

Physical Activity and Body Composition in Vegetarian and Omnivorous Female Medical Students: A Comparative Cross-Sectional Study

MUNEERA M. ALMURDI, PT, Ph.D.¹; AFAF A.M. SHAHEEN, PT, Ph.D.^{1,2};
ASMA S. ALRUSHUD, PT, Ph.D.¹; MAHA F. ALGABBANI, PT, Ph.D.¹;
SULTANA A. ALHURISHI, MPH, Ph.D.³; NORAH S. ALSHAHRANI, PT, BSc¹;
KHUZAMA F. ALSARRAH, PT, BSc¹; NADA M. ALDAWOOD, PT, BSc¹;
LAMA A. ALOBEID, PT, BSc¹ and NADA F. ALOTAIBI, PT, BSc⁴

*The Department of Health Rehabilitation Sciences, College of Applied Medical Sciences, King Saud University, Riyadh, Kingdom of Saudi Arabia*¹, *Basic Sciences Department, Faculty of Physical Therapy, Cairo University, Cairo, Egypt*², *Community Health Sciences Department, College of Applied Medical Sciences, King Saud University, Riyadh, Kingdom of Saudi Arabia*³ and *Physical Therapy Department, National Guard Health Affairs MNGHA, Riyadh, Saudi Arabia*⁴

Abstract

Background: Despite the rising popularity of vegetarianism, including in Saudi Arabia, there are relatively little data on the relationships between diet type, physical activity (PA) levels, and body composition, especially in young Saudi females.

Aim of Study: To compare PA levels and body composition metrics in vegetarian and omnivorous female medical students attending the [redacted], Riyadh, Saudi Arabia.

Material and Methods: One hundred and five students were enrolled, with a mean age of 21.86 ± 2.02 years. Students were classified as omnivorous (n=63) or vegetarian (n=42). PA was measured using the International Physical Activity Questionnaire (IPAQ) short-form. Body composition [BMI, total muscle mass, total fat mass, total body water, protein, minerals, and basal metabolic rate (BMR)] were calculated using a bioelectrical impedance analyzer.

Results: There were no significant differences in PA nor body composition variables between vegetarian and omnivorous students (all $p > 0.05$). PA was significantly negatively correlated with BMI, total fat mass, and protein (all $p < 0.05$) in omnivorous students, with weak, non-significant positive correlations between PA and body composition metrics in vegetarians.

Conclusion: PA level and body composition variables were not significantly different between vegetarian and omnivorous female medical students. PA was significantly correlated with BMI, total fat mass, and protein in omnivores.

Key Words: Vegetarian – Omnivore – Physical activity – Body composition – BMI.

Correspondence to: Dr. Muneera M. Almurdi, The Department of Health Rehabilitation Sciences, College of Applied Medical Sciences, King Saud University, Riyadh, Kingdom of Saudi Arabia

Introduction

AN increasing number of people worldwide are reducing their meat consumption [1]. Vegetarianism is defined as people who do not eat any meat, poultry, or fish but do eat dairy and eggs, [2,3] while veganism is defined as the complete exclusion of animal products including all animal-based products including added fats [4,5]. An omnivorous diet includes both plant-based food and food of animal origin including meat, dairy, and eggs [4,6]. While vegetarianism is growing in popularity, [7,8] its prevalence varies around the world. The prevalence of vegetarianism in India is especially high, with 30% of the population reporting a vegetarian diet [9,10] compared with only 5% of Americans, 8% of Canadians, [11] 4.3% of Germans, [12] and around 10% of Saudi Arabians [13]. In Saudi Arabia, 87% of the population is omnivorous, with only 5% vegetarian and 8% vegan [14].

The vegetarian diet is thought to be associated with various health benefits including reduced risks of obesity, type 2 diabetes, hypertension, and cardiovascular disease [15-19]. However, there have also been concerns that following a vegetarian diet may reduce physical activity (PA), [7] which itself can help to maintain a healthy weight and contribute to weight loss [20]. The exact interaction between vegetarianism on PA is, however, incompletely understood [21].

PA can be defined as “any body movement produced by skeletal muscles that result in energy

expenditure” [22] such as walking, climbing stairs, or shopping [23]. According to the World Health Organization, an adult between the ages of 18 and 64 should engage in at least 150 minutes of moderate-intensity aerobic PA per week or 75 minutes of vigorous-intensity aerobic PA per week [10]. Applying metabolic equivalent of task (MET) energy expenditure estimates to each category of activity, according to PA guidelines, moderate-intensity PA is equivalent to at least 150 minutes per week while vigorous PA is 60 minutes per week [24].

