

Evaluating the effect of a home-delivered meals service on the physical and psychological wellbeing of a UK population of older adults – a pilot and feasibility study.

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Abstract

We evaluated the effectiveness of a 3-week, daily meal provision service by a non-profit provider on the physical and psychological wellbeing of an older adult population. We further examined the feasibility of carrying out such measures in participant's homes. 19 older adult participants (8M, 11F; 78.3 ± 8.7 years) received 3 meals per day for 21 days and supplemented these meals *ad libitum*. Risk of malnutrition (Mini Nutritional Assessment; MNA) body composition, blood pressure, handgrip strength, balance, mobility, loneliness, social capital, satisfaction with life and mood were evaluated in participant's homes before and after the intervention. Following the intervention, MNA score increased significantly and participants rated themselves as significantly less depressed. We describe a methodology that was largely feasible and outline ways in which it could be improved. We have demonstrated that even short-term, home meal deliveries improve MNA scores and can positively alter some measures of mood.

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Introduction

Food insecurity is defined as not having the economic, social and physical resources to shop, cook and eat in order to ensure a sufficient supply of safe and nutritionally appropriate food ¹⁻³. Indeed, recent research in the UK has described a scenario where many older people live alone and experience substantial financial, and social barriers to accessing food ¹. Additionally, advanced age is associated with altered physiology and medical conditions that can contribute to the development of malnutrition; these include reduced appetite, difficulties in chewing and swallowing, side effects of medication, and the presence of morbidities that alter protein-energy balance ⁴. Malnutrition is estimated to affect 35% of community-dwelling adults who are admitted to care homes ⁵. Such poor nutritional status is associated with an increased risk of mortality ⁶. Indeed, protein energy malnutrition is a prominent aetiological factor in the development of sarcopenia – the age related loss of muscle mass and quality ⁷. Sarcopenia is associated with an increased risk of cardiovascular, metabolic and musculoskeletal diseases as well as poorer quality of life scores and an increased incidence of falls and fractures ⁸⁻¹⁰.

Community dwelling older adults are also at risk of poor mental health; 10-15% of community dwelling older adults experience minor depression ^{11,12} and a similar proportion report loneliness ¹³. Recent systematic reviews of the prevalence of depression in community dwelling older adults, have highlighted a dearth of UK-specific evidence, with no UK studies meriting inclusion ^{11,14}.

Previous studies of home-delivery of meals interventions in older adults have shown beneficial results on participant nutritional status, loneliness and social well-being ¹⁵. Many of these studies were conducted in the USA, where there are statutory minimum nutritional requirements for federal programs operating under the Older American's Act Nutrition Services Program (meals must provide at least one third of dietary reference intakes) ¹⁵. Such guidelines are similar to the recent guidelines developed by the Australian Meals on Wheels Association (Australian Meals on Wheels Association, 2016), which have an additional advantage in offering extensive practical advice for their implementation. Increasing

meal provision from 1 to 2 meals per day increases energy intake, enhances feelings of food security and reduces scores on the Geriatric Depression Scale measure of depression ¹⁶. However, in the UK, no statutory minimum nutritional requirements are imposed upon meal providers and fewer than half of local councils provide such services, with a quarter of councils terminating services since 2014 ¹⁷. There is a dearth of studies evaluating such services in the UK ¹⁵. Indeed, in Ireland, where no minimum nutritional requirements exist either, the benefits of such programs seem to be less convincing ¹⁸. However, regardless of whether studies of home-delivered meals services have taken place in the presence of a nutritional guideline framework, evaluations of such programs have typically been limited to dietary evaluations via telephone interview or have involved limited clinical, physiological, or psycho-social data collection (e.g. BMI) in the community ¹⁵. Therefore, there exists a need to expand the range of physiological and psychological outcome measures used to evaluate such services.

