that from my point of view, I'm not worried too much about the whole dentist thing [not letting the dentist look at his teeth] because I hope that will come with time, knowing that he is brushing and, you know, doesn't mind that aspect of it."
P42 IP-SMP

6.2.3 Not putting baby to bed with a bottle

Although the majority of mothers fed their babies to sleep with either breastfeeding or bottle feeding, none of the mothers reported leaving their babies with bottles to sleep with. Similarly, for night feeds. Therefore, this specific behaviour was not found to need supporting during the intervention.

For those mothers who breastfed their infants for comfort, particularly during periods of disturbed sleep, or had babies who still woke regularly for night feeds, advice was given regarding using a smear of family fluoride toothpaste (1,350-1,500 parts per million fluoride – ppmF) instead of infant toothpaste. This was to counter the increased regularity the primary teeth were being exposed to breast milk, especially for those infants who had also started weaning and may be being exposed to dietary sugars. This advice was delivered using a video recorded in a local supermarket showing all the different toothpastes available, and how and why, after a certain age, they all contain the same level of fluoride. This video was sent to

mothers with a social messaging engagement approach. The premise of the video was discussed in person with those mothers who met up.

***30/08/2018, 14:50 P37 SMP**: Really helpful and informative Nicole. Something I can share with my husband and Florence's Grandparents.*

***30/08/2018, 16:04 P28 IP-SMP**: I've been meaning to text for ages to ask what the difference is with all the toothpastes and brushes? I can get sucked into 'age ranges' and didn't understand the difference.*

***30/08/2018, 16:52 P43 SMP**: Thanks, that's really helpful Nicole. It's cleared up some questions. I was wondering why the children's toothpaste wasn't minty.*

6.2.4 No sugared drinks in bottles

None of the mothers this behaviour was discussed with, either in-person or using social messaging, said that they used bottles for fluid other than milk. In fact, to avoid confusing their infants, the mothers purposefully used a variety of different free-flow cups for liquids other than milk.

> *"<Baby> has his milk in a tommee tippee free flowbeaker and his water out of an open cup at meal times and a flip out straw beaker during the day. I thought it was a good way not to confuse him with what drink is coming!!"* ***P28 IP-SMP***

A discussion on the social messaging group gave an insight into why mothers may introduce liquids other than water or milk; a belief that their infant doesn't like the taste of water. This provided an opportunity to provide another possible explanation for an infant's rejection of water to discourage adding squash.

***02/07/2018, 21:55 P34 SMP**: Is it OK to give my 6 month old water at every meal when they start weaning? I swear I've read somewhere that too much water is bad for a baby until they're 1 year old xx*

***02/07/2018, 21:57 P29 IP-SMP**: I've being offering water with each. […] He doesn't really like water so he has really diluted sugar free squash.*

***02/07/2018, 22:07 NT**: Try different temperatures of water before adding any flavours. If you do decide to add a very weak squash, keep it to mealtimes and use family fluoridated toothpaste from the get go if possible.*

This explanation was also provided to a mother who was met in-person, to discourage diluting water with squash should they be approaching an age when their infants were ready to try water.

Talked about trying different temperatures of water as it's easy to be fooled into thinking they 'don't like it'. ***NT reflection after meeting P22 IP***

In contrast, a mother who was encouraged to only introduce water to her infant during an in-person meeting, minus suggesting different temperatures, described in the interview the belief that their infant was not drinking enough water at their childcare setting because they didn't like the taste. This meant the mother gave her child squash at home to encourage him to drink. The mother began to query this belief as we discussed it during the interview.

"The only thing now that I do slightly worry about is that he's drinking less water and he has a bit of squash instead, which is probably isn't as good for your teeth. It's in a cup and not a bottle so maybe it's not going on his teeth so much? I don't know. When he gets back from the childminders […] he drinks about two cups when he gets back. Super thirsty. ...I need to ask

really, because they haven't said that he's not drinking. Just that he's super thirsty." ***P15 IP***

Most of the mothers reported only giving their children water or milk during the interviews. One mother did express a concern about how this behaviour would be upheld with subsequent children discussing squash as an inevitability.

"I was thinking about it before we um, before we had this [interview] and I thought well, it's easy for him; if we have another one and by that point if he's drinking squash with his meals, then the younger will see it." ***P28 IP-SMP***

A control mother's attitude to water was that it is boring and described how her youngest child drank sugary drinks. This was attributed to a belief about the younger child being sneaky, as opposed to their role and responsibility in providing access to sugary drinks.

"So we're trying and he doesn't well, he only has water but he understands that <older child> drinks bottle contains very weak squash so he understands that he can, if she ain't looking, he'll have that. So, he knows his is just boring water […] he just goes and picks it up, and they'll be diluted blackcurrant in there. Sneaky." ***P27 C***

6.2.5 Early progression from bottle to cup

There were many discussions around introducing free-flow cups, particularly on the social messaging group, as mothers were confused about which designs were 'bad' for teeth. One mother expressed how the conversations on the social messaging group helped her become conscious about this behaviour as it wasn't something she was aware of at that time.

"So it's been good and I'm still…we still have a bottle at night occasionally and it's, it's thinking about cups and sipping and that whole – we're still getting through that. But, I don't think I would have even thought about that. I don't think I would have even known that without the group – that I need to think about how he's learning to drink." ***P38 IP-SMP***

Mothers were also conflicted as open top cups were a lot messier at the start of weaning, and not convenient when out and about with their infants. In addition, mothers received conflicting information from the baby-led weaning (BLW) guidance about the correct design of free-flow cup compared to the dental guidance which had different recommendations. This caused a great deal of anxiety about having to choose between two morally bound standpoints. Reassurance could be provided to help with a mothers' confidence and also to reinforce not introducing sugary drinks as being the main priority rather than the design of cup.

10/07/2018, 16:08 P37 SMP*: I have seen a few posts about cups on the group but wanted to double check I have understood/doing the right thing for <Baby>. I am currently using the Babycup at home…but finding it tricky when we are out so brought cups with lids to carry with us. For the BLW I should avoid non-spill but from the dental info I should avoid spouts. Eeeeeee, which one would you advise?*

10/07/18, 16:16 NT*: Non-spill beakers aren't going to ruin <Baby's> teeth at all. The guidance states to begin introducing a 'free-flow' cup from six months. Use whichever will make your life easier! The main thing is what you put in it – water or milk – which I have no doubt you already know.*

13/07/18, 18:02 P37 SMP*: Thank you, Nicole. I felt I was getting myself all tangled up in which cups to encourage <Baby> to use.*

Guidance for bottle feeding mothers is to replace bottles with open cups after the infant reaches twelve months old. This caused conflict for those mothers who still used bottles to

feed their infants to sleep. Reassurance was more easily and regularly given to mothers on the social messaging group. However, a mother met in-person also benefited from making a collaborative plan in how to start reducing bottles.

> *She was very grateful about the advice about the bottle because it's not something she thought about despite being aware that she shouldn't be using a bottle after 12 months old.* ***NT reflections after meeting P41 IP***

A mother discussed in her interview how she was not using a free-flow cup due to her child's competency in using one.

> *She had a sippy cup from when she weaned herself breastfeeding, like from then, for all her milk and drinks. […] I know they're not supposed to be brilliant, for teeth, so we do try and give her an open cup but she's really not very good at drinking.* ***P22 IP***

6.3 Teething Response

This is a new oral health behaviour being described, which was highlighted by the regularity of conversations and requests for reassurance which occurred on the social messaging group. A mother with an IP only engagement approach would also text for reassurance during difficult periods, particularly associated with teething. As a result, teething was explored as a cross-cutting theme within the data.

The emergence of teeth and how much the infant was affected appeared to impact capability of parents to work on the other oral health behaviours. How the mothers responded to teething and the associated difficulties became an additional oral health behaviour supported throughout the intervention.

When mothers led the conversation topics, questions relating to teething were more common, with teething conversations being independently initiated eighteen times on the social messaging group over the twelve months (see Figure 23). This is compared to teething being discussed only three times during in-person meetings where I led the conversation topics (See Figure 24). The results of the text network analysis also highlight how conversations around teething and toothbrushing were the most common topics in the social messaging group (see Figure 25). Appendix N provides a full list of categorised questions asked by the mothers either via the social messaging group or via direct text messaging during the intervention. Appendix N also lists oral health questions asked by the mothers during the interviews.

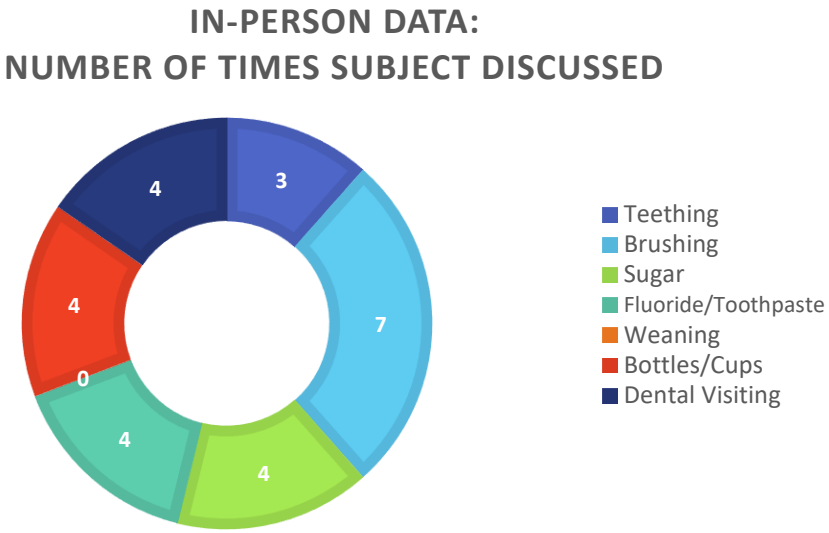


Figure 23. Count of subjects discussed by mothers in the social messaging group, over twelve months

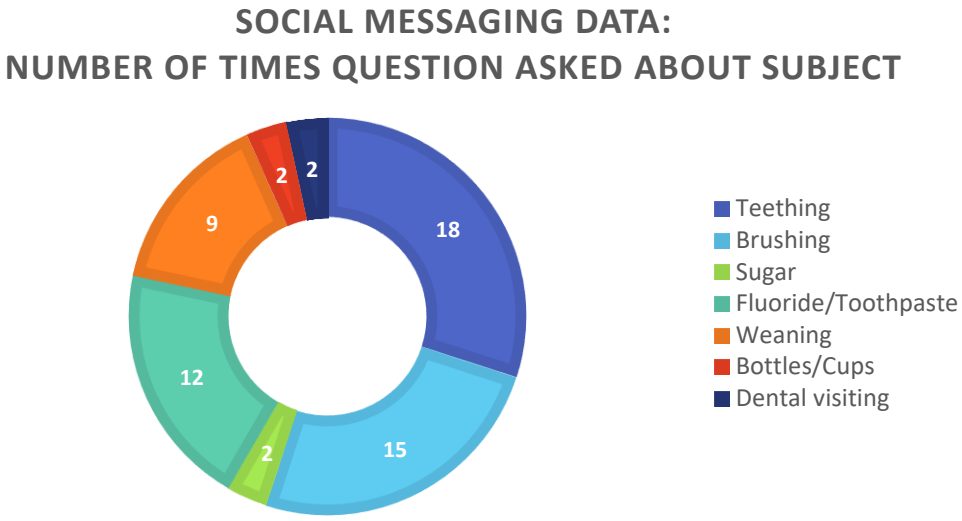


Figure 24. Count of subjects discussed with mothers during in-person meetings, over twelve months

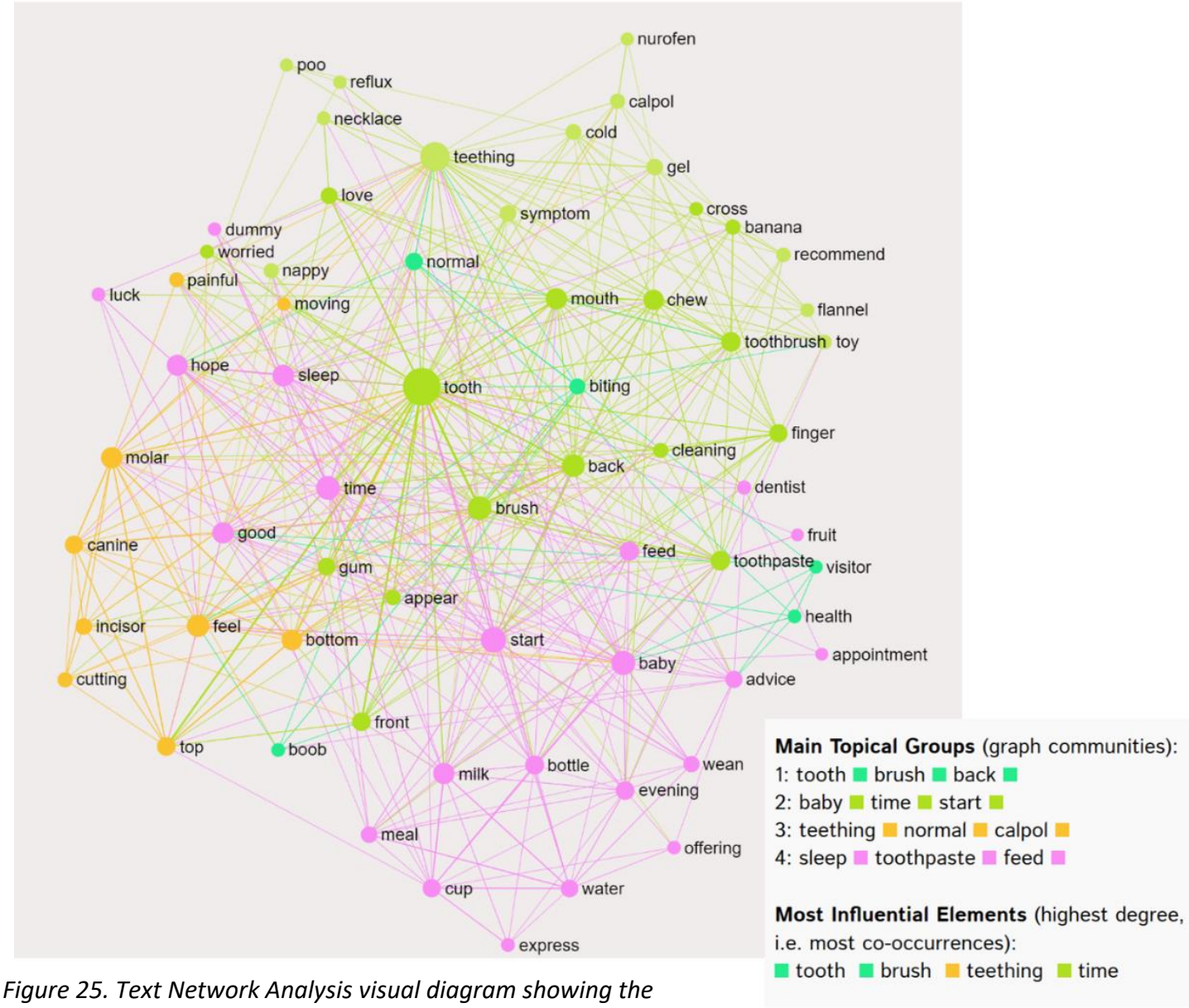


Figure 25. Text Network Analysis visual diagram showing the most influential social messaging group discussions

Teething was often attributed as the main cause of problems with brushing primary teeth. Some mothers struggled to maintain oral health behaviours during teething due to lack of sleep, changes in their infant's temperament and their infant's experiencing pain.

"Hi Nicole, at what point does teething pain mostly ease off do you think? Is it when it first breaks the gum or when the whole top of the tooth is through (so broken all along the tooth length)? <Baby> has four coming through at once and I'm just trying to work out at what point (if ever) I may sleep again." ***P23 SMP***

"My baby (4months) is like a rabid possessed being, devouring her teething toy whilst grunting and shouting, crying whenever it slips out, so much drool, I didn't appreciate how serious this testing thing could be- is this just constant until they have all their teeth? How long does that take? Should I expect years of possessed baby?!?" ***P13 SMP***

"I'm not sure of other's experience of teething, but the uppers have been horrid. <Baby> is so full of cold, she is struggling to breathe and feed. I am gentling brushing the lower two when she lets me but it seems her whole face hurts." ***P37 SMP***

"Because we're doing so well and then suddenly, 'What? What's gone wrong?!' and then, 'Yeah, there we are…it's the teething'". ***P41 IP***

The periods of teething caused a great deal of stress as there were concerns around long term implications, such as causing a general aversion to brushing teeth or not being able to clean their infant's teeth effectively.

"I think, to realise, with toothbrushing, it has been a bit… it's fair to say hit and miss with him and trying and get a balance of persisting but then not wanting it to be an issue forever." ***P23 SMP***

"I'm concerned that this will form a pattern in the future and I'm not brushing them for long enough." ***P42 IP-SMP***

"We've tried doing it the same time as us. We've tried distracting them. We've tried playing a game. But they will whack the toothbrush across the floor if they can." ***P43 SMP***

The social messaging group encouraged mothers to discuss their issues which in turn provided an opportunity to support 'good enough' alternatives to 'best practice'. This helped maintain the mother's confidence which kept mothers motivated to persist with positive oral health behaviours.

"One of the advice you gave us early on was, worst case, try and smear a bit of toothpaste around and I've always used that as a baseline. If he's teething or we're going through a bad time, we go for that and I think if I hadn't realised that other people struggled and had that piece of advice, […] I probably would have done less rather than persisted, because I would have thought, 'oh it will make an issue', I'd probably have given up for a bit and thought, 'oh well. It's not working.' I've persisted and I'm so glad" ***P23 SMP***

Mothers feeling emotionally supported during these difficult periods of teething was an important aspect of the intervention, which was interlinked with the increased acceptability of the intervention reported in the previous chapter. Needing support with teething was also reflected by a control group mother during the interview.

"It definitely seems to impact well-being doesn't it [teething]. Um…yeah. Does it have impact on oral health or is it just how happy everyone is? […] I think it's definitely comes under mental health." ***P13 SMP***

"I think so, [helpful having oral health support] *definitely, around teething because it's such a big thing for everybody, for like two years of life...I don't even know when it kind of typically stops either."* ***P5 C***

6.4 External Affects

This cross-cutting theme was found in the interview data. The theme discusses influential factors from the mother's environment which affected self-efficacy; hindering or facilitating the mothers' ability to carry out oral health behaviours for their infant. These factors included infant temperament and secondary carer support, and the wider external environment such as friends, childcare settings, geography, and marketing.

Some mothers expressed how their infant's temperament made the experience of being a new mum challenging, with getting through day by day being the priority over other essential behaviours.

> *Probably the fact that uh <Baby> has not been um not one for being put down at all so up until 8 months didn't, hadn't had a single nap in a bed, or a pushchair. Just all in her sling. […] I didn't ever get any opportunity to like clean up, or go to the loo or shower or you know, do anything like that because all those things that people talk about doing at nap times, I just didn't.* ***P13 SMP***

Support from the wider environment with these unforeseen challenges became especially important if they'd previously considered themselves a confident person in their professional life but was not experiencing that in their identity as a mother.

> *"I'd done the job I'd done for a long time and I was very, I'm quite a confident person with stuff I know, um, and then you're just thrown in at the deep end, obviously. You don't know what you're doing and you're suddenly like, 'alright…ok…I just know nothing'. I know nothing and actually not having that confidence was like, it was quite a sort of strange experience."* ***P25 SMP***

Feelings of loneliness and isolation during periods of difficulty were reflected by other mothers and how being part of the social messaging group helped overcome these feelings.

"It's just sharing experiences [in the social messaging group] *has been really… because it's like an, uh, sort of, isolating thing isn't it, being a parent."* ***P23 SMP***

"He struggled, we struggled quite a bit with teething in those first few months. It was really hard work and I was battling those days." ***P28 IP-SMP***

In addition to infant temperament being influenced by teething as discussed in section 6.3, refusal with toothbrushing also occurred during periods of illness, if a child was strong-willed in wanting to do the behaviour themselves, or because of possible sensory issues.

"Initially <Baby> was good at having his teeth brushed, quite liked it. Then we went through a phase for a couple of months when he was poorly / teething and generally unhappy…and was having none of it." ***P23 SMP***

"Could you tell me how concentete [sic] *baby to clean tooth, because growing and he wants himself to do it, but 3 seconds and he finish cleaning."* ***P10 SMP***

"They'd see the toothbrush and scream, throw themselves on the floor. Absolutely terrified of it! Hated it! I dreaded doing it." ***P43 SMP***

Mothers who did not experience as many problems with toothbrushing refusal, attributed it to their child's personality being easy or relaxed, or their own ability to enforce their will.

"I thought they'd be more issues and I'd struggle a bit more than I did. I think it all comes back to the child." ***P19 SMP***

"I just used to pin her down, yeah. And she used to scream and we probably didn't do it for long enough but we did it enough to like touch every tooth and make sure they'd all had a bit of a brush and like I said, now it is not a battle." ***P33 IP***

When mothers found carrying out oral health behaviours challenging, some partners did not take on a supportive role and did not share the responsibility of their infant's oral health.

"I mean, his Dad has brushed his teeth once? Maybe?" ***P30 IP***

"With her being registered with <husband>'s surgery, I kind of, almost saying, if she's got an appointment, you can take her? So, just to kind of help." ***P37 SMP***

The mothers with unsupportive partners reflected this was due to their partner's own attitudes towards oral health and dental visiting; some either just being unhelpful or avoiding entirely.

"He maybe doesn't listen to what I'm saying? We've had the discussion about how much toothpaste to put on and I'm showing him the picture that you've given about how much toothpaste to put on and yet we always have this HUGE amount of toothpaste on the entire toothbrush every time he gives it to him!" ***P28 IP-SMP***

"He hasn't been to the dentist for the whole time I've known him, so that's ten years. He's got an absolute fear so I've managed…I was like, 'I'll go with you, it's fine, I'll go.' And he was like, 'ok.' And he never booked anywhere." ***P29 IP-SMP***

In some cases, this conflict of attitudes caused friction with their partners, especially with mothers who felt like they knew what was best for their infants due to researching the most up-to-date information rather than relying on anecdote or opinion.

"Yeah…um, so, <husband> will have his ideals from his childhood and also, his parents will have their ideals from what they did for their children and things have changed so much, haven't they, over decades […] They're not educated. They don't read research." ***P37 SMP***

Having a supportive partner was crucial for periods of difficulty, especially to help maintain toothbrushing in particular.

"He's actually much better than me at getting her to brush her teeth. I don't know why! He just like gets her to straddle him and he opens his mouth as well? I don't know! He just like mesmerises her." ***P22 IP***

Grandparents were also either supportive or not to oral health behaviours, particularly around introducing sugary foods.

"'These are plain [biscuits].*' I was like, 'grandma, they're caramel and covered in chocolate!' She was like, 'they're the plainest option I've got!' and I was like, 'he doesn't need them.' So she fed him two!" P30 IP*

Mum wanted to give baby toothbrush to chew on. I said that would be fine and good to get her used to it even before teeth […] Mum was very happy with this because she had asked her own mum for advice and she had discounted the idea saying it was too early to get a toothbrush. NT reflections on meeting P16 IP-SMP

"She's over here twice a week, or is it three times? She's, um, she does intermittently say, 'shouldn't you introduce sugar to him?' […] bless my mum, I'm not sure she got it right. It was the 70's. 70's and 80's so sugar ahoy! And processed food ahoy! You know? And I had fillings." P38 IP-SMP

This finding was also found in the control group mothers who either had supportive or unhelpful partners, and either unhelpful or supportive grandparents. This either made maintaining their oral health goals easier or harder.

"When we went to a friend's...we'd said...don't really want her having anything with refined sugar...they then brought out the birthday cake and <baby> pointed and said, 'cake' and we were like, 'how do you know that word? Because we've never taught you that word?' and she doesn't go to nursery or anything...And I was like, 'who gives you cake, <name>?' 'Grandma.'" ***P39 C***

"Um, but yeah, well he's quite good with them, with both sort of get them to brush their teeth. […] I know he'll do the kid's teeth if I'm like busy or at work or something, he'll do them." ***P21 C***

An occasion when a mother was finding it difficult managing other friend's and family's opinions about her infant feeding choices around the time of weaning, reflected on the emotional impact, and how the social messaging group helped counter feelings of loneliness.

"Really, really hard, and it's still happening now. Um, but I know what's best for her and also sort of for her needs along with her dental care as well. So having your support and advice and the group's support and advice, I don't feel so alone? In all of those elements. It all kind of dovetails together really. So really helpful." ***P37 SMP***

In the wider social environment, some mothers discussed how they had to navigate challenges to maintaining oral health due to the influences of childcare settings, baby groups and marketing of baby foods. All of these influences centred around sugar with some mothers feeling that the battle against sugar was futile.

"I think you just need to be realistic, and that's like, he's only 15 months old and it's already been proven I can't control what he does and doesn't eat." ***P25 SMP***

"So, they didn't have any sugar for the first year. Um, and then they started nursery and they do put sugar in stuff at nursery. They give them cake. They have jelly, chocolate delight - whatever that is! I just see it when it comes home in their sheets." ***P43 SMP***

> *"Because you don't know what you're dealing with, you're just at the mercy of people marketing."* ***P38 IP-SMP***

A non-English mother described how she felt this country was full of sweets and cakes which makes it impossible to fight against. Equally, living in coastal towns where there is an excessive amount of ice-cream made dietary decision-making more difficult.

> *"In England, there is a lot of sweets and a lot of cakes and, I think even if you try not to have too much of it, it's really tempting everywhere, sugar everywhere."* ***P40 IP***

> *"I think we'll just try and limit the sugar as much as possible. Um, but, I mean, it's inevitable, if, you know, he literally, if he sees an icecream, he's like… you know…Well, we tried."* ***P29 IP-SMP***

Some mothers also said they found it a challenge being around friends who may have different behaviours to them, particularly around feeding their infants sugar, or if their child became challenging around sugary foods.

> *"There was a narrow miss at a friend's house because she bought us lovely salted caramel cake […] and proceeded to break off bits and feed it to her son. And I thought, 'oh no! I've got to avoid this'"* ***P38 IP-SMP***

> *"One of the girls madly invited us all to her house so there was 8 or 9 mums and babies. She put on a cream tea for all of us. […] All the other kids were fine. It was just <Child> throwing himself on the floor because he couldn't eat another crisp, or another…or he wanted all the adult cakes as well."* ***P36 IP-SMP***

For some of the mothers, they themselves became a positive external influence for their friends and family, sharing information they had learned from the intervention into the wider community.

> *"I've talked about what we've talked about, and yeah, so I've already shared with them, 'Saw Nicole the other day and we talked about this and this!'"* ***P41 IP***

> *"It's just been interesting because a few of my friends actually, have come to me now when they've got questions about teeth! Because usually, it's the same stuff that we've been talking about, so, you know, 'when do I brush their teeth?' 'how frequently do I do it?' 'where do I register with a dentist?' 'what happens if I can't get the brush in? Do I force it? Do I stop?' You know, 'what are we feeding them?' Just loads of questions that we've covered in the Whatsapp group."* ***P25 SMP***

Outside of the impact of relationships and the wider social environment, one mother described how the lay-out of her house hindered her ability to be able to remember to clean her infant's teeth in the morning.

> *"We've got a downstairs bathroom […] It's just easily… I find it's easily forgotten […] he's straight into the kitchen; you kind of just end up, you know, getting into your morning and I just think, 'oh I haven't brushed his teeth.'"* ***P41 IP***

6.5 Findings Summary

The intervention overall did not impact general self-efficacy. Mothers with the IP-SMP engagement approach were significantly more confident in carrying out future oral health behaviours for their infants compared to the control group. However, mothers with this engagement approach predominantly used the social messaging group and did not arrange an in-person meeting.

There was a trend of reduced self-efficacy during periods of infant milestones starting from the age of four months old. This included the emergence of primary teeth. Reductions in self-efficacy led to increased need for regularity of reassurance.

Joining the intervention prior to the emergence of primary teeth encouraged uptake of toothbrushing immediately once primary teeth appeared, sometimes before, and brushing after the last feed at night. Mothers who had already established feeding to sleep routines did not feel capable of altering the routine. This was due to mothers prioritising sleep over oral health behaviours, particularly during difficult periods of teething.

How mothers responded to their infant's teething experience was a new oral health behaviour supported in this intervention. This was to encourage maintenance of oral health behaviours. Mothers did not want to set up aversions to toothbrushing if their child was refusing to have their teeth brushed, particularly if they themselves identified as a 'gentle parent'. Mothers therefore appreciated alternatives to 'best practice' during periods of difficulty brushing their infant's teeth. Mothers also needed reassurance about not causing their infants distress when there was perceived pain associated with brushing their infant's teeth during teething.

Mothers felt avoiding sugar with their infants was unattainable. Mothers had concerns about their child's ability to regulate eating sugar in the future and therefore had a relaxed view to introducing sugar into their infant's diet. Mothers felt marketing around sugary foods and sippy cups was confusing along with misinformation about dental visiting, which impacted their oral health decision-making. Secondary carers, grandparents, friends, childcare settings and geographical location all impacted self-efficacy and oral health decision making, especially when related to feeding choices, sugar and dental visiting.

6.6 Emerging Theory

In the literature review presented in Chapter Three, behaviour change theories and models were introduced, with evidence suggesting the existence of a synergistic relationship

between self-efficacy and oral health literacy. According to these theories, an individual's belief and attitudes towards the behaviour and risk, how this corresponds with the attitudes and beliefs of their social networks and the subsequent willingness and intentions to comply, determines oral health behaviours. This study gave some insight into which areas of oral health information mothers found challenging, or not. This study also showed how levels of self-efficacy facilitated them being able to obtain, process and understand oral health messages whilst navigating their wider social environment. However, the findings in this study also suggest that other non-conscious processes and affective states may have impacted behaviours and played a more prominent role than self-efficacy. These include shame resilience, fear of regret, fear of disappointment and fear about the implications for the future.

Although there is evidence within the data, the framework used in this study was only concerned with social-cognitive determinants including beliefs, attitudes and self-efficacy. Therefore, how affective states motivated oral health decision-making was not reported explicitly within the findings. However, because affective states appeared to play a prominent role in the uptake and maintenance of the oral health behaviours described in this study, along with how the mothers engaged with other oral health services, affective states and oral health decision-making will be discussed as an emerging theory in the final chapter.

7.0 Chapter Seven: Discussion

The research questions of this PhD related to the feasibility, acceptability and effectiveness of a multi-component oral health education intervention, testing three different engagement approaches, including a social messaging component. The study aimed to work with family support services to act as gatekeepers, referring vulnerable primary caregivers with infants under 12 months old to the intervention. The intervention explored the use of different engagement approaches to support self-efficacy in the uptake of five key oral health behaviours.

The intervention study used mixed methods in a convergent design (see Appendix F). The feasibility, acceptability and effectiveness findings of the study were reported separately. However, all the findings were closely interlinked and will therefore be discussed in this chapter by merging the findings.

This chapter will begin discussing the key findings which add to the existing literature, such as the new oral health behaviour described in section 6.3. This appears to be the first definition of teething response as a possible new oral health behaviour. This finding was discovered through the novel use of two-way text messaging and a social messaging group oral health intervention engagement approach. Supporting mothers with this behaviour enhanced the acceptability and effectiveness of the intervention. Therefore, it appears this study has identified new insight into the impact of teething on maternal behaviours towards their infant's oral health. This also links to the optimal timing for providing professional oral health support.

The engagement approaches and the impact on self-efficacy, which interlink with acceptability findings, will be discussed next, starting with the two-way text messaging and

social messaging group components. Attention will be paid to the optimal timing for delivery of an oral health education intervention, the need for a family-centred component, the importance for caregivers to trust in oral health expertise, and reasons for healthcare avoidance. Finally, the chapter will discuss the strengths and limitations of the intervention study. This will include critical reflections on the feasibility of the processes of the study, such as the methods used for recruitment and the methods used for evaluating the intervention.

7.1 Teething Response

Previous studies on teething prevalence have shown symptoms of teething may affect a large percentage (68%; n=1000) of infants (Noor-Mohammed and Basha 2012) which include fever and stomach upsets. There is limited literature investigating direct links between teething and infant oral health. However, there are studies which indicate towards it. Child temperament has been previously described as a major barrier to toothbrushing (Amin and Harrison 2008, Miller et al., 2010), merging the incidence of teething with refusal of oral health habits (Elison et al., 2014, Duijster et al., 2015), increasing the risk for early childhood caries (Spitz et al., 2006). This study builds upon this evidence by demonstrating that the impacted oral health habits were toothbrushing, night-time infant feeding practices (both breastfeeding and bottle feeding), and healthy eating (both mother and infant).

In this study, a new oral health behaviour termed as 'teething response' was reported. Teething response related to how some mothers reacted if their infants showed distress, pain or illness during the emergence of their primary teeth. This typically started from four months old and remained throughout the intervention. Sleep was severely disrupted along with the infants experiencing severe discomfort when their teeth were brushed during active phases of tooth eruption. Providing a definition can assist future studies to report on the direct

impact of parental oral health behaviours hindered by teething. Therefore, teething response can be defined as:

> *Changes in caregiver oral health behaviour and oral health decision-making due to infant distress and sleep disturbance caused by the emergence of primary teeth.*

Due to the lack of evidence which shows any clear correlation between teething and other ailments such as spikes in temperature and stomach upsets, teething is often dismissed as a minor inconvenience by healthcare professionals (Ashley 2001). Although the study was not designed to address the issue of teething, using a compassionate engagement approach meant I was sensitive to the challenges associated with teething. As described in section 1.1, prioritisation of emotional wellbeing whilst not being a detriment to oral health behaviours was an approach I valued. Mothers reported issues associated with teething and difficulty carrying out oral health behaviours were not routinely discussed with their already available healthcare professionals. Therefore, this intervention appeared to bridge that gap for this group of mothers which impacted the findings of this study. Whether this gap in oral health support between early years services and caregivers exists in the wider population warrants further investigation.

As described by Greene (2014), parents can often feel there are only two options when faced with challenging behaviour with their children: enforce their will or to give up all expectations, which often occurs with oral health practices (Greene 2014). One mother in this study discussed how they enforced their will by physically restraining their infant to clean their teeth during periods of refusal. For most of the mothers, it appeared this approach was in direct conflict with their identity as a 'gentle parent' and they were compelled to avoid that

behaviour. In particular, mothers felt reluctant to maintain toothbrushing if their child showed distress, pain or were unwell. For some mothers, periods of teething was relentless, with infants seemingly being in great discomfort for weeks on end, which severely impacted sleep. This affected mothers' confidence, motivation and intentions to maintain oral health behaviours and shifted behaviour prioritisation towards maintaining sleep and emotional wellbeing for both their infants and themselves. It is therefore plausible that when a teething response alters a mother's priority towards sleep and emotional wellbeing and away from oral health behaviours, risk of early childhood decay is increased. This may be particularly so for mothers who identify themselves as a 'gentle parent'. Supporting mothers with how they can overcome oral health behaviour barriers based on how they respond to their infant's temperament is an emerging subject in the literature (de Jong-Lenters et al., 2019). Further research is needed to see if teething response is an oral health behaviour and whether it increases dental disease risk in infants.

