A short-term low fibre diet reduces body mass in healthy young men: implications for weight sensitive sports

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ABSTRACT:

Athletes from weight-sensitive sports are reported to consume low fibre diets to induce acute reductions in body mass (BM). However, evidence supporting their efficacy is anecdotal. Therefore, we aimed to determine the effect of a low fibre diet on acute changes in BM. Nineteen healthy males (32 ± 10 years, 1.79 ± 0.07 m, 77.5 ± 8.1 kg) consumed their habitual diet (HAB: ~30 g fibre •day^{-1}) for 7 consecutive days followed by 4 days of a low fibre diet (LOW: <10 g fibre •day^{-1}) that was matched for energy and macronutrient content. Participants also matched their daily exercise load during LOW to that completed during HAB (*p*= 0.669, avg 257 ± 141 AUs). BM was significantly reduced in LOW vs HAB after 4 days (**Δ**= 0.40 ± 0.77 kg or 0.49 ± 0.91%, *p*< 0.05, ES [95% CI] = -0.53 [-1.17, 0.12]) and on the morning of day 5 (**Δ**= 0.58 ± 0.83 kg or 0.74 ± 0.99%, *p* < 0.01, ES= -0.69 [-1.34, -0.03]). LOW resulted in moderately higher hunger (**Δ**= 5 ± 9 mm, *p*= 0.015, ES= 0.55 [-0.09, 1.20]), a decline in stool frequency from 2 ± 0 to 1 ± 0 bowel movements per day (*p*= 0.012, ES= 0.64 [-0.02, 1.29]) and stool softness decrease (*p*= 0.005). Nonetheless, participants reported the diet to be tolerable (n= 18/19) and were willing to repeat it (n= 16/19). Data demonstrate for the first time that consumption of a short-term low fibre diet induces reductions in BM.

Keywords: low fibre diet, acute weight loss, weight making

INTRODUCTION:

Body mass (BM) is frequently manipulated by athletes involved in weight-sensitive sports in an attempt to gain competitive advantages over their opponents. For example, in weight-restricted sports (e.g. combat sports, weightlifting, lightweight rowing), reducing BM allows athletes to compete in lower weight categories, against opponents with shorter limb length and lower power to mass ratios (Burke et al., 2021). In weight-bearing sports (e.g. road cycling, some disciplines of track and field, ski jump, etc), athletes may also strive to improve their power/work capacity relative to their BM (Burke et al., 2019; Phillips and Hopkins, 2020). Strategies to reduce BM can be broadly categorised according to acute (hours and days) and chronic (weeks and months) time-scales (Langan-Evans et al., 2021). Chronic strategies typically aim to reduce predominantly fat mass through energy deficit, whereas acute weight loss (AWL) strategies involve manipulation of body water, glycogen stores and gastrointestinal (GI) tract contents for rapid and pronounced shifts in BM (Burke et al., 2021).

As an AWL strategy, low fibre diets are purported to result in acute BM loss (Reale et al., 2017) ,though such interventions have been subject to little scientific enquiry in the context of sports nutrition. Low fibre diets are defined as diets with a maximum fibre intake of 10 g •day^{-1} (Vanhauwaert et al., 2015), and their effect in reducing BM is thought to be mediated by reducing the mass of undigested fibre, bacteria and water retained in the intestines (Stephen and Cummings, 1980a; b). Indeed, reduced dietary fibre intake may decrease colonic content (Bendezú et al., 2017) and in gastroenterology research, it has been demonstrated that low fibre diets are an effective method of intestinal preparation (emptying) for colonoscopy and colorectal surgery (Lijoi et al., 2009; Chen et al., 2020). Although emptying the gastrointestinal tract with preparations of bisacodyl and sodium phosphate also results in an acute BM loss, such an approach can induce dehydration that is not only a negative physiological side-effect (Holte et al., 2004), but also a confounding factor for determining the effect of colonic content on BM. Therefore, the ability of low fibre diets to reduce the intestine contents is not known. Nonetheless, this strategy is currently used by athletic populations to induce AWL.

For example, in a recent survey of Olympic combat sport athletes, 3-16% of athletes reported consumption of a low fibre diet as part of their AWL regime prior to weigh-in (Reale et al., 2018a). We have also observed the use of such interventions in both combat sports and endurance athletes, the latter amongst Grand Tour winning cyclists several days before a high-mountain stage (authors' unpublished observations). Anecdotally, we and others (Burke et al., 2019) have observed that a low fibre diet may result in a BM loss ~0.5-1.0 kg when consumed for two to four days. However, although one study has previously reported a 1.5% BM loss after two days of reduced fibre diet (10-13 g/day), the concomitant introduction of a mild energy deficit and the absence of a group with habitual fibre intake makes it difficult to establish the net contribution of reduced fibre intake to the reported weight loss (Reale et al., 2018b). Therefore, it remains to be established if, and to what extent, low fibre diets can acutely reduce BM.

With this in mind, the aim of the present study was to examine the effect of low fibre diet on acute changes in BM. We hypothesized that a low fibre diet would result in ~0.5 kg or ~0.5-1% BM loss.

METHODS:

Participants:

Twenty male participants volunteered to take part in this study. The participants were defined as recreationally active in accordance with the criterion that they perform at least 150-300 min moderate-intensity activity or 75–150 min of vigorous-intensity activity a week (McKay et al., 2021). None of the participants had any food allergy nor gastrointestinal diseases. One participant was removed from sample analysis due to the abnormally high BM loss during the habitual diet phase (>2x standard deviations (SD) of group mean = 0.97 [group mean SD = 0.41]). The exclusion resulted in a total of 19 participants (mean ± SD: age 32 ± 10 years, stature 1.79 ± 0.07 m, BM 77.5 ± 8.1 kg). Prior to the participation, participants provided informed written consent. This study was approved by Liverpool John Moores University Ethics Committee (M21_SPS_1456) and conducted in accordance with the Declaration of Helsinki.