It has been reported that vegetarian adults have lower PA than non-vegetarians in the Indian population, [10] although a study on Brazilian men showed that vegetarians were highly physically active compared with non-vegetarians [25]. Thus, there is continued debate on the effect of diet type (vegetarians and/or omnivorous) on PA levels in different populations, and only a few studies have investigated the differences between diet type and PA level in the young Saudi population. In Saudi Arabian university students, PA was estimated to be 6-24% [26]. In a later study, the estimated PA level in females was nearly 50%. Diet and PA are both important for maintaining health and reducing the risk of chronic diseases in young people [27]. Therefore, we sought to investigate women's dietary habits and their relationship with PA.

To our best knowledge, there has yet to be a study of diet type (vegetarian or omnivorous), PA levels, and body composition in young female Saudi adults. Here we aimed to detect associations between diet type (vegetarian or omnivorous), PA levels, and body composition [BMI, total muscle mass, total fat mass, total body water, protein, minerals, and basal metabolic rate (BMR)] in female medical students at [redacted] Saudi Arabia.

Material and Methods

Study design and ethical approval:

This was a three-month cross-sectional comparative study conducted between February and May 2022 at the [redacted] female campus, Riyadh, Saudi Arabia. The Health Sciences Institutional Review Board ethics committee at [redacted] approved the study with reference number [redacted].

Participants and power calculation:

A convenience sampling method was used to recruit participants. G*Power 3.1 statistical software [28] was used to calculate the sample size: using a two-tailed analysis with an effect size of 0.5, the a error probability of 0.05, and a power

of 0.80, 128 participants (64 per group) were needed. Participants were subdivided into two groups based on their diet: Vegetarians (n=42) and omnivorous (n=63).

Inclusion criteria were: (1) Aged between 18 and 28 years of age and (2) Following either a vegetarian or omnivorous diet for the last 12 months [29]. *Exclusion criteria were:* (1) The presence of any chronic diseases such as coronary artery disease, diabetes mellitus, and/or (2) Currently pregnant.

Procedure:

Social media was used to distribute a survey link (by SurveyMonkey) to screen for potential participants based on the inclusion and exclusion criteria. The screening survey included questions on demographic characteristics including age, gender, type of diet, duration of following the diet, the reason for following the diet, and contact information. Eligible participants were contacted by the research team via telephone and/or email to book an appointment for a single session at the [redacted] nutrition clinic with the research team to undergo study measurements. During the session, the study procedure was explained verbally to participants, and written informed consent was obtained from the participants.

Study measurements:

All study measurements were performed in the same session. Demographic data were obtained and height and weight were measured in the clinic using the Detecto 750 Scale (E01614-0194).

Total body composition parameters (BMI, total muscle mass, fat, water, protein, minerals, and BMR) were measured using the InBody 770 instrument. The InBody 770 is a safe, non-invasive, simple, and rapid instrument for measuring and calculating body composition variables, taking around 60 seconds to complete. Previous studies have reported that the InBody 770 is both reliable and valid [30,31].

For measuring body composition, each participant was asked to remove her shoes and stand on the InBody 770 base, hold the electrodes, and follow the instrument's instructions. The total body composition was measured immediately and printed out for analysis.

All participants were asked to complete a hard copy version of the International Physical Activity Questionnaire (IPAQ) short form (Arabic version), [32] which takes around 10 minutes to complete. Participants were asked to complete information

on the frequency (days/week), duration (in minutes), and level of intensity (low, moderate, and high) of PA undertaken over the last 7 days. Based on their responses, the PA level was calculated and recorded [33]. PA was classified into: Inactive or sedentary (<1 MET or <200 kcal/week), lightly active (<3 METs or 200-599 kcal/week), moderate activity (3-6 METs or 600-1499 kcal/week), and vigorous activity (>6 METs or >1500 kcal/week) [34-36].

Thus, the maximum time taken for each session was around 15-20 minutes per participant.