Due to the limited number of primary caregivers in this study, the findings cannot be used to explore the relevance of the results across different populations. The majority of mothers in this study were aged 35-44 years old and were not from diverse ethnic backgrounds. Age and other socio-demographic characteristics have been shown to influence oral health knowledge and priorities (Williams et al., 2002, Ashkanani and Al-Sane 2013). It is therefore possible that the teething response demonstrated in this study may have been a unique occurrence in this particular group of mothers. However, the evidence presented in this study suggests teething response is an important consideration when planning future oral health education interventions. In addition, the current advice for caregivers on dealing with teething is mainly focused on pain relief (NHS 2019). Within the continued professional development oral health module for health visitors (Institute of Health Visiting 2016), the impact of teething is given

very little attention. Including information in the training resource materials for early years services on how caregivers can overcome the challenges associated with teething to maintain oral health behaviours, is important. Targeting maintenance of toothbrushing and/or applications of appropriately fluoridated toothpaste during periods of increased night feeds and poor eating habits would benefit both infant oral health and maternal wellbeing, especially when supported compassionately. As shown in this study, the support for teething response was feasible, acceptable and effective especially when incorporating oral health education into a social messaging engagement approach. The use of two-way text messaging to offer reassurance about oral health behaviours during teething, whilst they are being tried and tested at home, warrants further investigation. In addition, the unique oral health-focused peer-to-peer support environment hosted by a social messaging group during teething, also warrants further testing.

7.2 Two-way text messaging and social messaging group support

Although there is an increase in interest in utilising text messaging in oral health, with literature reporting positive benefits (Borrelli et al., 2019, Lotto et al., 2020), this appears to be the first oral health education intervention study to utilise two-way text messaging to support mothers with their infant's oral health in the first year of their life. The literature also points out the importance of access to peer-to-peer oral health education, with research suggesting peer groups positively impact oral health behaviours (Sushanth et al., 2011, Vangipuram et al., 2016). This study also appears to be the first oral health education intervention study to support mothers using a social messaging group platform. This provided insight into the mechanisms involved in how and why the mothers engaged with the intervention and what made it impactful. Using a social messaging platform also created an

opportunity for an innovative way of measuring engagement. Whatsapp provided clues to when a user had blocked the number, as the profile photo of the person disappeared, and messages appeared undelivered. This provided an opportunity to observe periods of disengagement and re-engagement during the intervention which would have ordinarily gone unnoticed. An example of this was the mother who appeared to have blocked me on Whatsapp, but who subsequently saw me at a Children's Centre baby wellbeing session and then re-engaged via Whatsapp which was obvious from her profile photo reappearing, and messages being delivered.

Flexibility of choice in how the mothers accessed the intervention, increasing engagement and acceptability, was a key finding in this study and built upon findings from the pre-PhD study (Kay et al., 2019). Interestingly though, despite the in-person and social messaging engagement approach being the most acceptable, none of the mothers took up the option of an in-person meeting. This may have been due to the reported barriers of needing to think of questions ahead of time, or to be experiencing an issue at the time of an in-person meeting. Mothers appeared to view the in-person element as physical checking, as opposed to an opportunity to discuss potential issues. In this study, mothers reported feeling they were getting enough from the social messaging group, but still benefited from having the choice to meet up if they changed their minds or the circumstances warranted it. This has been reported elsewhere in the literature where parents valued in-person engagement but felt comfortable asking questions that were not urgent, or that they would feel hesitant to ask during face-face appointments, via text messaging (Palmer, 2019; Morris et al., 2021).

Based on these findings, it could be inferred the simplicity of two-way text messaging and group messaging including peer-to-peer support were key determinants to acceptability in

this oral health education intervention. Having the availability of a 'virtual' connection with health professionals is a low-resource way to deliver health interventions. This may be an acceptable adjunct to standard delivery of care and may even relieve some of the burdens of standard care, such as time and effort. Text messaging services designed to deliver early years services have shown good acceptability (Richardson et al., 2021) with mothers appreciating messages personalised to their circumstances (Broom et al., 2015). Parents from other mHealth studies have expressed wanting 'virtual' ways to connect with health professionals, not to replace in-person contact, but rather complement it (Backstrom et al., 2021; Action for Children, 2021).

However, it is important to discuss the possible mechanisms behind why acceptability may have been increased for the IP-SMP group of mothers, and why acceptability was not found with all mothers receiving this engagement approach.

What kind of mother an individual 'should' be is influenced by a number of complex social expectations based on characteristics, such as gender, race, class, religion, and may be imposed by friends, family, the healthcare community, the media and marketing (Brown 2006). Mothers who feel like they are 'failing' at motherhood find connecting with others who have had similar experiences is an effective support tool to build resilience to the feelings of shame and failure (Brown 2006). Peer-to-peer support encompasses many of the theories behind the self-determination theory such as choice, autonomy, self-efficacy and empowerment (van Uden-Kraan et al., 2008). It encompasses emotional and practical support through a mutually beneficial process of giving and receiving (Gidugu et al., 2015). In this study, mothers from the social messaging group expressed benefiting from sharing experiences and gaining reassurance about the oral health decisions they were making for

their infants. The mothers reported how the group was a 'healthy size', providing an environment where everybody was 'in the same boat', which was being carefully managed by an 'expert'. This finding of how peer support is beneficial, including expert-mediated virtual communities, is supported in the literature (van Uden-Kraan et al., 2008, Das and Faxvaag 2014, Jucks and Thon 2017, Ridings and Gefen 2017). In this study, having mothers who were more open to ask questions and disclose information about themselves set the tone of the social messaging group almost immediately. The social messaging group identity then evolved to become both mothers who needed regular reassurance and guidance, and were comfortable asking for it, and mothers who were grateful to them for asking the questions.

Reflecting further on the peer-to-peer support that evolved in the social messaging group, I provided encouragement to those who were more vocal and open with the struggles they were experiencing. I also reassured those who apologised for not being more active members and reinforced that the social messaging group was to be used how they felt most comfortable. This approach of allowing different roles to develop, which benefited all, may have also contributed to the acceptability of the engagement approach.

The social messaging group peer-led environment appeared to enhance the four stages of learning (Curtiss and Warren 1973). Questions asked by the more active users prompted those who were unaware of what they didn't know into being more consciously aware of their knowledge gaps. These conversations naturally led to further oral health discussions once information had been delivered. This not only facilitated learning at the time mothers most needed it, but also acted as a reference for mothers to refer back to when the time was more appropriate for them. Additionally, mothers were able to practice their skills and receive

further reassurance if needed and be given ideas on how to make adjustments with the aspects of the behaviour which did not work in their real-world situation. This allowed periods of trial and error and regular reassurance for mothers to ensure they were getting it right. This formed a very important part of the intervention. This correlates with the finding by Gajanan (2013), who described the importance of repeated reinforcement of the same information over a short space of time, to produce longer term benefits from the oral health education.

Literature suggests it is commonplace for virtual communities to contain both active and passive users, with both benefiting equally from the environment (Das and Faxvaag 2014). As shown in Table 7 (Chapter Five, section 5.4.4), the top three most active users of the social messaging group (based on their message count) were a multiparous mother with a household income of 0-19k and two primiparous mothers with a household income of over 100k. What appeared to connect the more active users of the social messaging group were their low levels of general self-efficacy but increased willingness to ask for regular reassurance. Figure 22 showed the SMP group mothers having a lower level of general self-efficacy in comparison to the other intervention arms. These same top three users of the social messaging group were in the SMP group. It could be suggested that these SMP group mothers showed shamed resilience (Brown 2006) in being able to show vulnerability in asking for help and honesty about the difficulties they were experiencing. A contrasting variance was also seen for those mothers who did not engage as fully with the intervention. One mother was recruited through the Family Nurse Partnership with a household income of 0-19k and classed as vulnerable, whereas the three other mothers were not part of the target demographic. What connected these mothers was their infants not experiencing any issues or an expressed confidence in their abilities to deal with challenges. It may be possible that

these mothers *were* experiencing issues but just did not feel comfortable or willing to discuss them due to appearing unknowledgeable and incompetent (Blanton et al., 2001). This is part of an emerging theory which is discussed in more detail in section 8.1.2, in the next chapter.

For those who seek to bridge knowledge gaps using online forums or discussion groups, there is a preference for groups which are expert-mediated to eradicate pseudoscience and to feel a sense of belonging within the group (van Uden-Kraan et al., 2008, Das and Faxvaag 2014, Jucks and Thon 2017, Ridings and Gefen 2017). For those who left the social messaging group, it is possible the group did not meet their attitudes, goals and motivations, or they felt they did not belong within the group due to not having similar experiences. This was expressed by one mother who found the timing of the intervention not acceptable as her infant was already 'too old' to benefit from the needs being expressed by others in the social messaging group. Lack of engagement with the social messaging group may have also been because of their personal self-identity as a virtual community user (Ridings and Gefen 2017) as some mothers described themselves as not being prolific users of social messaging groups in general. Unfortunately, these mothers did not leave feedback at the end of the intervention. Although it is possible they benefited from early group conversations and oral health information and support being given, their reason for disengagement can only be inferred to that of a lack of overall acceptability. This could be due to a preference for a different engagement approach or simply a lack of rapport with me.

Despite the mothers in this study being advised that support would be available between 7.30am to 9.30pm, Monday to Friday, the mothers often initiated support outside of this time. By analysing the time stamps from each social messaging group message, it was possible to see the social messaging group was most active between 6pm and 11pm. This time period

seemed to be most acceptable for the mothers in this study, especially for those who had returned to work. This may be interlinked with mothers prioritising sleep as the majority of mothers in the social messaging group were being supported with teething response. Some mothers in this study reported carrying out internet research which often occurred in the early hours of the morning. It is therefore plausible that support at this time of the day may have supported maternal wellbeing by alleviating worries prior to bedtime. Another likely explanation is that this time of evening is when their infants were being put to bed and therefore when mothers had free time to ask questions and get reassurance about their infant's oral health.

Further exploration into why this time period was most acceptable would have merit, to see whether it was unique to this particular group of mothers or whether the ideal timing of support is not only related to infant milestones, but also to time of day. In addition, further studies looking at the feasibility and acceptability of early years services providing oral health support outside of normal working hours may be beneficial. This may be using two-way text messaging or other forms of mOralHealth (mobile and wireless technologies in the support of oral health), to enhance access, flexibility of choice and engagement with oral health education initiatives.

7.3 General self-efficacy and optimal timing of oral health education

The levels of support the mothers needed varied between one off consultations to intensive support, which was mostly participant-led. This finding is similar to that found by Kay et al., (2019), who described how mothers valued ongoing support, with some requiring regular text messaging, whilst others felt they got what they needed from a single encounter. This also aligns with the local authority lead stakeholder input (section 4.3.3), which described three

types of service users; those who want one-off advice, those who want to seek advice online and those who want a more intensive support experience.

The statistical analyses carried out in this study showed no correlation between increases in general self-efficacy (GSE) and receiving the intervention. However, there was an interesting trend showing mothers' self-efficacy decreasing when their infants were between three and six months old. When viewed alongside the qualitative data, this infant age was significant to the mothers in this study and their receptivity to new oral health education information and support. Mothers reported this was due to this age corresponding with oral health infant milestones such as the emergence of primary teeth and weaning, but also sleep regression and challenges with teething which impacted their self-efficacy. This loss of self-efficacy around the three-to-six-month mark, occurred with mothers regardless of their vulnerability status. However, the small sample size means the results have to be viewed with caution as it cannot be applied to the general population of primary caregivers.

A previous study evaluating validated measurement tools for oral health quality of life determined that these tools cannot establish meaning and significance of small changes in the data (Locker and Allen 2007). This may also be the case for the validated GSE scale used in this study. It was of interest as to whether levels general self-efficacy impact behaviour. However, small changes of self-efficacy over time did not establish any meaning or significance to oral health behaviours or whether it had been directly impacted by the intervention. Using alternative measurement questions which explore self-efficacy specifically towards infant-focused oral behaviours (e.g., "Cleaning my child's teeth is a task I feel confident to carry out") may have elicited more meaningful findings related to the reported milestones (teething/sleep regression/weaning).

The literature currently states studies do not report the optimal time to deliver oral health interventions (George et al., 2019). However, when considering the teething response and the self-efficacy data, along with the time mothers reported feeling most receptive to new information, this study provides evidence that the ideal time to deliver an oral health education intervention may be from four months old. This has implications for healthcare teams and early years services in contact with primary caregivers during infancy, tasked with delivering oral health education as per the guidance from Public Health England (Public Health England 2021). Current guidance for 'proportionate universalism' means contact with caregivers at 3-4 months is at the discretion of the health teams (Institute of Health Visiting 2019) dependant on a needs assessment. Teething response is not currently seen as part of a needs assessment. However, a mother in this study stated how she felt it should come under mental wellbeing due to the impact it had. In addition, literature suggests mothers from a higher socio-economic status may return to employment sooner in the first year of their infant's life (Wallace et al., 2013). This may further reduce contact opportunities with new mothers. This also interlinks with the time-of-day mothers in this study engaged with the two-way text messaging and social messaging group due to returning to work. It could also be hypothesised that returning to work is also an additional factor in the observed reduction in self-efficacy around 3-6 months.

As described by Mattheus (2010), increased contact of community services with parents can help identify common factors which may increase their infants' vulnerability to oral disease. This includes the coping skills of caregivers. The four-month mark may therefore be an ideal checkpoint for health teams to make contact with caregivers to determine teething response and general confidence in ability to carry out oral health behaviours needed for their infants during prominent infant milestones and periods of difficulty. Therefore, factors which reduce

self-efficacy including teething response, could form part of the needs assessment for health teams to contact primary caregivers when their infants are four months old.

7.4 Family-Centred Oral Health Education

As discussed in the literature review, Bandura describes a theory of familial self-efficacy whereby the accumulative self-efficacy of the family to carry out behaviours has a positive overall effect on being able to deal with issues and overcome them (Bandura 2011). When discussing familial support during the interviews, mothers needed their partners to share their goals and ambitions, to feel respected in their decision-making, along with having joint responsibility for dental visiting and infant feeding. For those mothers without this supportive familial environment, behaviours were more difficult to maintain. Some mothers reported being perceived by their partners and loved ones as overbearing or controlling by enforcing their desires to breastfeed, not giving their infants sugar, and nagging about toothbrushing. The influence of lack of secondary carer support on oral health behaviours was not directly supported during the intervention. As discussed in section 6.4, 'External Affects', mothers described a number of influences which hindered oral health behaviours, most specifically with dietary sugar. For some mothers, they described fighting against 'sugar' as futile. This could be an explanation for mothers not directly seeking guidance with lack of secondary carer support, as the battle may have already felt lost or pointless, or they may not have wanted to further reinforce the perception of being 'controlling'.

As highlighted in the literature, those with a secondary caregiving role have less knowledge and involvement with infant oral health behaviours (Ashkanani and Al-Sane 2013). Grandparents with a direct involvement in the care and upbringing of the infants may increase risk of early childhood caries (Morita et al., 2019). In this study, grandparents were also

reported to be influential on oral health behaviours, either undermining or supporting the infant feeding goals of the parents. Although there are models within the literature which describe these familial influences on carer behaviour and infant oral health (Amin and Harrison 2008, Elison et al., 2014), there is a dearth of research looking at the behavioural drivers and intentions of secondary carers in carrying out oral health behaviours for their infants.

Family-centred care is already utilised in other areas of child healthcare and the strategy for implementation is described in the literature (Ridgway et al., 2020). Family-centred approaches may also have value in oral health education interventions. However, when and how a family-centred oral health education intervention is delivered may differ from interventions targeting the primary caregiver alone. Family-centred oral health education may be better suited during the antenatal period when typically both caregivers are present during education classes and could centre on the roles and responsibilities for both partners in caring for their infant's oral health. Further investigation into secondary carer confidence and ability to carry out oral health behaviours is warranted and should include investigating non-conventional family dynamics more commonplace today, such as blended families and same-gender relationships.

7.5 The how and why of infant toothbrushing

As described earlier in section 7.1, toothbrushing with appropriately fluoridated toothpaste was the most supported behaviour, particularly for mothers whose infants had challenging temperaments or had difficult teething experiences. As shown in the social messaging data (section 6.3), conversations on how to maintain toothbrushing dominated the chat with 75%

of the questions being asked relating to toothbrushing and the appropriate use of toothpaste (see Appendix N).

Supporting toothbrushing and the appropriate use of fluoridated toothpaste has been shown to have a greater impact on early childhood caries compared to other oral health behaviours (Kowash et al., 2000). Toothbrushing is a behaviour that requires a carer to supervise toothbrushing till the child is at least 7 years old (Public Health England 2021) and has been described as one of the most complex of oral health behaviours (Gray-Burrows et al., 2016). Parents wanting to know how to brush their infant's teeth as well as why, is reported in the literature (Amin and Harrison 2008). Resources used for early years services oral health training, such as Health Matters: Child Dental Health (Public Health England 2017), provides valuable information on *why* oral health behaviours are important in the prevention of dental disease. Yet, strategies for caregivers on *how* to carry out these behaviours in the presence of additional stressors, is not part of early years services' training, and is not extensively described in the literature. This study expanded on the barriers to mothers in carrying out oral health behaviours for their infants, including the drivers to oral health decision-making. This study therefore provided valuable insight into the complex relationship between parental identity ('gentle parent' described in section 7.1) that directly influences the child, and the temperament of the child that directly influences the parent ('Teething response' described in section 7.1). In having an understanding of the importance of this relationship, this intervention study increased knowledge (why) whilst also supporting the oral health behaviour by giving 'good enough' strategies (how) which impacted maternal self-efficacy.

Mothers in this study prioritised sleep routines over brushing last thing at night, with bath-times being the most popular time mothers built in a brushing habit with their infant. Not

only did this feel more acceptable in terms of 'gentle parenting' to make the habit fun, it also helped with routine setting and remembering to carry out the habit. With poor infant sleep patterns being linked to maternal depression (Sadeh et al., 2010), encouraging a bath-time toothbrushing habit instead of last thing at night may be more sustainable with additional benefits to maternal wellbeing.

Mothers valued knowing exactly when to start brushing, for how long and how to, should their infant be refusing to allow toothbrushing, along with navigating the vast amounts of choice in supermarkets. Throughout this intervention, the mothers needed regular reinforcement, support and reassurance, referring to the issues with oral health as specialist. Toothbrushing was viewed as very different compared to other tasks associated with caring for their infants; unlike potty training or introducing first foods, toothbrushing was *not* about teaching autonomy and was seen as ever-changing dependant on child development and temperament. Some mothers found brushing their infant's teeth highly stressful, especially when they were uncertain about not knowing what to do for the best (persevere or avoid). As previously addressed in section 7.1 regarding teething, the mothers in this study felt they had no-one expert to talk to about problems with toothbrushing outside of the intervention. Reasons given were due to it not feeling an important enough problem to ask for support from an already 'stretched' health professional. Prior to the intervention, or for those not receiving the intervention (control group), mothers sought information online.

Those who seek online advice and support prefer a single trustworthy expert source (Jucks and Thon 2017). Equally, significant protective factors to infant oral health have been found when mothers are able to maintain trust and rapport with a single primary health centre

instead of seeking information from multiple sources (Chaffee et al., 2013). Unfortunately, inconsistent messaging from healthcare providers can cause mothers to seek care from different healthcare settings (Chaffee et al., 2013) and impact oral health literacy (Amin and Harrison 2008). For mothers in this study, the oral health behaviour guidance they received, in-person or via social messaging, was made more acceptable knowing the advice and support was from a person with oral health expertise.

Despite a multi-disciplinary team being recommended to facilitate the regularity of support needed in the early years of life (Gray-Burrows et al., 2016), early years services and oral health education initiatives should take into account the regularity of support that some caregivers need from a single, trusted source of information. In addition, this support needs to work with the caregiver to form a habit that feels acceptable by corresponding with how they view themselves as a parent ('gentle parent'). However, as reported in the literature, non-dental healthcare professionals may lack the confidence in their own oral health expertise (Lewney et al., 2019, Weston et al., 2020). Therefore, not only should the regularity of support of caregivers in the early years of their infant's life be considered but also that of the healthcare professionals supporting them. Two-way text messaging enhanced the engagement of this intervention by making access to support more acceptable and feasible. Access to an oral health expert for early years services using the same delivery method may also need to be a serious consideration, to enhance the training on *how* caregivers can maintain toothbrushing during periods of difficulty and stress.

7.6 Healthcare avoidance

Loss of trust in healthcare service providers in vulnerable populations defined by their socioeconomic status (SES) have been associated with feelings of shame and with being

discredited or dismissed, triggering healthcare avoidance (Andrews et al., 2015). Distrust can be defined as "*feeling that something that is important does not feel safe with a person or situation*" which may include our identity and how we see ourselves (Feltman 2021). In this study, attention was paid within the data to how mothers interacted with their healthcare service providers. Mothers from the target population recruited in Ph1 expressed their distrust of healthcare professionals because of a perception that their skills as a parent were often bought into question due to their SES and their appearance. This distrust appeared to extend to their engagement with the intervention and may have influenced why mothers recruited in Ph1 were far less likely to engage with the intervention than mothers from Ph2. Other influences on engagement are discussed later in Section 7.8. Mothers seen in-person at the Children's Centre only spoke through their Children's Centre key worker and therefore key workers at Children's Centres may be viewed as a single trustworthy source of information, as described in the previous section 7.5. However, as expressed by a FNP family nurse, the teenage mothers they supported viewed Children's Centre workers with distrust and therefore did not engage with their services. Research into the role of trustworthiness and engagement with health services is a worthy area of study. This may also interlink with the emerging theory described in the next chapter.

The findings in this study correlated with evidence that suggests vulnerability from socioeconomic status is not necessarily causative of engagement issues and uptake of health behaviours (Vasiljevic et al., 2016). Mothers recruited from Ph2, who fulfilled less vulnerability criteria, also discussed losing trust in healthcare professionals, specifically health visitors, when a lack of compassion had been shown. These mothers experienced healthcare avoidance and decreased levels of self-efficacy because of feeling judged and blamed for their parental decisions. This was further compounded when their infants suffered from teething

or showed distress when carrying out oral health behaviours leading to further feelings of isolation. The findings in this study therefore also inferred another form of healthcare avoidance. Within the qualitative data, there appeared to be a correlation between mothers who were in the medical profession, or who had a close friend or family working in a medical field and having increased confidence about their abilities to look after their children's teeth. These mothers were recruited in Ph2 and therefore self-selected to take part. However, they did not see themselves as the target demographic and therefore did not engage fully with the intervention (and other health services). These mothers felt that it was common sense to brush their infant's teeth and to keep sugar to a minimum and therefore did not require information and support. One mother explicitly attributed her ability to restrict sugary foods being due to her educational level, expressing a belief, supported in the literature, that less educated mothers make poorer food decisions. However, it has also been shown in the literature, that regardless of parents restricting sugary foods with their 4–5-year-old children, overall consumption of sugars throughout the day were the same between parents who restricted intake and those who didn't (Liem et al., 2004).

In addition, these mothers reported that their infants did not present with problems such as teething and therefore they were not faced with any difficult events which challenged their identity and confidence in how to carry out these behaviours in the presence of obstacles. Another commonality were the mothers with increased confidence were part of the in-person only intervention delivery method. Having to think of questions prior to a meeting was described as a contributing factor to reducing the acceptability and engagement with the in-person intervention delivery method. It is therefore also possible that the lack of peer environment meant these mothers were not being prompted into an awareness of their knowledge gaps. This was an important feature of the social messaging group described in

section 7.2. This could have contributed to increased confidence and lack of engagement and could provide further argument for the benefit of incorporating peer-to-peer support and learning within oral health education initiatives.

The Prevention Paradox asserts that a large number of people at small risk may give rise to more cases of disease than a small number of people at high risk (Rose 1985). With high-risk groups making up a relatively small proportion of the population, oral health education initiatives need to reduce inequalities across the whole of society, not only for the worst off (Marmot 2019). Despite access to healthcare, social support, income and coping skills all being protective factors against oral health vulnerability (Mattheus 2010), it could be posited that a lack of, or loss of, trust in expertise could also reduce these protective factors, and may occur across a wide demographic of primary caregivers. Studying ways to build rapport to encourage engagement, universally across society and not just targeting the vulnerable, in addition to determining causes of distrust in healthcare professionals, seems important for the effectiveness of oral health initiatives in the prevention of early childhood caries.

7.7 Dental visiting, confusion around oral health messages and self-efficacy

As addressed in section 7.5, conflicting information from healthcare services can cause a decrease in oral health literacy. Maintaining a positive attitude to dental visiting required regular support in this intervention. This was especially so with mothers needing assistance navigating the conflicting information from both health teams and dental services on when to start taking their child for dental examinations. However, this support was undermined by the conflicting advice given by dental services.

With beliefs about risk being associated to intention and motivation (Ajzen and Madden 1986, Baum et al., 1997), this study supports findings which suggest conflicting messaging does

impact oral health behaviours, particularly dental visiting. Dental services giving conflicting advice about the Dental Check by One Initiative caused mixed messaging regarding risk to parents. It is plausible that the lack of urgency shown by dental professionals to see infants for examinations prior to one year old suggests the absence of risk, or lack of importance of primary teeth. As shown in the interview data, regardless of whether mothers did or did not receive intervention support with navigating the conflicting advice of dental services, mothers had reduced intention and motivation to visit the dentist with their infants. Mothers also reflected on friends being less motivated due to the unclear oral health messaging. Increasing awareness amongst dental teams, especially the gatekeepers (receptionists), regarding the Dental Check by One Initiative should be prioritised.

Intentions, motivations and self-efficacy around introducing sugar to their infants was also impacted by the confusion around what was 'sugar'. Mothers discussed 'fruit sugars' as bad for teeth as well as 'hidden sugars'. This created conflict with some mothers limiting their infants' fruit intake, or not giving fruit as a snack. It also created a sense of futility about limiting sugar with their children, especially if there was pressure from grandparents, if their friends were weaning differently, or if they lived near the seaside where ice-creams were part of everyday life. The NHS start4life initiative (NHS 2012), which provides advice and guidance on first foods for infants, states:

> *"Remember, babies don't need salt or sugar added to their food (or cooking water). Babies shouldn't eat salty foods as it isn't good for their kidneys and sugar can cause tooth decay."*

Providing more comprehensive information on sugar could deliver better oral health risk messaging to parents. This could in turn improve self-efficacy by giving parents a better

understanding of the risk associated with different sugars. Additionally, this may also impact motivation and intentions to adhere to a low-sugar diet for their infants. Including clearer information in governmental oral health guidance for parents is needed. Clearer knowledge dissemination regarding sugar could also be delivered during infant weaning sessions which occur around 6 months of age. In addition, evaluating the attitudinal impact of secondary care health providers using sugar as a treatment for hospitalised infants could also be investigated.

7.8 Limitations and critical reflections of the study

The current study design was adequate to answer the overall question of feasibility and acceptability. However, studies with larger and more diverse populations are required to explore the effectiveness of the intervention and generalisability of data.

7.8.1 Study Design

7.8.1.1 Critical Realism and Mixed Methods

A critical realism paradigm was used due to it being well positioned as an appropriate scientific approach to investigating the multiple complexities of child oral health and being well-matched with a mixed methods exploratory design.

A criticism of critical realism is that it can present with multiple theories to explain a set of data and the choice of one theory over another cannot be because it is alone consistent with the data (Cruickshank 2011). Alongside the challenges of mixing quantitative and qualitative data, particularly when it comes to reconciling any conflicting or antagonistic results, it can prove problematic for researchers to implement enough methods to deal with all the different types of bias that may present when choosing a critical realism, mixed methods approach (Almeida 2018).

A pragmatic approach could be more desirable as it is concerned with choosing a theory or practice which best fits the purpose of the desired outcome. However, by not being aware of multiple theories which a critical realism approach may help elicit, it may be difficult to understand why interventions weren't able to be effectively reproduced. These include the impact researchers themselves have on the design, delivery, and findings of a study. In this study, the critical lens in which I viewed the findings would have impacted the reporting of this PhD, which was discussed in section 1.1. I also critically reflect further how I may have impacted the outcomes in section 8.1.5.

Regardless of whether it is a single method study or a mixed method, quantitative models require adequate sample sizes to ensure reliability of the findings and it is without doubt that the small sample size in this study impacted the reliability of the results.

Many of the statistical models used to analyse engagement were unreliable and therefore not reported. Where statistical analyses were reported, it may have been an inaccurate representation of the findings, such as acceptability and effectiveness, due to very small sample. An example of this was the lack of reliability shown in the wide 95% confidence interval data range when looking at the phase mothers were recruited in and their subsequent engagement. However, as a feasibility study, the focus was not only on the intervention delivery approaches but also whether the analytical tools used to answer the research questions were feasible and adequate, and if a mixed methods methodology was appropriate. Interesting observations and trends *were* identified and therefore it was important not to discount the statistical analyses entirely. When viewed alongside the qualitative data and existing literature, these data still provided some key findings with

implications for policy and practice, which are explored further and discussed in the next chapter.

Refining the mixed methods analytical tools, such as the acceptability measurement questions would be beneficial due to being able to provide possible explanations to non-engagement, such as lack of understanding of the intervention purpose and lack of confidence in being able to carry out the tasks needed to participate. This is discussed further in section 7.8.4.

7.8.1.2 Randomised Controlled Design

Randomisation is used to reduce bias and provide a rigorous tool to examine cause–effect relationships between an intervention and outcome, but in order to be a reliable, randomised controlled trials need to be carried out robustly (Hariton and Locascio 2018).

Randomised controlled trials can fall short in monitoring bias due to the higher frequency of assessments that are taking place to measure a particular outcome and therefore do not replicate standard practice (Saturni et al., 2014). This can affect participant experience of the intervention due to the processes of the trial, which may impact the applicability of the results. This may have occurred in this study where participants were required to answer an intervention survey on three separate occasions, as well as take part in interviews at the end, particularly for mothers recruited in Ph1. This could also be seen as a limitation of using mixed methods for this study, instead of qualitative data alone.

Further possible influences the randomised controlled design had on the outcomes of the intervention are discussed in more detail in sections 7.8.3 and 8.1.3, including recruitment using family support services and the ethical considerations of using a randomised control design for this study.

7.8.2 Recruitment

This intervention was designed to support a vulnerable population of primary caregivers similar to those reported in the pre-PhD study, utilising the same recruitment method (Kay et al., 2019). In the pre-PhD study, working with the family nurses was key to gaining trust with and access to a particular hard-to-reach population. However, the recruitment and engagement findings in this study differed from those found in the pre-PhD study with only three mothers being recruited using referrals from family support services. This was due to a number of mediating factors which hindered the recruitment and engagement process and impacted the participant profile.

Using a project webpage for this study was hoped to facilitate the process by allowing healthcare services to share study information whilst still protecting identities and personal data of those information was shared with, and by giving the potential participant autonomy to take part. It was also hoped the healthcare services themselves would use the project webpage to inform themselves about the study. Most importantly, as explained in Chapter Four section 4.3.2.1, the project webpage was supported by the PPI to remove the potential stigma associated with being 'targeted'. Possible explanations for not utilising the webpage referral pathway may be due to not being familiar with, or not understanding the purpose of referring potential participants in this way. During Ph2 recruitment, the project webpage was viewed by potential participants who self-selected to take part. Although a previous study has suggested using social media for recruitment of vulnerable populations does not affect the sample composition, when reporting their data, vulnerable characteristics such as household income were not included in the analysis (Laws et al., 2016). This PhD study only recruited four out of forty-four mothers considered part of a vulnerable population by low income and/or being supported by additional family support services criteria. Both the failure for

healthcare services to refer to the study, along with participants self-selecting, considerably affected the overall demographic composition of the intervention. However, there were more mothers recruited in Ph2 who had issues with access to services due to living in remote areas of the Southwest UK. This may have also contributed to Ph2 mothers being 7.5 times more likely to engage with the intervention; self-selecting and for already experiencing difficulties in access.

Without the referrals from health services, it was required to change the operationalisation of the vulnerability status. Vulnerability was identified using household income and Index of Multiple Deprivation (IMD) data which was problematic. The inconsistencies between household income and IMD deprivation data made it difficult to identify vulnerable individuals using these criteria. For instance, some mothers were living in areas of least deprivation according to the IMD criteria but were in receipt of social welfare and living in local authority housing. In contrast, a mother living in an area of most deprivation had a household income of £40-59k. In addition, mothers recruited from Children's Centres located in areas of higher deprivation also did not meet the household income or IMD vulnerability criteria. This presents a real challenge for oral health intervention studies needing to identify and recruit high risk, vulnerable individuals without the use of healthcare services in the recruitment process.

In addition, mothers were asked about their access to early years services during recruitment (if they were recruited outside of a Children's Centre setting). This was a self-reported measure of vulnerability. Although the IMD data considers postcode and location of available services, within the literature accessibility has been reported as early years services not easily accessible due to inaccessible locations (eg., no direct bus routes), unavailability of services

in-person, significantly reduced mandated appointments, or parents not being aware of support or services (Action for Children, 2021, Bosley et al., 2021). Capturing this as a validated measure is difficult outside of the IMD data but is an important consideration when considering vulnerability status as opposed to replying on IMD data alone.

Only considering size of household in my reflections and not part of the vulnerability criteria alongside household income was a further limitation. Not directly measuring household size cannot accurately reflect the complexity of families of different sizes and incomes, and their resulting vulnerability.

Utilising healthcare services for recruitment is beneficial as they already having contact and trusted relationships with potential target populations (Kay et al., 2019). The reasons why healthcare providers do not identify and approach participants for studies are complex, with one study in the literature suggesting three interconnected factors: 1) protection of vulnerable people and of self; 2) institutional factors such as policies and practices; 3) research factors, such as a failure to see any beneficial outcomes (Williams 2020). The referrer's own oral health knowledge and prioritisation, not feeling like they have time, or not feeling it is their role to refer, may also be additional factors (Rabiei et al., 2012, Rose et al., 2021). Not feeling it appropriate to refer families to the intervention was the reason given by the family support service who withdraw from this intervention. This could be interpreted as the family support service wanting to protect the vulnerable families and themselves.

Recruitment is usually a three-step process that involves (1) initially identifying potential participants against inclusion and exclusion criteria, (2) approaching or contacting them about the study prior to (3) seeking their agreement to join the study (including obtaining their consent) (Preston et al., 2016). Looking at how many steps were needed using the gatekeeper

approach to recruit to this study shows it required a fourth and fifth step. This could provide a possible explanation as to why this recruitment approach was not feasible in this intervention study.

Utilising the Family Nurse Partnership added a fourth step to the standard three-step process; an administrator had to initially identify potential participants before informing the family nurses, who then decided whether the participants were suitable dependant on their life situations (see Figure 29).

This may have been hindered further as there were recommissioning processes being carried out amongst the healthcare services, delaying decision-making and increasing staff turnover. This led to new administrative staff not being familiar with the intervention study, or its purpose, and staff having more pressing priorities to address.

Looking at the Children's Centre recruitment approach, there were five steps in the process:

1) Children's Centre area managers have to inform the target Children Centre managers

2) Target Children's Centre managers inform key workers assigned to baby wellbeing clinics

3) Key workers to introduce or signpost potential participants

4) Study approaches potential participants

5) Study seeks agreement and consent to take part.

