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The contribution of ascitic fluid to body weight in patients with liver cirrhosis, and its estimation using girth: a cross-sectional observational study

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- 2 using girth: a cross-sectional observational study
- 3
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- 13 Authorship
- 14 EL conceived and designed the study, collected the data, carried out the analysis and wrote the
- 15 manuscript. MH co-designed and acted as Chief Investigator for the study. Both authors interpreted the
- 16 findings, commented critically on draft versions and approved the final version of the submitted paper.
- 17

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- 26 supporting this research study.

27 Transparency Declaration

- 28 The lead author affirms that this manuscript is an honest, accurate, and transparent account of the study
- 29 being reported. The reporting of this work is compliant with STROBE guidelines. The lead author
- 30 affirms that no important aspects of the study have been omitted and that any discrepancies from the
- 31 study as planned (IRAS Project ID: 218747) have been explained.

32 Conflict of Interest Statement

- 33 The authors have no conflicts of interest to declare.
- 34 Keywords: ascites, weight, girth, cirrhosis, liver, Body Mass Index, Alcoholic Liver Disease.

36 Abstract

37 *Background:* There is a high prevalence of malnutrition among people with decompensated liver

38 disease. Standard nutritional screening tools use weight and body mass index (BMI) to identify risk, but

39 these are difficult to measure for those with ascites, often secondary to liver cirrhosis. Dietetic guidance

40 suggests adjusting for ascitic weight by 2.2-14kg but there is a lack of evidence to substantiate these

41 figures.

42 *Aims*: Measure the contribution of ascitic fluid weight and compare to the current guidance and examine

43 whether girth circumference can be used to estimate ascitic weight.

44 *Methods*: A cross-sectional, observational study was conducted over 13-weeks. Participants attending

45 for paracentesis were weighed, their girths measured, and BMI calculated pre-and post-paracentesis.

46 Fluid removed via paracentesis was recorded. Ethical approval was received (IRAS ID: 218747).

47 *Results:* Eighteen participants underwent paracentesis. The range of ascitic fluid drained was 3.8–

48 19litres (mean=8.7, standard deviation (SD)=3.7). Weight difference range between pre-and post-

49 paracentesis=4.5–20kg, (8.7, SD=3.9). Ascitic fluid weight is shown to be higher in each category

50 (minimal, moderate, severe ascites) than the current guidance figures. Weight difference was greater

51 than 14kg in 11% (*n*=2) of participants. A strong, statistically significant relationship (*rho*=0.68,

52 p = < 0.01) between ascitic weight and pre-paracentesis girth was found. An equation was formulated to

53 enable the estimation of ascitic fluid from pre-paracentesis girth.

54 *Conclusion:* Current dietetic guidance should be re-evaluated to reflect the greater weight differences

55 identified. Measuring girth pre-paracentesis may help to inform dry weight estimation. Further

56 research is required to verify the accuracy of estimating ascitic weight from pre-paracentesis girth.

57

58

59 Introduction

It is widely recognised that people with liver disease are at high risk of protein-energy malnutrition
 (PEM)^(1; 2; 3). Evidence shows a particularly high prevalence of PEM amongst those with decompensated

- 62 cirrhosis, reportedly between 50 and 90 percent ^(4; 5). The reasons for this are multifactorial and include
- 63 metabolic changes secondary to cirrhosis; poor nutritional intake consequential to nausea, early satiety,
- 64 dysgeusia (taste changes) and dietary restrictions; additionally, malabsorption due to bile-acid
- 65 deficiency or small-bowel bacterial overgrowth ⁽⁶⁾. Malnutrition in liver disease is associated with a
- 66 poor quality of life ⁽⁷⁾, increased duration of hospital stay, higher rates of mortality and morbidity,
- 67 sarcopenia, increased infection risk and increased risk of encephalopathy ^(5; 8). Given the gravity of
- 68 these associated complications it is imperative that malnutrition is identified to enable the provision of
- 69 appropriate specialised nutrition support which can help improve or reduce complications ⁽⁹⁾.