Study Design:

A summary of the study design is portrayed in Figure 1. Briefly, in a one group pretest-posttest design, participants were screened for their habitual diet (HAB) and exercise habits during a baseline period, followed by four days of a low fibre diet (LOW), which replicated the exercise from the HAB period. The main outcome measures were dietary intake and BM, and secondary outcome measures included appetite, and stool type and frequency.

Dietary Intake assessment:

Dietary intake was assessed in real time using a modified version of the remote food photography method (RFPM), which has been shown to accurately measure the energy intake of free-living individuals (Martin et al., 2009). Participants took photographs of food and fluid prior to consumption and sent the photos to the researchers via WhatsApp in real time with a description of items in each picture (including information on quantities, brands, preparation and cooking methods) daily throughout the 11-day period. The images and details provided during HAB and LOW were analysed using a food analysis software (*Nutritics*™, Dublin, Ireland). Energy, carbohydrate, protein, fat, alcohol, fibre, fluid, and sodium intake were calculated. Prior to data collection, the RFPM method was explained in detail during an online video meeting and all participants were provided with opportunities to ask questions. To ensure participants did not omit any foods/drinks and to increase the accuracy of the food records, the participants were prompted for further information in real time on items that were difficult to identify, but no feedback was provided regarding the type and/or quantity of foods selected during recording. To minimise error in assessment of photographs, the dietary records were separately analysed by two researchers and the results averaged.

Body Mass:

Body mass was assessed daily in the mornings of days 1-5 during HAB and days 1-5 during LOW using bathroom digital scales (several brands) and the same unit used by each participant. Given that daily recording of BM can affect participant normal behavior and result in BM loss (Madigan et al., 2015), a gap of 3 days in the recording of BM was intended to restore normal behaviour, though dietary assessment continued during this period. Measurements of BM were performed on the morning of each day upon waking and after first urination. Two consecutive BM measures were performed. Participants were instructed to wear minimal clothing and for this to be consistent each time. The two measurements were immediately reported to researchers via phone message. To determine the sensitivity of the bathroom scales, a three-point calibration method was performed prior to the experiment with the following test loads: 1) BM, 2) BM + 0.5 kg (one filled 500 ml water bottle) and 3) BM + 1 kg (two filled 500 ml water bottles). Participants' scales proved to be sensitive, evidenced by 0.5 kg and 1 kg increments in addition to BM (77.5 ± 8.3 kg) for the second (78.0 ± 8.3 kg) and third test loads (78.5 ± 8.3 kg). Moreover, given the mean normal gut transit time is ~2 days (Asnicar et al., 2021), we decided to explore the relationship between fibre intake and BM changes using the changes in mean fibre intake between the last two days of HAB (days 6-7) and days 1 to 4 of LOW and the difference in absolute and relative BM losses reported after 4 days of HAB and LOW.

Exercise Assessment:

Upon completion of an exercise session during days 1-4 of HAB, participants notified the researchers immediately the type, duration (min) and rate of perceived exertion (RPE) using the modified CR-10 RPE scale (Borg, 1982).Training load was determined as the product of each session's RPE and its duration (min) (Foster et al., 2001). During days 1-4 of LOW, participants were reminded of the type, duration and RPE of exercise performed during HAB for each day and requested to replicate that on a day-by-day basis as HAB. To prove their compliance, participants reported the type, duration and RPE of exercise to the researchers immediately after each exercise session during LOW.

Low Fibre Diet Intervention

Based on the dietary records of days 1-4 of HAB, researchers created personalised 4-day low fibre detailed dietary plans and provided these to participants after day 7 of HAB. The low fibre diet contained <10 g fibre•day^{-1} and matched the energy, carbohydrate, protein, fat, alcohol, fluid and sodium on a day-by-day and meal-by-meal basis as participants' habitual diet. Participants were asked to follow the diet strictly by weighing out the food prescribed using own kitchen scales. Compliance with the diet was evaluated in real time with every single item ingested and assessed with the RFPM (method description provided earlier).

Stool Frequency, Stool Type and Stool Softness:

Participants informed the researchers via WhatsApp immediately following their bowel movements and classified their stool type using the Bristol Stool Scale Form (BSFS), ranging from the discrete lumps of slow transit (type 1) to the non-cohesive (type 6) and liquid stools (type 7) of rapid transit (O'Donnell et al., 1990). Stool frequency was defined as the number of bowel movements per day. Stool softness was determined by the multiplication of the stool type (type 1-7) and its daily prevalence (%).

Appetite assessment:

Upon consumption of each main meal (breakfast, lunch and dinner), participants rated their appetite on three variables including hunger, fullness and nausea using the 100-point visual analogue scales (VAS; Parker et al., 2004) using a smart-phone application (KoBo Toolbox, Cambridge).

Subjective Feedback:

At the end of the study participants responded to four closed-ended questions in written form, “Q1: Was the low fibre diet tolerable?”, “Q2: Did you experience any adverse events associated with the low fibre diet?”, “Q3: Outside your main meal, how did your hunger feel?” and “Q4: Would you be willing to use low fibre diet for acute BM management in future?” with the options of “Yes” or “No” for Q1, Q2 and Q4 and “Normal”, “Less than normal” or “Higher than normal” for Q3. If the participants answered “Yes” to Q2, they were asked to describe the adverse events experienced.

Statistical Analysis:

Data normality was assessed via the inspection of histograms and box plots. Mauchly’s test of sphericity was used to test the assumption of sphericity. The assumption of sphericity was met when $p > 0.05$ whereas the assumption of sphericity was violated when $p < 0.05$. Two-way repeated measures ANOVA was used to analyse BM changes, dietary intake, appetite scores and stool frequency. A Bonferroni adjusted post hoc test was used to locate variance, where significant statistical effects occurred. The starting BM was analysed by paired samples T-test. All data in text, tables and figures are expressed as means and SD with $p < 0.05$ indicating statistical significance. When appropriate, 95% confidence intervals (95% CI) and Hedges’s *g* effect sizes (ES) were reported. ES was interpreted as trivial (≤0.20), small (0.20-0.59), medium (0.60-1.19), large (1.20-1.99) and very large (≥2.00) (Hopkins, 2003). Due to the presence of outliers, the relationships between fibre intake and BM changes were evaluated via a Spearman’s rho correlation coefficient. All statistical tests were performed using SPSS for Windows (version 27, SPSS Inc, Chicago, IL).