As described in this study, there was a failure of Children's Centre managers to inform key workers about my presence and purpose at the baby wellbeing clinics meaning the research strategy was hindered at step two. This led to attempting to engage with mothers in a busy and stressful location, with rapport and understanding the purpose of the project being

impacted. This is also a possible explanation for lack of engagement from Ph1 mothers in comparison to Ph2 mothers.

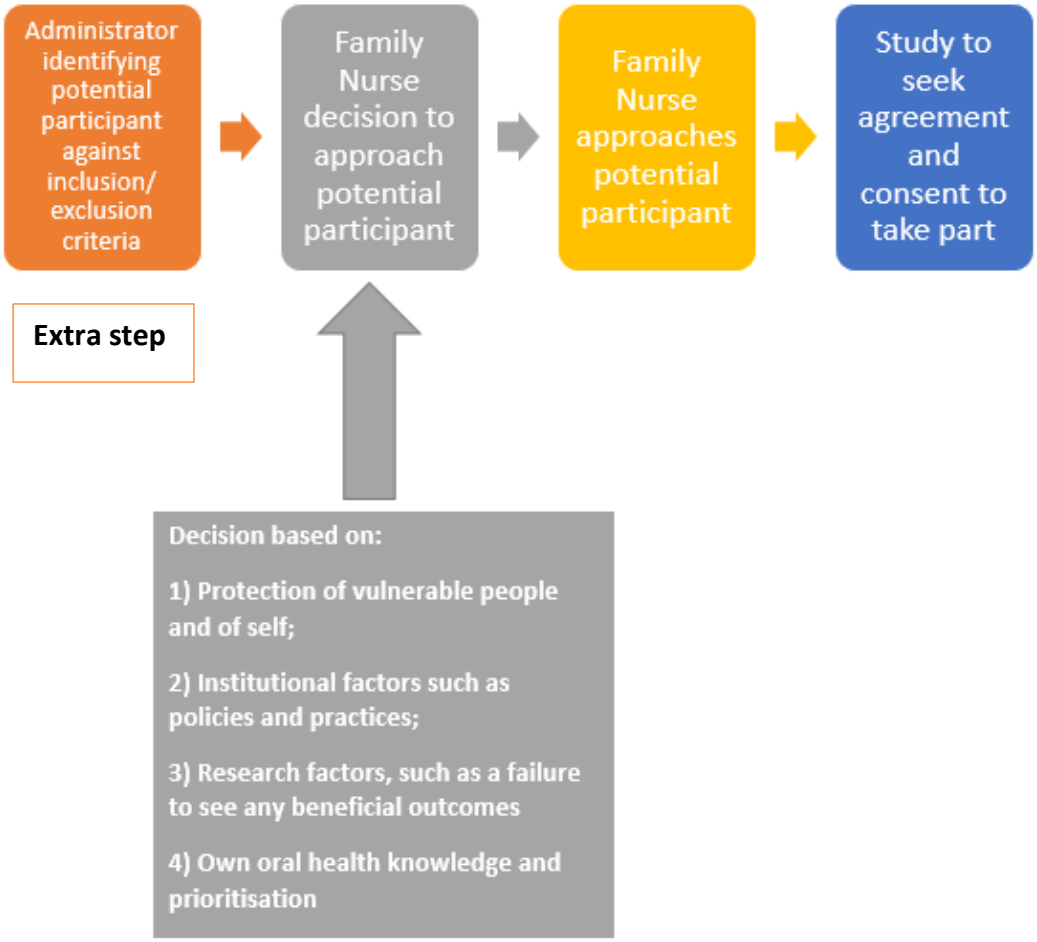


Figure 29: Conceptual model on the steps involved in using the Family Nurse Partnership to recruit participants, along with possible factors impacting their decision as described by Rabiei et al. (2012), Williams (2020), and Rose et al. (2021)

If recruitment approaches include utilising health services, careful consideration on how many steps are needed, and what the potential issues for each step might be should form part of the recruitment strategy. Recruitment of referrers could be considered, in the same way participants are recruited, with adverts describing the study and what is expected of the referrers. Support could be offered throughout the process to deal with issues regarding

acceptability of the recruitment approach, and/or self-efficacy in being able to refer eligible participants, particularly those from vulnerable populations.

If webpages or social platforms are used for recruitment, to ensure engagement with the target population, study adverts should be placed on the relevant social media platform. This is to counter the over representation of particular populations on social media (Pew Research Centre 2021), such as young white females on Facebook (Arigo et al., 2018). The use of community groups and peer leaders should also be considered to recruit and engage with vulnerable populations (Bonevski et al., 2014). In addition, the length of time needed, and the steps involved with community-based recruitment needs to be fully appreciated in order for engagement and the delivery of the intervention to not be hindered in anyway, especially if the person recruiting participants is also the person delivering the intervention (Bonevski et al., 2014).

Mothers with a mistrust of healthcare professionals, as found in some Ph1 mothers, may have benefited from seeing me more regularly at the baby wellbeing clinics, especially if a relationship was established with the key worker who was their trusted source of information. However, this was hindered by the recruitment approach failing at step two and due to cuts to services reducing the availability of baby wellbeing clinics. Having a recruitment manager, separate to the intervention facilitator, who could maintain the level of communication needed with the healthcare centres may have facilitated my delivery of the intervention and the relationships needed to build rapport with the more healthcare avoidant mothers.

7.8.3 Intervention Delivery

Keeping mothers to the engagement approach they had been assigned to was sometimes difficult and may have affected engagement and contributed to attrition. It may have also

contaminated the findings as those with an in-person component only, who still used text messaging to ask advice, were offered basic support whilst encouraging to meet in person. This was especially so for the engaged in-person mother who reported a high acceptability for the intervention, in comparison to those who did not text and did not meet in person.

A previous study looking at different intervention delivery methods used a Zelen double consent design (Plutzer and Spencer 2008) where mothers were able to switch trial arms once they had been allocated. This included control arm mothers switching to an intervention group. However, this is only suitable for large population studies due to the possibility of losing statistical power if there is significant attrition in a particular trial arm. The Zelen design is also usually reserved for research trials with ethical considerations such as cancer patients not receiving an intervention which could alter their health outcomes (Zelen 1979).

Possible ethical issues in this study which needed consideration were the control group mothers not receiving the intervention. Although this study followed guidance that control conditions should be comparable to real-world settings (Tunis et al., 2003, Russell et al., 2005, Zwarenstein 2009), as a dental healthcare professional, I felt an ethical obligation to answer oral health queries during the recruitment process which included control group mothers. This could have potentially contaminated the results. Control group mothers being recruited from the same Children's Centres as the intervention mothers could also have provided opportunity for contamination, especially as oral health knowledge was disseminated into the wider community by some of the intervention arm mothers. Although there were similarities and variances found within the control group, and non-parametric analyses finding significant differences in oral health confidence, the 45% attrition rate made control group comparisons to the intervention unreliable.

For larger oral health education intervention studies, using a randomised double consent Zelen design (Zelen 1979) without a control group may provide valuable insight into how participants prefer to engage with oral health education and support. A control arm could be separately recruited to ensure statistical power as a valuable comparator to the intervention, which would also eradicate the potential for contamination.

7.8.4 Measurement Tools

The Theoretical Framework of Acceptability (TFA) (Sekhon et al., 2017) was a useful analytical tool which provided insight into both quantitative and qualitative prospective, concurrent and retrospective data. However, due to the lack of reliability shown by the homogeneity test, the data relating to the construct 'burden' needed to be removed from the analysis. This meant a key component of acceptability was missing from the findings. The lack of heterogeneity could be attributed to ambiguity over the direction of the 0-100 scale. All constructs were given a 0-100 scale, with 0 being negative and 100 being positive. However, with 'burden' a low score usually denotes low effort, therefore having 0 meaning 'Excessive effort' and 100 as 'No effort' may have caused comprehension errors.

Using the TFA in this study did help to understand how flexibility of choice, expertise, and trust were of paramount importance to the mothers in this study. Understanding possible behavioural mechanisms which may have influenced behaviour to help interpret the effectiveness of interventions is important (Patey et al., 2018) and therefore further development of a validated acceptability survey is warranted and should be pursued.

The General Self Efficacy Scale was chosen as a validated measurement tool. However, as discussed in both the literature review and the findings from this study, many mediating factors exist which may alter self-efficacy on a daily basis. Therefore, using a general

measurement scale, at three points in time, was not have been effective in showing changes of any clinical significance. Although there are task-orientated oral self-efficacy scales that have been developed in adults and cancer patients (Soutome et al., 2011, Ohara et al., 2017, Matsuda et al., 2020), and oral health related self-efficacy in low-income African American mothers (Finlayson et al., 2005), there are no standardised parental oral health self-efficacy questionnaires. The development and validation of such a measurement tool would be beneficial due to the literature supporting the relationship between self-efficacy and parental oral health behaviours.

Despite the limitations to this study, the research design using mixed methods for measuring self-efficacy provided insight into the optimal time for delivering an oral health education intervention in the first year of life. Mixed methods for measuring acceptability also provided deeper insight into the mechanisms which may exist which hinder or facilitate uptake of oral health behaviours outside of self-efficacy. An emerging theory of the possible importance of emotional drivers to behaviour uptake, either working in conjunction with self-efficacy or as a pathway to self-efficacy will now be discussed in the next chapter.

8.0 Chapter eight: emerging theory and conclusion of PhD

This chapter introduces an emerging theory, outlined in section 6.6, relating to affective (emotional) states and how these emotional drivers may precede and be more important to oral health decision-making than beliefs, such as self-efficacy. This theory is based on a critical reflection on the findings from this study and a survey of the literature. This will be discussed first before the final conclusion of this PhD thesis is drawn. Recommendations for future practice and policy are summarised into a conceptual model towards the end of the chapter. In addition, a model for the ideal components of a social messaging group intervention delivery method is provided.

8.1 Emerging theory: affective states and oral health decision-making

Different emotions can illicit different behaviours (Marcatto and Ferrante 2008) and contribute to and influence health decision-making and outcomes (Ferrer and Mendes 2018). If affective states do have a primary function in oral health behaviours, this may have implications for how we support, not only the caregivers, but also the healthcare providers tasked with educating caregivers with their infant's oral health. Having a better understanding of how affective states and non-conscious processes hinder or facilitate oral health decision-making may change the focus of oral health promotion. This would be towards one that promotes positive emotional outcomes when carrying out behaviours instead of the confusion which has been found to occur with fear-based health promotion (Dodds and Chamberlain 2017).

As shown in this study, emotional drivers were present in the decision-making of the mothers. This was seen when exploring motivations for taking part and when supporting the oral health

behaviours of this intervention. This was particularly pertinent during teething response and dietary decision-making. With emotions being integral to cognitive processes which lead to learning, memory and actions (Tyng et al., 2017), it could be argued that focusing on affective states to encourage and overcome oral health behavioural challenges should be prioritised. This could work in unison with the already well-established behavioural theories, such as self-efficacy.

8.1.1 Affective states and engagement

Mothers reported a number of emotions relating to motivations for taking part and remaining engaged with the intervention. Motivating emotions were generally grounded in fear; fear of regret and disappointment and fear of failure or getting it wrong. Emotions relating to acceptability were based on feelings of safety and trust. This applied to both trust in themselves to be able to make the right decision, and healthcare professionals to offer compassionate evidence-based advice. As discussed in the findings reported in Chapter Five section 5.5.3 (pages 115-16), mothers who had experienced shaming or lack of compassion from their health visiting team, disengaged with the service and sought health information elsewhere. Other mothers, more difficult to engage with at the Children's Centres and those described in the pre-PhD study (Kay et al., 2019) had already established relationships built on trust with key healthcare workers.

Mothers discussed reasons for not seeking oral health support outside of the intervention was due to healthcare services already being stretched and referred to their enquiries, or requests for reassurance as 'silly'. The social messaging group delivery method was a 'safe' place to talk over these concerns with peers experiencing similar issues. The mothers in the social messaging group expressed talking freely without worrying about being made to feel

'stupid'. The reassurance was often related to alleviating fear of failure or fear of regret, in not being able to undo harm they may unwittingly cause their infant or 'ruining the prospect of good teeth'. This caused great confusion and anxiety over oral health decisions especially for those with infants experiencing teething symptoms. Giving the mothers alternatives such as using toothpaste around the teeth last thing at night if their infant was experiencing distress and pain when having their primary teeth brushed, facilitated self-efficacy by alleviating the fear of regret or failure. In addition to this, the peer support environment on the social messaging group regularly celebrated mothers with their oral health behaviour triumphs, such as returning to toothbrushing twice a day after a particularly difficult period of teething. It is plausible that the reinforcement of maternal wellbeing was facilitated by encouraging positive emotions such as pride as well as alleviating confusion and fear, which in turn increased the acceptability, engagement and uptake of behaviours. This could also be extended to the importance of flexibility of choice. Mothers knowing they had less barriers to access help and support relieved fear of being isolated and lonely when they had no-one to talk to about the issues they were experiencing.

How and why people seek health information varies greatly (Lambert and Loiselle 2007) with mothers who actively seek health information being more likely to be engaged with health promotion practices, rather than just illness prevention (Roden 2003). The literature suggests some mothers would also rather stay ignorant to their knowledge gaps as uncertainty may challenge valued beliefs about the self as knowledgeable and competent (Blanton et al., 2001) than seek information at all. This interlinks with how shame identities felt by mothers may lead to avoidance (Frank 2002, Brown 2006, Dolezal and Lyons 2017). Mothers may resist being shown to be lacking in knowledge and competence, or how their behaviours may be negatively impacting their infants, as this may affect how they feel about themselves, or how

they feel they are being perceived as a mother. This could be inferred by the variance seen in one mother who *was* a medical professional recruited in Ph2, but who did *not* claim the same level of confidence found in the other medically connected mothers in this study. This mother had seen the effect of poor oral health in children in her working life and was motivated to learn more to prevent poor oral health in her infant and avoid feeling 'bad' about herself as a mother. Other instances, as described in the Chapter Five findings, were a mother expressing how she couldn't trust healthcare services not to make assumptions on her abilities as a mother because of her appearance, and another feeling 'ashamed' and 'selfish' about using a pacifier and the judgement she would receive in public. As a result, both of these mothers' behaviours were significantly impacted by either avoiding healthcare services unless in an emergency or organising the day so to avoid leaving the house when the infant was napping so they wouldn't be seen using a dummy.

8.1.2 Affective states and healthy eating

Literature suggests that emotions regulate food choices as well as food choices impacting emotions (Macht 2008). Mothers in this study were often conflicted with providing their infants enjoyment from eating sugary foods or allowing grandparents to experience the positive exchange of giving 'treats' versus oral health behaviours. This reward-based attitude has been shown to impact the consumption of sugary foods (Alonso-Alonso et al., 2015). In this study, some mothers expressed how they rewarded their infants but within reason or were able to find a 'healthy balance'. However, this was purely subjective.

An interesting finding in this study was mothers perceiving their infant's dislike for the taste of water, which was used to justify adding sweetness. This corresponds with another study which found caregivers gave into to their children's demands for juice believing it was because

they did not like the taste of 'plain water' (Amin and Harrison 2008). This also occurred alongside fear that their infant was not drinking enough fluid. In addition, there were fears that restricting sugar would only cause more dependency on it in later life.

Navigating health messages around food was extremely complicated, with the external environment being so influential on a mother's affective states and self-efficacy. Mothers who enforced their dietary wishes of low/no sugar on childcare settings or close family members felt perceived as controlling or 'one of those mothers' which was sometimes to the detriment of their wellbeing. Mothers who had experience of taking their infant into hospital were equally confused and fearful about the high sugar foods infants were being fed by the medical staff, with anxiety over the addictive potential of sugar with their infant.

8.1.3 Affective states of healthcare service providers

Depth of oral health knowledge, self-efficacy and affective attitudes have been shown to be a barrier to non-dental healthcare professionals tasked with delivering oral health education (Skeie et al., 2011, Lewney et al., 2019, Weston-Price et al., 2020, Eskytė et al., 2021). As discussed in Chapter Three section 3.1, dental healthcare professionals' compassion and willingness to provide support to families may be due to deeply held beliefs and attitudes, or beliefs about their individual ability to make a difference due to the failings of the wider healthcare system (Mouradian 2007, Threlfall et al., 2007, Aljafari et al., 2015). Healthcare professionals' compassion and willingness to provide oral health support may also be due to beliefs and affective attitudes about vulnerable populations (Skeie et al., 2011, Lewney et al., 2019). In this study, family nurses and family support workers did not feel it was appropriate to discuss the oral health intervention with certain families in crisis. It could be inferred that the most acceptable delivery model described in this thesis for supporting mothers (in-person

or via two-text messaging/social messaging group) could also be transferred to supporting early years services tasked with delivering oral health messages and would be a valuable area of future investigation.

8.1.4 Affective states and recruitment

As discussed in the previous chapter section 7.8.1, the steps needed for recruitment using existing healthcare services supporting vulnerable populations relies on the decisions made by healthcare professionals during the screening process (Rabiei et al., 2012, Williams 2020, Rose et al., 2021). In this study, decisions were attributed to challenges families were facing or not meeting the inclusion criteria. However, the differing research design may have also played a part in altering the family nurse's affective state. The FNP nurses referring to the pre-PhD study knew the mothers would be guaranteed support. Whereas, for this intervention study, the FNP nurses knew mothers could be randomised into a control group. This may have altered the motivation to refer to the study due to feelings of disappointment if their chosen vulnerable mother did not get additional intervention support. As also discussed in the previous chapter, identifying high risk populations without the referral from healthcare services is challenging and therefore integrating with existing health services is ideal. To what degree affective states impact health service decisions in referring vulnerable individuals to research trials and how research trials can facilitate this process by supporting the emotional drivers to decision-making warrants further attention.

8.1.5 Reflections on my affective states and decision-making

As reported in Chapter Five, when reflecting on recruitment and engagement, my decision-making and feelings relating to acceptability had foundations in affective states. For example, recruitment was challenging when I felt I had to make judgements about mothers

based on their appearance or deciding whether the age of the baby was appropriate for the intervention. Prior to attending Children's Centres to directly approach mothers for recruitment, I had to work through fears about rejection in order to remain objective and understand that it was not personal to me if mothers did not want to engage with me or the intervention. I also felt uncomfortable at the randomisation process as it was in conflict with my ethical obligations to mothers as a dental healthcare professional. I therefore gave oral health information to control group mothers during recruitment, if they asked specific oral health questions, which may have contaminated the findings.

Fears of rejection and failure were similar for delivering the intervention, when making contact with non-engaging mothers. It was important for me to not take disengagement personally, although it was at times concerning when mothers left the social messaging group, and often led me to reflect on whether I had been a contributing factor to their leaving. Engagement with mothers from the social messaging group or with a social messaging component also felt easier due to time and access which increased my feelings of success.

Key demographic information was also missing due to a number of mothers from Ph1 not completing the questionnaires, or only collecting household income at the end of the intervention. I acknowledge that this was partly because of discomfort at asking for personal information at the start of the intervention due to concerns it may cause participants to disengage with the intervention.

8.2 Conclusion of the PhD

The original protocol of this PhD (see Appendix A) included using a caries measurement outcome to test the effectiveness of the oral health education intervention. Initial informal

consultation with stakeholders made us aware of the challenges of availability and time for vulnerable families. Recruiting families in remote areas of the Southwest would mean them needing to travel to the dental clinic based in Plymouth with their infants or a calibrated examiner needing to travel to them. Both had considerable implications for resource and opportunity costs. Therefore, a digital examination method needed to be tested first for feasibility and accuracy of dental caries measurement. However, due to changes to the original protocol, an endpoint examination method was no longer needed.

The digital screening method was still tested for feasibility and accuracy for use in future research trials and to add to the literature regarding the validity of digital epidemiology. However, the findings of the digital method suggested that using full arch images to detect dental caries in infants was not feasible or accurate and would not have been the method of choice for caries measurement in this intervention.

At the time the literature review and study was conducted, research was only available up to 2018. Since then, further research has been carried out on the use of AI technology for the detection of childhood caries for at home surveillance, with early indications showing it to be an acceptable and feasible way for families to be involved in monitoring their child's oral health (Al-Jallad et al., 2022). In addition, another recent study has shown that even without the use of AI, mothers were able to accurately identify dental disease in their children from photographic assessments (Kale et al., 2019).

With such advances in AI and video technology, the advantages to using digital methods for both oral health research trials and dental epidemiology means research into a digital caries assessment method is still worthy of investigation. Resource costs and opportunity costs would be reduced, and blinding could be strengthened for both research trials and dental

epidemiology. In addition, benefits to creating digital archives would allow for greater scientific collaboration and provide opportunities for tracking population changes over time.

Despite best efforts to replicate the recruitment approach shown to be acceptable and effective in the pre-PhD study (Kay et al., 2019), this study was not able to demonstrate feasibility, acceptability or effectiveness in using existing healthcare services to recruit a vulnerable population. This had implications for the participant profile and outcomes of the study. In addition, not accounting for household size and the use of particular vulnerability measures may have introduced a bias which was difficult to rectify.

However, the use of a critical realism mixed methods approach, and critically reflecting on both the research methods and the study findings add new knowledge to the literature, with potential areas of future research, as well as considerations for early years services. These include:

- The optimal time for dissemination of key oral health education messages being from four months old, ideally being delivered during baby weaning sessions, which should include clarification on free sugars in infant foods
- Consideration for family-centred oral health support to be included in antenatal sessions to involve secondary carers and advise of the importance of their role in supporting their partner with oral health behaviours
- More opportunities for peer-to-peer support environments to facilitate oral health knowledge dissemination and guidance, provided in the early years of parenting, including social messaging groups.

- Developing a two-way text service to support both caregivers and early years services in *how* to maintain toothbrushing during periods of difficulty, as well as *why*, to improve effectiveness of oral health education messages.

- Consideration of 'teething response' as an oral health behaviour, which should be investigated as a potential early childhood caries risk factor, and considered for inclusion in clinical guidelines and health promotion material

- Consideration of trustworthiness and the impact on engagement with early years services and dental care providers when a lack of compassion is shown which could be included in clinical guidelines and oral health training material

- The investigation of the role of affective states in oral health decision-making and behaviour uptake, which may precede the development of self-efficacy.

8.2.1 Implications for research trials

Although using a critical realism mixed methods approach can be fraught with challenges, it is felt important to use a theoretical and philosophical approach which deals with the complexities of a particular health behaviour. Child oral health relies on a caregiver implementing and maintaining oral health behaviours. In addition, it relies on the caregiver acquiring adequate information to be able to implement the behaviour. This most importantly requires the healthcare system delivering the information to the understand the needs of the caregiver and for those delivering the oral health education to have expertise or have access to the expertise needed to disseminate the knowledge.

As discussed in the literature, the multiple ways in which infant-focused oral health behaviours can be impacted is well documented but is still not clearly understood. Using an

approach such as a critical realism mixed methods which allows for multiple theories, helps provide a depth of understanding which can produce new explanations to provide solutions to the complexities described above.

Therefore, having a good understanding and knowledge about mixed methods research is vital in order to merge the data in such a way as to create a deeper understanding of the problem and the potential solutions (Creswell and Clarke 2011).

The feasibility of family support services referring vulnerable populations to the intervention was not shown in this study. However, the acceptability and engagement findings demonstrated the importance of partnering with healthcare services in order to access vulnerable, high-risk populations. There are a number of key considerations needed to increase chances of success with this recruitment method, as shown in Figure 27.

Prior to partnering with a healthcare service, identifying how many steps it will add to the recruitment process, along with identifying key persons involved in the decision-making and the influences on those decisions, will highlight potential stumbling blocks to the recruitment process. One of these blocks may be the time needed to establish and maintain relationships with healthcare services, particularly if there are changes to administrative staff, or the person recruiting is the same person delivering the intervention. In addition, key contacts better positioned to refer vulnerable, high-risk populations, may be peer leaders and community groups, or healthcare models such as Community Interest Companies, independent of institutional healthcare services. Employing a recruitment coordinator to build and maintain key relationships with healthcare services and community groups will increase likelihood of success and alleviate the difficulties associated with recruiting and delivering an intervention simultaneously. However, this relies on the

agreement of research funders to increase resources available for study trials.

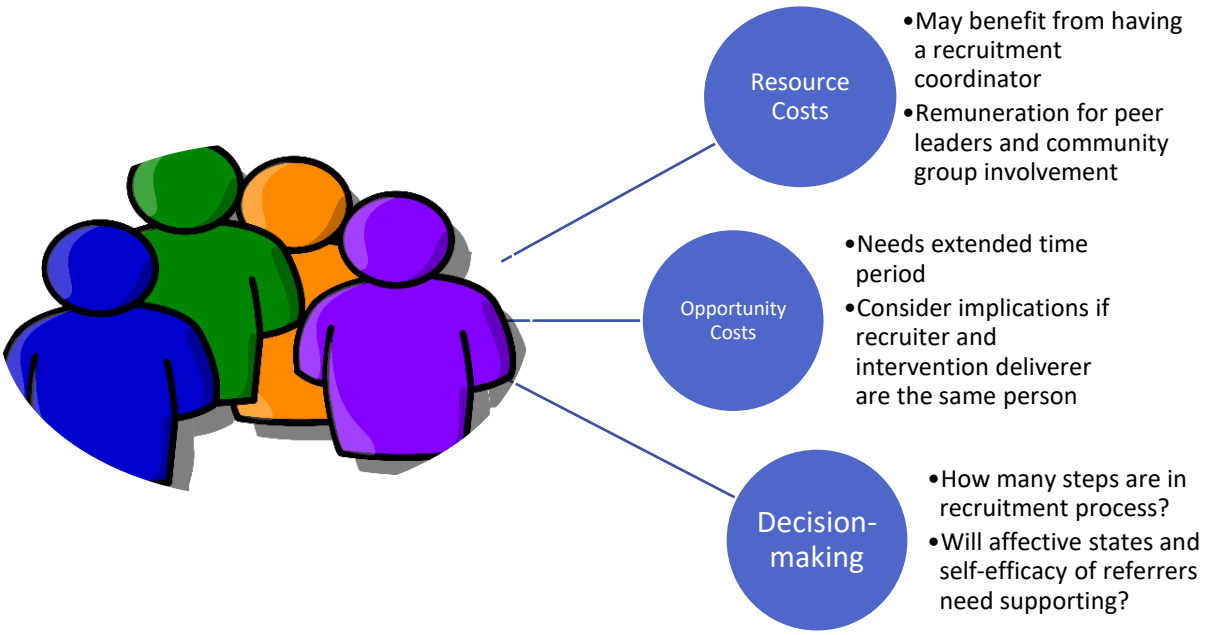


Figure 27: Key considerations for improving effectiveness of using healthcare services to recruit vulnerable populations to oral health interventions

As shown in this study, there are advantages to using social media for research recruitment, such as the significant decrease in resource and opportunity costs, and the snowball effect expanding reach. However, this method may be less appropriate if needing to target a particular population. The advertising and screening processes are therefore key in overcoming obstacles when using social media for recruiting a target cohort. Non-specific advertising to gain initial interest could be used prior to a more comprehensive screening process, alongside adverts with very specific inclusion criteria. Being mindful of social media demographics is also essential, as users differ in gender, age and culture/ethnicity depending on the platform (Pew Research Centre 2021). Figure 28 highlights considerations needed when using social media for recruiting high risk, vulnerable populations.

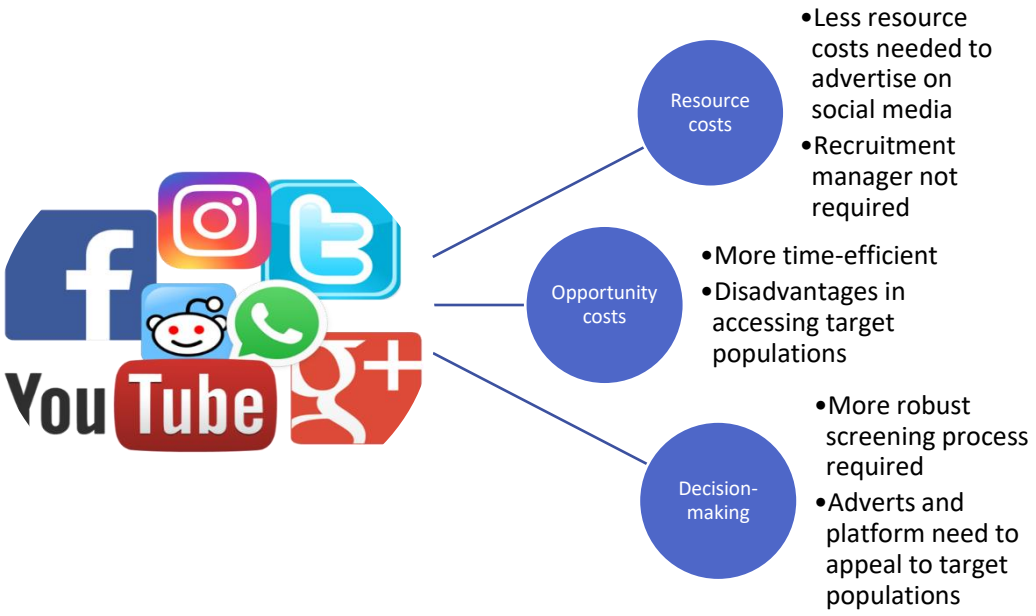


Figure 28: Key considerations for improving effectiveness of using social media to recruit vulnerable populations to oral health interventions

8.2.2 Implications for policy and practice

As part of the NICE guidance (NICE 2014), all early years services should include delivering advice about oral health as part of their parenting support initiatives. This is to ensure "*all frontline staff can help parents, carers and other family members understand how good oral health contributes to children's overall health, wellbeing and development*". This is in line with the Delivering Better Oral Health: Evidence-based Toolkit (Public Health England 2021) and part of the 'proportionate universalism' to provide oral health support to all, including tailored oral health support for more at-risk populations (NICE 2014). These include the key behaviours included in this intervention study.

The government provides a list of oral health resources for early years services involved in child safeguarding and welfare (GOVUK 2021). This includes information on the key oral health educational requirements for children ages 5 to 11 which should be integrated into the Early Years Foundation Stage framework. In addition, Health Education England eLearning for

healthcare includes an Oral Health module in their eLearning programmes to educate health and social care professionals on how to improve child oral health and reduce oral health inequalities in England (elfh 2021). Health visitors can access additional learning modules as part of their continuing professional development (Institute of Health Visiting 2016). The findings from this study could be included in the training resources. This includes the impact that a caregiver's teething response has on their ability to carry out oral health behaviours for their infants, as well as the impacts of an infant's temperament and inconsistent oral health messaging. In addition, raising awareness of the implications of caregivers losing trust in their early years service providers which impacts the opportunity to deliver oral health messages could also be incorporated into training resources. However, there are still calls for oral health to be part of healthcare professionals qualification curricula, as oral health education after gaining the qualification remains to be a self-led educational practice (Bhagat et al 2020, Ahmed et al 2021, Eskytė et al 2021). Evidence suggests, as discussed in sections 7.8.1 and 8.1.3, that early years services, including health visitors, may not feel confident in delivering oral health messages due to their lack of knowledge. The same two-way text service described in this intervention study could also be developed to increase the oral health knowledge of early years service providers to support the effective delivery of preventative oral health messaging. Two-way text message support could also include signposting to the existing oral health training resources for early years services.

Using the findings from this study alongside the literature, there appears to be four main modes of delivery that early years services could implement to deliver the oral health messages, which would benefit primary caregivers with their infant's oral health in the early years of life:

- Oral health education and support during antenatal sessions, including peer support
- Oral health education and support during baby weaning sessions, including peer support
- Vicarious oral health education and support, collaborating with key contacts involved with healthcare avoidant caregivers
- Two-way text messaging oral health support including the possibility of social messaging group support

The findings from this intervention study reported the importance of primary and secondary carers sharing responsibility for their infant's oral health. This was because of the challenges primary carers faced when their partners were less involved in their infant's oral care. The optimal time to disseminate family-centred support and advice could be during antenatal sessions. This provides opportunity to involve secondary carers in the role and responsibilities they can share with the primary carer when looking after their infant's teeth (see Figure 29, page 202).

The next optimal time to deliver oral health advice and support is during baby weaning sessions which occurs around four to six months of age (see Figure 29, page 202). This was a view shared by mothers who received the intervention, mothers from the control group and mothers from the PPI group. This would be a beneficial checkpoint for early years services to identify teething issues and how caregivers are responding, as well as providing education on the other key behaviours outlined in Delivering Better Oral Health: Evidence-based Toolkit (Public Health England 2021). More comprehensive advice and information on dietary sugars could also be delivered using a community engagement approach activity stream as the current health messages seemed confusing to the mothers of this PhD study.

The availability of a two-way text service could be made to provide reinforcement and reassurance for caregivers who may require additional support, have difficulties with accessing healthcare sessions, or prefer support in this way. This could also include a social messaging group to facilitate peer-to-peer support. Figure 30 on page 203 provides a model of the key components of the social messaging group found in this study which could provide guidance for future oral health education intervention research trials investigating social messaging platforms. Educating, collaborating and regularly supporting key workers and community peer-leaders in close contact with healthcare avoidant mothers using a community engagement approach could be a separate activity stream running in conjunction with delivering oral health education messages during antenatal and weaning sessions.

However, there are a number of practical considerations for early years services should they use these as oral health education delivery approaches. The main consideration would be who would have responsibility in overseeing these approaches. Whether it could or should be integrated into an individual healthcare provider's workload or whether it is run as an adjunctive oral health service delivered by dental healthcare professionals. Although it may be more resource efficient to integrate into existing health services, understanding how to minimise dental caries risk whilst *not* carrying out the current best practice policy recommendations comes with having an in-depth knowledge of the aetiology of early childhood caries. This would require more than one-off training sessions to ensure correct delivery of oral health education messages.

As discussed above, the two-way text service may also benefit the early years service providers themselves by providing support outside of the training resources and could be delivered by the same dental care professionals supporting families. However, whether run

by dental healthcare professionals or existing early years services, further additional training around the ethical and safeguarding issues relating to social messaging engagement, particularly if delivering oral health support as part of a social messaging group, would be needed.

Deciding on whether to integrate into existing health services or running as a separate enterprise would also impact the funding streams needed to facilitate the service. Re-allocation of funds within early years service providers to deliver more comprehensive oral health education may impact the other services already being delivered.

As shown in this study, the time-of-day mothers engaged most with the social messaging group were between the hours of 6pm and 11pm, which may not be feasible for an early years service, or a dental service to support. Whether having responses at those times are important to engagement and learning or whether having the same approach as Chat Health (Endicott and Clarke 2014), where messages are replied to within 24 hours, would be an important area of further research.

Collaborating with stakeholders in early years services to discuss the feasibility and acceptability of integrating oral health education into antenatal and weaning sessions, plus supporting and being supported by a two-way text messaging service, would be beneficial. This would identify the barriers to the suggested modes of oral health education delivery and provide avenues of research most beneficial to both the public and early years services.