In this pilot and feasibility study, we were invited to evaluate the effectiveness of a 3-week, daily meal provision service by a non-profit provider (Dartmoor Community Kitchen) on the physical and psychological wellbeing of an older adult population. We aimed to evaluate the feasibility of carrying out such measures in participants' homes. We further aimed to determine whether or not our primary outcome measure, the Mini Nutritional Assessment (MNA) score and measures of psychological wellbeing, change over a short-term meal provision intervention.

Materials and Methods

Ethical Approval

This study was approved by the University of Exeter Sport and Health Sciences Research Ethics Committee. All participants gave written informed consent to participate and the study conformed to the ethical principles regarding human experimentation described by the Declaration of Helsinki.

Recruitment

Community-dwelling older adults (≥ 65 years) were initially recruited to receive meals by the Dartmoor Community Kitchen. Potential participants were informed of the purpose of the research study and were asked if they were willing to be contacted by the research team. A member of the research team contacted potential participants via telephone and determined whether they met the inclusion criteria, i.e. 1) aged ≥ 65 years; 2) able to stand from a chair without help from another person; 3) no dementia or mental health condition diagnosis; 4) able to wash and dress independently; 5) no formal care support or *de facto* resident carer. A researcher arranged to visit those who agreed to participate in their homes on 2 occasions, 22 days apart. Meal deliveries were scheduled to take place in the intervening 3 weeks. The duration of the intervention for this pilot and feasibility study was determined in part by the financial resources and delivery capacity available to the non-profit meal provider. 24 participants initially agreed to take part, with 19 completing the study (8 male, 11 female; mean age 78.3 ± 8.7 years). 12 participants lived with a spouse or partner and 7 lived alone. All lived in the Dartmoor area. 3 participants were vegetarian.

Delivery Model

Participants were contacted by the Dartmoor Community Kitchen and provided with a menu. Participants were presented with 4 breakfast choices, 22 main course choices and 4 supper choices. Meals that were suitable for home refrigeration were delivered twice per week, with 3 meals being provided for each day. 2 participants requested that meal deliveries take place once per week. All meals that were intended to be consumed hot were suitable for microwaving or oven heating. Participants were instructed to consume additional meals and snacks *ad libitum*; this advice was re-iterated by the research team. Participants were asked to return any unconsumed food to their delivery driver for weighing.

Assessment

The same researcher conducted all assessments and visits took place in the participants' homes.

Medical History and Mini Nutritional Assessment

A brief medical history was obtained by a medically-trained researcher and the MNA was completed. The MNA is a validated questionnaire that assesses recent weight loss, protein intake and self-view of nutritional and health status. It incorporates measurement of mid upper arm circumference (MUAC) and calf circumference (CC) and is well validated and widely used in older populations^{19,20}. The MUAC was measured in the non-dominant limb with an inelastic tape measure, at the mid-point between the acromion and the olecranon, with the participant sitting and with the arm relaxed by their side. 3 measurements were obtained, with the average taken. The CC was measured in the non-dominant limb, at the widest part of the calf, and at a right angle to the long axis of the calf, with the foot flat on the floor. 3 measurements were taken, with the average used for data analysis.

Anthropometry

Body weight and percentage body fat were determined using a portable bioelectrical impedance scale (Tanita InnerScan UM076). A portable stadiometer was used to measure participant height.

Blood Pressure

Blood pressure was measured using a portable sphygmomanometer (A&D Medical UA-767PC). Participants sat quietly for 5 min and 3 measurements were then taken, 1 min apart. The reading with the lowest systolic blood pressure was used for analysis.

Handgrip Strength

Handgrip strength was measured using a handgrip dynamometer according to the Southampton Protocol²¹. Briefly, participants sat in a standardised chair (seat height 46 cm, arm rest height 65 cm), with their forearms resting on the armrest. The wrist was positioned just over the end of the arm of the chair, in a neutral position with the thumb facing upwards. The participants feet rested flat on the floor. Verbal instruction and the encouragement given was standardised. 3 trials were conducted on each hand and the test hand was alternated. The best score for either hand was used for data analysis²¹.