Statistical analysis:

Statistical analyses were performed using IBM SPSS Statistics for Windows v28.0 (IBM Corp., Armonk, NY). The Shapiro-Wilk test was conducted to assess the normality of the data distributions. Data are presented as mean \pm standard deviation (SD) for normally distributed data or median [interquartile range (IQR)] for skewed data. Categorical data are presented as frequencies and percentages. Independent sample *t*-tests or Mann-Whitney U tests were used to compare differences between diet groups depending on the distribution. Cross tabulations were used to assess differences between the type of diet and PA level assessed using IPAQ (categorical variables). To evaluate correlations between PA level and body composition variables, Pearson's and/or Spearman's rank correlations were applied depending on data normality. The correlation coefficients were interpreted as follows: no correlation: <0.1; weak: 0.1-0.3, moderate; 0.4-0.6, strong: 0.7-0.8, and perfect correlation: 1 [37]. The significance level was set to $p \leq 0.05$.

Results

Differences in demographics and body composition variables between vegetarians vs omnivores:

Three hundred and twenty-six participants initially agreed to participate in the study of whom 221 were excluded after applying the inclusion and exclusion criteria. The mean age of the 105 participating students was 21.86 ± 2.02 years, with a height of 158.44 ± 5.85 cm, weight of 64.08 ± 13.42 kg, and BMI of 25.79 ± 5.28 . Students were subdivided into two groups based on their diet: Vegetarians ($n=42$) and omnivores ($n=63$) (Fig. 1). The diet groups were matched in terms of demographic data (age, height, weight, and BMI) (Table 1).

Diet groups were also comparable in terms of body composition variables (BMI, total muscle mass, total body water, total fat mass, protein, minerals, and BMR) (all $p > 0.05$; Table 1).

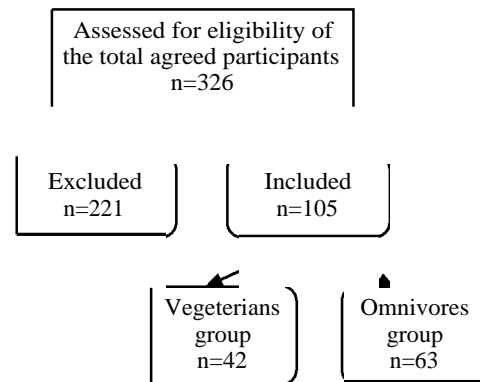


Fig. (1): Flowchart of the study participants.

Table (1): Description of the study participants.

Variable	Vegetarians (n=42)	Omnivores (n=63)	<i>p</i> -value
Age (years)	21.7 \pm 2.3	22.0 \pm 1.8	0.2
Height (cm)	159.1 \pm 6.6	158.0 \pm 5.3	0.2
Weight (kg)	61.5 (52,79)	62 (55,72)	0.6
BMI (kg/m ²)	25.5 \pm 5.3	26.00 \pm 5.2	0.8
Muscle mass (kg)	20.6 \pm 2.6	20.4 \pm 3.1	0.6
Total body water (L)	27.9 \pm 3.3	27.1 \pm 3.8	0.7
Body fat mass (kg)	23.8 (18.20, 37.90)	24.5 (17.7, 33.9)	0.8
Protein (kg)	7.5 \pm 0.89	7.3 \pm 1.0	0.9
Mineral (kg)	2.9 \pm 0.35	2.8 \pm 0.3	0.4
BMR (kcal)	1199.6 \pm 96.2	1192.4 \pm 106.6	0.9

- The independent sample *t*-test was used except for weight, where the Mann-Whitney test was used. Level of significance $p < 0.05$. Values are expressed as mean \pm SD or/and as median (IQR) for skewed data.

- BMR: Basal metabolic rate. Values are expressed as mean \pm SD or/and as median (IQR) for skewed data.

Differences in physical activity between vegetarians vs omnivores:

Of all participants, 41.9% had a high PA level, 40% a moderate PA level, and 18% a low PA level. Of vegetarians, 35.7% had a high PA level, 47.6% had a moderate PA level, and 16.7% had a low PA level, compared with 46%, and 34.9%. and 19%, respectively, for omnivores. There were no significant differences (chi-squared test $p=0.420$) in PA levels between vegetarians and omnivores.

Correlation between PA and body composition variables in vegetarians and omnivores:

Correlations between PA and body composition variables in the different diet groups are shown in Table (2). There were weak to moderate negative correlations between PA and body composition variables in omnivores compared with vegetarians. There was a significant moderate negative correlation between PA and BMI, body fat mass, and protein in omnivores but not vegetarians, and also there was also a weak but non-significant negative

correlation between PA and muscle mass, total body water, mineral content, and BMR in omnivores compared with vegetarians. In contrast, there were weak positive but non-significant correlations between PA and body composition variables except for total body fat mass in vegetarians [37].