RESULTS:

Comparison of dietary intake between HAB and LOW

There were no significant differences in the energy, carbohydrate, protein, fat, alcohol, fluid and sodium intakes between HAB and LOW from days 1 to 4 (Table 1). Fibre intake, however, was significantly reduced during LOW on days 1 to 4 when compared to HAB (all $p < 0.001$). Overall, the 4-day mean fibre intake during LOW was 22.8 ± 8.5 fibre•day^{-1} less than HAB ($p < 0.001$, ES = -3.54 [-4.56, -2.52]).

An overview of training load completed

Training load completed during HAB and LOW is presented in Figure 2. The training load performed during days 1-4 HAB was replicated during days 1-4 LOW, with participants exercising an average 54 ± 27 min at an RPE of 4 ± 2, resulting in training load of 257 ± 141 AUs showing no difference between conditions ($p = 0.669$).

Changes in body mass during HAB and LOW

Individual absolute BM data recorded during HAB and LOW are presented in Table 2. There was no significant difference in BM on days 1 of LOW and HAB ($p = 0.598$, ES = -0.01 [-0.65, 0.63]). BM decreased across time ($p < 0.001$) and the overall reduction in BM was greater in LOW when compared to HAB ($p = 0.004$), with greater magnitude of BM loss observed on days 4 and 5 of LOW in comparison with HAB ($p = 0.009$).

The absolute BM changes relative to day 1 of each diet (ABS, kg) decreased during LOW compared to HAB on day 4 (**Δ** = 0.40 ± 0.77 kg, $p = 0.036$, ES = -0.53 [-1.17, 0.12]) and day 5 (**Δ** = 0.58 ± 0.83 kg, $p = 0.006$, ES = -0.69 [-1.34, -0.03]) (Figure 3A). Similarly, relative BM changes in relation to day 1 of each diet (REL, %) decreased during LOW on day 4 (**Δ** = 0.49 ± 0.91%, $p = 0.031$, ES = -0.54 [-1.19, 0.11]) and day 5 (**Δ** = 0.74 ± 0.99%, $p = 0.004$, ES = -0.71 [-1.36, -0.05]) (Figure 3B). An absolute and relative BM loss to day 1 was observed in both diets on day 2 (HAB, $p = 0.038$ and $p = 0.041$, LOW, $p = 0.025$ and $p = 0.021$), but it did not differ between diets (ABS, $p = 0.193$, REL, $p = 0.233$), and only in LOW a significant BM loss was achieved in day 4

(ABS, p = 0.009, ES = -1.25 [-1.95, -0.56], REL, p = 0.006, ES = -1.32 [-2.02, -0.62]) and day 5 (ABS, p = 0.010, ES = -1.25 [-1.95, -0.56] , REL, p = 0.007, ES = -1.31 [-2.01, -0.61]). Thus, it takes 3 days for the detectable changes in BM to occur when consuming low fibre diet.

Relationship between fibre intake and body mass change

The changes in fibre intake between days 6 to 7 of HAB and days 1 to 4 of LOW showed a significant correlation with the changes in absolute (r_s = -0.495 [-0.781, -0.039], p = 0.031) (Figure 4A) and relative BM losses (r_s = -0.489 [-0.778, -0.030], p = 0.034), respectively (Figure 4B).

Changes in stool frequency and stool type

Stool Frequency: The mean daily stool frequency decreased from 2 ± 0 in HAB to 1 ± 0 bowel movements•day^{-1} during LOW (p = 0.012, ES = 0.64, 95% CI = -0.02 to 1.29). There was, however, no significant treatment x time interaction (p = 0.744) and main effect of time in stool frequency (p = 0.704).

Stool Softness Score: There was a significant treatment x time interaction (p = 0.025) and a main effect of treatment (p = 0.013), but no main effect of time (p = 0.388). Stool softness score reduced from 389 ± 40 to 338 ± 75 AUs during LOW (p = 0.013, ES = -0.83 [-1.49, -0.07]). Significant decline in stool softness was observed on day 3 of LOW when compared to HAB (298 ± 156 vs 420 ± 68 AUs, p = 0.005, ES = -0.99 [-1.67, -0.32) (Figure 5A). Harder stool types were more frequent on LOW than in HAB on day 4 (Type 1 12% vs 0%, and Type 2, 12% vs 9.4%, respectively) (Figure 5B).

Changes in appetite during HAB and LOW

The changes in hunger, fullness and nausea scores during days 1 to 4 of HAB and LOW are displayed in Figure 5. There was a main effect of treatment on hunger (p = 0.015) and fullness (p = 0.034) but no effect of time or treatment x time interaction (all

$p > 0.05$). Higher hunger (20 ± 12 vs 14 ± 9 mm, $p = 0.015$, ES = 0.55 [-0.09, 1.20]) and lower fullness (72 ± 18 vs 77 ± 16 mm, $p = 0.034$, ES = -0.31 [-0.95, 0.33]) were observed in LOW than HAB. There was no effect of time, treatment or interaction on nausea (all $p > 0.05$).

Subjective perception of diet and tolerability

Ninety five percent of participants found LOW tolerable (n = 18/19) and 84% reported willing to use LOW for acute BM management in future (n = 16/19). During LOW, 68% of participants (n=13) reported feeling hungrier outside of their main meals while the remaining six participants did not experience alterations in hunger. Six participants reported adverse events during LOW, these include stomach cramps (n = 3), sleep disturbances (n = 1), bloating (n = 1) and mood alterations (n = 1).

DISCUSSION:

Confirming our hypothesis, we report for the first time that a short-term low fibre diet induces an acute reduction in body mass in a cohort of recreationally active men. The observed reduction in body mass (0.6 kg or 0.7%) was also accompanied by a moderate increase in appetite, a reduction of bowel movements, and an increase in stool hardness. Nonetheless, the majority of participants (95%) found the practice tolerable and were willing to implement it in the future (84%). Importantly, we used an experimental design in which the low fibre intervention was matched to the energy and macronutrient intake (in a meal-by-meal and day-by-day basis) reported by participants in their habitual diet. From a practical perspective, these data suggest that low fibre diets could be employed as AWL strategy for athletes participating in weight sensitive sports.