Tests of Balance and Mobility

Balance tests were conducted as per the Short Physical Performance Battery (SPPB) ²². This measure incorporates 10 seconds of supervised standing with feet together side by side, if successful 10 seconds of standing with feet in a semi-tandem position and if successful 10 seconds of standing with feet in tandem position. Each position was demonstrated by the researcher prior to conducting the test and participants were instructed that they should not move their feet, but could move their arms, bend their knees, or move their body to maintain balance. Where necessary, the researcher helped participants into the starting position and remained next to them in case of a loss of balance during the test.

Psychological Measures

Measures of psychological and social wellbeing were administered. For ease of response, all items were answered on similar five-point Likert-type scales, with anchors varying between scale. The researcher asked the participants to consider in particular their feelings in the past week. Social wellbeing was operationalized as loneliness and social capital. Loneliness was assessed using three items from the UCLA Loneliness scale ²³ and an additional item directly asking participants the extent to which they felt lonely (from 1 = never to 5 = always). Together these items formed reliable scales both at pre-test ($\alpha = .86$) and at post-test ($\alpha = .79$). Social Capital was assessed with five items from the scale developed and validated by Sampson, Raudenbush, and Earls ²⁴. This scale was not reliable at pre-test ($\alpha = .51$) but this improved at post-test ($\alpha = .74$). Psychological wellbeing was assessed as satisfaction with life and mood. Satisfaction with Life Scale was assessed with the widely used five item scale of Diener, Emmons, Larsen, and Griffin ²⁵ with responses ranging from 1 = strongly disagree to 5 = strongly agree. This scale was reliable at pre-test ($\alpha = .87$) and at post-test ($\alpha = .81$). Participants were also asked to indicate their mood in the following domains: Happy, proud, relaxed, content, depressed, sad, bored, and stressed. These items were examined separately to enable the assessment of what specific aspects of mood might be affected by such an intervention.

Data Analysis

Data analysis was carried out using GraphPad Prism 7 and IBM SPSS Statistics 24. All data are presented as means \pm SD. The normality of data was established by a Shapiro-Wilk test, whereas

Levene's test was used to establish equality of variances. Data were analysed by paired samples t test. A p value of < 0.05 was considered statistically significant.

Results

19 participants (8 male, 11 female) aged 78.3 ± 8.7 years completed this study (Table 1). Women had significantly greater body fat percentages and lower handgrip strength than the male participants (Table 1). 7/19 participants (36 %) took fewer than 4 prescription medications per day, with 3 participants taking no regular prescription medication. 11/19 (57 %) participants had been diagnosed with hypertension or cardiovascular disease, 3/19 were glucose intolerant and 1 participant had diabetes mellitus type II.

Feasibility

40 potential participants were referred to the research team, with 24 agreeing to an initial visit via telephone and 19 completed the study. Participants were not obliged to give a reason if they chose not to continue with the study. However, drop-outs were due to late discovery of ineligibility, personal circumstances and a desire to return to habitual diet. Given the large geographical area covered by the Dartmoor Community Kitchen, the research team established a logistical framework for scheduling the initial visits and corresponding follow-up visits 22 days later. All appointments bar one went ahead at the scheduled time. For one follow-up visit, the participant was not home at the appointed time and the visit was rescheduled for the following day. All meal deliveries took place on the appointed day; it was noted by the delivery team that expanded delivery capacity would be required in order to offer more frequent meal deliveries and thus enhanced social contact for participants. Tests were safely conducted in participants' homes using portable equipment. In one circumstance it was deemed unsafe to collect measures of balance and mobility. 2 participants had cardiac pacemakers *in situ* and therefore bioelectrical impedance data could not be obtained. With a view to conducting longer term research studies, in which biochemical measures of nutritional status might be expected to change, participants were asked if they would have been happy for the researcher to take venous blood samples in their

homes. All agreed that this would be acceptable and indicated that they would be happy to wear a wrist worn accelerometer for the duration of such a study.

