



Applied nutritional investigation

Mediterranean diet adherence is associated with lifestyle, physical fitness, and mental wellness among 10-y-olds in Chile



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ABSTRACT

Objective: The aim of this study was to assess adherence to the Mediterranean diet (MD) within a population of children from Santiago, Chile. A secondary aim was to examine the relationship between MD adherence, body composition, physical fitness, self-esteem, and other lifestyle factors. **Methodology:** A cross-sectional study of a sample of children ($N = 515$; 10.6 ± 0.5 y) was conducted. Weight, body mass index, skinfolds, and waist circumference were measured. Physical fitness was determined using aspects of the Assessing Levels of Physical Activity health fitness test battery for children. Adherence to the MD was assessed using the Mediterranean Diet Quality Index for children and adolescents questionnaire. Self-esteem was evaluated using the Rosenberg scale and the Five-Factor Self-Concept Questionnaire measured self-concept. Participants completed the Physical Activity Questionnaire for Older Children and also were asked to report the number of hours per day they spent watching various screen-based devices.

Results: All findings were significant at the level $P < 0.001$. Adherence to an MD was consistently and negatively associated with percentage body fat ($r = -0.302$) and subscapular skinfold thickness ($r = -0.329$). Positive associations were found with PAQ-C ($r = 0.277$), self-esteem ($r = 0.301$) and self-concept ($r = 0.234$), and for physical fitness, especially for explosive power of the legs ($r = 0.355$). Positive correlations with handgrip strength were found in boys ($r = 0.323$), whereas negative correlations with screen time were found in girls ($r = -0.511$).

Conclusion: Given its relation to a healthier body composition, physical fitness, healthier lifestyle behaviors, and mental wellness, the MD should be promoted amongst youngsters.

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Introduction

The Mediterranean diet (MD) is rich in vegetables, fruit, legumes, nuts, and cereals, with olive oil as the staple dietary fat. Adherence to this diet has proven to have health benefits for adults such as reducing the prevalence and progression of metabolic

syndrome and improving blood pressure, waist circumference, high-density lipoprotein cholesterol, triacylglycerols, and glucose concentration [1].

As a result, the number of studies focusing on the influence of this diet on children and adolescents has increased in recent years. Overall, MD adherence has been shown to reduce several cardiovascular risk factors [2]. Additionally, adolescents with high adherence to this diet are more likely to reap physical benefits and tend to report higher levels of health-related quality of life, which could bring further benefits to mental well-being [3]. Childhood and adolescence are key stages in the acquisition of eating habits with lasting influence on habits into

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adulthood [4]. However, despite all the previously cited benefits, there exists a tendency to move away from the MD and lifestyle [5]. This is due to diverse factors such as the mother's educational level [6], socioeconomic status [2], and geographic region [7].

Wheat bread and olive oil are traditionally two staples of the MD. However, modern forms of the MD exclude bread or olive oil, or both, in countries where they may be difficult to obtain [8]. This adaptation of the diet could lessen the effects that geography, climate, or culture have on diet adherence. Chile has a climate and a food production network similar to that of the Mediterranean countries. This may contribute to the high life expectancy and low levels of cardiovascular disease found there [9]. Unfortunately, as in many other European countries, Chile is now beginning to abandon the MD, as studies suggest that few people show high adherence [10].

Thus, the aim of this study was to describe adherence to the MD within a sample of children (10–11 y) from a non-Mediterranean city, Santiago, Chile. A second aim was to identify the relationship between MD adherence, body composition, physical fitness, self-esteem, and other lifestyle habits.

Materials and methods

Participants

We conducted a cross-sectional study of a sample of children aged 10 and 11 y (10.6 ± 0.5) from the community of Santiago. The study was conducted between July and December 2014. Five hundred and fifty children attending one of the 22 schools in the community of Santiago were randomly selected and invited to take part in the study. Of these, 533 agreed to participate, and written informed consent was received from their parents or guardians. Eighteen children were excluded for failing to complete some element of testing, or because they failed to attend class on their testing day. The children took part in the study voluntarily during formal school hours. The children were informed of the objectives and methods of the study and told that they could withdraw at any time. Participants were instructed on how to fill out the questionnaires and how to conduct the tests. All tests were conducted on a single school day. A research assistant also was on hand to provide guidance on the completion of questionnaires and conduct physical testing. Ethical approval was granted by the Ethics Committee of the University of Santo Tomas of Chile (CE UST N°80/2014).

