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*BRIEF REPORT*

# ADHERENCE TO A MEDITERRANEAN DIET IS NOT ASSOCIATED WITH RISK OF SARCOPENIC SYMPTOMOLOGY: A CROSS-SECTIONAL ANALYSIS OF OVERWEIGHT AND OBESE OLDER ADULTS IN AUSTRALIA

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**Abstract:** Adherence to a Mediterranean Diet (MedDiet) is inversely associated with sarcopenia. The aim of this study was to examine the association between adherence to a MedDiet and sarcopenic symptomology in obese older adults. For confirmation of sarcopenia, low appendicular skeletal muscle (ASM: males, ≤7.25kg/m2; females, ≤5.5kg/m2) accompanied low handgrip strength (males, ≤30kg; females, ≤20kg) or low physical performance (Short Physical Performance Battery [SPPB]: ≤8; or gait speed: ≤0.8m/sec). Adherence to a MedDiet was determined using the Mediterranean Diet Adherence Screener (MEDAS). Sixty-five older adults were included. Adherence to a MedDiet was not associated with a decreased risk of sarcopenic symptomology (SPPB: OR = 0.20; 95% CI: 0.01-3.1; P = 0.234; Muscle strength: OR = 1.81; 95% CI: 0.32-10.15; P = 0.499; Gait speed: OR = 0.58; 95% CI: 0.13-2.50; P = 0.468). Future research should investigate whether a Mediterranean-style intervention can prevent or improve sarcopenic symptomology, including in non-Mediterranean populations.

**Key words:** Mediterranean diet, sarcopenia, muscle strength, physical performance, overweight, obesity.

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## Introduction

Ageing is associated with a progressive decrease in skeletal muscle mass (SMM) and quality, termed sarcopenia, coupled with a concomitant accumulation of body fat, particularly visceral adiposity (1). The coexistence of low SMM coupled with reduced physical performance such as gait speed and/or muscle strength in addition with excessive adiposity is termed sarcopenic obesity (SO) (2). The Mediterranean Diet (MedDiet) is an example of a dietary pattern that provides evidence for an association between diet quality and healthy ageing (3). Recently published evidence is suggestive of a decreased risk of physical frailty and sarcopenic symptomology with greater adherence to a Mediterranean Diet (MedDiet) (4, 5). However, this is yet to be examined in a cohort of obese older adults in Australia. Therefore, the aim of the present study was to examine the association between levels of adherence to a MedDiet and sarcopenic symptomology in overweight and obese older adults. We also explored the prevalence of sarcopenic symptomology and SO in this cohort.

## Methods

### *Participants and Recruitment*

This was a cross-sectional analysis of baseline data in overweight and obese older adults recruited as part of a 12-week randomized control trial (RCT) (6). The trial is registered with the Australian and New Zealand Clinical Trials Registry (reg no: ACTRN12616001400459). All procedures involving human subjects were approved by the Human Research Ethics Committee (A/16/801), University of the Sunshine Coast, Queensland, Australia. Participants were recruited from the Sunshine Coast, Queensland, Australia via local flyers, newspaper advertisements and social media and were eligible to participate if they were aged ≥60 years and were community dwelling with a BMI ≥27kg.m2 whom were otherwise healthy.

### *Measurements and Procedures*

*Diagnostic algorithm for sarcopenia and sarcopenic obesity*

In 2010, the European Working Group on Sarcopenia in Older People (EWGSOP) published a consensus definition and set of diagnostic criteria for age related sarcopenia (7). The cornerstone of this consensus definition is the presence of both low SMM and muscle function (strength or performance). Measures of ASM index (male, ≤7.25kg/m2; female, ≤5.45kg/m2), isometric hand-grip strength (male, ≤30kg; female, ≤20kg) and the Short Physical Performance Battery (SPPB) score (≤8) were used in the diagnostic algorithm for identification of sarcopenic symptomology in the present study. Usual gait speed was also used as an independent criterion measure to identify risk off sarcopenia (<0.8m/sec). There are currently no consensus definitions for SO, partly due to heterogeneity in