To our knowledge this is the first study directly assessing the effect of a low fibre diet on BM compared against a control condition. The BM reducing effects of a low fibre diet which we reported are in line with the suggested absolute BM loss of 0.5 kg (Burke et al., 2019), though it is lower than the ~1-2% and ~1.2 kg BM loss reported by Reale et al. (2018) and Holte et al. (2004), respectively. Differences from the latter two studies may be related to the fact that Reale et al. (2018) also induced a caloric deficit and controlled fluid intake during days 1 to 2 and had no experimental group with a habitual fibre intake. Furthermore, Holte et al. (2004) used an artificial bowel content removal method via means of a preparation containing bisacodyl and sodium phosphate which has significant adverse physiological effects and may induce dehydration.

We observed a significant decrease in BM in LOW compared with HAB on day 4 (~0.40 kg or ~0.49%) that became more pronounced on day 5 (0.58 kg or ~0.74%) (Figure 3) which is in line with our hypothesis of gut residue reduction and the expected time response of normal gut function. Individual typical gut transit times have been reported to be ~2 days on average (Asnicar et al., 2021) but also show a wide range of 10 to 96 hours (Lee et al., 2014; Asnicar et al., 2021), which may explain the variability in the timeframe required to achieve significant BM loss in different individuals (Table 2). Although we observed a significant correlation between the difference in fibre intake during days 6-7 of HAB and fibre intake during LOW and BM loss (Figure 4), the changes in fibre intake only accounted for ~24-25% of the variance in BM loss. This result suggests other factors may play heavier roles in the contribution to BM loss, but this will need to be further investigated by assessing the synchronization of gut transit times with weight loss using stool dye.

A possible mechanism could be that removal of different types of fibre contribute BM loss to varying extent, attributable to whether they are fermentable by gut bacteria or not. For example, faecal output increased most by fibres with high faecal bulking index such as wheat bran, whereas fibres from fruit and vegetables are extensively fermented, contributed much less to faecal output (Monro, 2000). Another possible explanation is that beyond the mass retained by fibre itself, lower intake of fermentable fibre reduces the energy input for maintenance of gut microbiota mass and part of the BM loss may be attributable to loss of some of the gut microbiota mass which has been estimated to be ~0.2 kg (Sender et al., 2016). Either way, our data supports previous findings reporting a reduction of gut contents with a low fibre diet, whatever the composition of it may be (Bendezú et al., 2017).

The moderate increase in hunger and decrease in fullness we observed in our individuals after each main meal is most likely attributable to the reduced satiety of a lower fibre diet, and differences in BM between groups attributable to fibre rather than differences in energy balance between groups. Dietary fibre has shown to reduce appetite (Wanders et al., 2011) and it is expected that a reduction in fibre would, in turn, increase appetite as it has been shown that an *ad libitum* diet with lower fibre and higher energy density is also associated with a higher energy intake (Hall et al., 2021). The similar patterns of BM change in HAB and LOW groups until day 3, indicate that the calorie and macronutrient intake were well-matched between groups throughout (Table 1). Therefore, the significant decrease in BM on day 1 in both groups, can be attributed to the effect of self-monitoring (daily weighing) (Madigan et al., 2015) and the later mean group BM loss (days 4-5) in LOW, attributable low fibre and the inter-individual variations in gut transit times as explained before. The disruption of the diet, of appetite and otherwise, appeared to be minimal and the practice well tolerated since 95% individuals reported to tolerate the diet and 84% were willing to implement it again.

A limitation of this study was that the foods for the low fibre diet were not provided to the participants, which might influence the participants' adherence to the meal plans, even if the dietary follow-up of our study was in real-time by a dedicated group of researchers. The careful assessment of the food photographic evidence provided by the participants indicate that the energy, macronutrients, alcohol, sodium and fluid were indeed matched across diets. Nonetheless, this type assessment is still liable to some measurement errors. These errors could result in small differences in —for example— the sodium intake between diets which could mask the BM changes induced by the low fibre diet. Thus, future scientific studies conducted in laboratory conditions, should also include full control of exercise and dietary intake to further test our hypothesis and the reproducibility of our findings. Moreover, this study exclusively examined male participants. With the GI motility being reportedly slower in females (Graff et al., 2001), assessing the potential of low fibre diet to reduce BM in females is warranted.

Therefore, considering the effectiveness and tolerability of the diet in a highly ecologically valid environment, the next steps are to test whether a fully controlled diet can induce moderate BM loss and positively affect performance outcomes in controlled laboratory settings and in a range of sports-performance tests. We believe that this type of intervention is simple, safe and can be applied in a wide range of settings, but we call for caution and openly express our stand against the use of low fibre diets chronically in healthy individuals. Dietary fibre is an important macronutrient for the maintenance of normal gut function and health and a well-balanced diet should contain ~25-35 g/day of fibre (Gill et al., 2021). Nonetheless, we believe that research on acute reduction of fibre intake in BM, metabolism, physiology, and performance is rather unexplored in sports nutrition and further research is warranted.

In conclusion, following a low fibre diet (<10 g fibre.day^{-1}), for a minimum of three days, appears to be effective for acute BM loss with minimal disruption but accompanied with a moderate increase in appetite, reduction of bowel movements and hardening of stools. Further research on the effect of low fibre diets on physiology, metabolism and performance is warranted.

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Table 1: Dietary intake of the participants from days 1 to 4 of the habitual diet (HAB) and low fibre diet (LOW) trials. CHO = carbohydrate, PRO = protein, BM = body mass. *significantly lower than HAB ($p < 0.001$).