Table (2): Correlations between PA and body composition variables in omnivores and vegetarians (Spearman's rho values).

Body composition variables	Vegetarians (n=42)	Omnivores (n=63)
BMI (kg/m ²)	0.052, $p=0.743$	-0.366, $p=0.003$
Muscle mass (kg)	0.153, $p=0.335$	-0.235, $p=0.064$
Total body water (L)	0.124, 0.432	-0.134, 0.295
Body fat mass (kg)	-0.013, 0.936	-0.346, 0.005
Protein (kg)	0.132, 0.405	-0.250, 0.048
Mineral (kg)	0.138, 0.385	-0.169, 0.186
BMR (kcal)	0.117, 0.460	-0.157, 0.220

Discussion

Here we aimed to detect differences in PA levels and body composition variables according to diet type in a group of young female students in Saudi Arabia. One hundred and five participants completed an online International Physical Activity Questionnaire (IPAQ) short form and had their body composition measured. We detected no significant differences in PA nor body composition variables between students eating different diets. However, there was a weak to moderate negative correlation between certain body composition variables (BMI, total fat mass, and protein) and PA in omnivores but not vegetarians.

Exercise is a subset of PA, [22] and our finding is consistent with previous findings that there are no significant differences between vegetarians and omnivores regarding exercise capacity, [38] PA, and physical performance [39]. Diet choice does not appear to influence PA levels, and indeed vegetarian diets do not appear to negatively impact endurance and muscle strength in young, physically active women [40]. Some previous studies have observed higher PA in vegetarians compared with omnivores, [38,41] while another study concluded that one in five vegetarians had insufficient PA levels [42]. These contradictory findings may be due to other socio-demographic factors such as gender, age, marital status, and income influencing PA levels.

We detected no significant differences in body composition variables including BMI, total muscle mass, total fat, total body water, protein, minerals, and BMR according to diet, perhaps because these variables were within normal ranges for most

participants. Navarro et al., reported that lean body mass was significantly higher in vegetarians compared with omnivores, and vegetarians have a lower fat body mass than omnivores [40]. This is because plant-based proteins have less of an anabolic effect than animal proteins due to their lower digestibility [43].

Based on BMI classifications, a BMI of 15-18.9 can be regarded as underweight, 19-24.9 normal, 25-29 overweight, 30-39.9 obese, and >40 morbidly obese [44]. Al Qauhiz et al., found that a large proportion of Saudi female university students were overweight (54% in the eastern region), in part due to unhealthy dietary intake and lifestyle [45]. This is consistent with our results and others, with our students having an average BMI of 25.79kg/m² [46]. Majeed et al., studied 215 female medical students at the University of Dammam, Saudi Arabia, and reported that "lack of time" was the main barrier preventing students from eating a healthy diet and practicing regular exercise [47]. This factor may also have been present in our cohort of students, and also academic stress may have caused students to choose unhealthy and fattening foods such as fast food instead of preparing healthier food.

The average BMI was similar between vegetarians and omnivores, consistent with previous studies [40]. Nevertheless, there are conflicting data. One study detected a higher BMI in omnivores, perhaps due to high fiber intake in vegetarians increasing satiety and reducing energy intake between meals [48]. Tonstad et al., also revealed that vegetarians may have a lower BMI, [17] perhaps due to higher consumption of vegetables, fruit, nuts, and fiber and lower consumption of saturated fat and cholesterol, which may consequently reduce the risk of chronic diseases such as obesity and cardiovascular disease [49].

The current study revealed weak to moderate negative correlations between PA and all measured body composition variables in the omnivorous group but not the vegetarian group, and these correlations were significant for BMI, total body fat, and protein. This result is consistent with studies of adolescent students, in which PA was negatively correlated with body composition, particularly for BMI, fat mass, and percentage fat mass, and overweight or obese students had lower PA regardless of their sex [50]. Zanovec et al., studied the association between PA and body composition variables including BMI, body fat, and lean tissue mass in young university students aged 18-25 years, similar to our demographic, and found

no significant differences in height, weight, and BMI according to PA level. PA was negatively correlated with percentage body fat (-0.40) and fat mass (-0.26), in agreement with our findings (-0.346 for the omnivorous group), and they also found that individuals with higher PA had a lower percentage of body fat and fat mass with higher lean tissue mass [36]. Similarly, Lohman et al. reported a significant inverse relationship ($r=-0.17$) between PA level and the percentage of body fat in adolescent girls [51]. Furthermore, Tudor-Locke et al. confirmed that there was a significant negative relationship (-0.27) between PA level and percentage fat in healthy White and African American adults [52]. Moreover, Salonen et al., examined the association between PA and body composition in young Finnish adults and similarly reported an inverse association between PA and body composition including BMI, waist circumference, and percentage of body fat in study participants [53].