70 Assessing the nutritional status of patients is commonly undertaken using a nutritional screening tool. 71 Standard screening tools in the United Kingdom include the 'Malnutrition Universal Screening Tool' (MUST)⁽¹⁰⁾ and the 'Subjective Global Assessment' (SGA)^(11; 12). These screening tools use weight and 72 73 BMI as primary components, however as these components are affected by fluid weight, including 74 ascites (a common symptom of decompensated liver disease), their use for patients with excess fluid is 75 limited. There is currently no agreed gold-standard method of malnutrition screening for patients with liver disease ⁽¹²⁾, consequently their malnutrition risk is often under-recognised ⁽⁵⁾. The American 76 Society for Parenteral and Enteral Nutrition (ASPEN) guidelines for the care of this patient group ⁽¹¹⁾, 77 78 recognise this and as such, provide a greater emphasis on the benefits of a full nutritional assessment. It is recommended that this is carried out by a dietitian ⁽¹³⁾ and is a more in-depth and specialised process 79 80 than nutritional screening.

81 Obtaining a dry weight (i.e. actual body weight without ascitic fluid or oedema) or estimating the weight 82 of ascitic fluid is required to assess patients however, this can be difficult to obtain or estimate. An actual weight after paracentesis is not always measured, particularly on hospital wards. Therefore, when 83 84 carrying out a full nutritional assessment, and to guide the estimation of dry body weight, UK based 85 dietitians may refer to the Pocket Guide for Clinical Nutrition, Parenteral and Enteral Nutrition Group (PENG)⁽¹⁴⁾. This provides reference guidance to adjust for weight of ascites by 2.2kg for minimal 86 ascites to 14kg for severe ascites. It is acknowledged this often underestimates ascitic weight ^(14; 15). The 87 evidence underpinning these figures stems from the American Veteran Administration Studies carried 88 89 out in the 1980's ⁽¹⁶⁾, which looked at weight gain among veterans with alcoholic liver disease in receipt 90 of nutritional therapy.

91 By employing the practical method of measuring weight before and after paracentesis (the draining of 92 ascitic fluid via a tube inserted into the abdomen) the present study provides evidence to help inform the 93 estimation of ascitic weight. Additionally, girth (abdominal circumference) measurement as a way of estimating ascitic weight has, to the authors' knowledge, only been explored via a single case study ⁽¹⁷⁾ 94 95 whose findings suggest that one inch equates to one kilogram of ascitic fluid. However, as well as the 96 clear limitations of a case study, the worth of this formula requires pre-existing knowledge of girth 97 measurement and therefore offers no practical method of estimating ascitic weight from pre-paracentesis girth. The present research study, therefore, provides novel findings that can be applied in practice. 98

99 Patients who had undergone paracentesis were consulted about the importance of investigating these100 issues and all patients felt the study was both important and acceptable.

101 Ultimately, overestimation of BMI can lead to malnutrition risk being overlooked. Likewise,

102 overestimating weight can result in a compromised nutritional assessment, as well as having

103 implications for prescribing medications. A more accurate method of estimating dry weight of patients

104 with ascites would reduce the risk of compromised nutritional screening and improve the accuracy of dietetic assessment.

105

106 In this study, we test the following hypotheses: ascitic fluid volumes can contribute greater weight gains

107 than current guidance suggests, and that abdominal girth circumference can be used to estimate ascitic

108 weight. Together these will improve the accuracy of dry weight estimation for patients with ascites,

109 secondary to liver disease, and consequently the accuracy of nutrition assessment and screening.

110

111 Methods

This study received approval from the Health Research Authority (IRAS project ID: 218747, REC 112

17/EE/023). Participants were eligible for inclusion if they were patients attending the Medical Day 113

Unit (MDU) at the general district hospital for the region, for therapeutic paracentesis drainage with 114

tense ascites secondary to liver disease. Prospective participants were identified from a clinic list of 115

116 patients who were booked in for therapeutic paracentesis. It was expected that they would primarily

117 have ascites secondary to liver disease, but this was confirmed prior to inclusion. Letters of invitation,

118 including study information and consent form, were sent with their standard paracentesis appointment

119 letters, so patients could take part at their next clinical appointment. It was anticipated that patients may

120 attend the MDU multiple times over the study duration; they were eligible to participate at each

attendance, but repeat participation was noted. Patients were excluded if they were unwilling or unable 121 122 to remove thick clothing, unable to stand unaided, or were unable or unwilling to give written informed

123 consent.

124 **Data collection**

All data were collected by EL eliminating inter-observer variability (18) and standard assessment 125

126 protocols were followed to limit intra-observer variability. Demographic data were obtained from the

127 participant (gender, ethnic origin, age, the aetiology of the liver disease and duration since diagnosis).