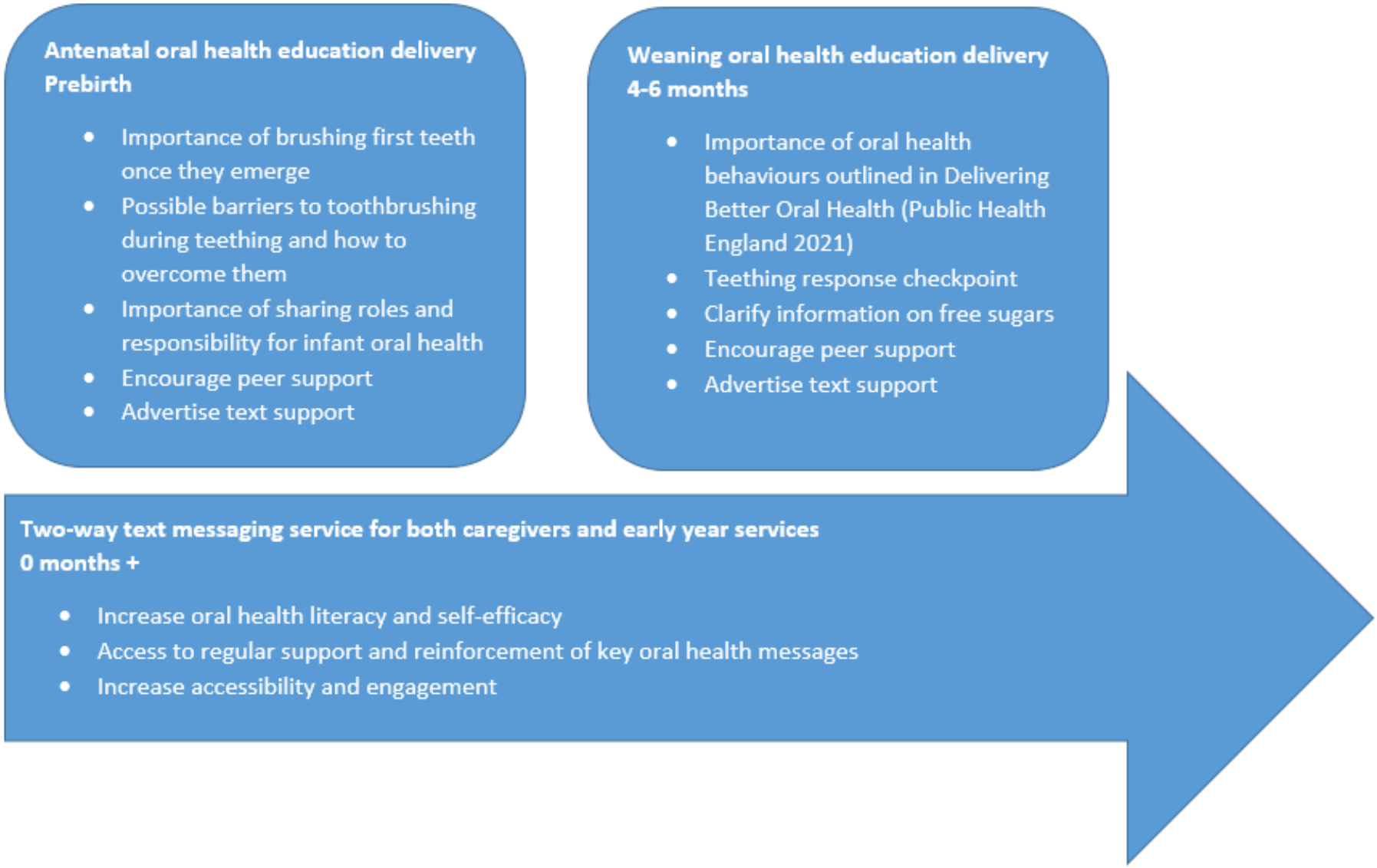


Figure 29: Conceptual model of the optimal times of delivery of an oral health intervention to increase oral health literacy and modes of delivery, including increasing early years services oral health literacy

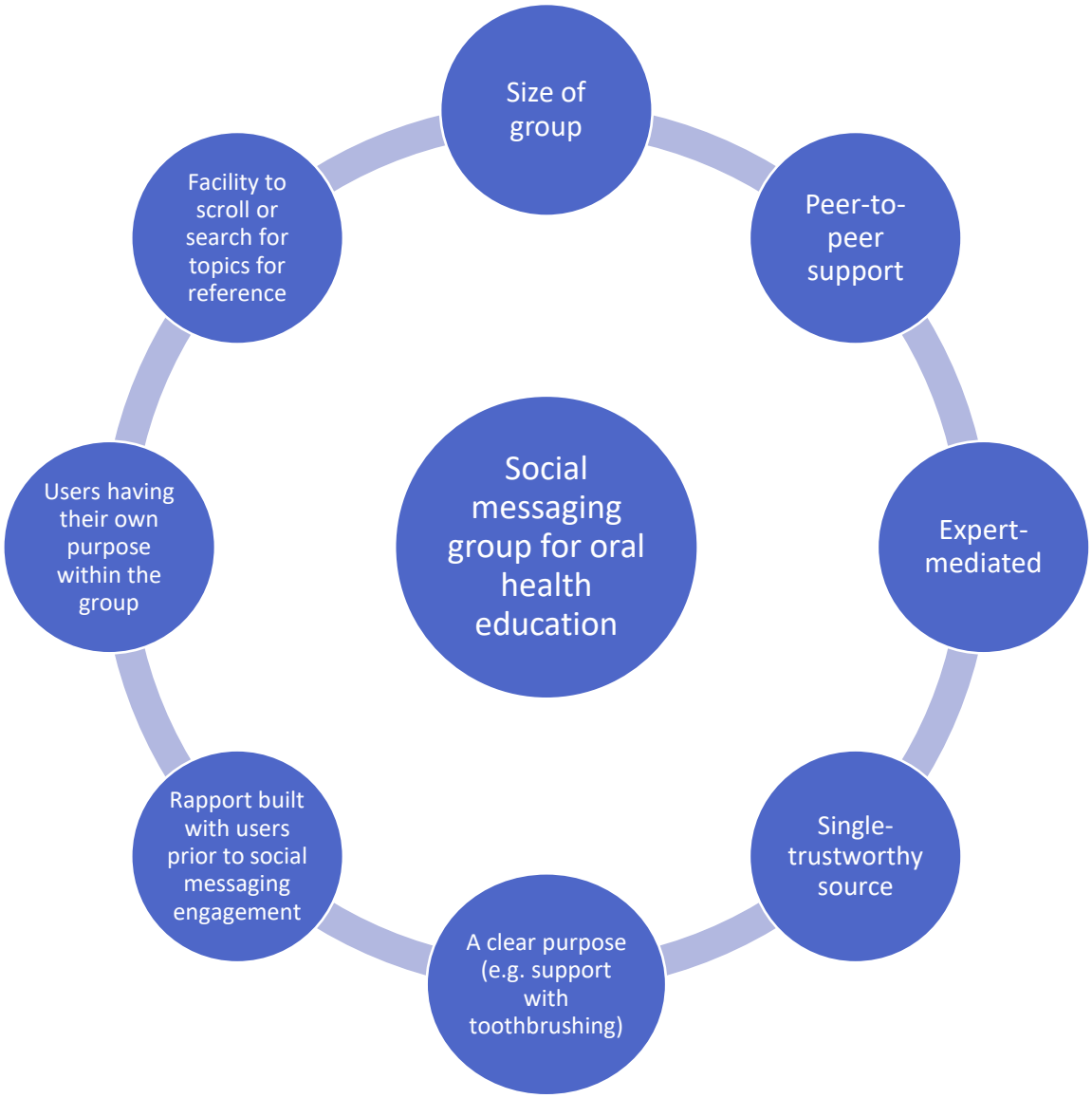


Figure 30: Conceptual model on the key components of the social messaging group which enhanced the acceptability of the engagement approach

In Chapter Three, a conceptual model (Figure 9, section 3.6) was developed which incorporated Bandura's self-efficacy theory with the Stages of Change theory. Where the intention-behaviour gap may occur within the cycle was included. Questions relating to "why" and "how" were presented as these were the main components reported in the literature that caregivers expressed needing support with. How often the support should occur, and optimal location of support (home visits versus health centres) were gaps in knowledge.

Using the findings of the study, and the emerging theory, this conceptual model could be a useful blueprint for early years services and oral health interventions to use when considering the main components of their intervention delivery. Supporting caregivers with *how* they can carry out the oral health behaviours is key, along with the evidence-based information on why. This may need to be reinforced regularly throughout the early years of life to encourage action and maintenance after periods of lapsing. In addition to this is the possibility of how they *feel* about the behaviour which may be impacted by the temperament of their infant, secondary carer involvement and wider external factors such as extended family, friends and childcare settings. This may be key in motivating oral health decision-making.

Although key points in time have been highlighted previously (antenatal and baby wellbeing sessions), flexibility of choice in how and when caregivers access the information is also important. This may be due to additional pressures of returning to work or needing to coordinate appointments around nap times. Informal conversations with stakeholders also made us aware of a caregiver's vulnerability status and the impact on their time and availability. Cuts to services mean the availability of baby wellbeing drop-in clinics have been

reduced, increasing the need for alternative ways for caregivers to access support. Several mothers who self-selected to take part (Ph2) lived in remote areas. This provides evidence for the importance in caregivers having flexibility in how they can access oral health support in the early years of their infants' life.

The conceptual model from Chapter Three has therefore been amended to include the above findings (see Figure 31), with further research needed to investigate the influence of affective states on behaviour uptake and maintenance.

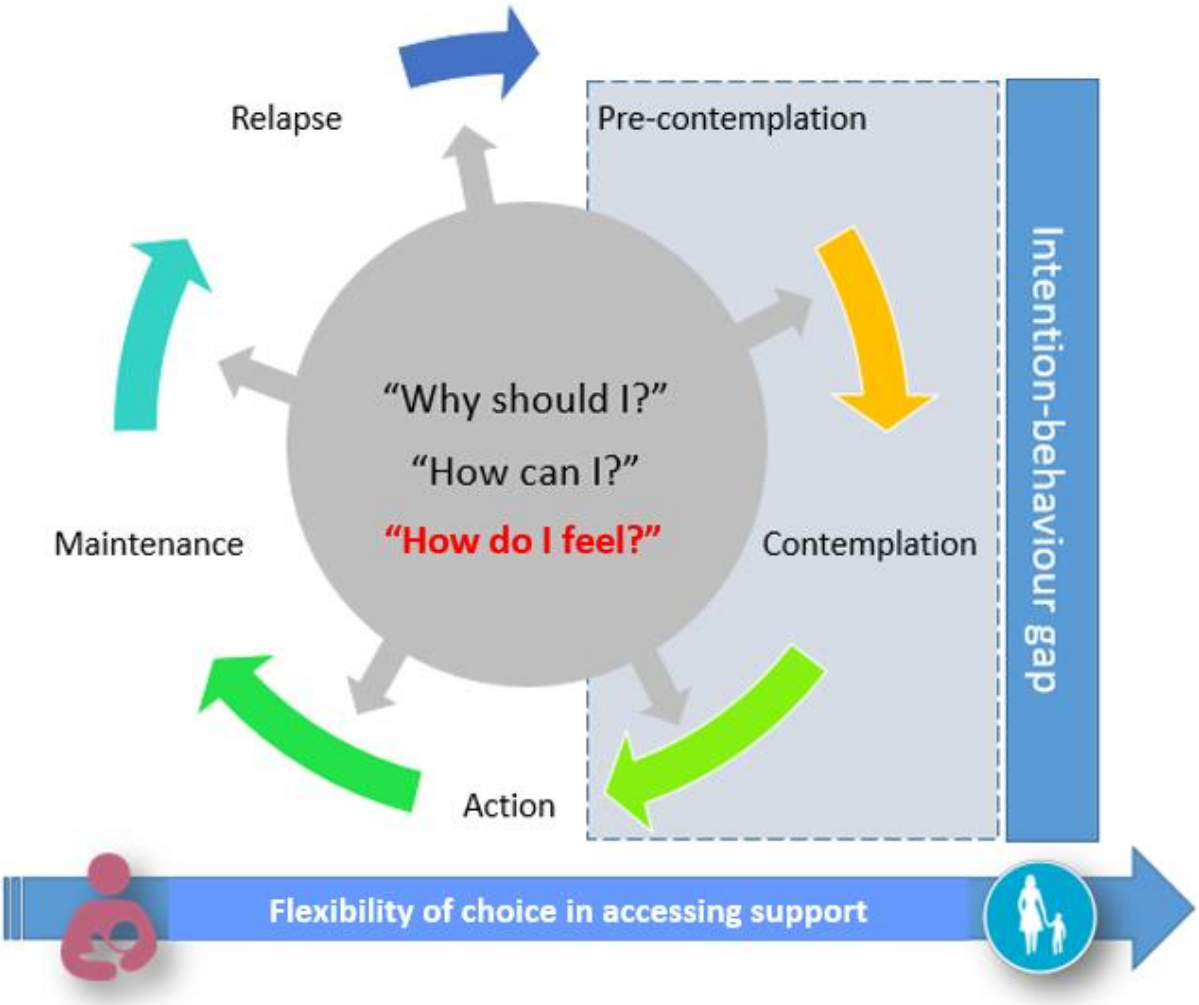


Figure 31: Conceptual model incorporating Bandura's self-efficacy theory with the Stages of Change theory, with the addition of affective states as an additional driver to behaviour change

Before finalising this PhD thesis, it is important to acknowledge a major global event which occurred in 2019 and is still ongoing in 2022. Had the study been carried out in today's climate, the outcomes of this PhD may have differed. Compared to when the data was analysed in 2018, the findings are possibly more relevant now due to the change in landscape and drive to move non-communicable disease prevention, such as dental disease, to a more digital form. This will be discussed next and will conclude this thesis.

8.3 The Covid-19 Pandemic and mOralHealth

In late December 2019, an outbreak of a highly contagious and deadly acute respiratory disease occurred in Wuhan, Hubei, China, which began to spread across the globe (Wu et al., 2020). This led to widespread lockdowns across all continents to try and gain control of the spread of disease and ease pressure on overwhelmed healthcare services. In March 2020, the UK entered its first lockdown, with impacts on mental health, child education, the economy and access to health services (Cachón-Zagalaz et al., 2020, Monaghesh and Hajizadeh 2020, Xiong et al., 2020). At the same time, primary care dental services were advised to cease all face-to-face contact (Chief Dental Office 2020). This accelerated the development of telehealth and photographic triage methods to overcome barriers to access (Monaghesh and Hajizadeh 2020, Thomas 2021).

The isolation that occurred as a result of the Covid-19 pandemic has brought into the forefront the importance of supporting emotional wellbeing, not only for service users, but also for healthcare service providers. Policymakers have been advised to adopt more supportive environments utilising peer support and technology to encourage, protect and motivate healthcare workers (De Kock et al., 2021). In September 2021, the World Health Organisation (WHO) released an implementation guide on mobile technologies for oral health (World Health Organisation 2021). This document described the importance of advancing mOralHealth to capitalise on a mobile phone's utility of text messaging, social messaging platforms and apps, in four key areas as shown in Figure 32.

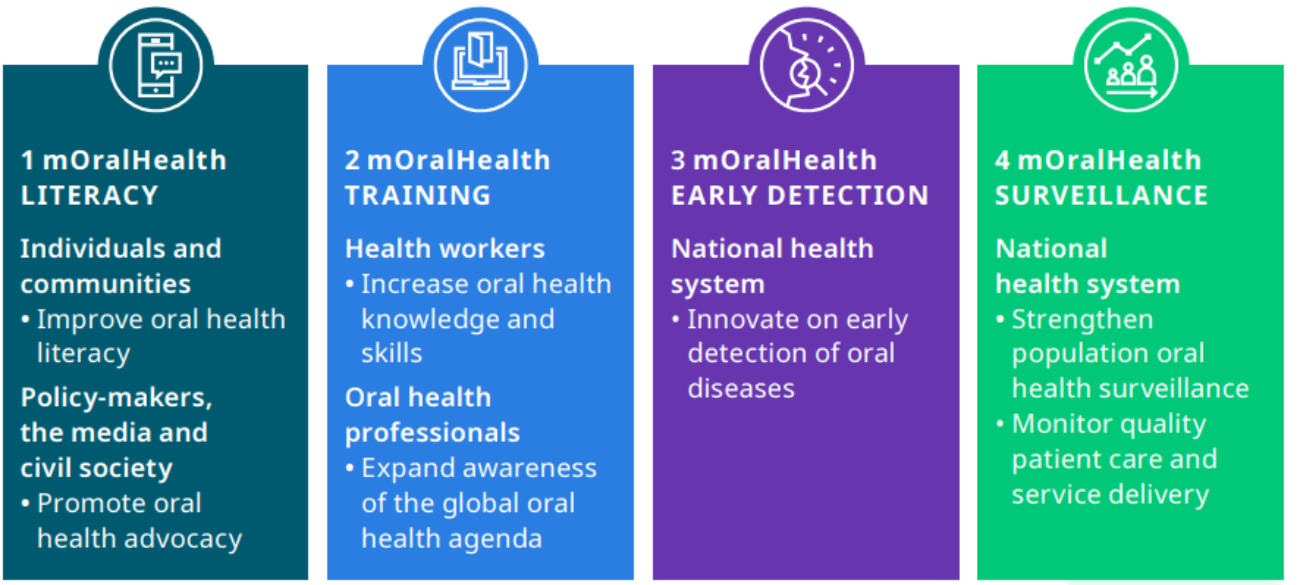


Figure 32: The four complementary modules of the mOralHealth programme, their target groups and their goals. Taken from Mobile technologies for oral health: an implementation guide (World Health Organisation 2021).

The aim of this guide is to complement, support and strengthen national oral health policy or preventative initiatives of non-communicable diseases using mobile and digital technologies. Within the document, five studies were cited as evidence for text messaging as a behaviour change tool, three of which were systematic reviews (Cole-Lewis and Kershaw 2010, Wei et

al., 2011, Free et al., 2013, Iribarren et al., 2017, Whittaker et al., 2019). Within oral health, these studies were focused on smoking cessation. The use of text messaging to support behaviour change with caregivers in the early years of life did not feature in any of these studies. In addition, the studies included as examples for how to implement mOralHealth were newly developed apps or automated messaging systems (World Health Organisation 2021). The development of "technologically advanced" systems are often favoured despite their applicability to support behaviour change theory, or their acceptability and feasibility not being fully explored (Willcox et al., 2019). Proven established technologies, such as two-way text messages or SMS, are therefore overlooked (Willcox et al., 2019) despite still being predominantly used across society.

Reflecting on the findings of this PhD and the WHO document, both studies (OW study and FtG study) fit within the four complementary modules recommended by the WHO (WHO September 2021). The two-way text messaging intervention delivery method, including the social messaging group platform, was shown to increase oral health literacy and support how to maintain oral health behaviours during the challenging early years of infancy. It had advantages in being a low resource method to support the mothers, located in mixed rural and urban areas of the Southwest, UK. However, the study findings also highlighted the importance of trust, which may only be gained by regular interaction in-person. This study also discussed how two-way text messaging could be used to support the oral health literacy of early years services and enhance training, focusing on the importance of a compassionate-engagement approach and regularity of support needed by some individuals. The advantages of digital epidemiology was discussed, which with training, could be carried out by non-dental professionals as shown in the OW study.

Future research into the efficacy and effectiveness of two-way text messaging, including social messaging groups, to support both caregivers *and* early years services in increasing oral health literacy, would be a valuable area of study to build upon this research and the recommendations by the World Health Organisation.

This PhD highlights critical areas currently missing within oral health literature, including the importance of trust, compassion and reassurance when delivering oral health education interventions. This was accomplished by using a critical realism mixed methods approach, still not widely used within oral health research. This PhD strengthens our understanding of the role of self-efficacy with key findings on why some oral health behaviours are taken up and others are not. The PhD demonstrates the value of incorporating peer-to-peer support in the early years of life to encourage the uptake of oral health behaviours prior to, during and after the emergence of an infant's primary teeth. The PhD describes and defines a new oral health behaviour, teething response, which may have implications for future research, for policy makers and for training of early years services. The PhD provides avenues of further investigation for strengthening the role of mobile technology within oral health as set out by the World Health Organisation. The PhD describes a novel way to collect and analyse acceptability data using mixed methods which strengthens our understanding of factors which hinder and facilitate engagement with an oral health intervention. Finally, this PhD describes an emerging theory of affective states and their role in oral health decision-making which may open up a whole new valuable area of research within oral health.

REFERENCES:

Abou El Fadl, R., M. Blair and S. Hassounah (2016). *Integrating Maternal and Children's Oral Health Promotion into Nursing and Midwifery Practice- A Systematic Review***.** PLoS One **11**(11): e0166760-e0166760.

Absolom, K., P. Holch, B. Woroncow, E. Wright and G. Velikova (2015). *Beyond lip service and box ticking: how effective patient engagement is integral to the development and delivery of patient-reported outcomes***.** Journal of the International Society of Quality of Life Research **24**(5): 1077-1085.

Action for Children. 2021. "Beyond Reach: Barriers to Accessing Early Years Services for Children," September. https://media.actionforchildren.org.uk/documents/Beyond_Reach_-_Barriers_to_accessing_early_years_services_for_children.pdf.

Ajzen, I. and T. J. Madden (1986). *Prediction of goal-directed behavior: Attitudes, intentions, and perceived behavioral control*. Journal of experimental social psychology **22**(5): 453-474.

Alan, J. S., J. M. Gary, M. Tatiana, J. S. Alan (2018). *The cost of an epidemiological study*. Epidemiological Studies: A Practical Guide. Oxford, UK, Oxford University Press.

Aljafari, A. K., J. E. Gallagher and M. T. Hosey (2015). *Failure on all fronts: general dental practitioners' views on promoting oral health in high caries risk children- a qualitative study*. BMC oral health **15**(1): 45.

Alonso-Alonso, M., S. C. Woods, M. Pelchat, P. S. Grigson, E. Stice, et al. (2015). *Food reward system: current perspectives and future research needs*. Nutrition reviews **73**(5): 296-307.

Altman, D. G. and J. M. Bland (1983). *Measurement in Medicine: The Analysis of Method Comparison Studies*. Journal of the Royal Statistical Society. Series D (The Statistician) **32**(3): 307-317.

Amin, M. S. and R. L. Harrison (2008). *Understanding Parents' Oral Health Behaviors for Their Young Children.* Qualitative Health Research **19**(1): 116-127.

Anaise, J. Z. (1984). *Measurement of dental caries experience--modification of the DMFT index*. Community Dentistry & Oral Epidemiology **12**(1): 43-46.

Andrews, E. J., A. Symon and A. S. Anderson (2015). *'I didn't know why you had to wait': an evaluation of NHS infant-feeding workshops amongst women living in areas of high deprivation.* J Hum Nutr Diet **28**(6): 558-567.

Arigo, D., S. Pagoto, L. Carter-Harris, S. E. Lillie and C. Nebeker (2018). *Using social media for health research: Methodological and ethical considerations for recruitment and intervention delivery*. Digital Health **4**: 2055207618771757.

Armitage, P. (1972). *Oral Health Surveys: Basic Methods.* Journal of the Royal Statistical Society. Series A (General) **135**(3): 449-449.

Ashkanani, F. and M. Al-Sane (2013). *Knowledge, Attitudes and Practices of Caregivers in Relation to Oral Health of Preschool Children*. Medical Principles and Practice **22**(2): 167-172.

Atkins, D., M. Eccles, S. Flottorp, G. H. Guyatt, D. Henry, et al. (2004). *Systems for grading the quality of evidence and the strength of recommendations I: critical appraisal of existing approaches The GRADE Working Group*. BMC Health Service Research **4**.

Bandura, A. (1977). *Self-efficacy: toward a unifying theory of behavioral change*. Psychology Review **84**.

Bandura, A., G. V. Caprara, C. Barbaranelli, C. Regalia and E. Scabini (2011). *Impact of Family Efficacy Beliefs on Quality of Family Functioning and Satisfaction with Family Life*. Applied Psychology **60**(3): 421-448.

Bandura, A., W. H. Freeman and R. Lightsey (1999). *Self-Efficacy: The Exercise of Control*. Journal of Cognitive Psychotherapy **13**(2): 158-166.

Biesta, G. (2010). *SAGE Handbook of Mixed Methods in Social Behavioral Research*. Thousand Oaks, California, SAGE Publications, Inc.

Blanton, H., B. W. Pelham, T. DeHart and M. Carvallo (2001). *Overconfidence as Dissonance Reduction*. Journal of Experimental Social Psychology **37**(5): 373-385.

Boaz, A., S. Hanney, R. Borst, A. O'Shea and M. Kok (2018). *How to engage stakeholders in research: design principles to support improvement.* Health Research Policy and Systems **16**(1): 60.

Bonevski, B., M. Randell, C. Paul, K. Chapman, L. Twyman, et al. (2014). *Reaching the hard-to-reach: a systematic review of strategies for improving health and medical research with socially disadvantaged groups.* BMC Medical Research Methodology **14**(1): 42-42.

Borrelli, B., M. Henshaw, R. Endrighi, W. G. Adams, T. Heeren, et al. (2019). *An Interactive Parent-Targeted Text Messaging Intervention to Improve Oral Health in Children Attending Urban Pediatric Clinics: Feasibility Randomized Controlled Trial*. JMIR Mhealth Uhealth **7**(11): e14247-e14247.

Bottenberg, P., W. Jacquet, C. Behrens, V. Stachniss and A. Jablonski-Momeni (2016). *Comparison of occlusal caries detection using the ICDAS criteria on extracted teeth or their photographs.(International Caries Detection and Assessment System)(Report).* BMC oral health **16**(1).

Bowen, D. J., M. Kreuter, B. Spring, L. Cofta-Woerpel, L. Linnan, et al. (2009). *How We Design Feasibility Studies*. American Journal of Preventive Medicine **36**(5): 452-457.

Boye, U., G. R. K. Foster, I. A. Pretty and M. Tickle (2012). *Children's views on the experience of a visual examination and intra-oral photographs to detect dental caries in epidemiological studies*. Community Dent Health **29**(4): 284.

Boye, U., G. R. K. Foster, I. A. Pretty and M. Tickle (2013). *The views of examiners on the use of intra-oral photographs to detect dental caries in epidemiological studies.* Community Dent Health **30**(1): 34.

Boye, U., I. A. Pretty, M. Tickle and T. Walsh (2013a). *Comparison of caries detection methods using varying numbers of intra-oral digital photographs with visual examination for epidemiology in children*. BMC oral health **13**: 6-6.

Boye, U., T. Walsh, I. A. Pretty and M. Tickle (2012a). *Comparison of photographic and visual assessment of occlusal caries with histology as the reference standard.* BMC oral health **12**: 10.

Boye, U., A. Willasey, T. Walsh, M. Tickle and I. A. Pretty (2013b). *Comparison of an intra-oral photographic caries assessment with an established visual caries assessment method for use in dental epidemiological studies of children.* Community Dent Oral Epidemiol **41**(6): 526-533.

Braga, M. M., L. B. Oliveira, G. A. V. C. Bonini, M. Bönecker and F. M. Mendes (2009). *Feasibility of the International Caries Detection and Assessment System (ICDAS-II) in Epidemiological Surveys and Comparability with Standard World Health Organization Criteria.* Caries Res **43**(4): 245-249.

Broom, Matthew A., Amy S. Ladley, Elizabeth A. Rhyne, and Donna R. Halloran. 2015. *Feasibility and Perception of Using Text Messages as an Adjunct Therapy for Low-Income, Minority Mothers With Postpartum Depression*. JMIR Mental Health 2 (1): e4.

Brown, B. (2006). *Shame Resilience Theory: A Grounded Theory Study on Women and Shame.* Families in Society **87**(1): 43-52.

British Society Paediatric Dentistry (2017). *Dental Check by One.* Accessed October 2021 https://www.bspd.co.uk/patients/dental-check-by-one

Cachón-Zagalaz, J., M. Sánchez-Zafra, D. Sanabrias-Moreno, G. González-Valero, A. J. Lara-Sánchez et al. (2020). *Systematic Review of the Literature About the Effects of the COVID-19 Pandemic on the Lives of School Children*. Frontiers in psychology **11**: 569348-569348.

Cane, J., D. O'Connor and S. Michie (2012). *Validation of the theoretical domains framework for use in behaviour change and implementation research*. Implement Sci **7**.

Carey, J. W. (1993). *Linking Qualitative and Quantitative Methods: Integrating Cultural Factors into Public Health.* Qualitative Health Research **3**(3): 298-318.

Casey, M., P. S. Hayes, F. Glynn, G. Olaighin, D. Heaney, et al. (2014). *Patients' experiences of using a smartphone application to increase physical activity: the SMART MOVE qualitative study in primary care*. The British Journal of General Practice : the Journal of the Royal College of General Practitioners **64**(625): e500.

Cetrano, G., F. Tedeschi, L. Rabbi, G. Gosetti, A. Lora, et al. (2017). *How are compassion fatigue, burnout, and compassion satisfaction affected by quality of working life? Findings from a survey of mental health staff in Italy*. BMC Health Serv Res **17**(1): 755.

Chaffee, B. W., C. A. Feldens and M. R. Vítolo (2013). *Cluster-randomized trial of infant nutrition training for caries prevention*. Journal of Dental Research **92**(7 Suppl): 29S-36S.

Chau, V. and R. Giallo (2015). *The relationship between parental fatigue, parenting self-efficacy and behaviour: implications for supporting parents in the early parenting period*. Child: Care, Health and Development **41**(4): 626-633.

Chen, K. J., S. S. Gao, D. Duangthip, E. C. M. Lo and C. H. Chu (2019). *Prevalence of early childhood caries among 5-year-old children: A systematic review*. J Investig Clin Dent **10**(1): e12376.

Chief Dental Office (2020). Preparedness for Primary Dental Care. www.england.nhs.uk/coronavirus/wp-content/uploads/sites/52/2020/03/issue3preparednessletterforprimarydentalcare25march2020.pdf.

Children's Commissioner for England (2017). *Constructing a Definition of Vulnerability – Attempts to Define and Measure.* England, UK. basw_85628-1_0.pdf

Christensen, L. B., S. Twetman and A. Sundby (2010). *Oral health in children and adolescents with different socio-cultural and socio-economic backgrounds.* Acta Odontol Scand **68**(1): 34-42.

Clarke, I., T. B. Flaherty and M. Yankey (2006). *Teaching the Visual Learner: The Use of Visual Summaries in Marketing Education.* Journal of Marketing Education **28**(3): 218-226.
Cohen, J. (1960). *A Coefficient of Agreement for Nominal Scales*. Educational and Psychological Measurement **20**(1): 37-46.

Cole-Lewis, H and Kershaw, T (2010). *Text messaging as a tool for behavior change in disease prevention and management.* Epidemiologic Reviews. **31**(1).

Concannon, T.W., Grant, S., Welch, V. et al (2019). *Practical Guidance for Involving Stakeholders in Health Research.* J GEN INTERN MED 34, 458–463

Cortelyou-Ward, K., D. N. Atkins, A. Noblin, T. Rotarius, P. White et al. (2020). *Navigating the Digital Divide: Barriers to Telehealth in Rural Areas*. J Health Care Poor Underserved **31**(4): 1546-1556.

Creswell, J. W. and V. L. P. Clark (2011). *Designing and Conducting Mixed Methods Research*, SAGE Publications.

Curtiss, P. R. and P. W. Warren (1973). *The Dynamics of Life Skills Coaching*, Training Research and Development Station, Department of Manpower and Immigration.

Davies, A., R. Howells, S. M. G. Lee, C. J. Sweet and S. Dominguez-Gonzalez (2020). *Implementation of photographic triage in a paediatric dental, orthodontic, and maxillofacial department during COVID-19*. Int J Paediatr Dent.

de Jong-Lenters, M., M. L'Hoir, E. Polak and D. Duijster (2019). *Promoting parenting strategies to improve tooth brushing in children: design of a non-randomised cluster-controlled trial*. BMC oral health **19**(1): 210.

De Kock, J. H., H. A. Latham, S. J. Leslie, M. Grindle, S.-A. Munoz, et al. (2021). *A rapid review of the impact of COVID-19 on the mental health of healthcare workers: implications for supporting psychological well-being*. BMC Public Health **21**(1): 104.

Deci, E. L. and R. M. Ryan (2000). *The "What" and "Why" of Goal Pursuits: Human Needs and the Self-Determination of Behavior*. Psychological inquiry **11**(4): 227-268.

Deci, E. L. and R. M. Ryan (2012). *Self-determination theory in health care and its relations to motivational interviewing: a few comments*. The International Journal of Behavioral Nutrition and Physical Activity **9**: 24-24.

Divaris, K., J. Y. Lee, A. D. Baker and W. F. Vann (2011). *The relationship of oral health literacy with oral health-related quality of life in a multi-racial sample of low-income female caregivers*. Health and quality of life outcomes **9**(1): 108.

Dodds, A. and K. Chamberlain (2017). *The problematic messages of nutritional discourse: A case-based critical media analysis*. Appetite **108**: 42-50.

Dolezal, L. and B. Lyons (2017). *Health-related shame: an affective determinant of health?* Med Humanit **43**(4): 257-263.

Dowell, T. B., P. J. Holloway, D. Keshani and V. Clerehugh (1983). *Do dentists fill teeth unnecessarily?* British Dental Journal **155**(7): 247-249.

Duijster, D., M. de Jong-Lenters, E. Verrips and C. van Loveren (2015). *Establishing oral health promoting behaviours in children – parents' views on barriers, facilitators and professional support: a qualitative study*. BMC oral health **15**: 157.

Elfrink, M., J. Veerkamp, I. Aartman, H. A. Moll and J. ten cate (2009). *Validity of scoring caries and primary molar hypomineralization (DMH) on intraoral photographs.* Journal of the European Academy of Paediatric Dentistry. **10**: 5-10

Elison, S., S. Norgate, L. Dugdill and C. Pine (2014). *Maternally Perceived Barriers to and Facilitators of Establishing and Maintaining Tooth-Brushing Routines with Infants and Preschoolers.* International Journal of Environmental Research and Public Health **11**(7): 6808-6826.

Ellard-Gray, A., N. K. Jeffrey, M. Choubak and S. E. Crann (2015). *Finding the Hidden Participant: Solutions for Recruiting Hidden, Hard-to-Reach, and Vulnerable Populations*. International Journal of Qualitative Methods **14**(5): 1609406915621420.

Endicott, J. and M. Clarke (2014). *Nurses in step with the smartphone generation: With communications trends developing rapidly, mobile messaging can be seen as a way to help meet service-user expectations about timely access to services*. *Jimmy Endicott and Maggie Clarke explore the implications for front line nurses*. Primary health care **24**(8): 20-24.

Entwistle, V. A., M. J. Renfrew, S. Yearley, J. Forrester and T. Lamont (1998). *Lay Perspectives: Advantages for Health Research*. BMJ: British Medical Journal **316**(7129): 463-466.

Eskytė, I., K. A. Gray-Burrows, J. Owen, B. Sykes-Muskett, S. H. Pavitt, et al. (2021). *Organizational Barriers to Oral Health Conversations Between Health Visitors and Parents of Children Aged 9-12 Months Old*. Frontiers in public health **9**: 578168-578168.