Nutrients	**Day 1**		**Day 2**		**Day 3**		**Day 4**		**Interaction**	**Treatment**	**Time**
	HAB	*LOW*	*HAB*	*LOW*	*HAB*	*LOW*	*HAB*	*LOW*			
Energy (kcal)	2682 ± 501	2670 ± 523	2910 ± 474	2911 ± 473	2855 ± 633	2827 ± 598	2923 ± 471	2882 ± 478	$p = 0.311$	$p = 0.112$	$p = 0.076$
Energy (kcal.kg BM^{-1})	34.9 ± 7.0	35.1 ± 7.2	37.8 ± 6.1	37.8 ± 6.1	37.0 ± 7.6	36.6 ± 7.2	38.1 ± 6.8	37.5 ± 6.8	$p = 0.273$	$p = 0.080$	$p = 0.080$
CHO (g)	303 ± 76	306 ± 79	317 ± 77	321 ± 81	318 ± 100	314 ± 99	326 ± 80	323 ± 76	$p = 0.189$	$p = 0.964$	$p = 0.425$
CHO (g.kg BM^{-1})	3.9 ± 1.0	4.0 ± 1.0	4.1 ± 1.0	4.2 ± 1.1	4.1 ± 1.2	4.0 ± 1.2	4.2 ± 1.0	4.2 ± 1.0	$p = 0.160$	$p = 0.656$	$p = 0.464$
PRO (g)	142 ± 34	142 ± 30	159 ± 47	161 ± 46	147 ± 40	147 ± 38	160 ± 39	156 ± 40	$p = 0.335$	$p = 0.819$	$p = 0.120$
PRO (g.kg BM^{-1})	1.8 ± 0.4	1.8 ± 0.3	2.0 ± 0.5	2.1 ± 0.3	1.9 ± 0.5	1.9 ± 0.5	2.1 ± 0.5	2.0 ± 0.5	$p = 0.174$	$p = 0.801$	$p = 0.164$
Fat (g)	99 ± 34	100 ± 34	112 ± 36	109 ± 35	108 ± 29	107 ± 28	107 ± 35	105 ± 36	$p = 0.784$	$p = 0.088$	$p = 0.378$
Fat (g.kg BM^{-1})	1.3 ± 0.5	1.3 ± 0.5	1.5 ± 0.5	1.4 ± 0.5	1.4 ± 0.4	1.4 ± 0.4	1.4 ± 0.5	1.4 ± 0.5	$p = 0.469$	$p = 0.087$	$p = 0.439$
Alcohol (g)	1.4 ± 6.2	1.8 ± 6.9	0.4 ± 2.0	0.4 ± 1.9	3.9 ± 8.2	3.8 ± 8.1	3.2 ± 8.1	2.9 ± 7.8	$p = 0.216$	$p = 0.889$	$p = 0.327$
Fluid (L)	3.79 ± 0.82	3.75 ± 0.86	3.98 ± 0.95	3.92 ± 0.85	3.67 ± 0.97	3.71 ± 0.99	3.60 ± 0.84	3.56 ± 0.78	$p = 0.414$	$p = 0.355$	$p = 0.153$
Fibre (g)	28.9 ± 10.1	8.7 ± 1.0*	34.9 ± 9.6	8.6 ± 1.1*	29.5 ± 9.7	8.7 ± 1.1*	32.5 ± 10.6	8.8 ± 0.8*	**$p = 0.008$**	**$p < 0.001$**	**$p = 0.009$**
Sodium (mg)	3094 ± 898	3130 ± 899	3524 ± 1148	3476 ± 1134	3035 ± 939	3073 ± 804	3211 ± 953	3171 ± 948	$p = 0.669$	$p = 0.915$	$p = 0.317$

Table 2: Individual body mass changes across days 1 to 5 of habitual and low fibre diet.

Participants	**HAB**					**LOW**				
	Day 1	*Day 2*	*Day 3*	*Day 4*	*Day 5*	*Day 1*	*Day 2*	*Day 3*	*Day 4*	*Day 5*
1	79.75	79.50	80.35	79.85	80.65	79.80	79.50	79.30	79.20	79.35
2	81.20	80.25	80.00	80.40	80.10	80.70	80.40	79.90	80.00	80.30
3	75.60	74.80	75.40	75.10	76.00	74.70	75.00	75.20	75.00	75.40
4	81.60	81.35	81.30	81.10	80.90	81.00	80.20	80.95	80.20	80.10
5	63.70	63.40	63.40	63.20	63.50	63.20	63.60	63.40	62.30	62.30
6	79.30	78.90	79.30	79.05	79.80	79.75	78.80	78.30	78.00	78.35
7	75.30	75.40	74.40	75.00	74.80	75.00	74.50	73.50	73.50	73.20
8	79.80	80.20	79.90	79.80	79.90	80.10	80.20	79.80	79.70	79.80
9	64.00	64.20	63.40	63.80	63.40	63.80	63.70	63.90	63.40	62.50
10	69.35	68.80	69.05	68.75	68.55	68.25	67.30	68.00	67.90	67.60
11	90.00	89.30	89.70	90.90	90.40	91.20	89.10	89.80	89.80	89.10
12	78.60	77.50	77.40	77.60	77.80	77.30	76.90	76.70	76.70	76.60
13	84.20	83.50	82.80	82.75	82.50	80.05	82.80	82.00	82.20	81.60
14	65.95	66.10	65.60	65.60	65.95	65.25	65.15	65.35	64.50	64.90

15	85.70	85.80	85.80	85.80	85.90	86.30	86.10	86.00	86.30	86.10
16	76.20	76.30	76.70	77.00	76.90	76.80	76.70	77.80	77.60	77.40
17	91.60	90.50	90.40	90.10	90.10	91.30	90.10	90.60	89.20	89.80
18	82.10	82.10	82.10	81.30	82.00	82.90	81.90	81.90	82.60	82.50
19	68.90	68.10	68.30	68.60	68.50	68.80	68.30	67.80	68.40	68.00
Mean	**77.52**	**77.16**	**77.12**	**77.14**	**77.24**	**77.43**	**76.86**	**76.85**	**76.66**	**76.87**
SD	**8.13**	**7.99**	**8.09**	**8.11**	**8.09**	**8.50**	**8.09**	**8.14**	**82.3**	**8.29**