Presence of peripheral oedema was based on patient reporting, clinical judgement, observation and the 128

guidance provided by PENG⁽¹⁴⁾, where minimal, moderate and severe oedema are given estimated 129

values of 1kg, 5kg and 10kg respectively. Weight, height and girth were then measured according to 130

WHO protocols ⁽¹⁹⁾, described briefly as follows: 131

132 Weight: Participants were asked to stand on calibrated scales placed on a flat, firm surface, after first

133 removing all heavy or outer clothing, including footwear and headwear. Weight was noted to one

134 decimal place in kilograms (kg).

- 135 *Height*: Participant removed heavy or outer clothing, including footwear and headwear, with their hair
- 136 flattened down to the scalp. The participant stood with their feet together, legs straight and heels against
- 137 the backboard of the stadiometer. With the participant's head in the Frankfort plane ⁽²⁰⁾, the measure
- 138 lever was positioned, compressing hair as required. Height was read to nearest 0.1cm.

Abdominal girth: Using a disposable non-stretch paper tape measure, measurement was taken as close to skin as possible or over light clothing; only heavy clothing was removed. The participant stood upright, with feet together and arms resting at the sides. The participant located the midpoint between the top of the hipbone and last palpable rib, and then wrapped the measuring tape around their girth at this point. The researcher ensured the tape was parallel to the floor, horizontal across the back and front of the body, and around the widest part of the girth. The measurement was taken to the nearest 0.1cm, at the end of expiration, with the tape as close to skin as possible without compression.

146 Data were collected between March and June 2017.

147 Statistical analysis

A formal sample size calculation was not used. The aim was to recruit as many people as possible in the four months available for data collection. On average seven patients attend the unit each week, thus we estimated there would be approximately 112 patient visits that might be eligible for inclusion during the study period.

152 Analysis was carried out using Statistical Package for Social Sciences (SPSS) Version 23 (IBM, 2015).

153 Spearman correlation coefficients (*rho*) were conducted for continuous and ordinal, non-parametric

- 154 variables, along with Pearson's rank correlation coefficients (r) for parametric variables. For all analyses
- 155 p < 0.05 was considered statistically significant.
- 156 To test the second hypothesis, that pre-paracentesis abdominal girth circumference can be used to
- 157 estimate ascitic weight, an initial descriptive analysis was undertaken. This was followed by the
- 158 exploration of relationships between girth, fluid drained and difference between pre-and post-
- 159 paracentesis weight using scatterplots. Correlation coefficients were then explored using all participant
- 160 visits to increase the strength of statistical tests. The strength of the correlation coefficients was
- regarded as strong where r = 0.50 to 1.00, moderate where r = 0.30 to 0.49, and weak where r = 0.10 to 162 0.29 ⁽²¹⁾.
- 163 To calculate the coefficient of determination, which offers an idea of how much variance the variables
- share, the *r* values were squared and converted into a percentage of variance. Linear regression was
- 165 performed to assess the relationship between pre-paracentesis girth and body weight difference to
- 166 discover a regression equation. R-squared is a statistical measure of how close to the regression line the

167 data fit ⁽²²⁾. To measure the level of agreement between the estimated ascitic weight from girth

168 circumference and the actual measured ascitic weight, a Bland-Altman plot was used ⁽²³⁾. To estimate

169 statistical power a post hoc analysis was undertaken using the statistical package Minitab (State College,

170 PA: Minitab, Inc).

171

172 Results

Figure 1 displays study participation details, including reasons for exclusion. This shows that over the 13-week data collection period 47 study assessments were made, including 24 unique individuals, of whom 18 underwent full paracentesis at least once. There was a total of 38 paracenteses drains for which all the required data were collected. Three patients declined to have post-paracentesis data measured and six were not drained due to inadequate fluid.

Table 1 summarises the demographic characteristics of the 24 unique participants who consented to taking part in the study and the 18 participants who had paracentesis. All consenting participants had baseline data collected (including demographic information, pre-paracentesis weight, girth and height) and all of these potential participants are included in figure 1 and table 1 for completeness. All were of white British ethnic origin, they had a mean age of 65 years, the majority were male, diagnosed with alcoholic liver disease of over 2 years duration, had two or more previous paracentesis, used diuretics, and had minimal or no peripheral oedema.