Estai, M., S. Bunt, Y. Kanagasingam, E. Kruger and M. Tennant (2016). *Diagnostic accuracy of teledentistry in the detection of dental caries: a systematic review*. J Evid Based Dent Pract **16**(3): 161-172.

Estai, M., J. Winters, Y. Kanagasingam, J. Shiikha, H. Checker, et al. (2016a). *Validity and reliability of remote dental screening by different oral health professionals using a store-and-forward telehealth model*. BDJ **221**: 411.

Evans, R. E., P. Craig, P. Hoddinott, H. Littlecott, L. Moore, et al. (2019). *When and how do 'effective' interventions need to be adapted and/or re-evaluated in new contexts? The need for guidance*. J Epidemiol Community Health **73**(6): 481-482.

Eysenbach, G., J. Powell, M. Englesakis, C. Rizo and A. Stern (2004). *Health related virtual communities and electronic support groups: systematic review of the effects of online peer to peer interactions.* BMJ (Clinical research ed.) **328**(7449): 1166-1166.

Faries M. D (2016). *Why We Don't "Just Do It": Understanding the Intention-Behavior Gap in Lifestyle Medicine.* American journal of lifestyle medicine, 10(5), 322–329.

Feldens, C. A., E. R. J. Giugliani, B. B. Duncan, M. d. L. Drachler and M. R. Vítolo (2010). *Long-term effectiveness of a nutritional program in reducing early childhood caries: a randomized trial.* Community Dent Oral Epidemiol **38**(4): 324-332.

Feldens, C. A., E. R. J. Giugliani, Á. Vigo and M. R. Vítolo (2010a). *Early Feeding Practices and Severe Early Childhood Caries in Four-Year-Old Children from Southern Brazil: A Birth Cohort Study*. Caries Res **44**(5): 445-452.

Feltman, C. (2021). *The Thin Book of Trust: An Essential Primer for Building Trust at Work*, Thin Book Publishing Company.

Ferrer, R. A. and W. B. Mendes (2018). *Emotion, health decision making, and health behaviour*. Psychology & Health **33**(1): 1-16.

Field, A. (2013). *Discovering Statistics Using IBM SPSS Statistics*, SAGE Publications. London UK

Finlayson, T. L., K. Siefert, A. I. Ismail, J. Delva and W. Sohn (2005). *Reliability and validity of brief measures of oral health-related knowledge, fatalism, and self-efficacy in mothers of African American children*. Pediatric Dentistry **27**(5): 422-428.

Fleming, P. S., C. D. Lynch and N. Pandis (2014). *Randomized controlled trials in dentistry: Common pitfalls and how to avoid them*. Journal of Dentistry **42**(8): 908-914.

Fogarty, J. S. (1997). *Reactance theory and patient noncompliance.* Soc Sci Med **45**(8): 1277-1288.

Forgie, A. H., C. M. Pine and N. B. Pitts (2003). *The assessment of an intra-oral video camera as an aid to occlusal caries detection*. Int Dent J **53**(1): 3-6.

Frank, D. (2002). *Shame: The Elephant In The Room: Managing Shame Is Important For Improving Health Care*. BMJ: British Medical Journal **324**(7338): 623-624.

Free, C., Phillips, G., Galli, L., et al., (2013). *The effectiveness of mobile-health technology-based health behaviour change or disease management interventions for health care consumers: a systematic review.* PLos One. **10**(1): e1001362

Freeman, R. (2008). *Communicating with children and parents: recommendations for a child-parent-centred approach for paediatric dentistry*. Eur Arch Paediatr Dent **9**(S1): 16-22.

Gajanan, V. K. (2013). *Long-Term Effectiveness of Parent Education Using the Baby Oral Health Model on the Improvement of Oral Health of Young Children*." Int J Dent **2013**: 137048-137045.

Gale, N.K., Heath, G., Cameron, E. et al. (2013). *Using the framework method for the analysis of qualitative data in multi-disciplinary health research.* BMC Med Res Methodol 13, 117

Gavriel, J. (2016). *Perceived self-efficacy*. Education for Primary Care **27**(2): 144-145.

George, A., M. S. Sousa, A. C. Kong, A. Blinkhorn, T. Patterson Norrie, et al. (2019). *Effectiveness of preventive dental programs offered to mothers by non-dental professionals to control early childhood dental caries: a review*. BMC oral health **19**(1): 172-172.

Gilbert, P. (2015). *The Evolution and Social Dynamics of Compassion*. Social and personality psychology compass **9**(6): 239-254.

Goold, S. D. (2002). *Trust, distrust and trustworthiness.* Journal of General Internal Medicine **17**(1): 79-81.

Gray-Burrows, K. A., P. F. Day, Z. Marshman, E. Aliakbari, S. L. Prady et al. (2016). *Using intervention mapping to develop a home-based parental-supervised toothbrushing intervention for young children.* Implementation Science **11**(1): 61.

Green, L. W. and R. E. Glasgow (2006). *Evaluating the relevance, generalization, and applicability of research: issues in external validation and translation methodology.* Eval Health Prof **29**(1): 126-153.

Greene, J. C., V. J. Caracelli and W. F. Graham (1989). *Toward a Conceptual Framework for Mixed-Method Evaluation Designs*. Educational Evaluation and Policy Analysis **11**(3): 255-274.

Grzywacz, J. G. and C. L. M. Keyes (2004). *Toward health promotion: physical and social behaviors in complete health*. Am J Health Behav **28**(2): 99-111.

Hallas, D., J. Fernandez, L. Lim, P. Catapano, S. Dickson, et al. (2015). *OHEP: An Oral Health Education Program for Mothers of Newborns*. J Pediatr Health Care **29**(2): 181-190.

Hallingberg, B., Turley, R., Segrott, J. et al. (2018). *Exploratory studies to decide whether and how to proceed with full-scale evaluations of public health interventions: a systematic review of guidance.* Pilot Feasibility Stud 4, 104

Harrison, R. L., J. Veronneau and B. Leroux (2012). *Effectiveness of Maternal Counseling in Reducing Caries in Cree Children*. J Dent Res **91**(11): 1032-1037.

Hart, E. (1995). *Action research for health and social care : a guide to practice*. Open University Press.

Hashemian, T. S., D. Kritz-Silverstein and R. Baker (2015). *Text2Floss: the feasibility and acceptability of a text messaging intervention to improve oral health behavior and knowledge*. J Public Health Dent **75**(1): 34-41.

Herman, A. N., K. Malhotra, G. Wright, J. O. Fisher and R. C. Whitaker (2012). *A qualitative study of the aspirations and challenges of low-income mothers in feeding their preschool-aged children*. The International Journal of Behavioral Nutrition and Physical Activity **9**: 132-132.

Hilton, I. V., S. Stephen, J. C. Barker and J. A. Weintraub (2007). *Cultural factors and children's oral health care: a qualitative study of carers of young children*. Community Dent Oral Epidemiol **35**(6): 429-438.

Hiratsuka, V. Y., J. M. Robinson, R. Greenlee and A. Refaat (2019). *Oral health beliefs and oral hygiene behaviours among parents of urban Alaska Native children.* Int J Circumpolar Health **78**(1): 1586274-1586274.

Hogan, R., M. Goodwin, N. Boothman, T. Iafolla and I. A. Pretty (2018). *Further opportunities for digital imaging in dental epidemiology.* Journal of Dentistry **74**: S2-S9.

Hollister, M. C. and M. G. Anema (2004). *Health Behavior Models and Oral Health: A Review*. J Dent Hyg **78**(3): 6-6.

Hooley, M., H. Skouteris, C. Boganin, J. Satur and N. Kilpatrick (2012). *Parental influence and the development of dental caries in children aged 0–6 years: A systematic review of the literature*. J Dent **40**(11): 873-885.

Horowitz A.M and Kleinman D (2013). *Creating a health literacy-based practice.* Dental Abstracts **58**(4): 185-187.

Huebner, C. E. and C. A. Riedy (2010). *Behavioral Determinants of Brushing Young Children's Teeth: Implications for Anticipatory Guidance.* Pediatric Dentistry **32**(1): 48-55.

Huston, P., V. L. Edge and E. Bernier (2019). *Reaping the benefits of Open Data in public health*. Canada communicable disease report **45**(11): 252-256.

Institute of Health Visiting (2019). *iHV launches 'Health Visiting in England: A Vision for the Future'*. Accessed October 2021. https://ihv.org.uk/news-and-views/news/ihv-launches-health-visiting-in-england-a-vision-for-the-future/**:** 23-24.

Institute of Health Visiting (2016). *Oral Health Promotion e-learning*. Accessed October 2021. https://ihv.org.uk/for-health-visitors/resources-for-members/resource/e-learning/oral-health-promotion-e-learning

Inês Meurer, M., L. J. Caffery, N. K. Bradford and A. C. Smith (2015). *Accuracy of dental images for the diagnosis of dental caries and enamel defects in children and adolescents: A systematic review*. Journal of Telemedicine and Telecare **21**(8): 449-458.

Iribarren S. J, Cato K, Falzon L, et al., (2017). *What is the economic evidence for mHealth? A systematic review of economic evaluations of mHealth solutions.* PLos One. **12**(2): e0170581

Ismail, A. I. (2004). *Visual and visuo-tactile detection of dental caries*. J Dent Res **83 Spec No C**: C56-66.

Ismail, A. I., W. Sohn, M. Tellez, A. Amaya, A. Sen, H. Hasson and N. B. Pitts (2007). *The International Caries Detection and Assessment System (ICDAS): an integrated system for measuring dental caries*. Community Dent Oral Epidemiol **35**(3): 170-178.

Jackson, G. L., B. J. Powers, R. Gray, J. W. Williams, R. Chatterjee, et al. (2013). *The Patient-Centered Medical Home: A Systematic Review*. Ann Intern Med **158**(3): 169-178.

Jackson, L., L. De Pascalis, J. Harrold and V. Fallon (2021). *Guilt, shame, and postpartum infant feeding outcomes: A systematic review*. Matern Child Nutr: e13141-e13141.

Jagosh, J., P. Pluye, A. C. Macaulay, J. Salsberg, J. Henderson, et al. (2011). *Assessing the outcomes of participatory research: protocol for identifying, selecting, appraising and synthesizing the literature for realist review.* Implement Sci **6**(1): 24-24.

Jazaieri, H., G. T. Jinpa, K. McGonigal, E. L. Rosenberg, J. Finkelstein, E. Simon-Thomas, M. Cullen, J. R. Doty, J. J. Gross and P. R. Goldin (2013). *Enhancing Compassion: A Randomized Controlled Trial of a Compassion Cultivation Training Program*. Journal of Happiness Studies **14**(4): 1113-1126.

Jelalian, E., G. D. Foster, A. F. Sato, K. S. Berlin, C. McDermott et al. (2014). *Treatment adherence and facilitator characteristics in a community based pediatric weight control intervention*. Int J Behav Nutr Phys Act **11**(1): 17-17.

Jucks, R. and F. M. Thon (2017). *Better to have many opinions than one from an expert? Social validation by one trustworthy source versus the masses in online health forums.* Computers in Human Behavior **70**: 375-381.

Julious, S. A. (2005). *Sample size of 12 per group rule of thumb for a pilot study*. Pharmaceutical Statistics **4**(4): 287-291.

Karanicolas, P. J., F. Farrokhyar and M. Bhandari (2010). *Practical tips for surgical research: blinding: who, what, when, why, how?* Canadian journal of surgery. Journal canadien de chirurgie **53**(5): 345-348.

Karl, P. (1894). *Mathematical Contributions to the Theory of Evolution. II. Skew Variation in Homogeneous Material. [Abstract]*. Proceedings of the Royal Society of London **57**(340-346): 257-260.

Kay, E. J., C. Quinn, A. Gude, A. Taylor and J. Erwin (2019). *A qualitative exploration of promoting oral health for infants in vulnerable families*. British Dental Journal **227**(2): 137.

Khatri, C., S. J. Chapman, J. Glasbey, M. Kelly, D. Nepogodiev, et al. (2015). *Social media and internet driven study recruitment: evaluating a new model for promoting collaborator engagement and participation*. PLoS One **10**(3): e0118899-e0118899.

Kieffer, M. J. (2010). *Socioeconomic Status, English Proficiency, and Late-Emerging Reading Difficulties*. Educational researcher **39**(6): 484-486.

Kirch, W (2008). *Oral Health Behavior*. Encyclopedia of Public Health.. Dordrecht, Springer Netherlands**:** 1040-1040.

Kirkwood, B. R. (2003). *Essential medical statistics*. Malden, Mass., Malden, Mass. Blackwell Science.

Koch, G. (1982). *Intraclass correlation coefficient*. New Tork, John Wiley & Sons.

Kok, G., G.-J. Y. Peters, L. T. E. Kessels, G. A. ten Hoor and R. A. C. Ruiter (2018). *Ignoring theory and misinterpreting evidence: the false belief in fear appeals*. Health Psychology Review **12**(2): 111-125.

Koo, T. K. and M. Y. Li (2016). *A Guideline of Selecting and Reporting Intraclass Correlation Coefficients for Reliability Research*. Journal of chiropractic medicine **15**(2): 155-163.

Kowash, M. B., A. Pinfield, J. Smith and M. E. Curzon (2000). *Effectiveness on oral health of a long-term health education programme for mothers with young children*. British Dental Journal **188**(4): 201.

Krouwer, J. S. (2008). *Why Bland-Altman plots should use X, not (Y+X)/2 when X is a reference method*. Stat Med **27**(5): 778-780.

Kuhnisch, J., I. Goddon, S. Berger, H. Senkel, K. Bucher, et al. (2009). *Development, methodology and potential of the new Universal Visual Scoring System (UniViSS) for caries detection and diagnosis*. Int J Environ Res Public Health **6**(9): 2500-2509.

Lambert, S. D. and C. G. Loiselle (2007). *Health Information—Seeking Behavior*. Qualitative Health Research **17**(8): 1006-1019.

Landis, J. R. and G. Koch (1977). *The Measurement of Observer Agreement for Categorical Data*. Biometrics **33**(1): 159-174.

Laws, R. A., E.-K. V. Litterbach, E. A. Denney-Wilson, C. G. Russell, S. Taki, et al. (2016). *A Comparison of Recruitment Methods for an mHealth Intervention Targeting Mothers: Lessons from the Growing Healthy Program*. Journal of medical Internet research **18**(9): e248-e248.

Lee, C. and P. Bobko (1994). *Self-Efficacy Beliefs: Comparison of Five Measures*. Journal of Applied Psychology **79**(3): 364-369.

Lee, J. Y., K. Divaris, A. D. Baker, R. G. Rozier and W. F. Vann (2012). *The Relationship of Oral Health Literacy and Self-Efficacy with Oral Health Status and Dental Neglect*. American Journal of Public Health **102**(5): 923-929.

Lemos, L. V. F. M., S. I. Myaki, L. R. d. F. Walter and A. C. C. Zuanon (2014). *Oral health promotion in early childhood: age of joining preventive program and behavioral aspects*. Einstein (Sao Paulo) **12**(1): 6-10.

Leong, P. M., M. G. Gussy, S. Y. L. Barrow, A. Silva-Sanigorski and E. Waters (2013). *A systematic review of risk factors during first year of life for early childhood caries.* International Journal of Paediatric Dentistry **23**(4): 235-250.

Letherby, G., J. Scott and M. Williams (2012). *Objectivity and Subjectivity in Social Research*. SAGE Publications. London UK.

Lewis, J., R. Cuthbert and S. Sarre (2011). *What are Children's Centres? The Development of CC Services, 2004-2008.(Report).* Social Policy & Administration **45**(1): 35.

Lewney J., R. D. Holmes, J. Rankin and C. Exley (2019). *Health visitors' views on promoting oral health and supporting clients with dental health problems: a qualitative study*. J Public Health (Oxf) **41**(1): e103-e108.

Lin, YL., Davies, K. & Callery, P (2017). *Experience of maintaining tooth brushing for children born with a cleft lip and/or palate.* BMC Oral Health 17, 120

Locker D (2000). *Deprivation and oral health: a review.* Community Dent Oral Epidemiol. Jun; **28**(3):161-9.

Lotto M., Strieder A P., Ayala Aguirre P E., Oliveira T M., Andrade Moreira Machado M A., Rios D. and Cruvinel T (2020). *Parental-oriented educational mobile messages to aid in the control of early childhood caries in low socioeconomic children: A randomized controlled trial.* Journal of Dentistry 101: 103456-103456.

Luszczynska, A., U. Scholz and R. Schwarzer (2005). *The General Self-Efficacy Scale: Multicultural Validation Studies*. J Psychol **139**(5): 439-457.

Macht, M. (2008). *How emotions affect eating: A five-way model.* Appetite **50**(1): 1-11.

Malcom, D. R. (2019). *The Critical Role of Self-Compassion and Empathy in Well-Being*. American journal of pharmaceutical education **83**(10): 7784-7784.

Marcatto, F. and D. Ferrante (2008). *The Regret and Disappointment Scale: An instrument for assessing regret and disappointment in decision making*. Judgment and Decision making **3**(1): 87-99.

Marmot M (2019) Blog: *The Marmot Review 10 years on.* The Health Foundation. https://www.health.org.uk/ news-and-comment/blogs/the-marmot-review-10-years-on

Martinez-Brockman, J. L., N. Harari and R. Pérez-Escamilla (2018). *Lactation Advice through Texting Can Help: An Analysis of Intensity of Engagement via Two-Way Text Messaging.* J Health Commun **23**(1): 40-51.

Matsuda, Y., M. Karino and T. Kanno (2020). *Development and Validation of the Oral Health-Related Self-Efficacy Scale for Cancer Patients.* Journal of cancer education: the official journal of the American Association for Cancer Education.

Mattheus, D. J. (2010). *Vulnerability related to oral health in early childhood: a concept analysis*. Journal of Advanced Nursing **66**(9): 2116-2125.

Maxwell, J. and K. Mittapalli (2010). *Handbook of Mixed Methods in Social and Behavioral Research.* Thousand Oaks, California, Sage Publications.

McGrath, C. (2019). *Behavioral Sciences in the Promotion of Oral Health*. J Dent Res **98**(13): 1418-1424.

Menegaz, A. M., A. E. R. Silva and A. M. Cascaes (2018). *Educational interventions in health services and oral health: systematic review.* Revista de saude publica **52**: 52-52.

Michie, S., M. Johnston, C. Abraham, R. Lawton, D. Parker and A. Walker (2005). *Making psychological theory useful for implementing evidence based practice: a consensus approach*. Quality & safety in health care **14**(1): 26-33.

Miller, E., J. Y. Lee, D. A. DeWalt and W. F. Vann, Jr. (2010). *Impact of caregiver literacy on children's oral health outcomes.* Pediatrics **126**(1): 107-114.

Miller, W. R. and S. Rollnick (2012). *Motivational Interviewing: Helping People Change.* New York, New York: Guilford Publications.

Milne, A., C. A. Weijs, R. J. Haines-Saah and L. McLaren (2017). *Parents' online discussions about children's dental caries: A critical content analysis*. Canadian Journal of Public Health **108**(3): e265-e272.

Ministry of Housing, Communities and Local Government (2015). *English Indices of Deprivation*. Accessed November 2020. https://www.gov.uk/government/collections/english-indices-of-deprivation

Mitropoulos, C. M., M. A. Lennon and H. V. Worthington (1990). *A national calibration exercise for the British Association for the Study of Community Dentistry regional examiners.* Community Dent Health **7**(2): 179-187.

Mitropoulos, C. M., Pitts, N.B., Deery, C. (1992). *BASCD Trainers' Pack on Caries Diagnosis*. Dundee, Dental Health Services Research Unit.

Monaghesh, E. and A. Hajizadeh (2020). *The role of telehealth during COVID-19 outbreak: a systematic review based on current evidence*. BMC Public Health **20**(1): 1193.

Moncher, F. J. and R. J. Prinz (1991). *Treatment fidelity in outcome studies.* Clinical psychology review **11**(3): 247-266.

Morita, A., Y. Matsuyama, A. Isumi, S. Doi, M. Ochi et al. (2019). *Association between grandparent co-residence, socioeconomic status and dental caries among early school-aged children in Japan: A population-based prospective study*. Scientific Reports **9**(1): 11345.

Morris, Melanie Hall, Maureen Barton, Marietta Zane, Sadie P. Hutson, Rameela Raman, and R. Eric Heidel. 2021. *A Nurse-Navigated, Postpartum Support Text Messaging Intervention: Satisfaction Among Primiparous Women*. The Journal of Perinatal & Neonatal Nursing 35 (4): 330–39.

Mosa, A. S. M., I. Yoo and L. Sheets (2012). *A systematic review of healthcare applications for smartphones.* BMC Med Inform Decis Mak **12**(1): 67-67.

Mouradian, W. E. (2007). *Ethics and Leadership in Children's Oral Health*. Pediatr Dent **29**(1): 64-72.

Movsisyan, A., L. Arnold, R. Evans, B. Hallingberg, G. Moore, et al. (2019). *Adapting evidence-informed complex population health interventions for new contexts: a systematic review of guidance*. Implementation Science **14**(1): 105.

Moyers, T. B. P. D., L. N. M. S. Rowell, J. K. P. D. Manuel, D. P. D. Ernst and J. M. P. D. Houck (2016). *The Motivational Interviewing Treatment Integrity Code (MITI 4): Rationale, Preliminary Reliability and Validity*. J Subst Abuse Treat **65**: 36-42.

NetMums (2017). *Drop in Clinic*. Accessed March 2018 https://www.netmums.com/coffeehouse/drop-clinic-984/.

NHS (2012). *What to feed your baby.* Accessed October 2021. https://www.nhs.uk/start4life/weaning/what-to-feed-your-baby/around-6-months/

NHS (2019). *Baby teething symptoms*. Accessed October 2021. https://www.nhs.uk/conditions/baby/babys-development/teething/baby-teething-symptoms/

NHS Digital (2017). *Hospital Episode Statistics (HES).* Accessed May 2021. https://digital.nhs.uk/data-and-information/data-tools-and-services/data-services/hospital-episode-statistics.

NICE (2014). *Oral health: local authorities and partners*. Accessed October 2021. https://www.nice.org.uk/guidance/ph55.

NICE (2014a). *Recommendation 14: Ensure early years services provide additional tailored information and advice for groups at high risk of poor oral health*. Accessed October 2021. https://www.nice.org.uk/guidance/ph55.

NICE. (2020). *Feeding your baby sessions to deliver oral health messages.* Accessed October 2021. https://www.nice.org.uk/sharedlearning/feeding-your-baby-sessions-to-deliver-oral-health-messages

Noor-Mohammed, R. and S. Basha (2012). *Teething disturbances; prevalence of objective manifestations in children under age 4 months to 36 months*. Medicina oral, patologia oral y cirugia bucal **17**(3): e491-e494.

Office of the Director of Public Health, Plymouth County Council (Updated August 2019). *Dental extractions under general anaesthetic in plymouth children*. GA dental extractions report 2018-19_0.pdf

Ohara, Y., N. Yoshida, H. Kawai, S. Obuchi, H. Yoshida, et al. (2017). *Development of an oral health-related self-efficacy scale for use with older adults*. Geriatr Gerontol Int **17**(10): 1406-1411.

Owen-Jones, E., M.-J. Bekkers, C. C. Butler, R. Cannings-John, S. Channon, et al. (2013). *The effectiveness and cost-effectiveness of the Family Nurse Partnership home visiting programme for first time teenage mothers in England: a protocol for the Building Blocks randomised controlled trial*. BMC Pediatrics **13**(1): 114.

Palmer, C. (2019). *Use of a text messaging service for communication with parents and carers*. Primary health care **29**(2): 22-25.

Paranyushkin, D. (2011). *Identifying the pathways for meaning circulation using text network analysis*. Computer Science

Patey, A. M., C. S. Hurt, J. M. Grimshaw and J. J. Francis (2018). *Changing behaviour 'more or less'—do theories of behaviour inform strategies for implementation and de-implementation? A critical interpretive synthesis*. Implementation Science **13**(1): 134.

Perez-Bret, E., R. Altisent and J. Rocafort (2016). *Definition of compassion in healthcare: a systematic literature review*. Int J Palliat Nurs **22**(12): 599-606.

Petersen P.E (2010). *Improvement of global oral health--the leadership role of the World Health Organization*. Community Dent Health. Dec; **27**(4):194-8. PMID: 21473352.

Phantumvanit, P., Y. Makino, H. Ogawa, A. Rugg-Gunn, P. Moynihan, et al. (2018). *WHO Global Consultation on Public Health Intervention against Early Childhood Caries.* Community Dentistry and Oral Epidemiology **46**(3): 280-287.

Pine, C., N. Pitts and Z. J Nugent (1997). *British Association for the Study of Community Dentistry (BASCD) guidance on the statistical aspects of training and calibration of*

examiners for surveys of child dental health. A BASCD coordinated dental epidemiology programme quality standard. **14 Suppl 1**: 18-29

Pitts, N. B., D. J. Evans and C. M. Pine (1997). *British Association for the Study of Community Dentistry (BASCD) diagnostic criteria for caries prevalence surveys-1996/97*. Community Dent Health **14 Suppl 1**: 6-9.

Pitts, N. B. and J. W. Stamm (2004). *International Consensus Workshop on Caries Clinical Trials (ICW-CCT)—Final Consensus Statements: Agreeing Where the Evidence Leads.* J Dent Res **83**(1_suppl): 125-128.

Pla, G. W. (1994). *Oral health and nutrition.* Primary care **21**(1): 121-133.

Plutzer, K. and M. J. N. C. Keirse (2014). *Influence of an Intervention to Prevent Early Childhood Caries Initiated before Birth on Children's Use of Dental Services up to 7 Years of Age.* The Open Dentistry Journal **8**: 104-108.

Plutzer, K. and A. J. Spencer (2008). *Efficacy of an oral health promotion intervention in the prevention of early childhood caries.* Community Dent Oral Epidemiol **36**(4): 335-346.

Pozzebon, M. (2017). *The Sage Handbook Of Action Research: Participative Inquiry and Practice*. Journal of Business Management **57**(4): 415.

Pew Research Centre (2021). *Social Media Use in 2021.* Accessed September 2021. https://www.pewresearch.org/internet/2021/04/07/social-media-use-in-2021/

Preston, N. J., M. C. Farquhar, C. E. Walshe, C. Stevinson, G. Ewing, et al. (2016). *Strategies designed to help healthcare professionals to recruit participants to research studies.* Cochrane Database of Systematic Reviews(2).

Prochaska, J. O., C. C. DiClemente, W. F. Velicer, S. Ginpil and J. C. Norcross (1985). *Predicting change in smoking status for self-changers*. Addict Behav **10**(4): 395-406.

Public Health England (2009). *Sugar.* Accessed October 2021. https://www.nhs.uk/change4life/food-facts/sugar.

Public Health England (2016). *Improving oral health: a toolkit to support commissioning of supervised toothbrushing programmes in early years and school settings*. Accessed May 2018. https://www.gov.uk/government/publications/improving-oral-health-supervised-tooth-brushing-programme-toolkit.

Public Health England (2017). *Health Matters: Child Dental Health*. Accessed October 2021 https://www.gov.uk/government/publications/health-matters-child-dental-health.

Public Health England (2018). *National Dental Epidemiology Programme for England: oral health survey of five-year-old children 2017.* Accessed July 2021. https://NDEP_for_England_OH_Survey_5yr_2017_Report.pdf

Public Health England (2021). *Delivering Better Oral Health. An evidence based toolkit*. Accessed October 2021. https://www.gov.uk/government/publications/delivering-better-oral-health-an-evidence-based-toolkit-for-prevention.

Rabiei, S., S. Z. Mohebbi, K. Patja and J. I. Virtanen (2012). *Physicians' knowledge of and adherence to improving oral health*. BMC Public Health **12**(1): 855.

Ranganathan, P., C. S. Pramesh and R. Aggarwal (2017). *Common pitfalls in statistical analysis: Measures of agreement.* Perspectives in clinical research **8**(4): 187-191.

Ridgway, L., N. Hackworth, J. M. Nicholson and L. McKenna (2020). *Working with families: A systematic scoping review of family-centred care in universal, community-based maternal, child, and family health services*. Journal of Child Health Care **25**(2): 268-289.

Riggs, E., N. Kilpatrick, L. Slack-Smith, B. Chadwick, J. Yelland, et al. (2019). *Interventions with pregnant women, new mothers and other primary caregivers for preventing early childhood caries.* Cochrane Database Syst Rev **2019**(11).

Richie, J. Spencer, L. (2004). *Analysing Qualitative Data.* SAGE Publications. London. 10: 172-194

Richardson, Brittany Paige, Jeannie van der Linde, Bhavani Pillay, and De Wet Swanepoel. 2021. *Do Text Messages about Health and Development in Young Children Affect Caregiver Behaviour and Child Outcomes? A Systematic Review*. Health Education Journal 80 (2): 225–37.

Robinson, L. (2018). *An investigation of the predictors, barriers and facilitators to recruitment and retention of children and families to oral health trials*. PhD Thesis, University of Liverpool.

Roden, J. (2003). *Capturing parents' understanding about the health behaviors they practice with their preschool-aged children*. Issues Compr Pediatr Nurs **26**(1): 23-44.

Rollnick, S., C. C. Butler, P. Kinnersley, J. Gregory and B. Mash (2010). *Motivational interviewing*. BMJ **340**(7758): 1242-c1900.

Rose, G. (1985). *Sick individuals and sick populations*. Int J Epidemiol **14**(1): 32-38.

Rose, J., K. Lynn, J. Akister, F. Maxton and S. A. Redsell (2021). *Community midwives' and health visitors' experiences of research recruitment: a qualitative exploration using the Theoretical Domains Framework.* Primary Health Care Research & Development **22**: e5.

Rosenstock, I. M. (1974). *Historical origins of the health belief model*. Health education monographs **2**(4): 328-335.

Royal College of Anaesthetists (2008) *Your Child's General Anaesthetic. Information for parents and guardians of children.* 07-ChildsAnaestheticweb.pdf

Royal College of Surgeons. (2017). *Shocking 24% increase in tooth extractions performed on children aged 0-4 in last decade.* Accessed May 2020. https://www.rcseng.ac.uk/news-and-events/media-centre/press-releases/child-tooth-extractions-24-per-cent/

Russell, E. G., J. M. David, B. Arne, R. Debra and A. E. Paul (2005). *Practical Clinical Trials for Translating Research to Practice: Design and Measurement Recommendations.* Med Care **43**(6): 551-557.

Sadeh, A., L. Tikotzky and A. Scher (2010). *Parenting and infant sleep*. Sleep Medicine Reviews **14**(2): 89-96.

Sale, J. E. M., L. H. Lohfeld and K. Brazil (2002). *Revisiting the Quantitative-Qualitative Debate: Implications for Mixed-Methods Research*. Quality and Quantity **36**(1): 43-53.

Saltaji, H., S. Armijo-Olivo, G. G. Cummings, M. Amin, B. R. da Costa et al. (2018). *Influence of blinding on treatment effect size estimate in randomized controlled trials of oral health interventions*. BMC medical research methodology **18**(1): 42-42.

Sbaraini, A., S. M. Carter, R. W. Evans and A. Blinkhorn (2012). *Experiences of dental care: what do patients value?* BMC Health Services Research **12**(1): 177.

Scholz, U., B. Gutiérrez-Doña, S. Sud and R. Schwarzer (2002). *Is General Self-Efficacy a Universal Construct? Psychometric Findings from 25 Countries.* European Journal of Psychological Assessment **18**: 242-251.

Schou, L. and A. S. Blinkhorn (1993). *Oral Health Promotion*, OUP Oxford.

Schwarzer, R., & Jerusalem, M. (1995). *Generalized Self-Efficacy scale*. *Measures in health psychology: A user's portfolio*. Causal and control beliefs: 35-37.

Sekhon, M., M. Cartwright and J. J. Francis (2017). *Acceptability of healthcare interventions: an overview of reviews and development of a theoretical framework.* BMC Health Services Research **17**(1): 88.

Sheeran, P., and Webb, T. L. (2016) *The Intention–Behavior Gap. Social and Personality Psychology Compass*. **10**: 503– 518.

Shoaib, L., C. Deery, D. N. Ricketts and Z. J. Nugent (2009). *Validity and reproducibility of ICDAS II in primary teeth*. Caries Res **43**(6): 442-448.

Silberzahn, R., E. L. Uhlmann, D. P. Martin, P. Anselmi, F. Aust, E. et al. (2018). *Many Analysts, One Data Set: Making Transparent How Variations in Analytic Choices Affect Results*. Advances in Methods and Practices in Psychological Science **1**(3): 337-356.

Silva-Sanigorski, A., R. Ashbolt, J. Green, H. Calache, B. Keith, et al. (2013). *Parental self-efficacy and oral health-related knowledge are associated with parent and child oral health behaviors and self-reported oral health status*. Community Dentistry & Oral Epidemiology **41**(4): 345-352.

Sim, J. and M. Lewis (2012). *The size of a pilot study for a clinical trial should be calculated in relation to considerations of precision and efficiency*. J Clin Epidemiol **65**(3): 301-308.

Sinclair, S., L. B. Russell, T. F. Hack, J. Kondejewski and R. Sawatzky (2017). *Measuring Compassion in Healthcare: A Comprehensive and Critical Review*. Patient **10**(4): 389-405.

Skeie, M. S., E. Skaret, I. Espelid and N. Misvær (2011). *Do public health nurses in Norway promote information on oral health?* BMC oral health **11**(1): 23.

Smith, S.R., Kroon, J., Schwarzer, R. and Hamilton, K (2021). *Social-cognitive predictors of parental supervised toothbrushing: An application of the health action process approach.* Br J Health Psychol, **26**: 995-1015

Soltani, R., G. Sharifirad, B. Mahaki and A. A. Eslami (2018). *Determinants of Oral Health Behavior among Preschool Children: Application of the Theory of Planned Behavior*. J Dent (Shiraz) **19**(4): 273-279.

Soutome, S., K. Kajiwara and T. Oho (2011). *Combined use of self-efficacy scale for oral health behaviour and oral health questionnaire: A pilot study*. Health education journal **71**(5): 576-589.

Sparkol. (2020). *VideoScribe for Education.* Accessed May 2018. https://www.videoscribe.co/en/Education.

Spitz, A. S., K. Weber-Gasparoni, M. J. Kanellis and F. Qian (2006). *Child Temperament and Risk Factors for Early Childhood Caries*. J Dent Child (Chic) **73**(2): 98-104.

Stephen, K. W., L. M. D. Macpherson, W. H. Gilmour, R. A. M. Stuart and M. C. W. Merrett (2002). *A blind caries and fluorosis prevalence study of school-children in naturally fluoridated and nonfluoridated townships of Morayshire, Scotland*. Community Dentistry and Oral Epidemiology **30**(1): 70-79.

Sushanth, V. H., M. Krishna, A. M. Suresh Babu, G. M. Prashant and G. N. Chandu (2011). *A peer group approach model of oral health promotion among orphans at Puduchery, South India*. Journal of International Society of Preventive & Community Dentistry **1**(2): 71-75.

Tamanna, T., R. Nayanjot, C. Eivi, G. Hilda and C. Mirna (2017). *A Community-Based Participatory Research Approach to Understand Urban Latino Parent's Oral Health Knowledge and Beliefs*. Int J Dent **2017**: 9418305-9418306.