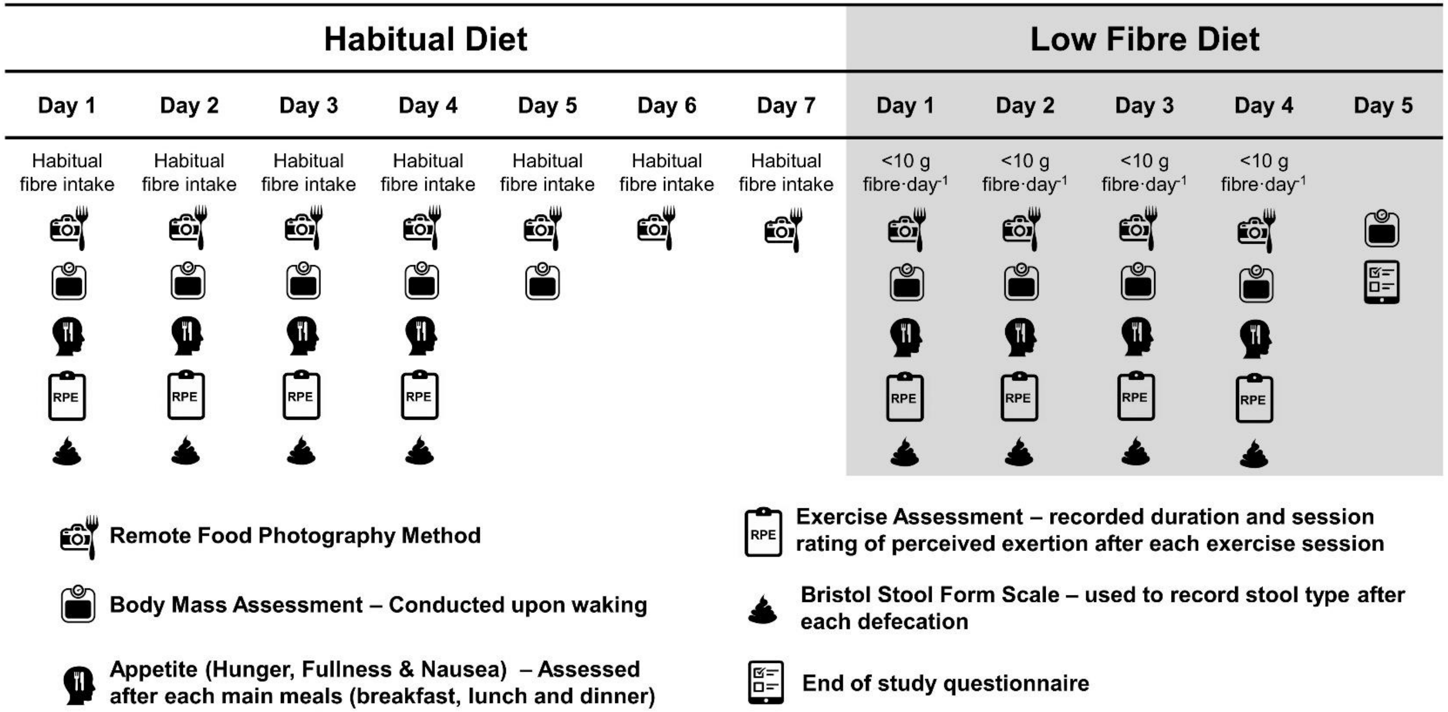

Figure 1: Schematic overview of study design. Participants first completed 7 days of habitual diet (HAB), followed by 4 days of low fibre diet (LOW). Body mass was reported upon waking after urine void on days 1 to 5 of HAB and LOW. Exercise performed on days 1 to 4 of HAB was recorded via the session rating of perceived exertion method and replicated on a day-by-day basis during LOW. Dietary intake was assessed throughout using the remote food photography method (RFPM). Participants reported their appetite (fullness, hunger and nausea) immediately after each main meal and stool type after each defecation on days 1 to 4 of HAB and LOW. No other assessment was performed on days 5 to 7 of HAB except body mass on day 5, and RFPM on days 5-7. An end of study questionnaire was administered following the completion of LOW.

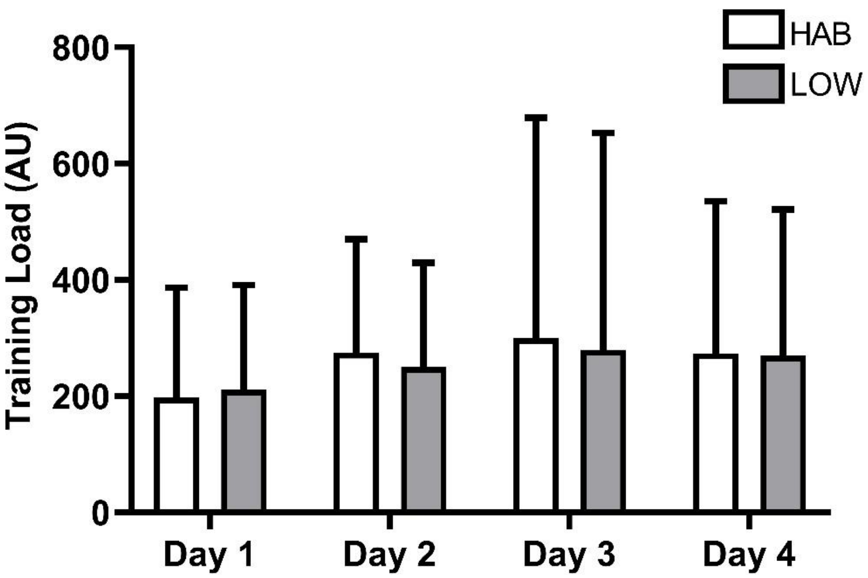

Figure 2: Training load (arbitrary units) completed during habitual (HAB) and low fibre diet (LOW) phases determined with 10-point Rate of perceived exertion scale x time in minutes.