185 Our first hypothesis was that ascitic fluid volumes can contribute greater weight gains than current 186 guidance suggests. Using only data from each unique participant's first paracentesis (first time of study participation) (n=18), table 2 shows the range of volume of fluid drained and pre-and post-paracentesis 187 weight difference, compared to the current guideline weights ⁽²⁴⁾. The values from our sample were 188 189 divided into tertiles to allow estimates for minimal, moderate and severe ascites in accordance with the 190 guideline ⁽²³⁾. The current guideline appears to under-estimate weight contribution of ascitic fluid for 191 many patients. Figure 2 displays the weight difference and fluid volume drained for each of the 192 individual participants, indicating that two (11%) patients had ascites greater than 14kg. One

193 participant's weight difference was 6kg over the maximum in the guidelines.

194 The changes in BMI pre-and post-paracentesis are shown in figure 3, which also depicts where there

195 was a change in the classification category of BMI. Table 3 shows BMI split into its quartile categories

196 with the number and percentages of participants falling within each category both before and after

197 paracentesis. This table and figure show that all participants' BMI reduced post-paracentesis, with 56%

198 (*n*=10) of participants' BMI falling into a lower category post-paracentesis and 61% (*n*=11) falling into

a lower category when weight was additionally adjusted for oedema.

Our second hypothesis was that abdominal girth circumference can be used to estimate ascitic weight.
For these analyses we used data from the 38 paracentesis drains for which we had complete data.

202 Testing showed that the difference in girth pre and post paracentesis was positively skewed with a non-203 normal distribution; consequently, non-parametric tests were employed. Median (9.6cm) and inter-204 quartile range (IQR: 8.0-12.0cm) were calculated along with the minimum (2.5cm) and maximum 205 (18.7cm). Strong and statistically significant correlations were found between fluid drained and weight 206 difference (*rho*=0.88, p<0.01), fluid drained and girth difference (*rho*=0.67, p<0.01), and weight 207 difference and girth difference (rho=0.60, p<0.01). Unless dry girth (i.e. post paracentesis) is known 208 these relationships are not clinically useful, nevertheless, it suggests that a relationship exists. In our 209 sample we asked participants to estimate their dry girth but only 38% attempted to do so (18/47), and of 210 these none were within 10% of their measured post-paracentesis girth. Since pre-paracentesis girth can 211 be measured, its relationship with pre-and post-paracentesis weight difference would be clinically 212 useful, since potentially it could be used to predict weight difference. The Spearman's correlation 213 coefficient demonstrated a strong and significant relationship (*rho*=0.68, p<0.01) with a regression 214 equation:

215 Weight difference (kg) = -20.05+0.25*x (where x = pre-paracentesis girth in cm).

A Bland-Altman plot is presented in figure 4. This illustrates the level of agreement between predicted and measured ascitic fluid weights, with 92% (n = 35/38) of results lying within the 95% limits of agreement. The line of best fit slopes upward ($R^2=0.277$) indicating that the equation tends to overestimate at small weight differences and underestimate at larger weight differences. An ideal line of best fit would be horizontal.

A post hoc estimation of statistical power was carried out using the statistical package Minitab (State College, PA: Minitab, Inc) to check the probability of a type 2 error. Using the difference in means of 3.16 kg and 3.16 litres in pre-and post-paracentesis weight and fluid volume, a SD=3.9, alpha=0.05, and a sample size of 18 unique participants the power was 0.9 or 90%, suggesting a low probability of a type 2 error (accepting the null hypothesis when it is actually false).

226 **Discussion**

In order to correctly identify people at risk of undernutrition and thus initiate treatment plans, it is

crucial to measure dry weight in patients retaining fluid. However, this is often not practicable and so

the accurate estimation of the contribution ascitic weight makes to total body weight is important. This

study shows that ascitic fluid volumes can contribute greater weight gains than current guidance

suggests, supporting the first hypothesis. Ascitic fluid weight is shown to be higher in each category

(minimal, moderate, severe ascites) than the figures in current guidance ⁽²⁴⁾, with 11% of participants 232 233 over the maximum value of 14kg. However, it is important to note that this study provides results 234 generalisable only to those with tense ascites that is large enough to warrant paracentesis. The data 235 supporting the current guidelines originates from studies carried out by Mendenhall in the 1980's, for the Veterans Health Administration Cooperative Studies Program ⁽¹⁶⁾. The study sample used by 236 237 Mendenhall were military and based ascitic fluid weight on approximations developed from calculations 238 using dry body weight and weight gain among American military veterans with alcoholic liver disease 239 who were receiving nutritional therapy. This study sample is not representative of a British civilian 240 population and thus has considerable limitations.