Thomas, N. (2021). *Should photographic triage become common practice?* Evidence-Based Dentistry **22**(2): 52-53.

Thomas, N., S. Blake, C. Morris and D. R. Moles (2018). *Autism and primary care dentistry: parents' experiences of taking children with autism or working diagnosis of autism for dental examinations.* International Journal of Paediatric Dentistry **28**(2): 226-238.

Thomson, G., K. Ebisch-Burton and R. Flacking (2015). *Shame if you do – shame if you don't: women's experiences of infant feeding*. Matern Child Nutr **11**(1): 33-46.

Threlfall, A. G., C. M. Hunt, K. M. Milsom, M. Tickle and A. S. Blinkhorn (2007). *Exploring factors that influence general dental practitioners when providing advice to help prevent caries in children*. Br Dent J **202**(4): E10; discussion 216-217.

Timimi, F. K. (2012). *Medicine, morality and health care social media*. BMC Medicine **10**(1): 83.

Tunis, S. R., D. B. Stryer and C. M. Clancy (2003). *Practical Clinical Trials: Increasing the Value of Clinical Research for Decision Making in Clinical and Health Policy*. JAMA **290**(12): 1624-1632.

Tyng, C. M., H. U. Amin, M. N. M. Saad and A. S. Malik (2017). *The Influences of Emotion on Learning and Memory.* Frontiers in psychology **8**: 1454-1454.

University of Plymouth (2020). *Guidance for Assessor/Supervisors and learners when carrying out unaccompanied home visits and for the use of learners' own vehicle for placement activity*. Accessed October 2021. https://www.plymouth.ac.uk/student-life/your-studies/academic-services/poppi/policies-procedures-and-guidelines

UyBico, S. J., S. Pavel and C. P. Gross (2007). *Recruiting Vulnerable Populations into Research: A Systematic Review of Recruitment Interventions.* Journal of General Internal Medicine **22**(6): 852-863.

Vadiakas, G (2008). *Case definition, Aetiology and Risk assessment of Early Childhood Caries (ECC): A revisited review.* Eur Arch Paediatr Dent **9**, 114–125.

Van den Branden, S., S. Van den Broucke, R. Leroy, D. Declerck and K. Hoppenbrouwers (2015). *Predicting oral health-related behaviour in the parents of preschool children: An application of the Theory of Planned Behaviour.* Health education journal **74**(2): 221-230.

Vanagas, G., Z. Milasauskiene, V. Grabauskas and A. Mickeviciene (2009). *Associations between parental skills and their attitudes toward importance to develop good oral hygiene skills in their children*. Medicina (Kaunas) **45**(9): 718-723.

Vangipuram, S., A. Jha, R. Raju and M. Bashyam (2016). *Effectiveness of Peer Group and Conventional Method (Dentist) of Oral Health Education Programme Among 12-15 year Old School Children - A Randomized Controlled Trial*. Journal of clinical and diagnostic research : JCDR **10**(5): ZC125-ZC129.

Vansteenkiste, M. and K. M. Sheldon (2006). *There's nothing more practical than a good theory: integrating motivational interviewing and self-determination theory*. British Journal of Clinical Psychology **45**(1): 63-82.

Vasiljevic, M., Y.-L. Ng, S. J. Griffin, S. Sutton and T. M. Marteau (2016). *Is the intention–behaviour gap greater amongst the more deprived? A meta-analysis of five studies on physical activity, diet, and medication adherence in smoking cessation*. British Journal of Health Psychology **21**(1): 11-30.

Versi, E. (1992). *"Gold standard" is an appropriate term*. BMJ (Clinical research ed.) **305**(6846): 187-187.

Viera, A. J. and J. M. Garrett (2005). *Understanding interobserver agreement: the kappa statistic*. Family medicine **37**(5): 360.

Wade, K. J. (2013). *Oral hygiene behaviours and readiness to change using the TransTheoretical Model (TTM).* N Z Dent J **109**(2): 64-68.

Wallace, M., M.-J. Saurel-Cubizolles and Eden mother–child cohort study group (2013). *Returning to work one year after childbirth: data from the mother-child cohort EDEN*. Maternal and child health journal **17**(8): 1432-1440.

Wamala, S., J. Merlo, G. Bostrom and C. Hogstedt (2007). *Perceived discrimination, socioeconomic disadvantage and refraining from seeking medical treatment in Sweden*. J Epidemiol Community Health **61**(5): 409-415.

Wan, A. K. L., W. K. Seow, D. M. Purdie, P. S. Bird, L. J. Walsh et al. (2003). *A Longitudinal Study of Streptococcus mutans Colonization in Infants after Tooth Eruption.* J Dent Res **82**(7): 504-508.

Watt, R. G. (2002). *Emerging theories into the social determinants of health: implications for oral health promotion.* Community Dentistry and Oral Epidemiology **30**(4): 241-247.

Webb, T. L., J. Joseph, L. Yardley and S. Michie (2010). *Using the internet to promote health behavior change: a systematic review and meta-analysis of the impact of theoretical basis, use of behavior change techniques, and mode of delivery on efficacy*. Journal of medical Internet research **12**(1): e4.

Webb, T. L. and P. Sheeran (2006). *Does changing behavioral intentions engender behavior change? A meta-analysis of the experimental evidence*. Psychol Bull **132**(2): 249-268.

Wei, J., Hollin, I., Kachnowski, S., et al (2011). *A review of the use of mobile phone text messaging in clinical and health behaviour interventions.* J of Telemed Telecare. **17**(1): 41-8

Weiner, I. B. (2003). *Psychotherapy Relationships That Work: Therapist Contributions and Responsiveness to Patients*. Psychother Res **13**(4): 529-532.

West, R. (2005). *Time for a change: putting the Transtheoretical (Stages of Change) Model to rest*. Addiction **100**(8): 1036-1039.

Weston-Price, S., J. Csikar, K. Vinall-Collier, P. Bishop, D. D'Antoni et al. (2020). *Barriers and facilitators to health visiting teams delivering oral health promotion to families of young children: a mixed methods study with vignettes.* Community Dent Health **37**(4): 260-268.

Whitmarsh, J. (2008). *Mums, Dummies and 'Dirty Dids': The Dummy as a Symbolic Representation of Mothering?* Children & society **22**(4): 278-290.

Whittaker, R., McRobbie, H., Bullen, C., et al. (2019). *Mobile phone text messaging and app-based interventions for smoking cessation.* Cochrane Database of Systematic Reviews. **10**: CD006611.

Willcox, J. C., R. Dobson and R. Whittaker (2019). *Old-Fashioned Technology in the Era of "Bling": Is There a Future for Text Messaging in Health Care?* J Med Internet Res **21**(12): e16630.

Williams, N. J., J. G. Whittle and A. C. Gatrell (2002). *The relationship between socio-demographic characteristics and dental health knowledge and attitudes of parents with young children.* British Dental Journal **193**(11): 651-654.

Williams, P. (2020). *'It all sounds very interesting, but we're just too busy!': exploring why 'gatekeepers' decline access to potential research participants with learning disabilities.* European Journal of Special Needs Education **35**(1): 1-14.

Wilson, A. R., K. A. Fehringer, W. G. Henderson, K. Venner, J. Thomas, et al. (2018). *Fidelity of motivational interviewing in an American Indian oral health intervention.* Community Dent Oral Epidemiol **46**(3): 310-316.

Wilson, A. R., M. J. Mulvahill and T. Tiwari (2017). *The Impact of Maternal Self-Efficacy and Oral Health Beliefs on Early Childhood Caries in Latino Children*. Frontiers in public health **5**: 228-228.

World Health Organisation (2008). *Closing the gap in a generation: health equity through action on the social determinants of health – final report of the Commission on Social Determinants of Health.* WHO_IER_CSDH_08.1_eng.pdf

World Health Organization (2013). *Oral Health Surveys: Basic Methods*, World Health Organization. Fourth Edition.

World Health Organisation (2019). *What is the burden of oral disease?* Accessed July 2020. https://www.who.int/oral_health/disease_burden/global/en/.

World Health Organisation (2020). *Oral Health Information Systems.* Accessed July 2020. https://www.who.int/oral_health/action/information/surveillance/en/.

World Health Organisation (2021). *Mobile technologies for oral health: an implementation guide.* Published September 2021. 9789240035225-eng.pdf https://www.who.int/publications/i/item/9789240035225

Wu, J., K. S. Dean, Z. Rosen and P. A. Muennig (2017). *The Cost-effectiveness Analysis of Nurse-Family Partnership in the United States*. Journal of health care for the poor and underserved **28**(4): 1578.

Wu, Y.-C., C.-S. Chen and Y.-J. Chan (2020). *The outbreak of COVID-19: An overview*. Journal of the Chinese Medical Association **83**(3).

Xiong, J., O. Lipsitz, F. Nasri, L. M. W. Lui, H. Gill, et al. (2020). *Impact of COVID-19 pandemic on mental health in the general population: A systematic review*. Journal of Affective Disorders **277**: 55-64.

Yevlahova, D. and J. Satur (2009). *Models for individual oral health promotion and their effectiveness: a systematic review*. Australian Dental Journal **54**(3): 190-197.

Zachariadis, M., S. Scott and M. Barrett (2013). *Methodological Implications of Critical Realism for Mixed-Methods Research*. MIS quarterly **37**(3): 855-879.

Zayas, L. H., K. R. B. Jankowski and M. D. McKee (2005). *Parenting Competency Across Pregnancy and Postpartum Among Urban Minority Women*. Journal of Adult Development **12**(1): 53-62.

Zelen, M. (1979). *A new design for randomized clinical trials.* N Engl J Med **300**(22): 1242-1245.

Zhang, J., L. Shi, D. Chen, J. Wang and Y. Wang (2009). *Using the Theory of Planned Behavior to examine effectiveness of an educational intervention on infant feeding in China*. Prev Med **49**(6): 529-534.

Zwarenstein, M. (2009). *What kind of randomized trials do patients and clinicians need?* Annals of internal medicine **150**(10): JC5.

PAPERS AND CONFERENCES

Published:

Thomas N, Blake S, Morris C, Moles DR (2018). *Autism and primary care dentistry: parents' experiences of taking children with autism or working diagnosis of autism for dental examinations*. International journal of paediatric dentistry. 28(2):226.

Thomas N (2021). *Should photographic triage become common practice?* Evidence-based Dentistry Vol 22, 52-53

Thomas N (2021). *Dental disease risk in children with autism: a meta-analysis.* Evidence-based Dentistry Vol 22, 34-35

Thomas N, Kay E, Witton R, Quinn C (2021). *Comparison of a full arch photographic assessment of caries prevalence in 4 to 5 year old children with an established visual assessment method: A cross sectional study.* BDJ Open. 7(1): 32

Schofield P, Thomas N, McColl E, Witton, R (2022). *Dental Pain in Care Homes: Is It a Phenomenon? A Systematic Review of the Literature.* Geriatrics, 7(5)

In preparation:

Thomas N, Nasser M, Blake S, Witton R, Kay E
Feasibility of Recruitment Approaches and the Effects of Engagement with a Vulnerable Population in an Oral Health Education Intervention: Gatekeeper Referrals, Direct-Approach or Social Media?

Thomas N, Nasser M, Blake S, Witton R, Kay E
Acceptability of a multicomponent oral health education intervention: supporting mothers in the first year of their infant's life using two-way text messaging

Thomas N, Nasser M, Blake S, Witton R, Kay E
Effectiveness of a multicomponent oral health education intervention: supporting self-efficacy in the uptake and maintenance of key oral health behaviours

Thomas N, Nasser M, Blake S, Witton R
Teething response: a new oral health behaviour?

Invited talks:

Using Videoscribe for recruitment and dissemination of findings.
Creative Communications Seminar, University of Exeter Medical School (December 2017).

Prevention vs damage limitation; supporting parents with their baby's dental health.
Health and Nutrition in the First Year of Life. Plymouth Guildhall (July 2018).

Conferences:

Thomas N, Kay E, Witton R, Quinn C (March 2017)
Design of an oral health intervention to prevent oral disease in a highly vulnerable child population. Poster presentation at the Annual Research Event, Plymouth, UK.

Thomas N, Blake S, Morris C, Moles DR (September 2017)
How Can We Improve Dental Services for Children with Autism?
Oral presentation at the British Association for Oral and Dental Research Annual Conference. Plymouth, UK.

Thomas N, Kay E, Witton R, Quinn C (March 2018)
Preliminary investigation of the effectiveness of an intervention to prevent oral disease in a highly vulnerable child population.
Poster presentation at the Annual Research Event, Plymouth, UK.

Thomas N, Kay E, Witton R, Quinn C (March 2019)
Comparison of using intra-oral images and BASCD epidemiological screening for dental disease: A novel approach to using Bland-Altman plots.
Poster presentation at the Annual Research Event, Plymouth, UK.

Thomas N, Kay E, Witton R (April 2019)
Validity of using photographs for screening dental disease in children.
Oral presentation at the International Association for Dental Research. Vancouver, Canada

Thomas N, Kay E, Witton R, Quinn C (July 2019).
Preliminary investigation into supporting parental self-efficacy for child oral health.
Poster presentation at the British Association for Oral and Dental Research Annual Conference. London, UK.

APPENDICES

APPENDIX A: Revisions to original protocol (Return to Page 20) (Return to Page 71) (Return to Page 187)

Revised Protocol

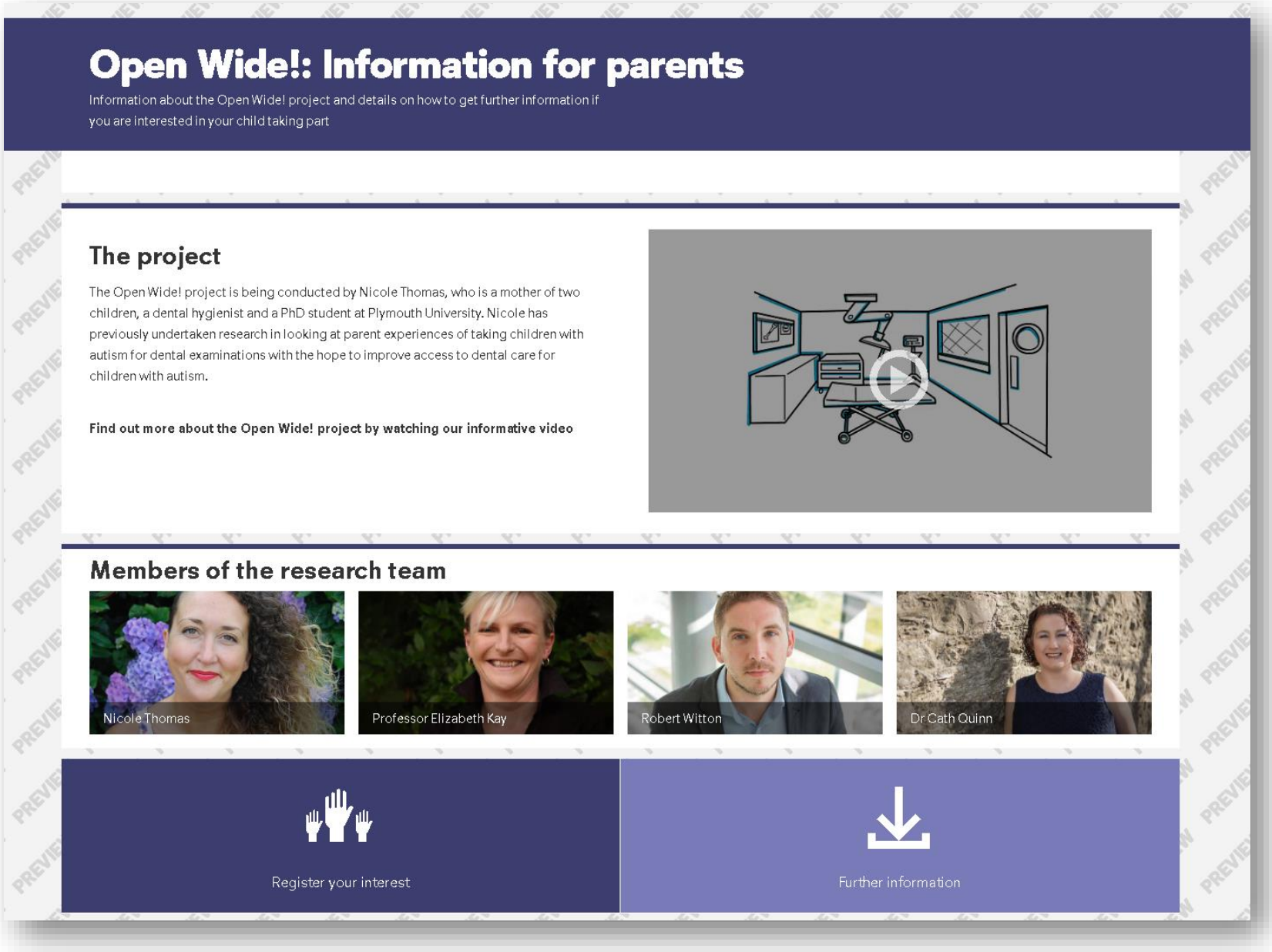
The original aim of this PhD was to conduct a two-stage study, running concurrently. The first stage of the PhD was to test a digital dental disease screening method, which if shown to be feasible and accurate, would be used as a caries outcome measurement tool for the end of the second stage. The second stage was to investigate the feasibility, acceptability and effectiveness of a two-year multi-component oral health education intervention, recruiting first time mothers from a vulnerable population to support them with their infants' oral health. The infants would have been aged between two to three years old upon completion of the intervention.

The research design was to follow the same recruitment strategy from an earlier pre-PhD study on which this PhD was influenced. However, due to the challenges encountered in replicating the pre-PhD study recruitment design, revisions needed to be made to the protocol. This was namely reducing the intervention length from two years to one year due to the length of time recruitment took. This also meant using a caries outcome measure was no longer appropriate due to the age of infants graduating from the intervention. However, the stage one study investigating a digital caries screening method still took place and the results of which are described within this thesis.

This appendix provides information on the key revisions made and reasons for deviating from the original protocol. These may also be of value to future oral health education interventions when choosing research strategies.

	Inclusion Criteria	Recruitment Strategy	Intervention Length	Caries outcome data collection	Social messaging platform
Original Protocol	First time caregivers only (primiparous)	Key gatekeepers from children's centres in contact with vulnerable families, and FNP practitioners, would refer and introduce eligible families to the principal investigator, as per the pre-PhD Study recruitment protocol.	Two years	BASCD examination to detect caries incidence, either using digital images or standard visual examination	Facebook closed group – by invitation only
Revised Protocol	Multiparous caregivers	In addition to above, mothers were approached directly at the children's centres (located in areas of high need). These children centres also shared the study details via their social media.	One year	No caries outcome measures included	Whatsapp
Reason for revision	Feedback from Children Centre Gatekeepers felt that their anecdotal evidence suggested caregivers with children who have already experienced dental treatment, in particular dental general anaesthesia were more motivated with their infant's oral health than first time mothers. Consultation with a researcher involved with the Family Nurse Partnership advised their studies had only been on first time mothers and suggested studies should explore the motivations of multiparous caregivers.	A number of challenges were encountered with replicating the pre-PhD study recruitment strategy to wider health services. In order to reach the recruitment target, additional strategies were employed. The difference in recruitment was considered when exploring engagement effectiveness and self-efficacy in the findings.	Due to the length of time recruitment took using the pre-PhD study strategy, it was no longer possible to support caregivers for two years.	Due to the revised length of invention, some infants would be too young for an examination leaving the results severely statistically underpowered. Effectiveness of the intervention will be concerned with the engagement approaches and behaviour uptake	Less user information available and only needed mobile number to engage Despite feedback from the RAG, not all participants used Facebook or wanted to

APPENDIX B: Screengrab of the university hosted 'Open Wide' project webpage Return to Page 40



APPENDIX C: Parent information leaflet for the stage one study

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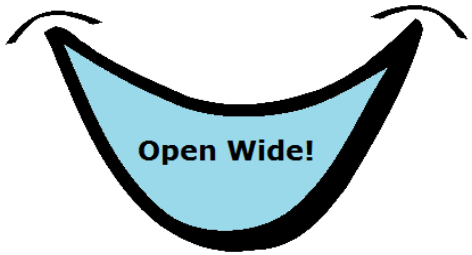
Version 1.0 March 2017 – Participant Information Leaflet (parents)

Parent Information Leaflet



Using Photographs to Assess the Oral Health of Children

Your child is being invited to take part in a research study looking at how effective using photos are for assessing the health of the mouth.

Before you decide, it is important for you to understand why the research is being carried out and what it will involve.

Please ask us if there is anything that is not clear or if you would like more information. You can find our contact details at the end of this leaflet.

If you give consent for your child to take part, you can withdraw from the research at any point during the study.

What is this research about?

This study is looking at how easy and reliable it is to use photos taken inside the mouth (intra-oral photographs) to see how healthy the mouth is.

The number of children needing teeth removed under general anaesthetic is still very high. Studies that help support families with oral health require ways to detect the levels of tooth decay at the beginning and end of the studies to be able to make comparisons. This can make studies of this kind very expensive.

By developing a quicker and cheaper way of evaluating the health of a child's mouth, it could open the door for future research to extensively explore how to make a positive influence on the oral health of children.

Do I qualify?

We are looking to take intra-oral photographs of 30 school children aged 4 and 5 years old.

What will happen if I decide to take part?

If you would like your child to take part, Nicole Thomas, a dental hygienist and researcher, will attend your child's school and carry out a fun lesson on how to look after teeth. The children will be given a free toothbrush and toothpaste and taught how to brush their teeth properly. After this, Nicole will take photographs of inside your child's mouth.

At the same time, a dentist will look inside your child's mouth to examine the teeth in the traditional way.

As the photographs will be focussed only on the teeth, there will be no way to identify your child from the photographs. Additional information such as child's age and gender may be collected to accompany the photographs. Names, addresses, or any other identifiable information will NOT be collected.

The children will NOT be by themselves with Nicole or the dentist at any time.

The photographs will be scored by Nicole and separately by an examiner. They will then compare their findings with the dentist to see how reliable photographs are for looking at the health of a child's mouth.

Who is carrying out the study?

Nicole, a mum to a 5 year old boy with autism and a 7 year old girl, qualified as a dental hygienist in 2004. Nicole has recently finished a study looking at parent experiences of taking a child with autism to the dentist.

Nicole is being supervised by Elizabeth Kay, a Professor of Dentistry at Plymouth University, Dr Cath Quinn, a Senior Research Fellow at Plymouth University and Dr Robert Witton, a Director of social engagement and community-based dentistry.

The research is being funded by Wrigley. Wrigley have no input into the design or analysis of this research.

Who has reviewed the study?

This study has been reviewed and approved by the Health & Human Sciences Research Ethics Committee at Plymouth University. <<INSERT REF NUMBER>>

Can parents change their mind and withdraw from the project?

You may withdraw from taking part in the research at any time, without giving a reason. If you would be willing to provide feedback on why you decided to withdraw, this information will be used to improve our studies in the future.

What about confidentiality?

All information collected during this study will be kept confidential. However, there is no reason to collect personal information for this study and photographs taken will not be identifiable.

What are the possible risks and benefits of taking part?

A child may feel uncomfortable with opening their mouth and having their picture taken. The child has a right to refuse and will not be forced to take part against their wishes.

If Nicole or the dentist notices any problems with your child's teeth, they will, in confidence, inform the teacher who will send your child home with a letter identifying the problem and how you may wish to resolve it.

By taking part, your child will receive a free toothbrush, toothpaste and extensive lesson on how to keep their teeth clean and why it is important to keep their teeth clean.

How will the information collected be stored and used?

All data collected for this study will be kept safely either in locked cabinets or in secure computer files at the Plymouth University. It will be held for five years before being destroyed.

What if I have a complaint?

If you have any concerns you should first speak to Nicole or Professor Kay, who will do their best to answer your questions (see contact details below).

If you have any complaints about the way in which this research has been carried out, please contact the Chair of the Health & human Sciences Research Ethics Committee:

Chair,
Health & Human Sciences Research Ethics Committee
Plymouth University
Drake Circus, Plymouth PL4 8AA
Tel: 01752 585339
Email: hhsethics@plymouth.ac.uk

Contact Us

If you have any questions about the study, either now or in the future, please feel free to contact:

Nicole Thomas
Room C507,
Portland Square,
Drake Circus,
Plymouth,
Devon, PL4 8AA

nicole.thomas@plymouth.ac.uk

Elizabeth Kay
Room C520,
Portland Square,
Drake Circus,
Plymouth,
Devon, PL4 8AA

elizabeth.kay@plymouth.ac.uk

Thank you for taking the time to consider this study.

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APPENDIX D: Example of a digital image assessment sheet Return to Page 43

UNIVERSITY OF PLYMOUTH

PHOTOGRAPHIC ANALYSIS – Open Wide Project

C018

Plaque measurement 0

0-Teeth appear clean
1- Little plaque visible
2- Substantial amount of plaque visible
9- Assessment could not be made

Right UPPER Left

E	D	C	B	A	A	B	C	D	E	
										D
										O
										M
										B
										P

Right LOWER Left

E	D	C	B	A	A	B	C	D	E	
										D
										O
										M
										B
										L

Tooth Codes

Extracted caries……..6
Unerupted or missing other…8

Surface codes

Sound….Blank, '-', Or 0
Hard, arrested caries……1
Decayed……2
Decay +pulpal involvement….3
Roots only remaining……3
Filled and decayed……4
Filled……5
Filled, needs replacement……R
Obvious sealant rest'n……N
Sealed surface……$
Crown……C
Trauma……T

APPENDIX E: Bland Altman Plots for all digital photographic assessors compared to the gold standard, for dt and dmft respectively. Plots include the mean digital photographic assessor scores and 95% confidence intervals (CI). Individual cases which fell outside of the 95% CI were explored to find explanations for disagreement.

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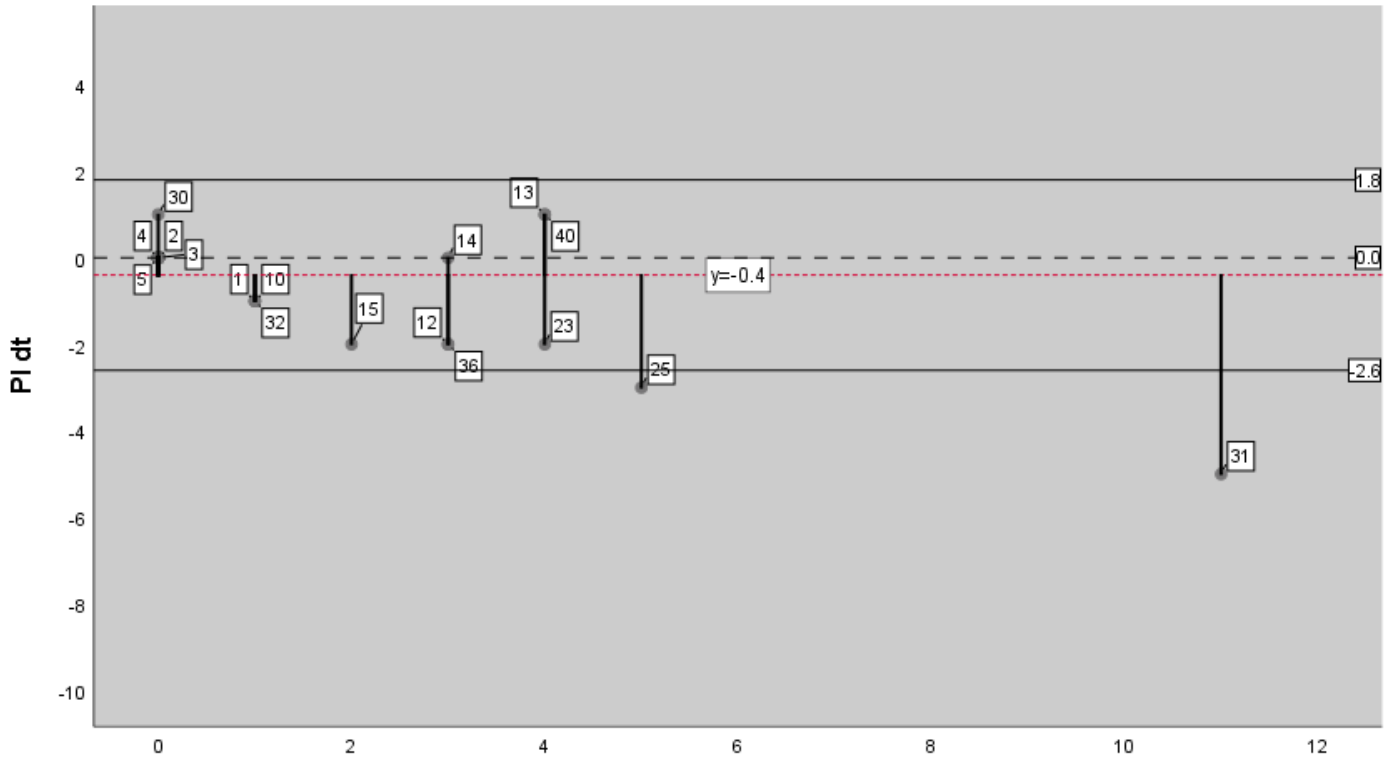