A recent study compared body composition including bone mass, fat-free mass, lean mass, tissue mass, total mass, and visceral and subcutaneous adipose tissue of young healthy adult women with different diet types (vegetarian/vegan and omnivorous) and found that vegetarian participants had lower – but non-significant - total bone mass, fat mass, lean mass, tissue mass, and fat-free mass and higher levels of subcutaneous and visceral adipose tissue than those in the omnivorous group [54].

This study is cross-sectional, so there may be some recall bias, and cannot be inferred. There was difficulty in identifying and recruiting participants in this study, leading to unequal numbers in both groups. Increasing the number of participants would help to further assess the associations between dietary patterns and their relationship with PA. Adding male students, assessing dietary patterns over a longer period, and assessing multivitamin and protein intake might help to draw constructive conclusions that will help in understanding student health and behavior.

Conclusion:

Vegetarianism is a relatively new and increasing phenomenon in Saudi Arabia [14]. This study is unique in providing insights into the dietary habits of young Saudi females and their association with PA. We detected no relationship between PA and diet type in young female students in Saudi Arabia, nor were there any differences in body composition variables between vegetarians and omnivores. We did, however, detect negative correlations between PA and body composition in omnivorous students

compared with vegetarian students. PA is recommended to maintain a healthy and lower BMI and fat mass. Further studies to investigate the association between the diet type and PA in terms of age and gender are required.

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النشاط البدني ومتغيرات تكوين الجسم لدى طالبات التخصصات الطبية الآتى يتبعن الحمية النباتية والغير نباته : دراسة مقارنة مستقطعة

خلفية الدراسة : على الرغم من ارتفاع نسبة فئة متبعين الحمية النباتية فى المملكة العربية السعودية، لا توجد دراسات كافية عن علاقة هذا النوع من الحمية الغذائية مع مستوى النشاط البدني وتكوين الجسم خاصة عند السيدات.

أهداف الدراسة : مقارنة مستوى النشاط البدني وتكوين الجسم لدى طالبات التخصصات الطبية المتبعات الحمية النباتية والغير نباتية فى المملكة العربية السعودية.

الطريقة : تم تسجيل مائة وخمسة طالبات، بالمتوسط العمرى ٢٠.٢±٢١.٨٦ سنة. تم تصنيفهم إلى مجموعتين مجموعة تتبع الحمية الغذائية الغير نباتية وعددهم ٦٣ طالبة ومجموعة تتبع الحمية الغذائية النباتية وعددهم ٤٢ طالبة. تم قياس النسخة المختصرة. كذلك تم قياس تكوين الجسم (IPAQ) مستوى النشاط البدني باستخدام استبيان النشاط البدني الدولي الذى يحتوى على مؤشر كتلة الجسم، كتلة العضلات الكلية، كتلة الدهون الكلية، الماء الكلى، البروتين، المعادن، باستخدام محلل المعاوقة الكهربية الحيوية ومعدل الأيض القاعدى فى الجسم أو متغيرات تكوين الجسم بين مجموعات مستوى النشاط البدني.

النتائج : لم تكن هناك فروق ذات دلالة إحصائية فى الطالبات المتبعات الحمية النباتية أم غير النباتية. مستوى النشاط البدني مرتبط بشكل كبير ومتناسب سلبياً مع قياس مؤشر كتلة الجسم، وكتلة الدهون الكلية فى الجسم وكذلك نسبة البروتين فى الجسم لدى الطالبات الذين يتبعون الحمية الغير نباتية وهناك ارتباطات إيجابية ضعيفة بين مستوى النشاط البدني وتكوين الجسم لدى الطالبات المتبعات الحمية الغذائية.

الخلاصة : لم يكن مستوى النشاط البدني ومتغيرات تكوين الجسم مختلفاً بشكل كبير بين المجموعة المتبعه للحمية النباتية والغير نباتية لدى طالبات التخصصات الطبية. النشاط البدني مرتبط بشكل كبير مع قياس مؤشر كتلة الجسم، وكتلة الدهون الكلية بالإضافة إلى البروتين فى الجسم لدى المجموعة المتبعة للحمية الغير نباتية.