241 The importance of dry weight estimation is demonstrated by the change in BMI pre-and post-

242 paracentesis. BMI calculated using pre-paracentesis weight over-estimated BMI, resulting in patients 243 being classed in higher BMI categories. When post-paracentesis weight was used 56% of participants 244 dropped into a lower BMI category, moving two people from normal weight to underweight. Nevertheless, despite patients with liver disease being at risk of undernutrition, the majority of 245 246 participants did not have a dry BMI that fell into the underweight category. This could be partly explained by fluid retention despite paracentesis but could also suggest that our study sample had a 247 248 lower proportion of underweight individuals than expected. Ten of the eighteen participants had 249 additional fluid retention in the form of peripheral oedema, which is not affected by paracentesis. Although we accounted for this oedema using practice guidelines ⁽¹⁴⁾, clinical judgement and patient 250 251 reporting, it was not an objective measurement, therefore the accuracy of dry weight estimation is still uncertain. The evidence for the oedema data in the current practice guidelines is unknown⁽²⁰⁾. In 252 253 addition, despite therapeutic paracentesis draining off as much ascitic fluid as possible, there may still 254 have been some remaining thereby confounding the final dry weight. There was no way of alleviating 255 this risk, however given the duration of paracentesis and the fact that the drains had slowed to dry prior 256 to removal, the volumes of fluid remaining post-paracentesis were likely to have been minimal.

Paradoxically, evidence suggests that being overweight or obese may have a protective effect for those
 with cirrhosis, with lower mortality rates in hospitalised cirrhotic patients with obesity ⁽²⁵⁾. This is

thought to be due to the greater nutritional reserves associated with obesity which play a part in increasing survival rates during acute illness ⁽²⁵⁾. Thus, it may be that BMI categories for the general

261 population are not appropriate for those with cirrhosis and adjusted categories should be developed.

It is well accepted that BMI alone is not suitable for assessing malnutrition risk ^(9; 10; 26), and some screening tools do not require it at all ⁽²⁷⁾. Many screening tools include an assessment of unintentional weight loss but estimating unintentional weight loss in patients with ascites requires a succession of dry weight measurements. This would be easier in routine practice if more accurate estimations of ascitic weight were available, as we present here. Clearly, the most accurate method would be to weighpatients' post-paracentesis, adjusting for any other oedema, but this is not always possible.

A relationship between pre-paracentesis girth and ascitic weight was found and this has the potential to aid ascitic weight estimation and consequently dry weight calculation, in particular for those unable to undergo paracentesis or when nutritional assessment is required when a dry weight is not available.

271 However, the equation we developed did not provide a precise enough estimate; only 34% of

272 participants' weight difference could be predicted to within 1kg. 84% of participants' weight could be

273 predicted to within 3kg but this is not accurate enough for reliable nutritional screening. Further research

is recommended to verify the accuracy of variance and clinical sensitivity of these important and novelfindings.

One weakness of this study is the lack of ethnic diversity in the study population; the sample were only 276 of White British origin. This is reflective of the local population ⁽²⁸⁾ but limits the applicability of the 277 278 data to patients from other ethnic backgrounds. Additionally, the data were not analysed according to 279 gender (due to the small sample size), therefore it was not possible to identify any specific gender 280 differences. Another limitation is that the influence of food and fluid intake, IV albumin solution or 281 bowel movements on weight were not accounted for; diurnal variation in weight may be as much as 2kg ⁽²⁰⁾. These factors may account for the differences found between weight and fluid volume drained. 282 283 Finally, our study is small with only 18 unique participants; a larger sample to confirm our formula would be beneficial. 284

In summary, this study shows that the current guidelines for the weight of ascitic fluid may underestimate the true value in this sample of patients with cirrhosis of the liver. However, because patients with minimal ascites may not have adequate ascitic volume to drain, ascitic weight may be overestimated in this group. We recommend that the guidelines are updated using these contemporary and robustly derived figures. However, they should be used with caution in ethnic groups other than white British. It may be possible to estimate ascitic fluid weight using the pre-paracentesis girth measurement, but the formula requires further validation.

292

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310 **Conflict of Interest Statement**

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- *Figure 2. Weight difference pre- and post-paracentesis and the volume drained for each of the 18 unique*
- *participants*.