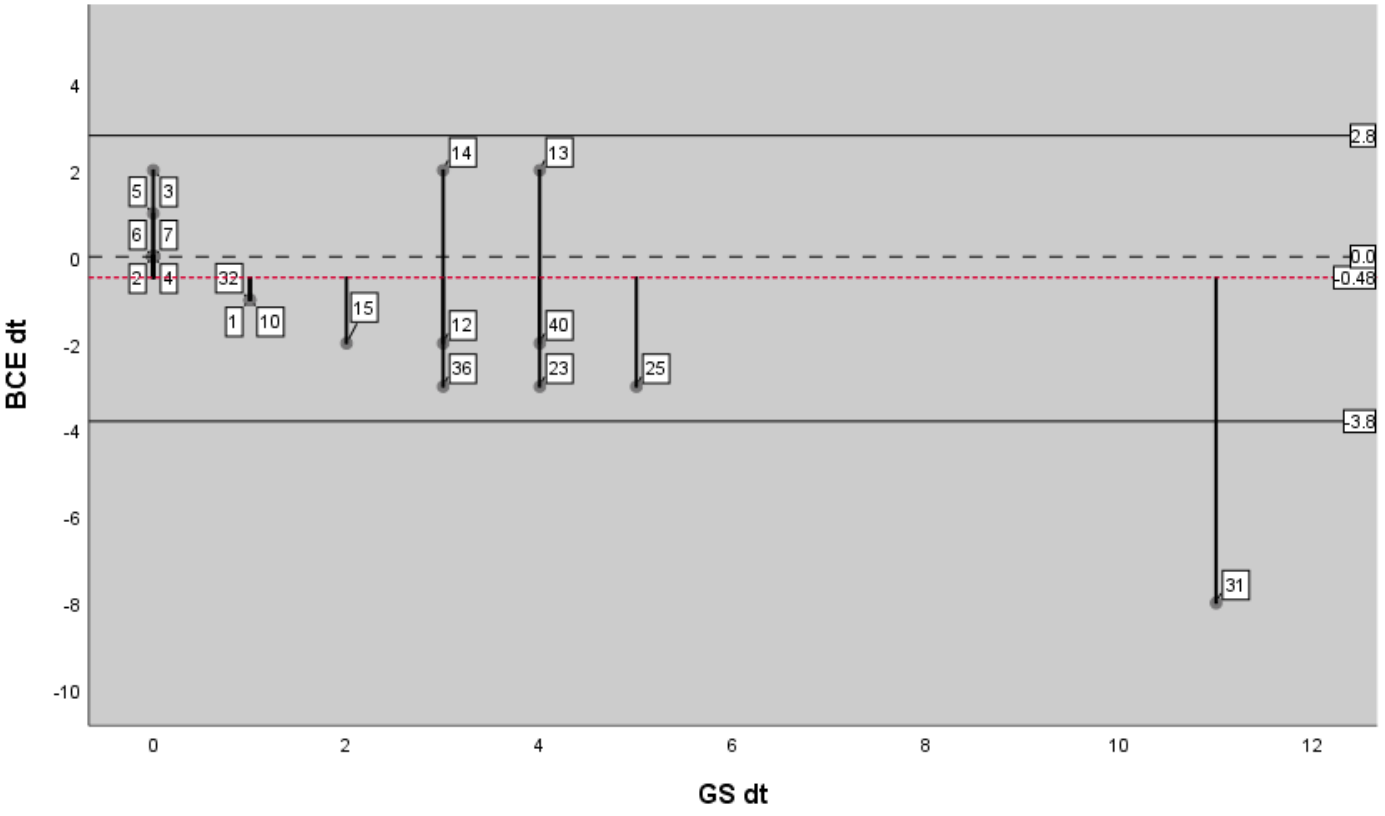

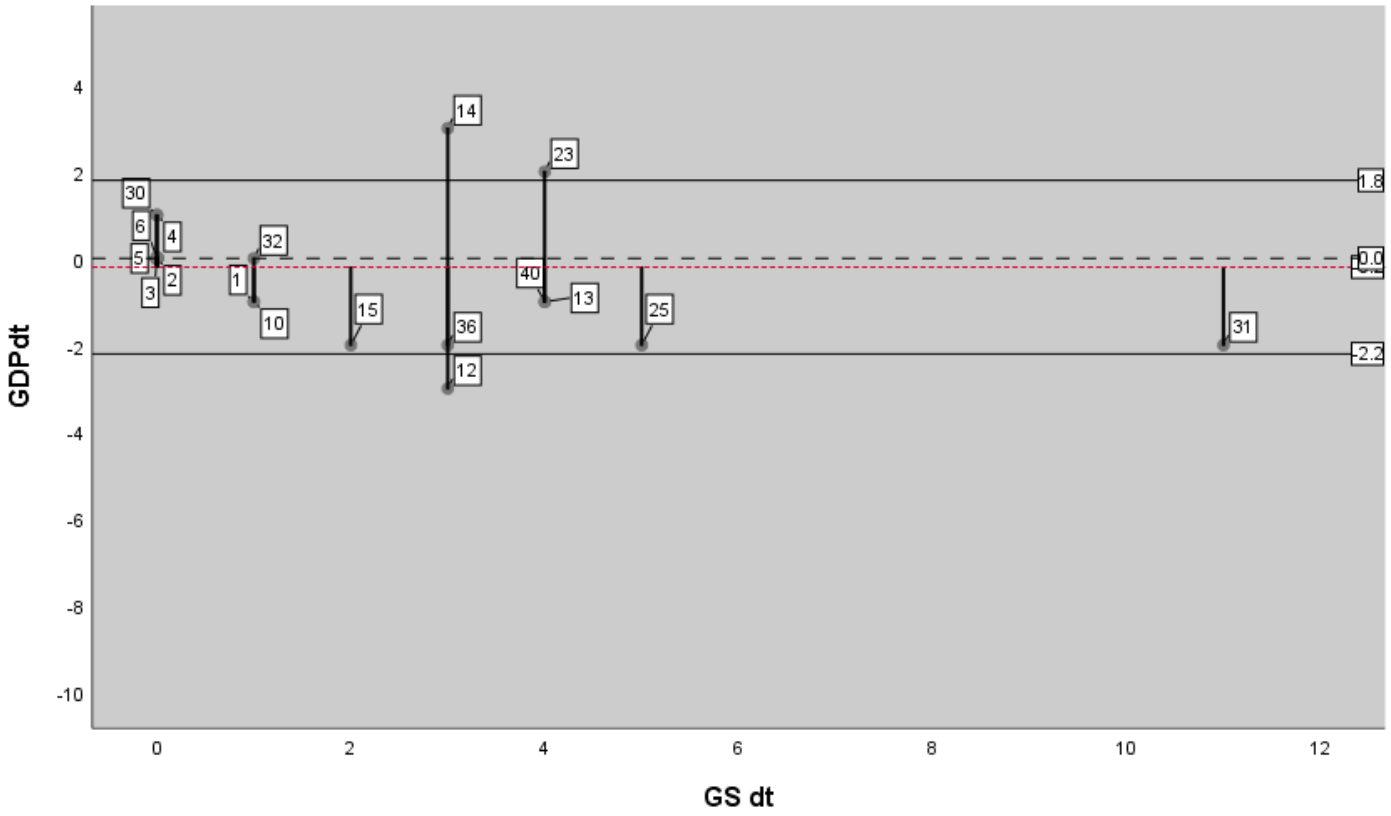
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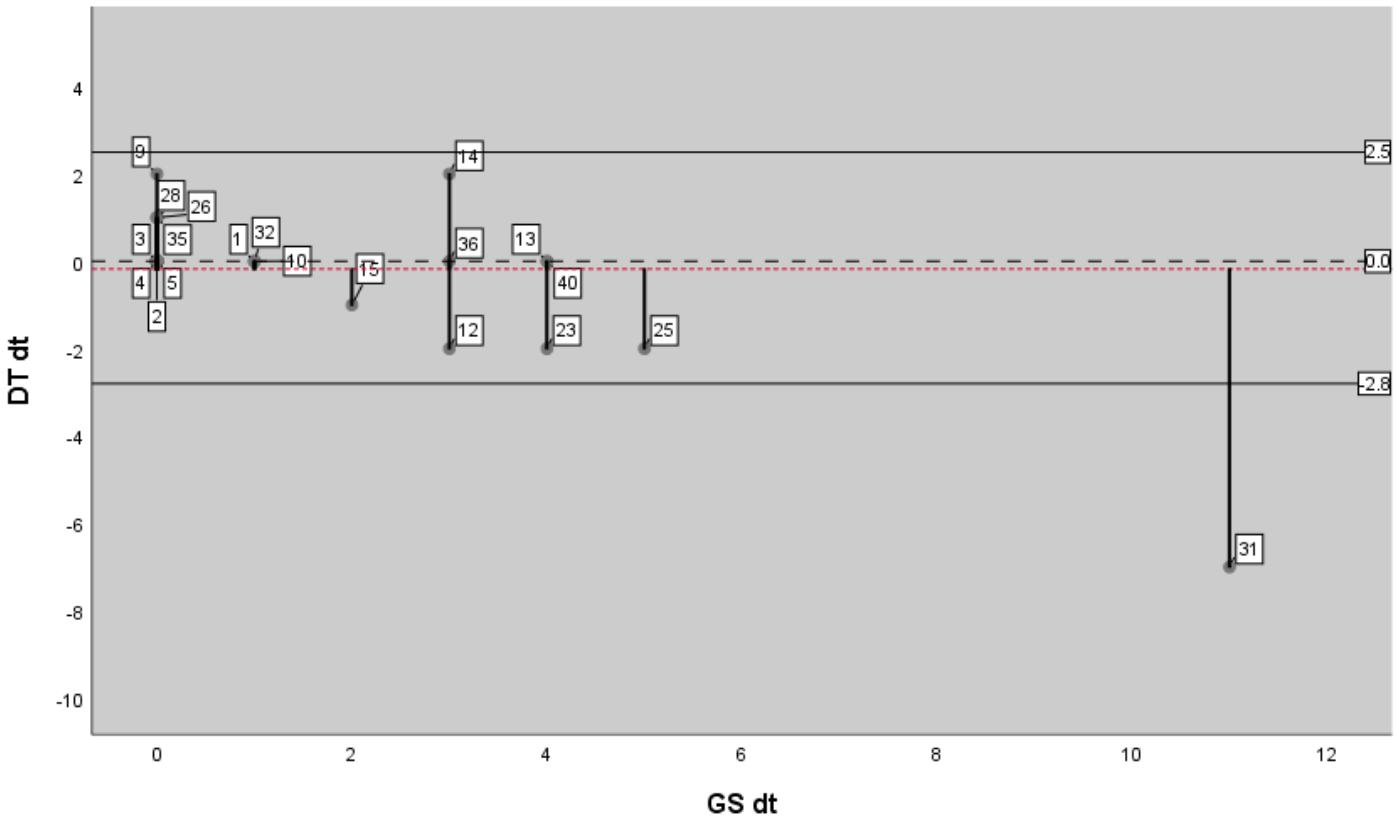
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3
35
4
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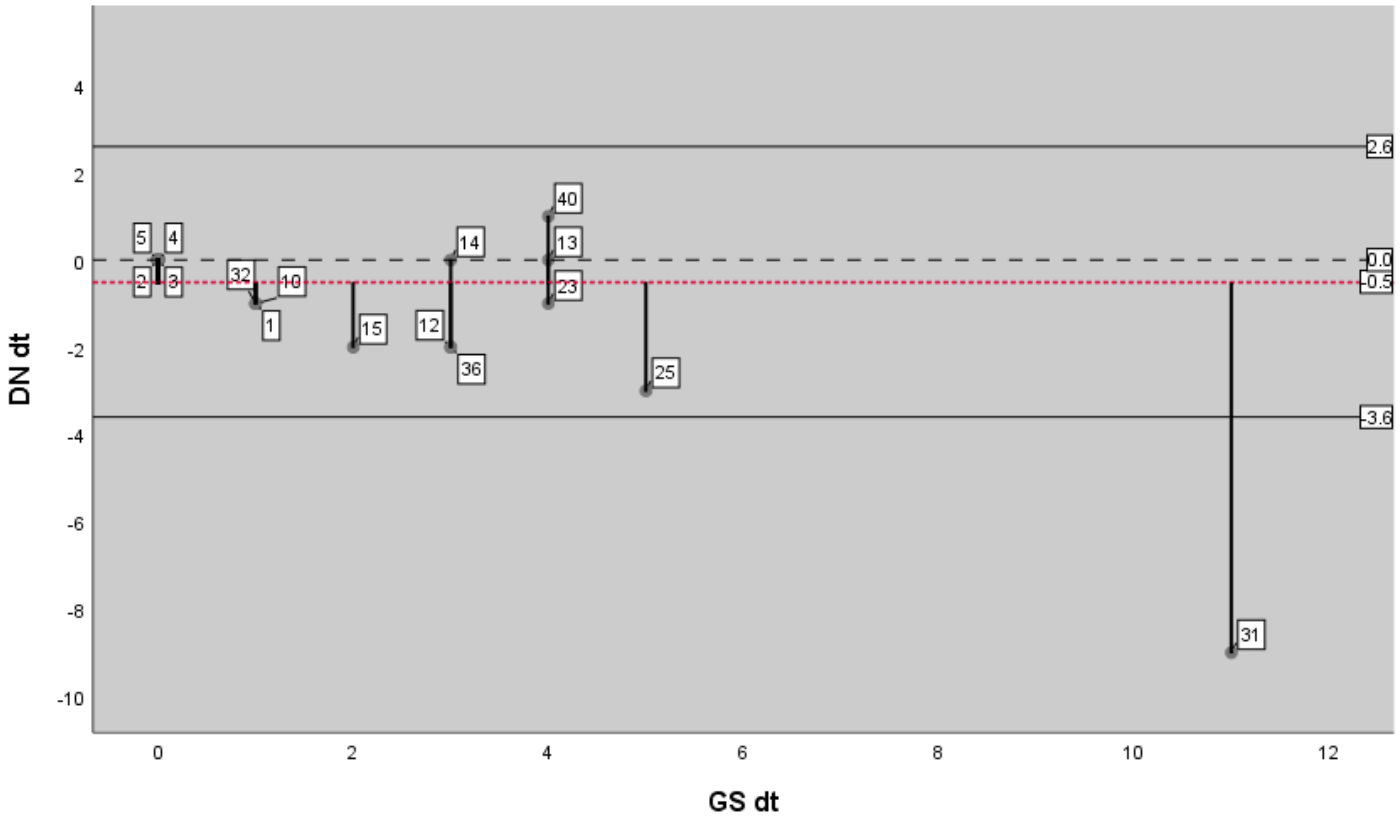
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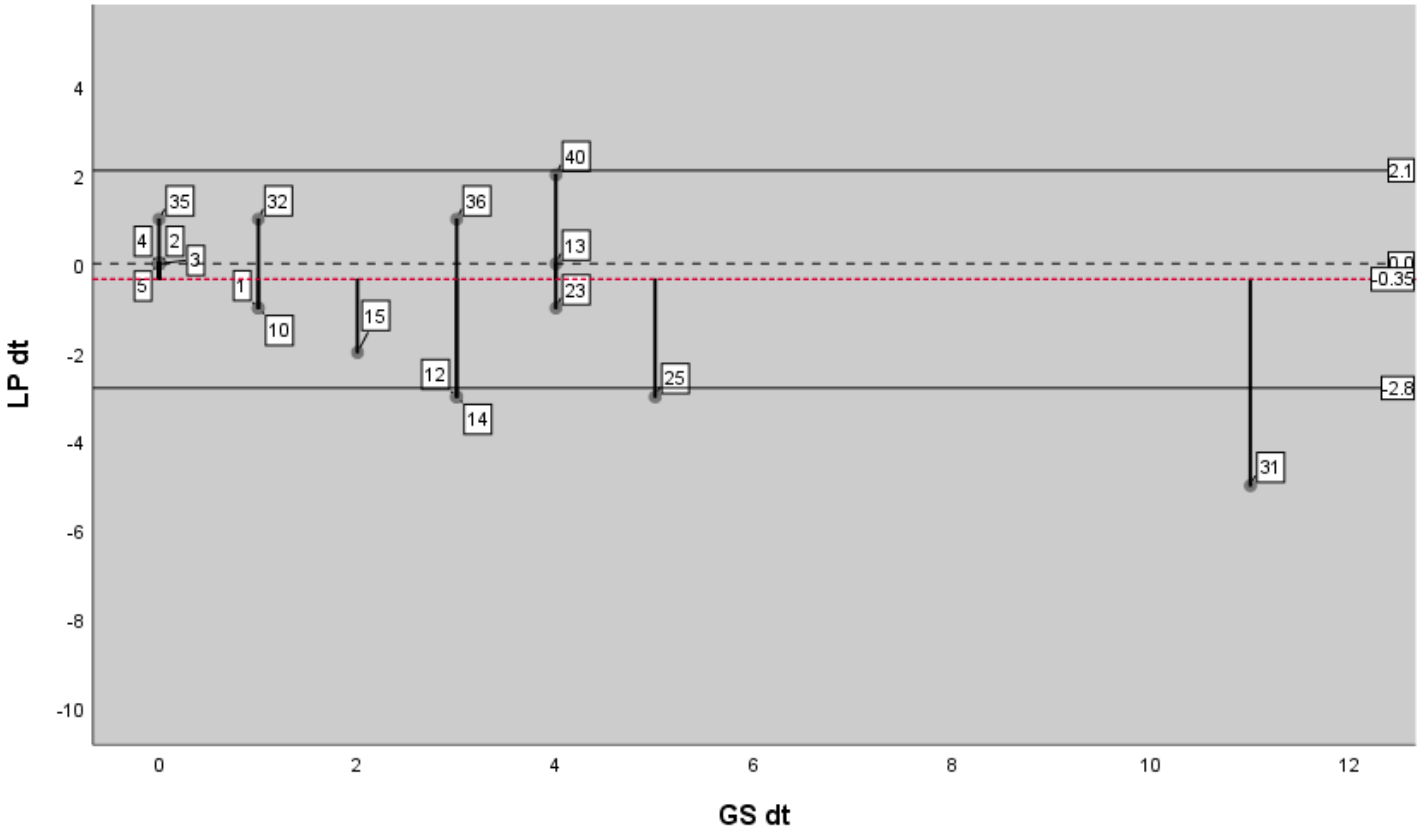
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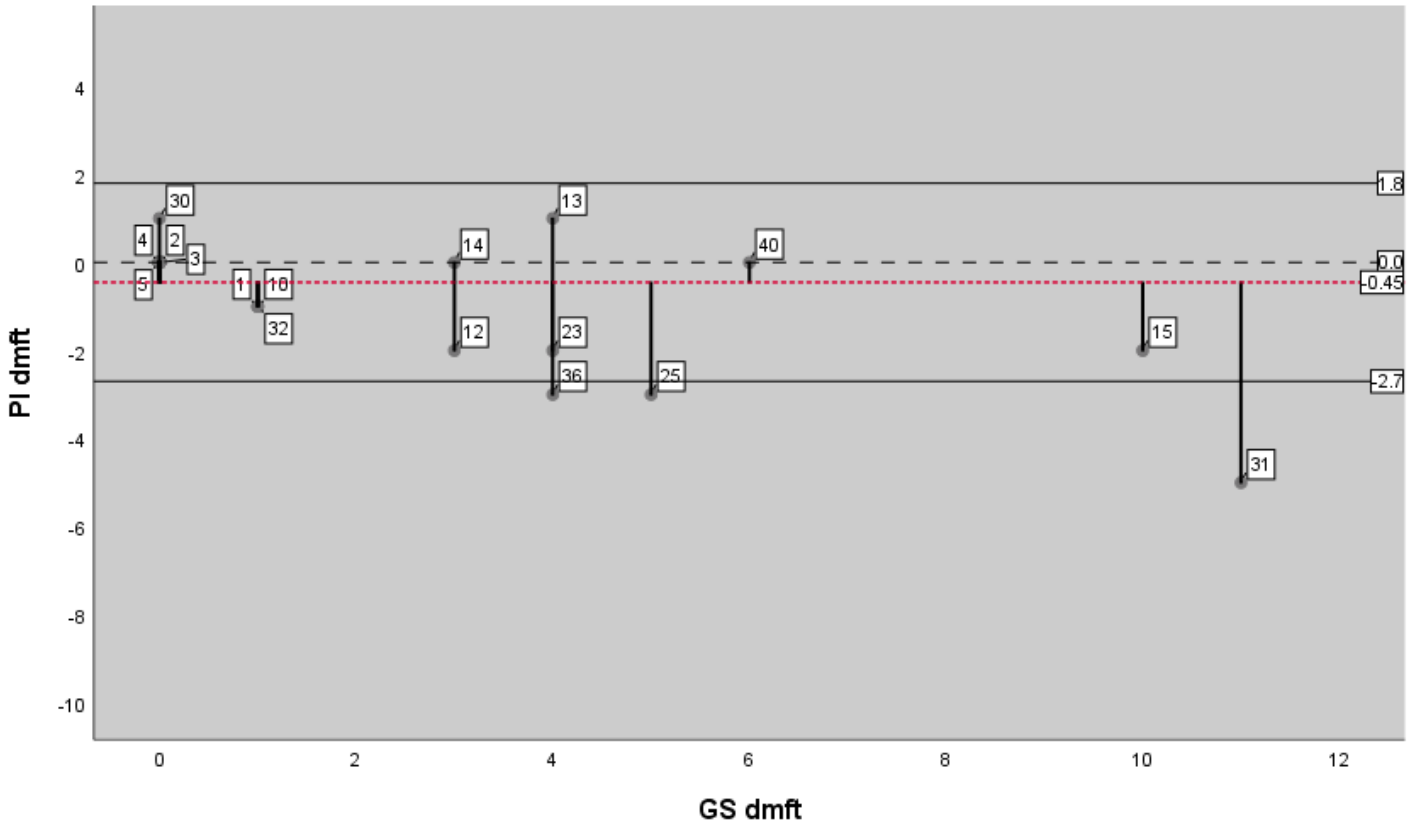
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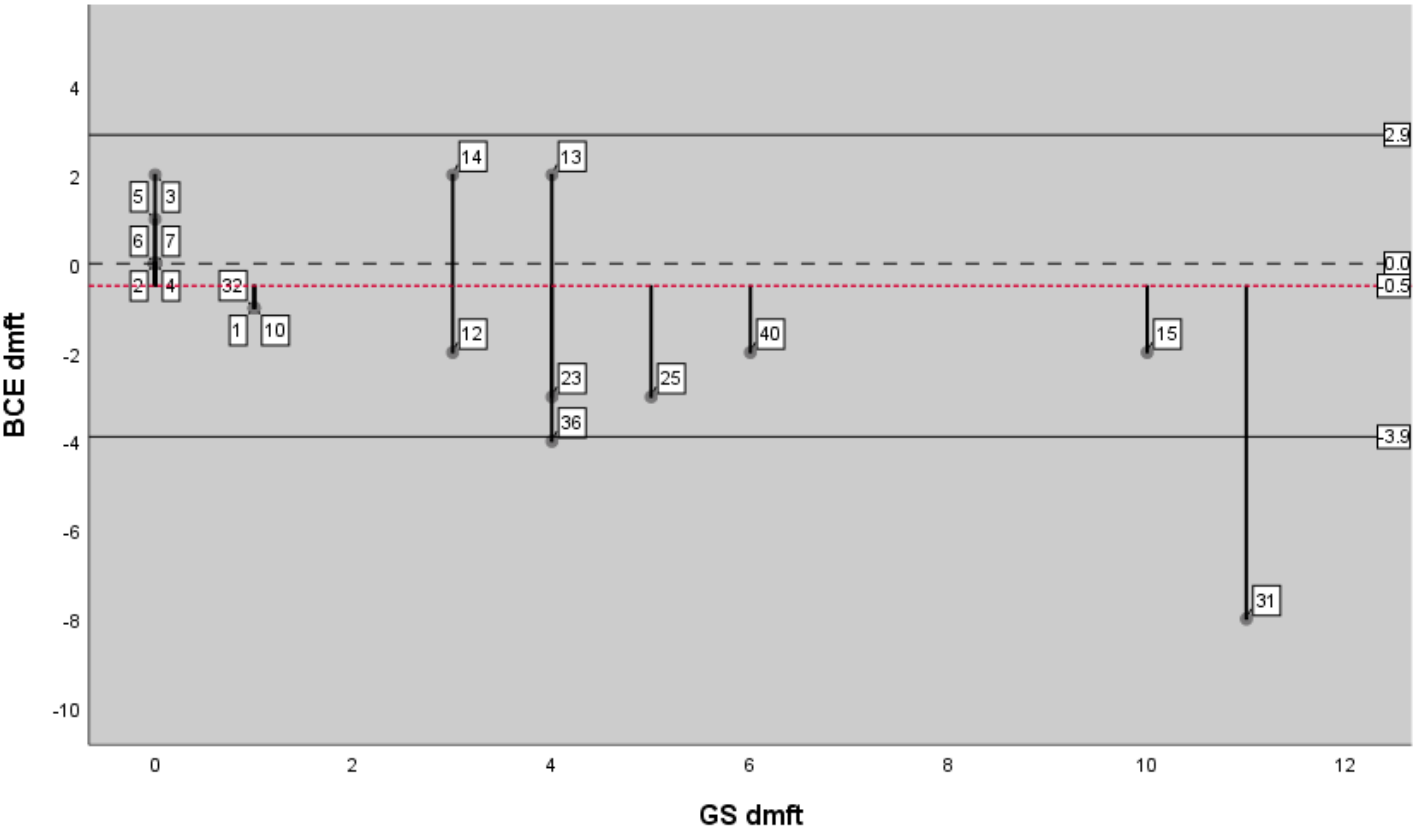
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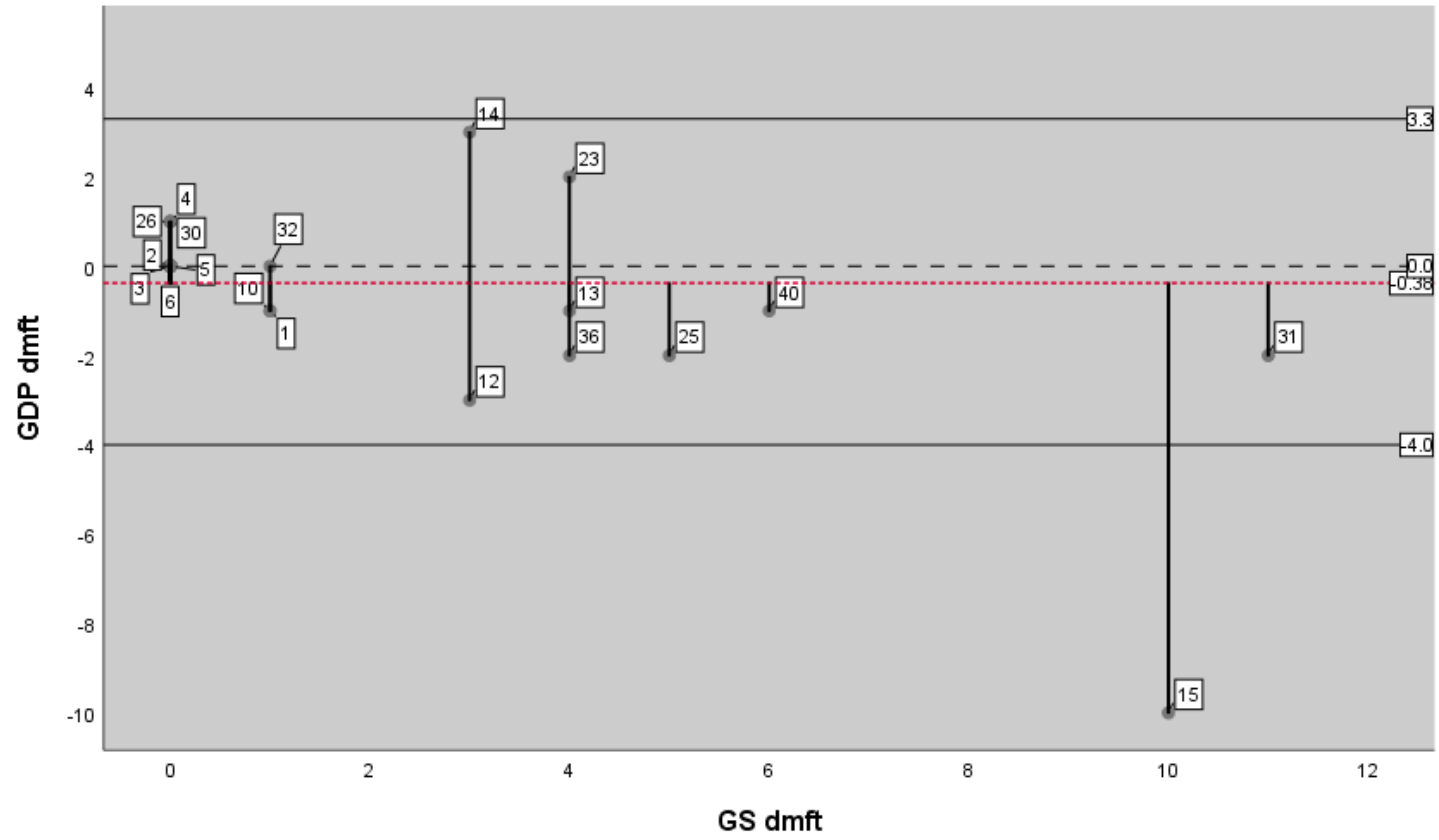
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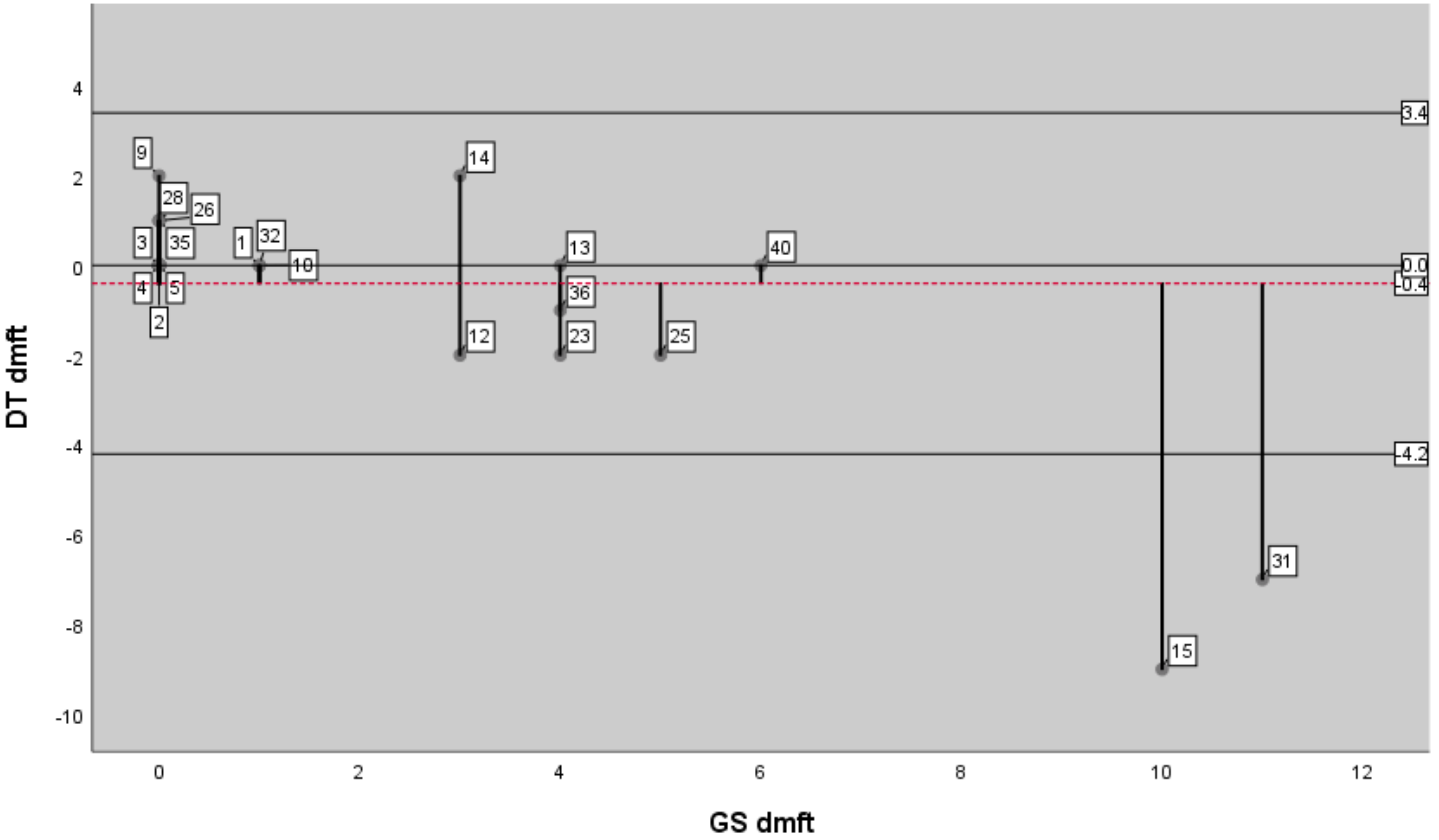
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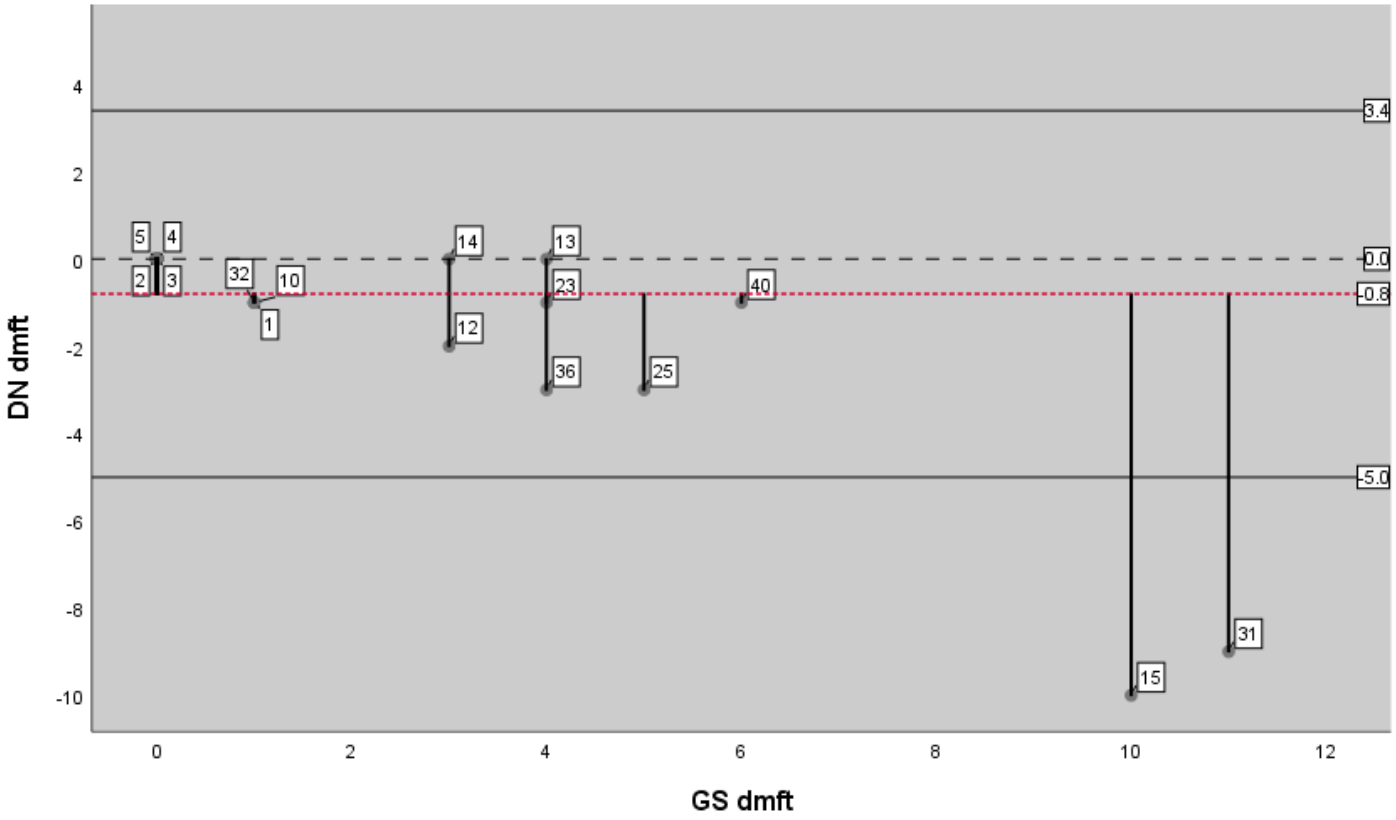

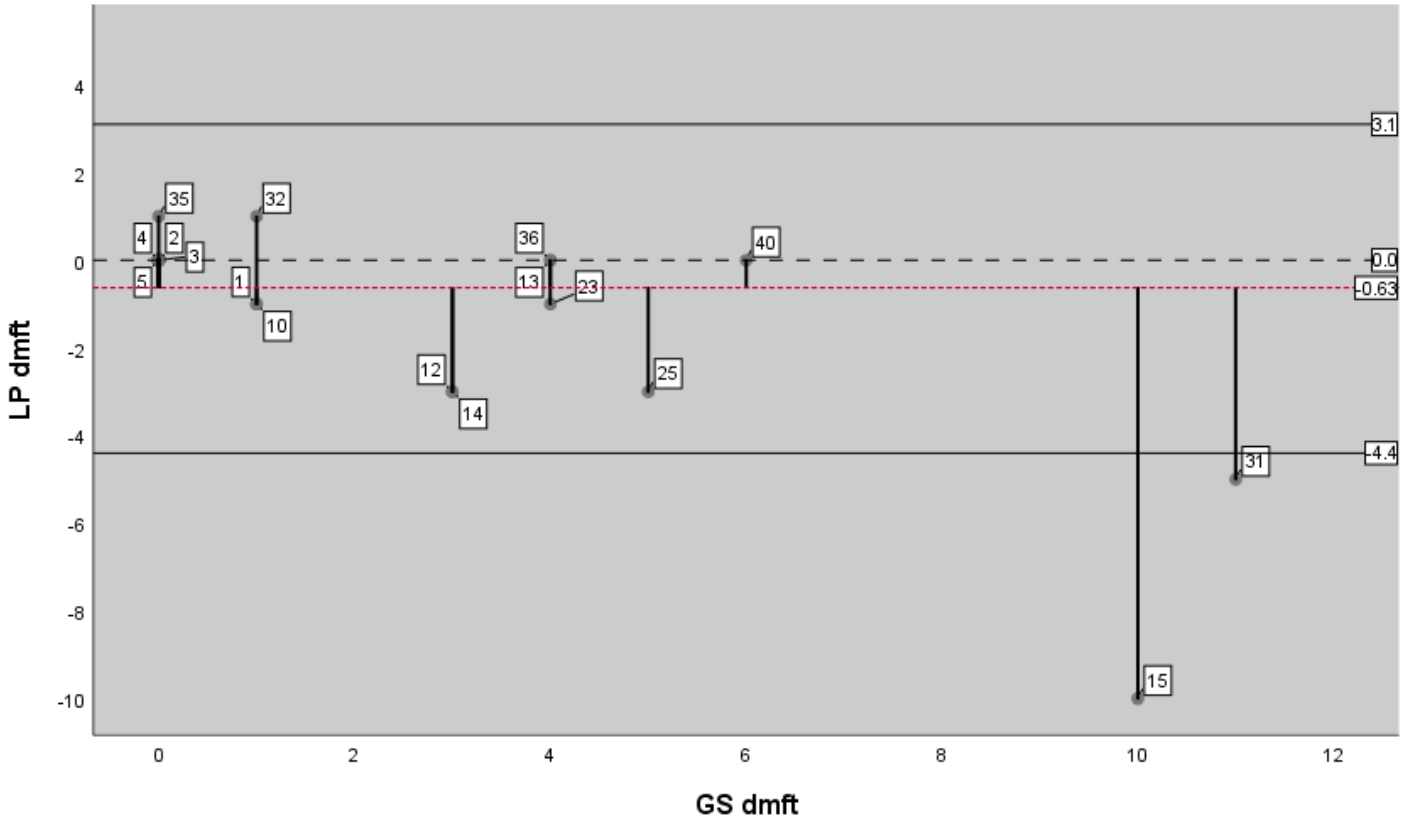

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APPENDIX F: Research design diagram

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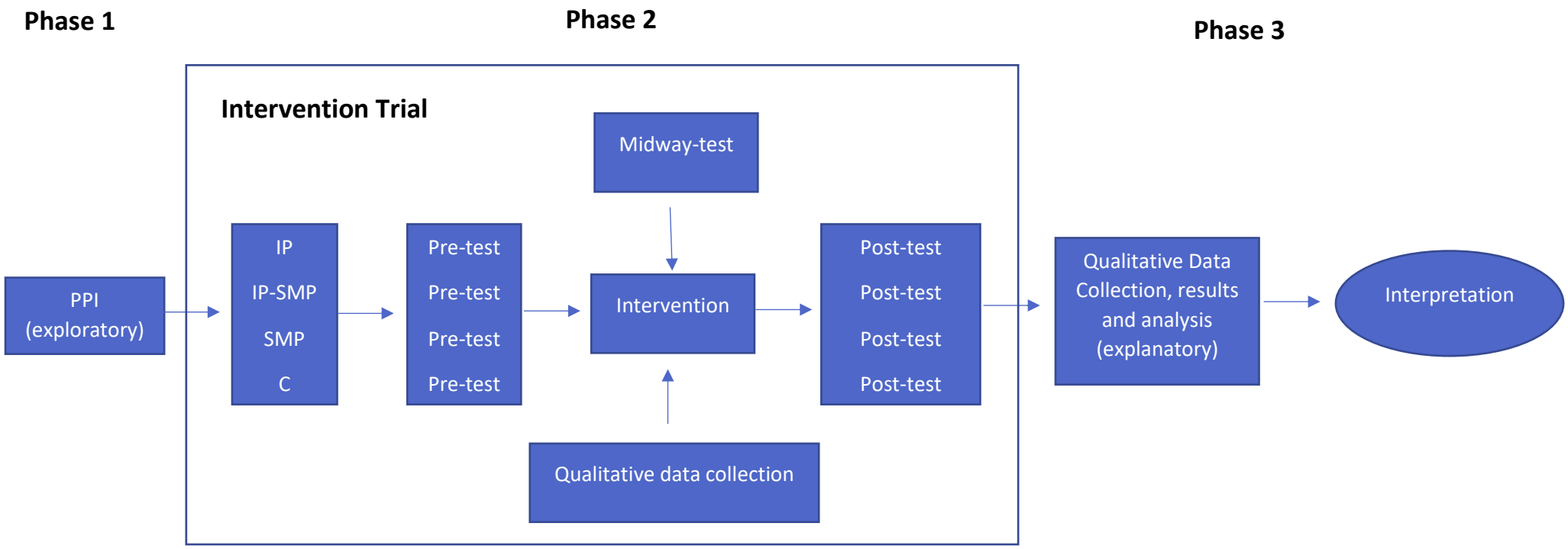

- Research advisory group with caregivers
- Advising on project execution and intervention design

- Random assignment
- *N=40*
- Personalised ID in SPSS

- Self-efficacy data
- Acceptability data
- Descriptive results in SPSS

- Conduct Intervention
- Midway self-efficacy (all research arms) and Acceptability data (Trial arms only)
- Engagement
- Open questions about progress
- Social Messaging data
- Facilitator reflections

- Self-efficacy data
- Acceptability data
- Engagement
- Descriptive results in SPSS

- Semi-structured interviews with all trials arms
- Social messaging data
- Facilitator reflections
- Framework analysis

- How quant and qual explain outcomes
- Critical reflections on psychosocial contextual factors which impact interactions between people and social structures

APPENDIX G: Minutes from the PPI group stakeholder meetings

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Minutes for PPI Meeting 10th May 2017
<Name> Children's Centre
Present: 4 (out of 6 invited) mothers that access family support

There was a discussion about who I am, a bit of background information on child oral health and what my study is about. The parents were then asked about their thoughts on the study, whether the online aspect is important and what that might look like, thoughts on whether families from particular backgrounds need additional support as the evidence suggests and what would get them interested in the study. We then looked at the information sheet material and the group gave feedback on whether it made sense and any amendments they thought was necessary.