Meal Delivery and Nutritional Status

Overall, the mean MNA score increased significantly following the intervention (24.3 ± 2.8 vs 26.4 ± 2.6 , $p = 0.02$). 9 participants (47%) had an initial MNA score of 23.5 or below, placing them in the 'at risk of malnutrition' category. 6 of these 9 were no longer at risk of malnutrition following the meal delivery intervention (Fig 1, A). 2/19 participants returned some food throughout the delivery period, returning 11.1 and 2.7 % (w/w) respectively. Energy and protein provision exceeded that recommended by Australian home-delivered meals guidelines (Table 2), although this provision took place in the form of three separate meals, rather than as one large meal consisting of an entrée, main and dessert, as recommended by the guidelines.

Measures of Physical Wellbeing

No measure of physical wellbeing changed significantly over the course of the study (Fig.1, B-F). Lack of space and safety concerns prevented tests of balance being conducted in 2 cases. All participants successfully performed a balance test with feet side-by-side for 10 s. 15/17 participants successfully completed the semi-tandem stand phase of balance testing at baseline and the same 15 participants were successful at the follow up visit. 11/15 participants that progressed to the full tandem stand phase of balance testing were successful in maintaining the position for 10 s. 2 additional participants improved their baseline scores (7 s, 1.5 s respectively) to 10 s at follow up.

Self-reported sedentary time (hours spend sitting per day) did not change post-intervention (6.7 ± 3.4 vs 6.7 ± 2.7 hr). The number of hours spent walking per week decreased over the study course, although this did not reach statistical significance (5.1 ± 1.2 vs 3.7 ± 0.7 hr, $p = 0.06$).

Psychological Measures

Participants reported being significantly less depressed (2.2 ± 1.3 vs 1.8 ± 1 , $p = 0.03$) (Fig. 2, E) following the intervention than at the start. We also noted a trend for participants to report being more

content (3.9 ± 1.2 vs 4.4 ± 0.6 , $p = 0.06$) (Fig. 2, D) and less stressed (2.2 ± 1.1 vs 1.9 ± 1 , $p = 0.08$) after the intervention (Fig. 2, H). No significant changes in measures of loneliness, satisfaction with life or social capital and belonging were observed (Table 3). Notably, 12 of the 19 participants (63%) in this study lived with a spouse or partner and single participants were noted to rate themselves as more than 1 point lonelier, an observation that approached statistical significance (2.6 ± 1.3 , 1.5 ± 1 , $p = 0.06$). No significant decrease in loneliness was observed following the intervention in the single cohort. No other psychological measure differed between the cohabiting and single cohorts.

Discussion

In this pilot and feasibility study, we were invited to evaluate the effectiveness of a 3-week, daily meal provision service by a non-profit provider (Dartmoor Community Kitchen) on the physical and psychological wellbeing of an older adult population. We identified a dearth of such studies in the UK and globally, and of those studies that have been performed most have relied upon telephone interviews or very limited physiological data collection. Here, we found that carrying out an expanded range of physiological measures (e.g. BMI, body composition by bioelectrical impedance, handgrip strength, tests of balance and mobility) in participants' homes is feasible with the appropriate planning. Furthermore, participants indicated that more invasive measures, such as obtaining venous blood samples in their homes would be acceptable and would not have altered their decision to participate.

Given the short duration of this pilot study, our primary outcome measure was the MNA score. We demonstrated a significant increase in the overall MNA score, with 6 of the 9 participants who were initially deemed 'at risk of malnutrition' no longer being designated 'at risk' following the intervention. As expected, none of the other physiological outcome measures were significantly altered over this short duration 3-week study. The MNA is known to be a good prognostic indicator of frailty²⁶, functional decline²⁷ and mortality^{27,28} in a number of older adult populations, yet the prognostic value of our observed increases in MNA score in a home delivery of meals intervention is unknown. Further longer-term studies of such interventions, incorporating the MNA and a range of clinical, psychological and physiological outcome measures are required. As a result of our work, we suggest that future studies could screen participants with the MNA and thus target a nutritionally at-risk population.