- 383 Figure 31. Body Mass Index pre- and post-paracentesis and additionally adjusted for peripheral
- 384 oedema for each of the 18 unique participants, and comparison with Body Mass Index categories.



386 *Participant 1, post-paracentesis BMI=18.5kg/m², ** Participant 10, post-paracentesis BMI=25.2kg/m²

387 NB: Oedema estimated based on a combination of clinical judgement, participant reported volume and guidance
 388 according to Todorovic and Micklewright (2011) ⁽¹⁴⁾

389

390



Figure 4. Bland-Altman plot of difference between measured ascitic weight and predicted weight from
pre-paracentesis girth, using above equation

		All participants recruited (<i>n</i> =24)		Participants with at least one completed	
				paracentesis (n=18)	
		Frequency	Percentage	Frequency	Percentage
		(<i>n</i>)	(%)	(<i>n</i>)	(%)
Gender	Male	17	70.8	14	77.8
	Female	7	29.2	4	22.2
Ethnicity	White British	24	100	18	100
	Other	0	0	0	0
Aetiology of liver	Alcoholic liver disease	16	66.7	11	61.1
disease	NAFL	2	8.3	2	11.1
	Hepatitis C	2	8.3	2	11.1
	Cryptogenic	4	16.7	3	16.7
Previous number of	None	3	12.5	0	0
paracentesis	One	6	25.0	5	27.8
	Two or more	15	62.5	13	72.2
Diuretic use	No	5	20.8	4	22.2
	Yes	19	79.2	14	77.8
Estimated amount	None (0)	14	58.3	8	44.4
of peripheral	Minimal to moderate (0.5-<5)	8	33.4	8	44.4
oedema* (kg)	Moderate to severe (5-10)	2	8.4	2	11.1
Duration since liver	Less than 6 months	7	29.2	3	16.7
disease diagnosis	6 months to 1 year	2	8.3	1	5.6
	1-2 years	4	16.7	4	22.2
	Over 2 years	11	45.8	10	55.6
Participant age		Range = 45-83		Range =45-83	
(years)		Mean (SD) = 65 (10.5)		Mean (SD) = 65 (10.6)	

* Oedema estimated based on a combination of clinical judgement, participant reported volume and guidance according to Todorovic and Micklewright (2011)⁽¹⁴⁾.SD=Standard deviation; NAFL=non-alcoholic fatty liver

Table 2. The range of pre-and post-paracentesis weight difference and volume of fluid drained in the

Current dietetic	Findings from present study				
guidelines*					
Guide for assessing	Ascitic weight	Ascitic volume	Ascitic weight	Ascitic fluid	
weight of ascites (kg)	difference (kg)	drained (litres)	difference (kg):	drained (litres):	
	<i>n</i> = 18	<i>n</i> = 18 (SD)	Range in tertiles	Range in	
			(mean of tertile)	tertiles (mean	
				of tertile)	
Minimal	Minimum	Minimum	15 65 (56)	3.75 - 7.3 (5.6)	
2.2	4.5	3.75	4.5 - 0.5 (5.0)		
Moderate	Mean	Mean		7.4 - 8.35 (7.7)	
6	9.2 (SD:3.5)	9.1 (SD:3.5)	6.5 – 8 (7.3)		
Severe	Maximum	Maximum		9.8 – 19 (12.8)	
14	20	19	9.5 – 20 (13.1)		

study sample compared to current dietetic guidelines.

*Wicks and Madden (1994)⁽²³⁾.

Table 3. Body Mass Index pre- and post-paracentesis, adjusted for peripheral oedema for the study
 sample, and comparison with Body Mass Index categories.

Classification Category	BMI (kg/m ²)	Percentage in category pre- paracentesis (n)	Percentage in category post- paracentesis (n)	Percentage in category post-paracentesis adjusted for peripheral oedema (dry BMI) (n)
Underweight	<18.5	0% (<i>n</i> =0)	6% (<i>n</i> =1)	11% (<i>n</i> =2)
Normal weight	\geq 18.5 – 24.9	28% (n=5)	55% (n=9)	44% (<i>n</i> =8)
Overweight	\geq 25.0 – 29.9	39% (<i>n</i> =7)	33% (<i>n</i> =6)	33% (<i>n</i> =6)
Obese	\geq 30.0	33% (<i>n</i> =6)	11% (n=2)	6% (<i>n</i> =2)

Oedema estimated based on a combination of clinical judgement, participant reported volume and guidance

414 according to Todorovic and Micklewright (2011) (14)