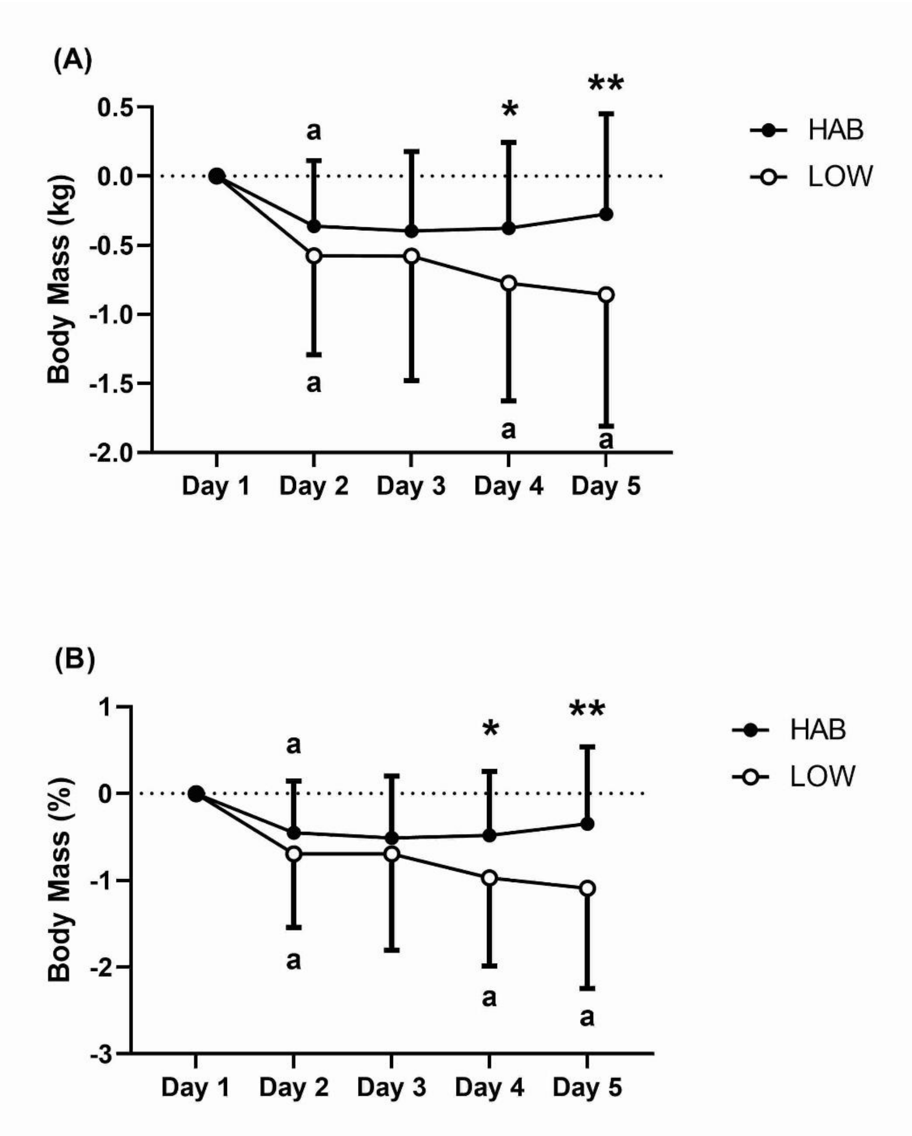

Figure 3: Changes in absolute (A) and relative (B) body mass relative to day 1 during habitual (HAB) and low fibre diet (LOW). *Significant different from LOW ($p < 0.05$). **Significant different from LOW ($p < 0.01$). aSignificant different from day 1 ($p < 0.05$).