The meals provided by the Dartmoor Community Kitchen exceeded the average daily energy and protein provision recommended by the Australian Meals on Wheels Association. Participants were encouraged to consume other food *ad libitum*, as would be the case in any population receiving commercial, subsidised or charitable home meal deliveries. However, Dartmoor Community Kitchen provided 3 meals to achieve an energy provision that was approximately double that recommended by the Australian guidelines for a single meal (entrée, main, dessert). Therefore, provision of fewer, but more energy dense meals may be a desirable strategy. The current recommended daily intake (RDI) of 0.8 g protein/kg/d appears insufficient to prevent loss of lean body mass (LBM) and protein intakes of greater than 1.2 g/kg/d are safe and are likely to preserve skeletal muscle mass and strength in the older adults^{29,30}. The average daily protein provision to participants in this study represents a protein intake of 0.72 g/kg/d for the mean participant weight of 76.8 kg, and needs to be increased in any future work. In this pilot study, participants were not asked to keep a food diary. Our principal goal was to ascertain whether functional physical and psychological improvements could be attained by the provision of such meals and to assess the feasibility of conducting such an extensive battery of tests in participants homes in a rural area. Dietary assessment methods such as dietary records, 24 hour dietary recalls and food frequency questionnaires have substantial limitations in terms of accuracy, precision and participant burden^{31,32}.

Others have previously reported improvements in quality of life and depressive symptoms in those receiving home delivery of meals^{16,33,34}. Our assessment of wellbeing demonstrated that participants reported significantly less depressed mood following the intervention. Future studies choosing to focus on this aspect of psychological wellbeing might opt for a more complex measure of depression, such as the Beck Depression Inventory II³⁵ or the short Geriatric Depression Scale³⁶. Trends towards participants reporting being more content and less stressed were also noted. Loneliness scores declined after the intervention but neither this change nor change in social capital and belonging attained statistical significance. However, it is possible that the sample was too small to reveal the small to average effect sizes that can be expected with such a short-term intervention. Future studies should be sufficiently powered to reliably assess the effect of home meal delivery interventions, and to enable the

comparison of effects for those living alone and those living with a spouse or partner. The lack of significant effects on social capital must also be seen in the context of the low reliability of this scale in this study. Future interventions will need to use an alternative measure to assess effects on social wellbeing. The high scores on social capital already observed at pre-test also suggest the possibility that this type of intervention might have stronger effects on social wellbeing in populations that are less cohesive.

Participants tended to report walking less following the intervention. This is an important observation, given that home delivery of meals reduces the need to shop for food and may therefore reduce physical activity levels. Although the IPAQ-SF is considered a reliable and valid instrument for assessing physical activity in adults³⁷, some studies in older adults suggest that it may not be reliable in this population^{38,39}. Participants indicated that they would be willing to wear an accelerometer for the duration of a longer-term study and we consider this to be a desirable approach for any future work.

Limitations

In this pilot and feasibility study, we evaluated the effectiveness of a three-week, daily meal provision service by a non-profit provider (Dartmoor Community Kitchen) on the physical and psychological wellbeing of an older adult population. We describe a methodology that was largely feasible and outline ways in which it could be improved. The principal limitation of this work is its limited sample size, which we consider appropriate for a pilot and feasibility study that was designed to inform future work, but which should be considered in interpreting our data. Participants completed an MNA, but were not asked to keep a food diary, therefore we cannot estimate the energy or macronutrient composition of any food consumed in addition to the delivered meals. Given our observation that participants tended to walk less following the intervention, we suggest that the IPAQ-SF should be replaced with accelerometry data in future work. Our social capital assessment scale was not reliable in this population, despite being well-validated by others; future interventions will need to use an alternative measure. Finally, due to the remote and rural nature of the study location, meal deliveries took place twice per week. We hypothesise that psychological wellbeing would be further improved by more

frequent social contact and consider it important to explore the benefits of enhancing delivery capacity to such a population.