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**Table 1**
Baseline characteristics for each diagnostic parameter of sarcopenia and sarcopenic obesity across levels of adherence (low versus moderate/high) to a Mediterranean Diet (all such values reported as mean ± SD)

| Characteristics | Total Sample | MEDAS[1] | | P[2] |
|---|---|---|---|---|
| | (n= 65) | ≤5 (n= 42) | 6-14 (n=23) | |
| Age | 68.7 ± 5.6 | 67.9 ± 5.6 | 70.1 ± 5.5 | 0.128 |
| BMI (kg/m2) | 33.6 ± 4.9 | 33.8 ± 5.1 | 33.4 ± 4.6 | 0.754 |
| Body Fat (%) | 44.9 ± 7.5 | 43.9 ± 7.9 | 46.7 ± 6.4 | 0.151 |
| ASM index (kg/m2) | 8.2 ± 1.2 | 8.3 ±1.1 | 7.9 ± 1.2 | 0.193 |
| Hand-grip Strength (kg) | 30.7 ± 10.8 | 31.4 ± 10.4 | 29.5 ± 10.9 | 0.492 |
| SPPB | 10.5 ± 1.6 | 10.6 ± 1.5 | 10.4 ± 1.7 | 0.667 |
| Walking Speed (m/sec) | 0.9 ± 0.2 | 0.9 ± 0.2 | 0.8 ± 0.1 | 0.119 |

MEDAS: Mediterranean Diet Adherence Screener; BMI: Body Mass Index; ASM Index: Appendicular Skeletal Muscle; SPPB: Short Physical Performance Battery; 1. MEDAS score ≤5 indicates low adherence; MEDAS score 6-14 indicates moderate/high adherence; 2. Significant differences between levels of adherence to a MedDiet by independent samples t-test (P<0.05).

its diagnostic criteria and the lack of a unanimous consensus definition to define low SMM and excessive adiposity (8). Consistent with previous literature, obesity was defined in the present study as body fat percentage ≥30% for men or ≥40% for women (9). Participants meeting the diagnostic criteria for both sarcopenia and obesity were classified as SO.

*Outcome Measures*

A detailed description of all outcome measures related to this investigation is reported elsewhere (6). In brief, whole body and regional body composition were estimated using Dual-energy X-ray absorptiometry (DXA) (Lunar iDXA; GE Healthcare, Madison, WI). Grip-strength was measured in the dominant hand with a calibrated Smedley Hand Dynamometer (Tokyo, Japan). All measures were performed on three separate occasions with ~60-s rest intervals between each measure with the mean of the three measures used in the final analyses. Physical performance was assessed using the SPPB which evaluates lower extremity function by measuring three domains of physical function which mimic activities of daily living: 1) balance; 2) gait speed; 3) lower extremity strength. Scores from each test are ranked using a 0–4 scale and the composite score was summed, with higher scores reflecting a higher level of function.

***Mediterranean Diet Adherence***

Adherence to a MedDiet was assessed using the previously validated 14-item Mediterranean Diet Adherence Screener (MEDAS) (10). The MEDAS establishes adherence scores according to pre-defined normative criterion cut-off points for the consumption of specific food groups that are consistent with a MedDiet pattern. Each item in the questionnaire is scored as 0 or 1, yielding a maximum score of 14 (10). Higher scores indicate greater levels of adherence to a MedDiet. Specifically, a MEDAS score ≥10 is suggestive of high adherence, scores between 6-9 is considered moderate adherence, whereas a score ≤5 indicates low adherence. Given the unlikely occurrence of high adherence scores in a non-Mediterranean region, for the present study we combined moderate and high adherence levels into one category of adherence.

***Statistical Analysis***

In the present study, data are presented according to categories of adherence to a MedDiet. Independent samples t-tests were conducted to explore differences amongst all descriptive statistics between low versus moderate/high adherence. Chi-squared analysis was undertaken to identify adherence differences amongst participants falling above or below sarcopenic diagnostic criteria. Odds ratio (OR) and 95% confidence interval (CI) obtained from logistic regression using two different models was used to determine the association between moderate/high adherence and risk of sarcopenic symptomology. The first model (crude model) was unadjusted whereas the second model was adjusted according to age, gender, BMI, percent body fat and ASM index. All data were included in the final analysis. Analyses was performed using SPSS for Windows 24.0 software (SPSS Inc., Chicago, IL, USA) with statistical significance set at $P < 0.05$.

## Results

A total of 65 overweight and obese older adults (68.7 ± 5.6 years; female, n = 41; males, n = 24) were included in the final analyses. The primary measures of interest in the present study are shown in Table 1. No significant differences between levels of adherence to a MedDiet were observed. Mean MEDAS adherence scores were 5.1 ± 2.0 (low adherence: 3.9 ± 1.1; moderate/high adherence: 7.3 ± 1.2).