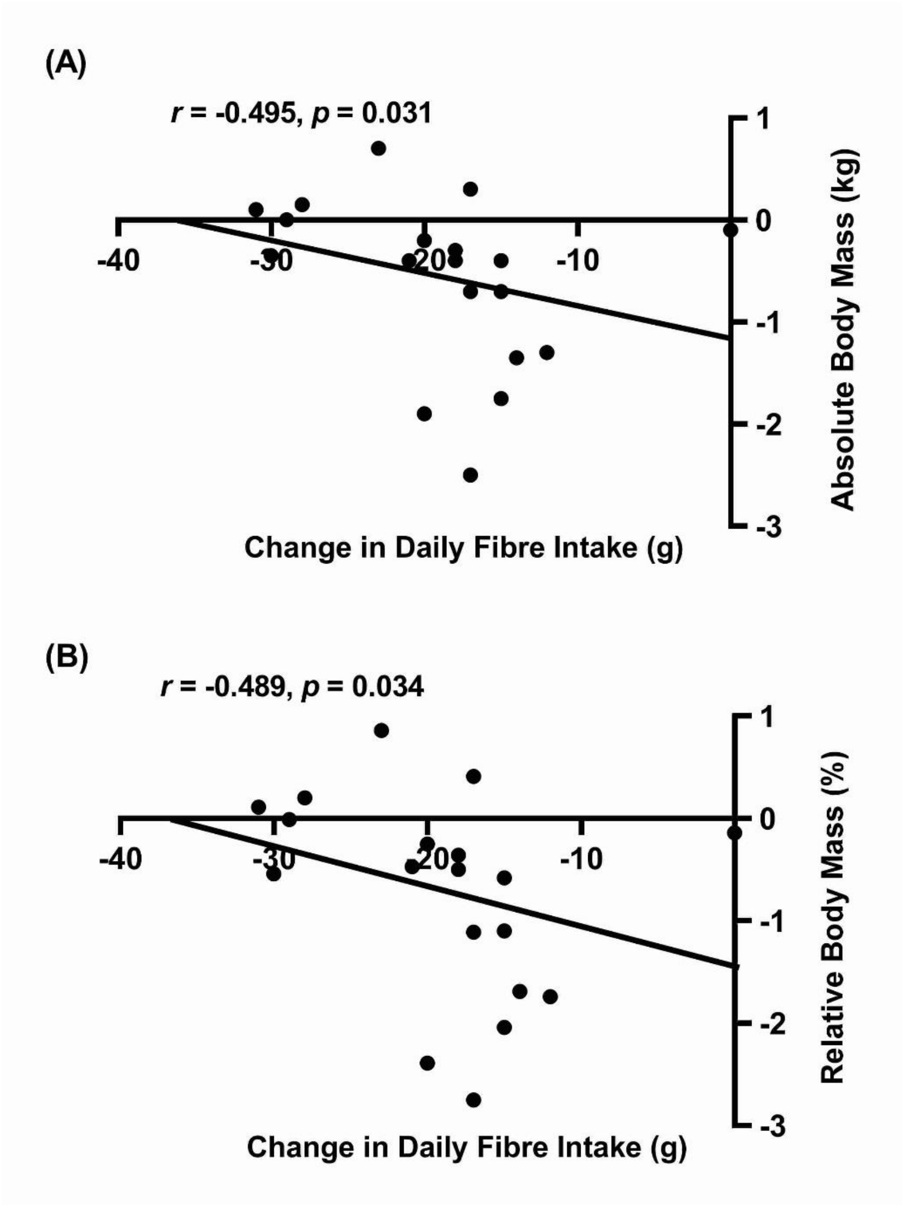

Figure 4: The relationship between the changes in absolute (A) and relative (B) body mass losses after 4 days of HAB and LOW and the changes in fibre intake between days 6-7 of HAB and days 1-4 of LOW.

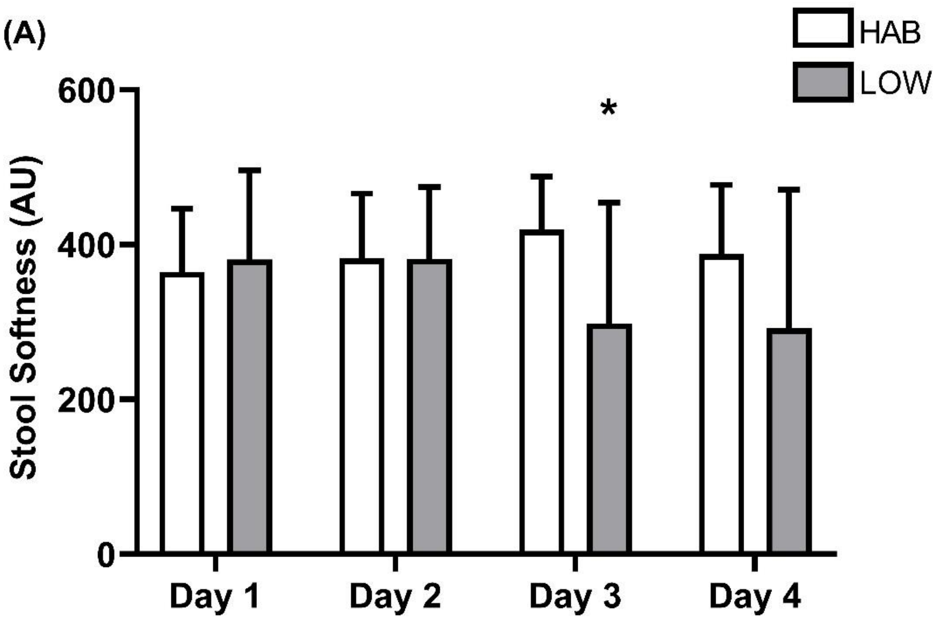

Figure 5A: The changes in stool softness (arbitrary units) during habitual (HAB) and low fibre diet (LOW). *Significantly lower than HAB (p = 0.005).

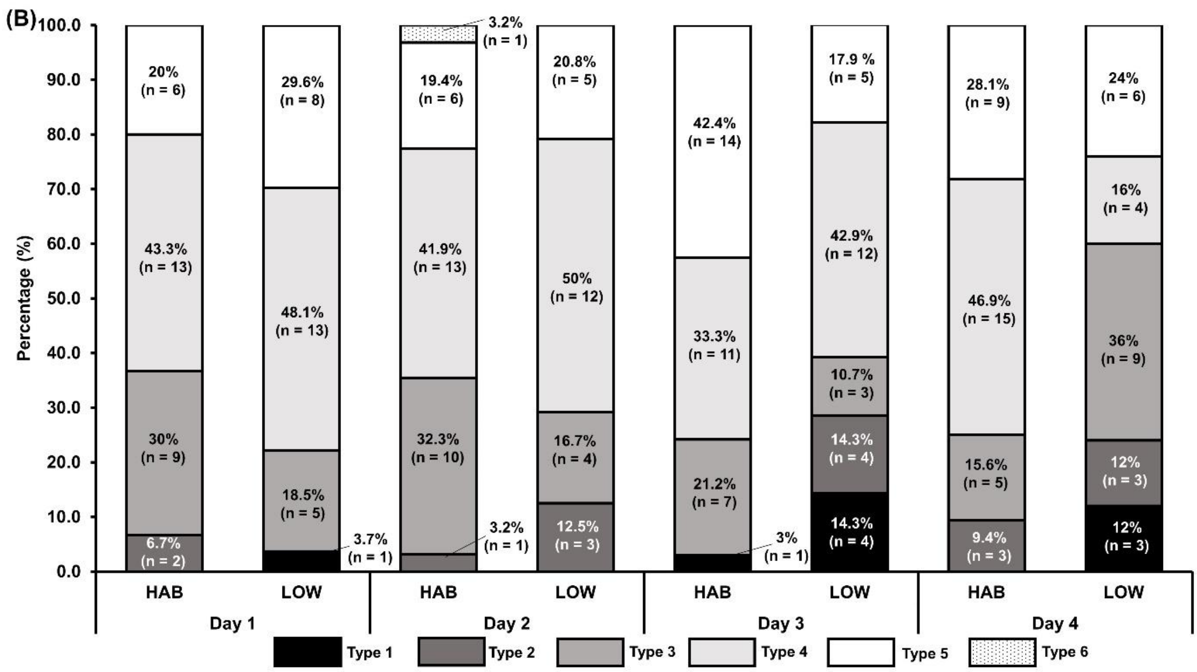

Figure 5B: Stool type reported according to Bristol Stool Form Scale from days 1 to day 4 of habitual diet (HAB) and low fibre diet (LOW) trials. Types 1 and 2 are associated with constipation, types 3 to 4 are normal whereas types 5 (to some degree) and 6 are associated with diarrhea.