Take Home Points

- This pilot and feasibility study shows that MNA scores, body composition, blood pressure, handgrip strength, balance, mobility, loneliness, social capital, satisfaction with life and mood can be safely evaluated by a trained researcher in home-delivery of meals participant's homes.
- Following a short home delivery of meals (3 weeks) intervention, MNA score increased significantly.
- Participants rated themselves as significantly less depressed. We also noted a trend for participants to report being more content and less stressed.

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Declaration of Interests

None declared.

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Table 1. Participant Baseline Characteristics

	Male	Female
Age (y)	80.0 ± 9.4	77.5 ± 8.1
Body Mass Index (kg.m⁻²)	26.9 ± 4.3	30.5 ± 7.5
Blood Pressure (Systolic)	151.6 ± 25.7	135.5 ± 11.3
Body Fat (%)	24.8 ± 6.6	39.6 ± 6.2 ^a
Mini Nutritional Assessment Score	23.8 ± 3.3	25.1 ± 2.3
Handgrip Strength (Kg, Max)	29.1 ± 10.5	21.1 ± 3.8 ^a

Data are presented as mean ± standard deviation

Table 2. Mean Energy and Protein Provision per Day

	Dartmoor (Men)	Australian Guidelines (Men)	Dartmoor (Women)	Australian Guidelines (Women)
Energy (kJ)	5180 ± 1730	2600	4572 ± 309	2300
Protein (g)	63 ± 24	40	49 ± 6	29

Table 3. Means and SDs of the Psychological measures at pre- and post-test

	Pre-test	Post-test
Loneliness	1.68 ± .82	1.55 ± .55
Social capital	4.43 ± .54	4.41 ± .59
Life satisfaction	4.03 ± .83	4.06± .73
Happy	4.11 ± .81	4.00 ± .82
Proud	3.74 ± 1.19	3.68 ± 1.16
Relaxed	4.00 ± .82	3.95 ± 1.03
Content	3.95 ± 1.22	4.42 ± .61 ^b
Depressed	2.21 ± 1.27	1.79 ± .98 ^a
Sad	1.95 ± 1.27	2.11 ±1.33
Bored	1.79 ± 1.08	1.84 ± 1.07

Stressed

2.26 ± 1.09

1.95 ± .97^b

^a = $p < 0.05$, ^b = $p < .09$

Figure 1. Mini Nutritional Assessment Score and physical wellbeing outcomes before and after a meal delivery intervention. 19 (8 men, 11 women) older adult participants received daily meal deliveries for 3 weeks. * $p < 0.05$ vs pre-intervention condition.

Figure 2. Participants' self-reported mood. 19 (8 men, 11 women) older adult participants received daily meal deliveries for 3 weeks. * $p < 0.05$ vs pre-intervention condition.

Figure 3. Participants' self-reported loneliness using a modified UCLA Loneliness Scale. 19 (8 men, 11 women) older adult participants received daily meal deliveries for 3 weeks.

Figure 4. Participants' self-reported satisfaction with life. 19 (8 men, 11 women) older adult participants received daily meal deliveries for 3 weeks.