The number of participants presenting above or below diagnostic criteria for identification of sarcopenic

**Table 2**
Frequency (percentage) of participants (n=65) presenting above or below diagnostic cut-off criterion for sarcopenic symptomology

| Diagnostic parameters[1] | MEDAS score ≤5 (n= 42) | | MEDAS score 6-14 (n=23) | | P[5] |
|---|---|---|---|---|---|
| | Above cut-off (%) | Below cut-off (%) | Above cut-off (%) | Below cut-off (%) | |
| Physical Performance[2] | 39 (92.9%) | 3 (7.1%) | 20 (87.0%) | 3 (13.0%) | 0.657 |
| Muscle Strength[3] | 33 (78.6%) | 9 (21.4%) | 20 (87.0%) | 3 (13.0%) | 0.515 |
| Gait Speed[4] | 29 (69.1%) | 13 (31%) | 14 (60.9%) | 9 (39.1%) | 0.587 |

MEDAS: Mediterranean Diet Adherence Screener; 1. Diagnostic criterion cut-offs and parameters for identification of sarcopenic symptomology derived from the consensus definition established by the European Working Group on Sarcopenia in Older People (EWGSOP); 2. Physical performance assessed using the Short Physical Performance Battery. A score ≥8 reflects a higher level of function; 3. Muscle strength (hand-grip strength) >30kg in males and >20kg in females; 4. Gait speed >0.8m/sec; 5. Significant differences in participants falling above or below sarcopenic diagnostic criteria, depending on levels of adherence to a MedDiet assessed by Chi-squared analysis; P <0.05

symptomology is presented in Table 2. Chi-squared analysis revealed no significant difference between level of adherence to a MedDiet and the proportion of participants presenting above or below sarcopenic diagnostic criteria (Table 2). Using the diagnostic criteria proposed in the present study, zero participants were identified as sarcopenic or SO, with no participants recording an ASM index below gender specific diagnostic criterion cut-offs (males: 9.3 ± 1.0kg/m2; females: 7.6 ± 1.0kg/m2). Almost all participants (97%) met the criteria for body fat percentage using the SO diagnostic criteria. Of these, 33% were identified as at risk for SO with usual gait speeds below diagnostic criterion cut-offs.

Compared with participants in the lowest category of adherence to a MedDiet, greater adherence was not associated with a decreased risk of sarcopenic symptomology (SPPB: OR = 0.51; 95% CI: 0.10-2.80; P = 0.438; Muscle strength: OR = 1.81; 95% CI: 0.44-7.52; P = 0.409; Gait speed: OR = 0.70; 95% CI: 0.24-2.0; P = 0.506). Similar results were also observed when adjusted for all variables (SPPB: OR = 0.20; 95% CI: 0.01-3.1; P = 0.234; Muscle strength: OR = 1.81; 95% CI: 0.32-10.15; P = 0.499; Gait speed: OR = 0.58; 95% CI: 0.13-2.50; P = 0.468).

## Discussion

To the best of our knowledge, this is the first Australian study to investigate the association between adherence to a MedDiet and risk of sarcopenic symptomology. Unlike results presented in this study, previous evidence is suggestive of a decreased risk of physical frailty and sarcopenic symptomology with greater adherence to a MedDiet (4, 5). However the exact mechanisms associated with this relationship remains poorly understood, with the most compelling theory relating to the potential synergy of nutrients apparent in the MedDiet, including non-nutritive compounds such as carotenoids and polyphenols and their potential role in attenuating the physiological mechanisms implicated with sarcopenic symptomology such as oxidative stress and inflammation (11, 12).

Zero participants in the present study were identified as sarcopenic or SO. In the present study no participants had an ASM index below gender specific diagnostic cut-offs, yet 1 in 3 participants had usual gait speeds below diagnostic cut-offs and 1 in 5 participants were below muscle strength cut-offs. This demonstrates that in obese older adults, poor gait performance or low muscle strength does not necessarily accompany low muscle mass. Paradoxically, many obese individuals not only have increased fat mass but also increased muscle mass (8). This raises the possibility of a new obese phenotype, 'dynapenic obesity' given that the loss of muscle strength, termed dynapenia, is a more important factor in maintaining physical functioning given that the rate and magnitude of strength loss typically exceeds the loss of muscle mass with age (13).

Although findings from the present study were unexpected, there are some key limitations. Specifically, the sample size was small and results underpowered. An additional consideration was the potential for selection bias at study entry (i.e. overweight/obese community dwelling older adults whom were otherwise healthy) resulting in potential sarcopenic or frail participants being excluded. Furthermore, although a number of diet quality indices such as a priori scoring systems have been used to quantify adherence to a MedDiet, these scoring systems are not homogeneous making comparisons difficult, particularly in non-Mediterranean populations.

In this cross-sectional analysis of overweight and obese older adults, greater adherence to a MedDiet was not associated with sarcopenic symptomology. Future studies are needed to investigate whether a Mediterranean-style intervention can prevent or improve sarcopenic symptomology, including in non-Mediterranean populations.

*Ethical Standards:* This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects were approved by the Human Research Ethics Committee (A/16/801), University of the Sunshine Coast, Queensland, Australia. Written informed consent was obtained from all participants.

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*Conflict of Interest:* All authors declare no conflict of interest

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