The research group unanimously agreed that families that are having additional support from health services would not like having to make appointments for an additional person to come into their home for 'another appointment' and that they would be far more likely to engage if the oral health educator was available to speak to at drop in centres, like the weekly weigh in sessions run by the local health centres.

The group collectively discussed having a text or social messaging announcement, that on a particular date an oral health advisor would be available, would give them a choice and would be an incentive to attend as often as once a month, instead of having home visits.

The group suggested that from birth to 4 months, they would not have even been considering oral health behaviours and therefore would probably not feel the study would be relevant to them if they were approached about it. To overcome this, ideas about giving out information about the research during antenatal sessions or getting families involved by starting with teething advice would be a way to start building a relationship early on.

Families living on low income and those with children with special needs were viewed as families that might be in need of additional support with establishing good oral health behaviours as they view healthy food as being more expensive and making healthy choices needs to be financially viable. Support in this area was seen as important.

Facebook was agreed unanimously to be the best way to connect with mothers online and a closed expert-led Facebook group was seen as something that would be really helpful and useful, even more so than the face to face support. Signposting to good websites and useful information online, interacting with other mothers in a similar situation, as well as being notified when I would be available to be seen in person would be the main reasons for using an online group.

The "About This Study" section of the parent information leaflet was shared with the group and language was discussed. They agreed it made sense and was jargon-free, however, they felt that more should be made about the fact that it is research and therefore it will be non-judgmental and that they weren't going to be 'reported'. They also felt it was important to include that I am a mother and that I have a child with additional needs as this will 'humanise' me and make them more likely to engage with the study.

Minutes for PPI Meeting 11th October 2017
Exmouth Children's Centre
Present: 4 (out of 6 invited) mothers that access family support

I described the reason for using questionnaires in studies and the reason behind using one in this study. We then discussed factors that put them off filling out questionnaires which were as follows:

- When there's too many choices
- Questions are too long or wordy
- Questionnaires that feel like taking exams
- Can't be bothered as doesn't feel relevant to them
- Complicated language that doesn't make sense
- The subject isn't important to them
- If the description at the start of a questionnaire is too long, they complete it

Having time was the biggest factor so keeping questions short and simple was a key point in ensuring answers were genuine. One parent reported having dyslexia and said questionnaires make her feel stupid as she doesn't always understand the meaning of words or struggles when there's too many words.

I showed the parents four different possibilities for the acceptability survey answer formats. Multiple choice, text box, slider scale and star ratings. Unanimously, the group preferred the slider scale but reported that if questions didn't make sense or didn't seem relevant to them, they would very likely just put the slider in the middle or just make it up, making it even more important to making questions understandable so the answers are genuine.

I described the idea of the seven domains from the theoretical framework on acceptability and what each domain means. Everyone agreed they understood. We then went through each question to see whether they made sense and were easy to answer. 5 of the 7 questions were deemed appropriate and easy to understand/answer and would get a genuine response.

The two questions that were more challenging were:

Q1 How would you describe your feelings towards the dental study?
Q3 How morally/ethically acceptable is the dental study to you?

Q1 was deemed as very ambiguous with 'negative and positive' as not relatable to feelings. The group wanted questions that had answers such as 'useful to un-useful', 'interesting to uninteresting' or 'good idea to bad idea'.

Q3 was deemed as a very difficult to interpret with 'morals' and 'ethics' being a concept very difficult to understand without an example or explanation attached to the question, which might put them off answering honestly. Most reported, they'd just put the slider in the middle for that one because they didn't have an opinion on it or didn't feel that a dental study has any moral or ethical issues attached to it.

A final comment was made about Q7, changing the words "necessary behaviours" to "appropriate steps" or "necessary tasks".

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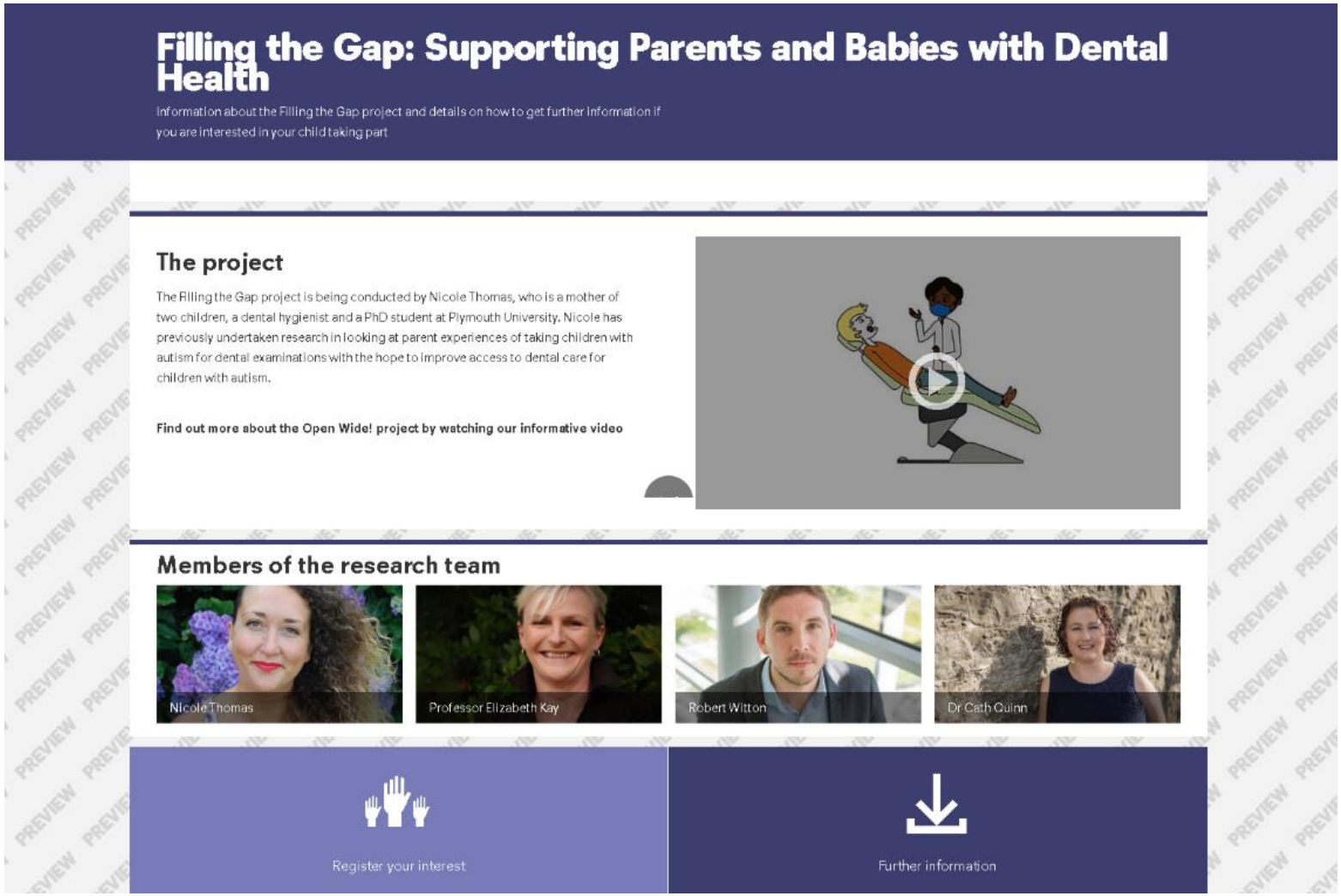
APPENDIX H: Screengrab of the university hosted 'Filling the Gap' project webpage Return to page 71



APPENDIX I: Information sheet for parents for the stage two oral health education intervention.

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Hosted by: *Plymouth University Peninsula Schools of Medicine and Dentistry*
Funded by: *Wrigley UK*
Phase II Information Sheet March 2018 V4

Information for parents considering taking part:

You are being invited to take part in a research study looking at ways to support parents of 0-12 months olds with establishing healthy habits when looking after their baby's first teeth.

Before you decide, it is important for you to understand why the research is being carried out and what it will involve.

This leaflet provides information about the project and details on how to get further information if you are interested in taking part.

Why are we doing this study?

The number one reason for children having to go into hospital is problems with their teeth. Many children who have their baby teeth taken out go on to have problems with their grown-up teeth. Nicole, the project lead, understands the challenges that go along with being a parent and therefore wants to develop a package to support parents to look after their baby's first teeth and to avoid them having problems with their teeth as they get older.

To do this, Nicole wants to look at three different types of support for new parents during the first year of their child's life to see which one works best. The support packages include help and advice on toothbrushing especially when first teeth start to erupt, introducing complementary foods/liquids and establishing positive oral health routines. This may be in person, via a closed Facebook group or a mixture of both.

Why have I been asked to take part?

We are asking parents of 0-12 month olds to take part.

Do I have to take part?

It's entirely up to you to decide. You do not have to take part. If you do decide to, you will be asked to sign a consent form to show you have agreed to take part. You can withdraw at any time, without giving a reason. If you decide not to take part, or later withdraw, any data already obtained from you may be used in the study unless you request any information gathered to be removed from the study.

What will happen if I decide to take part?

If you would like to take part, Nicole will talk through the details of the study with you again and a consent form to participate will be signed. You will then be randomly assigned to one of four groups:

Face to face support - Nicole would hope to meet you at your home or a local baby weigh in session as little or as often as you wish, over the year.

Online support - Nicole would be available to answer questions/concerns and send helpful information via a closed Facebook group or text/Whatsapp over the year.

Face to face and online support - You would be able to access support from Nicole in both ways over the year.

Control group - Nicole would like to meet with this group at the end of the year to talk about the normal level of support open to everyone.

For all groups, there will be two short questionnaires to complete at the beginning, middle and end of the project.

Nicole might also like to chat with you at the end of the project to find out in more detail what you thought about the support offered in the project and how it could be improved. This will probably take around 45 minutes.

All the information you give us will be kept confidential and will only be available to members of the research team. Your participation will be of great value to helping to improve oral health promotion interventions designed for young children. If you have any concerns about this, please talk them through with Nicole.

The results of the study will be published in reports and scientific journals, but it will not be possible to identify any individuals from these reports. Nicole can send you a summary of the results at the end of the study if you would like one.

What are the possible risks and benefits of taking part?

You will be asked to give up some of your time to take part. We do not expect there are any disadvantages or risks to you. We will do our best to arrange any face to face meeting at a time and place to suit you. If taking part in the study raises other issues that you would like to talk about, Nicole will refer you to other possible sources of help or advice.

You will, at the very least, be given free toothpaste and toothbrushes over the year. Most participants will receive personalised oral health support and advice over the year. However, it is still possible, that your child may develop tooth decay at some point during the study. If at any point you or Nicole have concerns, Nicole will be able to assist you in getting the care you need for your child's dental health.

What if there is a problem?

If you have any concerns you should first speak to Nicole or Professor Elizabeth Kay, who will do their best to answer your questions (see contact details below).

If you have a complaint about the way you have been approached or treated during this study you should contact the University Research Governance Specialist. In the highly unlikely event something goes wrong and you are harmed during the research, and this is due to someone's negligence, then you may have grounds for a legal action for compensation but you may have to pay your legal costs.

What about confidentiality?

All information collected during this study will be kept confidential. This means that apart from the research team, no one will know what you have said.

Your name and any other personal details will not be included when the audio-recording of the interview is typed out. The audio-recording will be marked with a number only, so no written record of names and the data collected will exist side by side.

You will not be named or identified in any reports. Brief quotations from your discussions may be included in the reports, but it will not be possible to identify anyone from these quotations as they will be anonymised.

All data collected for this study will be kept safely either in locked cabinets or in secure computer files at the Plymouth University. It will be held for ten years before being destroyed.

Audio-recordings to be stored they will be destroyed at the end of the study.

Can parents change their mind and withdraw from the project?

You may withdraw from taking part in the research at any time, without giving a reason. If you would be willing to provide feedback on why you decided to withdraw, this information will be used to improve our studies in the future.

Who is carrying out the study?

Nicole qualified as a dental hygienist in 2004. Nicole has two young children and has recently finished a study looking at parent experiences of taking a child with autism to the dentist and has a keen interest in child dental health. This is an area of personal interest due to her son having additional needs.

Nicole is being supervised by Elizabeth Kay, a Professor of Dentistry at Plymouth University, Dr Robert Witton, a Director of social engagement and community-based dentistry and Dr Cath Quinn, a Senior Research Fellow at Plymouth University.

The research is being funded by Wrigley UK. Wrigley have no input into the design or analysis of this research.

Who has reviewed the study?

This study has been reviewed and approved by the University of Plymouth Faculty Research Ethics and Integrity Committee (FREIC) for Health and Human Sciences (17/18-863).

Contact Us

If you have any questions about the study, either now or in the future, please feel free to contact:

Nicole Thomas
Room C507,
Portland Square,
Drake Circus,
Plymouth,
Devon, PL4 8AA
nicole.thomas@plymouth.ac.uk

Elizabeth Kay
Room C520,
Portland Square,
Drake Circus,
Plymouth,
Devon, PL4 8AA
elizabeth.kay@plymouth.ac.uk

Thank you for taking the time to consider this study.

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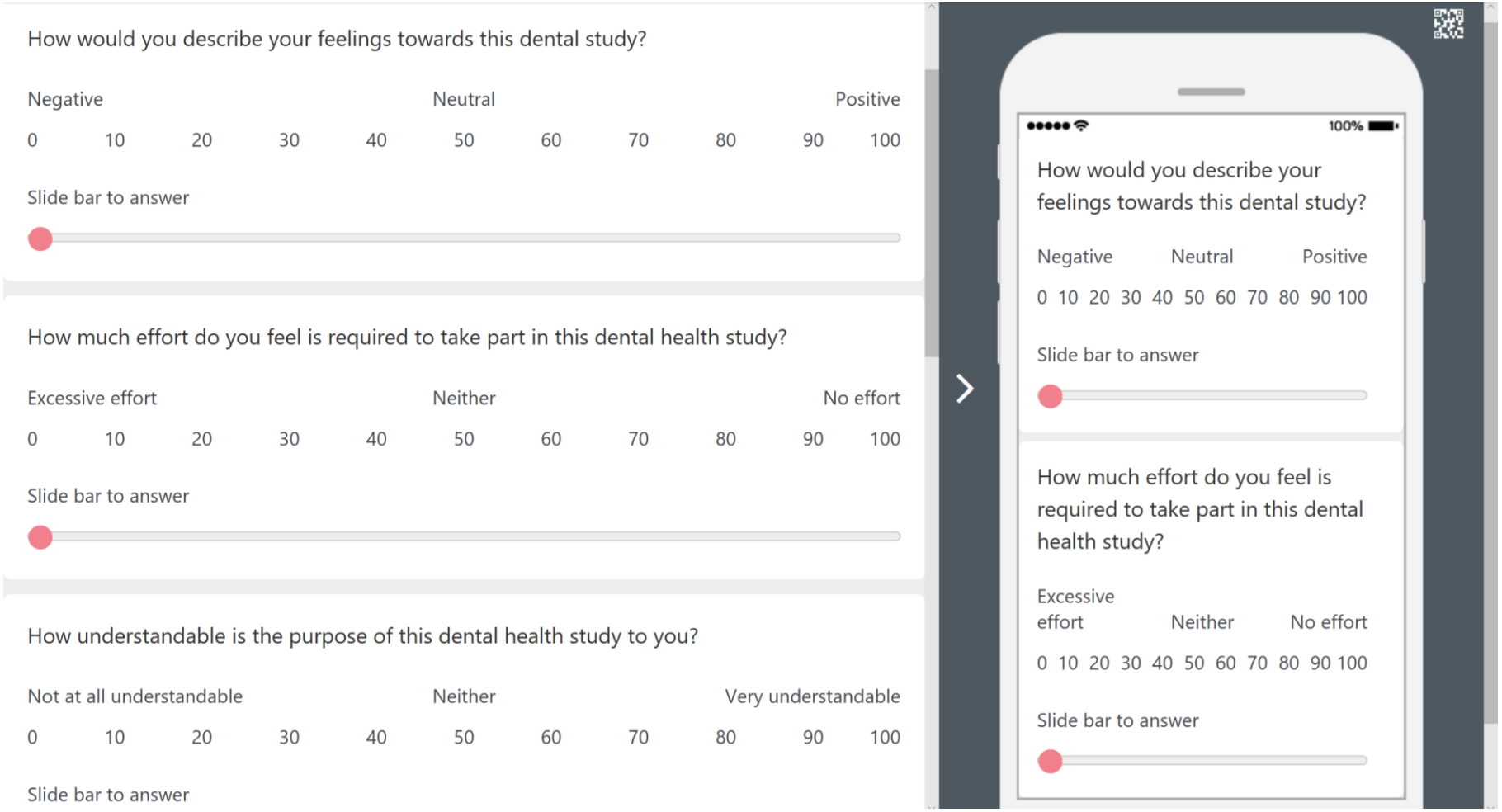
APPENDIX J: Preview example of the acceptability questionnaire, as viewed electronically on a laptop or smartphone. Return to page 77



APPENDIX K: Example of framework matrix with box qualitative and quantitative data

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<table>
<tr>
<td>Self-efficacy</td>
<td>MAIN THEMES
Not all participants felt confident that they were/would be able to perform the tasks required to engage with the intervention. This may have been due to their dislike of online groups or their busyness meaning contributing to the group with questions or responses would be limited. This didn't stop some participants remaining in the group, however. P42 described the flexitivity of 'always being able to leave' decreased the pressure of engaging with the online group. For those that were IPO or O, they did not feel they required the in-person element or would they have been able to engage with appointments or meeting in person due to remote location or busyness. P5 commented on only engaging in cyber groups when having something relevant to say, whereas, P28, despite having the oldest child in the group, felt she was able to pass on her knowledge and therefore was able to contribute relevant information. In direct contrast, P31 (not interviewed) commented on her final questionnaire "I'm sorry I have not participated more, I think just because my son was on the upper age limit at the start that I had less to add to the group. I appreciate hat it's been a source of information and nice to have had support if needed."

Therefore, choices in how and when to engage seems to be key, with the majority being online and the option of an occasional in-person meet up as well. The timing of joining an intervention also seems to influence the participant's engagement.

STATS

Baseline: 92.1 (n=35)
Midway: 92.6 (n-=20)

Baseline mean (without control): 90.8 (n=27)
Midway mean (without control): 92.6 (n=20)

Question was changed to ask how confident participants felt in carrying out oral health behaviours to reduce tooth decay risk in the future
End: 87.9 (n=28)

<table>
<tr><td>Research Arm</td><td>IP</td><td>IP-SMP</td><td>SMP</td><td>C</td></tr>
<tr><td>Mean</td><td>88.9</td><td>96.3</td><td>87.3</td><td>78.8</td></tr>
<tr><td>Std.Dev</td><td>9.8</td><td>6.8</td><td>11.9</td><td>12.3</td></tr>
</table>

<table>
<tr><td>Research Arm</td><td>IP</td><td>IP-SMP</td><td>SMP</td><td>C</td><td>Whatsapp Group</td></tr>
<tr><td>Mean</td><td>88.9</td><td>-</td><td>70.0</td><td>78.8</td><td>92.8</td></tr>
<tr><td>Std.Dev</td><td>9.8</td><td>-</td><td>-</td><td>12.3</td><td>9.3</td></tr>
</table>
</td>
<td>If you'd asked me that question…if you'd said a couple of years ago, "will you go into a Whatsapp group and you don't know anyone in it", I'd be like, "well, that's a bit weird." But actually, it was just like, well we're all the same boat. We know why we're here and, um, as soon as people start interacting with one another, you just get involved. P25 SMP

I struggle with even just replying to messages sometimes just because I get so busy and um, it, I go, "I must do that" and it just leaves me and then being prompted online is actually quite helpful. Um, so that is enough. Definitely enough. P37 SMP

I did dip in and out of it. But I just didn't really have much input because I didn't really go through the problems that they did. P19 SMP

I get really annoyed sometimes when you join a Whatsapp group and you're getting messages at midnight or something like that, you just think, "ugh" and you end up leaving the group, so I guess as long as you have some kind of rule within… P22 IP

I think if we'd have said, let's meet once every month or once every three months or something, I'm not sure I would have had questions because they'd have come and gone and that like, moment of trauma would have passed! P23 SMP

...it became very evident to me very early on that <child> was the oldest so they were asking questions and I'd already done that so I felt, "ooo, I can tell all about this because this is what I did and it worked out" or "this is what I did and it didn't work." Um, so that kind of made me feel like almost I know what I'm talking about. P28 IP-SMP

I don't feel there was any specific I was particularly worried about so I don't think there was that need to go and get advice from anywhere. P33 IP

...it worked fine for me and the thing is, you can leave if you want to, can't you? So, you know, it's really flexible. You're not pressured or anything like that. P42 IP-SMP

… if I think I've got something relevant that might be helpful, I'll say but I don't just describe what we're going through just to share… I would in person but that I wouldn't sit there on my phone all day...I don't know how they've got the time! P5 C</td>
</tr>
</table>

APPENDIX L: Participant Information Data Return to Page 88

ID	Mother's Age	Trial Arm	Recruitment Phase	Infant Age	IMD Decile	Parent Status	Average household income
P1	18-24	C	Ph1	0-3 mo	8	P	0-19k
P5	25-34	C	Ph1	3-6 mo	2	P	40-59k
P11	.	C	Ph1	6-9 mo	3	M	.
P14	.	C	Ph1	6-9 mo	2	P	.
P18	.	C	Ph1	6-9 mo	2	P	.
P21	18-24	C	Ph2	6-9 mo	7	M	20-39k
P27	35-44	C	Ph2	0-3 mo	8	P	40-59k
P32	35-44	C	Ph2	3-6 mo	8	M	.
P35	35-44	C	Ph2	6-9 mo	7	P	20-39k
P39	25-34	C	Ph2	6-9 mo	5	P	20-39k
P44	25-34	C	Ph2	3-6 mo	7	P	60-79k
P2	.	IP	Ph1	0-3 mo	2	M	.
P7	25-34	IP	Ph1	0-3 mo	3	M	20-39k
P9	.	IP	Ph1	0-3 mo	3	M	.
P15	25-34	IP	Ph1	3-6 mo	3	P	40-59k
P17	.	IP	Ph1	3-6 mo	2	P	.
P22	35-44	IP	Ph2	3-6 mo	5	P	40-59k
P26	35-44	IP	Ph2	3-6 mo	7	M	20-39k
P30	25-34	IP	Ph2	0-3 mo	10	P	20-39k
P33	35-44	IP	Ph2	6-9 mo	8	M	40-59k
P40	35-44	IP	Ph2	0-3 mo	4	P	40-59k
P41	35-44	IP	Ph2	9-12 mo	5	P	40-59k
P3	.	IP-SMP	Ph1	6-9 mo	2	M	.
P6	.	IP-SMP	Ph1	6-9 mo	3	M	.
P12	18-24	IP-SMP	Ph1	3-6 mo	4	P	.
P16	.	IP-SMP	Ph1	3-6 mo	2	P	.
P20	18-24	IP-SMP	Ph1	3-6 mo	1	P	.
P24	25-34	IP-SMP	Ph2	3-6 mo	7	M	0-19k
P28	35-44	IP-SMP	Ph2	9-12 mo	7	P	60-79k
P29	25-34	IP-SMP	Ph2	6-9 mo	5	P	40-59k
P36	25-34	IP-SMP	Ph2	0-3 mo	6	P	60-79k
P38	35-44	IP-SMP	Ph2	3-6 mo	4	P	20-39k
P42	35-44	IP-SMP	Ph2	9-12 mo	6	P	80-99k
P4	.	SMP	Ph1	6-9 mo	2	M	.
P8	.	SMP	Ph1	3-6 mo	3	M	.
P10	.	SMP	Ph1	6-9 mo	3	P	.
P13	35-44	SMP	Ph1	0-3 mo	4	P	40-59k
P19	18-24	SMP	Ph1	3-6 mo	1	P	0-19k
P23	35-44	SMP	Ph2	6-9 mo	7	P	100k+
P25	35-44	SMP	Ph2	3-6 mo	10	P	60-79k
P31	25-34	SMP	Ph2	6-9 mo	4	P	40-59k
P34	35-44	SMP	Ph2	3-6 mo	7	P	100k+
P37	35-44	SMP	Ph2	3-6 mo	7	P	40-59k
P43	35-44	SMP	Ph2	3-6 mo	8	P	20-39k

APPENDIX M: Table showing vulnerability criteria and which participant fulfilled which criteria

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Participant ID	Vulnerability criteria			
	Access to services	IMD decile	Household income	In receipt of family support services
P1			X	X
P2		X	?	?
P3		X	?	?
P4		X	?	?
P5		X		
P6		X		
P7		X		?
P8		X	?	?
P9		X	?	?
P10		X	?	?
P11		X	?	?
P12		X	?	X
P13	X	X		
P14		X	?	?
P15		X		
P16		X	?	?
P17		X	?	?
P18		X	?	?
P19		X	X	X
P20		X	?	X
P21				
P22	X			
P23				
P24			X	
P25				
P26				
P27				
P28				
P29				
P30				
P31	X	X		
P32				
P33				
P34				
P35	X			
P36	X			
P37				
P38	X	X		
P39	X			
P40		X		
P41				
P42	X			
P43	X			
P44				

X = fulfilled. ? = unknown. <blank> = not fulfilled

APPENDIX N: Social messaging data – examples of questions asked by mothers in the Whatsapp group and direct messaging Return to Page 146 or 169

Teething	How many teeth are they meant to have <Baby> only has 8 teeth and is now 15 months? <Baby> still doesn't have any teeth should I be worried? Nothing seems to be helping much do many babies just get loads all at once? I have read somewhere (online forum I think) to use teething gels with caution. Is there a reason for this? Can you also see how far apart his front two top teeth are? Is that normal? How long roughly does it take from the first signs of a tooth poking through to a fully fledged baby tooth? How do you know when a tooth is coming? Teeth update. I'm sure I saw a top one the other day, but now there's one coming on the bottom. Do they move?! <Baby> (15weeks) has started teething I think (red cheeks, sooo much dribble, grouchy) - any tips besides bibs? Should I be giving her anything for it? Is there any scientific evidence base for amber necklaces for teething do you know? I didn't appreciate how seriously this testing thing could be- is this just constant until they have all their teeth? How long does that take? Should I expect years of possessed baby?!? <Baby>'s latest tooth is cutting and the gum is ulcerated and really sore. I can't get near it with anbesol but have been giving calpol / nurofen. He's having breastmilk which will hopefully help as it has antiseptic properties I think. Is there anything else I can do? At what point does teething pain mostly ease off do you think? Is it true that it gets worse with each tooth? Could this be reflux related to teething? Anyone got any teething aid suggestions for back teeth? Do you think these are signs of teething? How long before the whole tooth is through?
Brushing	My older two have an odd need to use my tooth brush? Should I just start buying adult ones? How long should we aim to brush for? I also let him have a try after lol he mainly just sucks it is this OK? Do I need to get a brush with bristles?

	Should I introduce a toothbrush now the food has started or wait for a tooth to appear? At the moment he'll take the toothbrush and happily put it in his mouth and chew / suck it. And I move it around a bit. Is this ok for now? When do I need to worry about 'quality' of brushing?! I wanted to ask a question about how long we should be aiming to brush for when going through a good phase? What motion should I take to brush? How often should I change the toothbrush? Did I see earlier in this thread that we should brush teeth first thing in the morning before we have breakfast? If so why is this? I read somewhere that I should brush His teeth in a circular motion, is this correct? Just wondered what you thought of this toothbrush? Any tips on persuading little one that he really does want to have his teeth cleaned?!
Fluoride/Toothpaste	Do we need fluoride? Is it essential for children and adults? At the last check up the dentist didnt raise any concerns? But is it better to use fluoride? When would you start to introduce toothpaste to the boys they are 9 months now and both have two teeth they have a tooth brush but haven't used the toothpaste yet as I'm unsure of when to let them try it and of what one to use? So would you do the toothpaste after the feed at night? And only once a day? Now I'm weaning <Baby> should I still keep just wiping his mouth after food and milk until teeth come in and then smallest smear of paste? Should I introduce a brush to chew on or toothpaste on a muslin after his evening meal? (After his last feed from me, but before bottle feed to sleep) Should I go for a specific baby toothpaste? Is the toothpaste I'm using ok? I am just double checking but what toothpaste is recommend for under 1's? I used to use the 'milk teeth' toothpaste but since I learned that there is less fluoride in it I tried switching to the fruit flavoured one and adult one. He hates the fruit flavoured one and isn't keen on the adult one. Is it better to go back to the milk teeth one which he put straight in his mouth or persist but knowing that hardly any goes it now? I just avoided that area for a few days. Would it have been better to try get some paste on there? Is it OK rubbing the toothpaste on?

Weaning	I'm thinking of starting with porridge late morning for the first week - does that sound OK or should I be starting with some veg? I'm going to start weaning my little one next week and I wondered how often 1 food should be repeated before trying something else? Also, when do we go from 1 to 2 feeds a day? Has anyone given their little ones extra supplements when weaning? I'm reading up on it and it says babies should have vitamin drops from 6 months to 5 years? Is it OK to give my 6 month old water at every meal when they start weaning? If I'm only feeding one meal a day at the moment, do I only offer her water once ie at every meal? Is tap water OK or do I need to boil and cool it first?
Sugar	<Baby> was admitted to hospital this week... But they gave him juice in a bottle will that be OK? Just once. I haven't offered dried raisins, prunes or apricots yet. But wondering if they are too sticky/sugar loaded for baby teeth? Should I just avoid them?
Bottles/Cups	I think I've read somewhere that it's best to stop using a bottle at a certain age and move to a cup as it's better for teeth. Is this correct or have a imagined it?! If so what age? I'm looking to move <Baby> onto a cup for his expressed milk when he's at nursery and before bed. He has a munchkin 360 for water but I was thinking of having a different one for milk. Which are ok teeth wise?
Dental Visiting	Random question but I realise I don't know when you first take them for a dental check, assuming no concern has come up? Nicole - how on earth do I go finding a dentist?

Questions also came up during the interviews, particularly among the in-person and control arms. These questions mirror those asked in the social messaging group.

Teething	Because I don't know how many they're meant to have and I don't know if he's got them all? Or if he's missing some? It sounds weird, but are really small teeth something to worry about? How often other mums are brushing their baby's teeth?
Brushing	I just wanted to ask, like the best way of, because she's kind of at the age where she's starting to try and do it herself? Like what are the best ways to, obviously, you want her to start learning to do it, but at the same time, she can't brush her own teeth? I can't quite figure out how I'm going to work out is how I'm going to get him brushing his teeth properly. At which age we start introducing the whole, brushing like mum and dad do?

	I don’t know what happens with the teeth start coming out and the adult teeth start coming through? I don’t know any issues that you get with that or what you’re meant to do?
Sugar	The only thing now that I do slightly worry about is that he’s drinking less water and he has a bit of squash instead, which is probably isn’t as good for your teeth. It’s in a cup and not a bottle so maybe it’s not going on his teeth so much? I don’t know? What do you do if you have a child that will only eat sugary things?
Fluoride/Toothpaste	My friend took her little girl to the dentist and they said they can put fluoride paste on them but baby toothpaste is lower in fluoride so why put paste on a baby if you’re using lower fluoride in your toothpaste? I don't know if it's to do with fluoride level in the toothpaste or what it is to why there is different ones of the ages or if it's just a marketing thing?
Weaning	I’m going to have to really watch what he eats! Unless it’s just a phase and he’s just really hungry? I don’t know!
Bottles/Cups	I was wondering about drinking bottles. He, um, he’s never had a bottle bottle, so he quite likes anything…is that still fine?
Dental Visiting	Should I take him to the dentist, or is my dentist wrong?