Figure 1

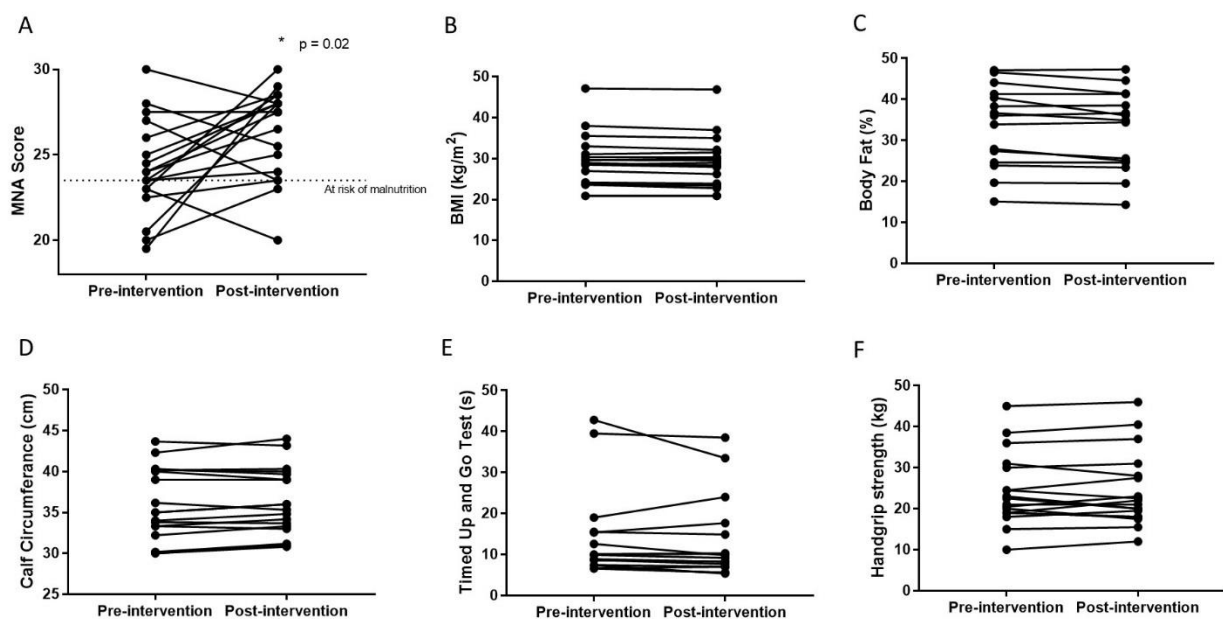


Figure 2

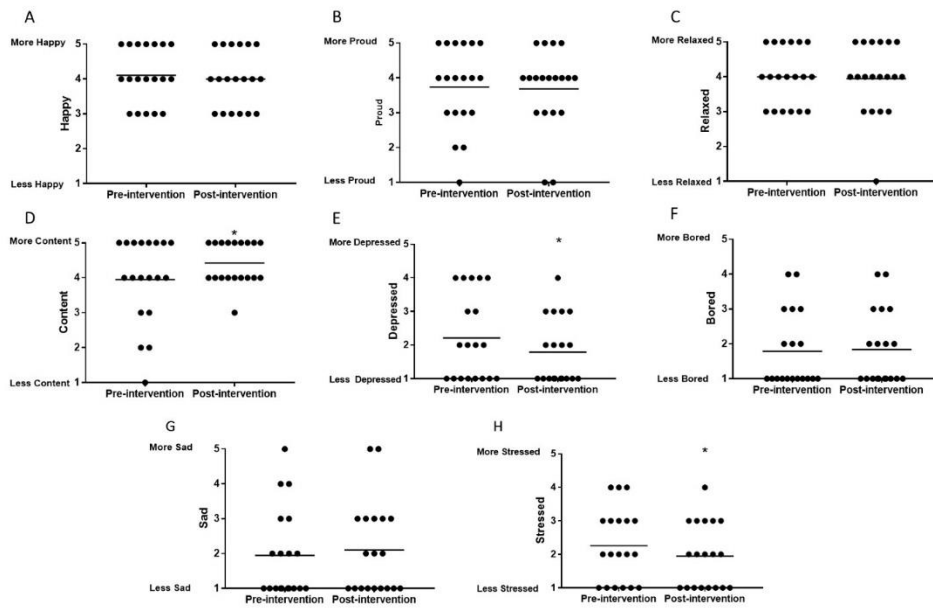


Figure 3