Anthropometric measurements

Measurements were performed according to the guidelines outlined by the International Society for the Advancement of Kinanthropometry [11]. Weight was calculated using an electronic scale (model 707, Seca Corporation, Columbia, Maryland; ± 50 g accuracy). Height was determined using a stadiometer (GPM, Seritex, Inc., Carlstadt, NJ, USA; ± 1 mm accuracy). Skinfolts were measured at the triceps and subscapular using a Holtain skinfold compass (Holtain Ltd, Crymych, UK; ± 1 mm accuracy). Waist circumference was measured using a Holtain flexible metallic metric belt (Holtain Ltd, Crymych, UK; ± 1 mm accuracy). Body mass index (BMI) was determined using standard equations. Body fat percentage was determined using the Slaughter equation [12]. Overweight and obese were defined according to international criteria [13].

Physical fitness

Physical fitness was determined using aspects of the Assessing Levels of Physical Activity health fitness test battery for children [14].

Maximal oxygen uptake (VO_2 max) was estimated using a 20-m incremental-maximum shuttle run field test. The VO_2 max relative to body mass (mL/kg/min) was calculated using established formula [15]. Handgrip strength was measured with a hand dynamometer with adjustable grip (TKK 5101 Grip D; Takey, Tokyo, Japan) with the highest score achieved being recorded. The standing long jump test was used to measure explosive power of the legs. Children attempted the jump twice, and their best score was recorded.

Adherence to the Mediterranean diet

Adherence to the MD was assessed using the Mediterranean Diet Quality Index for children and adolescents (KIDMED) questionnaire [16], which was

created for use with children and young adults. This questionnaire consists of 16 dichotomous (yes/no) items that relate to Mediterranean dietary patterns. Twelve questions described positive actions and affirmative answers were scored as +1. Four questions described negative actions and affirmative answers were scored as -1. From their responses, children were then placed into one of three groups according to their adherence to the MD: optimal (≥ 8 points), medium (4–7 points); and low (≤ 3 points).

Self-esteem, self-concept, and lifestyle

Self-esteem was evaluated using the Rosenberg scale [17]. The scale is comprised of 10 questions that are rated on a scale from 1 (*highly disagree*) to 4 (*highly agree*). Negative items were reverse scored. A minimum score of 10 points and a maximum score of 40 points were therefore possible, with higher scores indicating higher self-esteem. Based on these scores, children's self-esteem was classified as being high (≥ 30 points), medium (26–29 points), or low (≤ 25 points).

The Five-Factor Self-Concept Questionnaire [18] was used to measure five dimensions of self-concept (academic, social, emotional, family, and physical). The 30 items are answered on a Likert scale ranging from 1 (*complete disagreement*) to 5 (*complete agreement*). Scores for all dimensions were averaged to provide an overall score in which higher scores indicate higher self-concept.

Participants completed the Physical Activity Questionnaire for Older Children (PAQ-C) to provide an estimate of the moderate-to-vigorous physical activity they engaged in during the 7 d before completion of the questionnaire. The PAQ-C contains nine items which are rated on a 5-point scale and has been validated and adapted to Spanish [19]. A higher score indicates that children are more active. Participants were classified into physical activity tertiles (low, medium, and high). To determine sedentary screen time, participants were asked to report the number of hours per day they spent watching or using TV/DVD, computer, PDA, tablets, or other different devices.

Statistical analysis

Means and SD are reported for all quantitative variables, and averages and percentages are presented for all qualitative variables. Normality of the data was tested using the Kolmogorov–Smirnov test with Lilliefors correction, and homoscedasticity was assessed using Levene's test. After verifying that the variables were not normally distributed, the data were analyzed using the Mann–Whitney U test for two-group comparison and Kruskal–Wallis for three-group comparison. Associations between qualitative variables were determined using the χ^2 test. Associations between quantitative variables were determined using Spearman correlation analysis. The Statistical Package for Social Sciences, version 22 (IBM Corp., Armonk, NY, USA) was used to analyze the data with α set at 0.05.

Results

Anthropometric characteristics, physical fitness, self-esteem, self-concept, and lifestyle habits of the study participants are presented in Table 1. The sample was examined according to sex and level of adherence to the MD. As shown in Table 1, boys weighed more than girls, but BMI did not significantly differ between sexes. Boys demonstrated higher physical fitness in all tests ($P < 0.001$), except in the standing long jump test where no significant differences were found ($P = 0.081$). Boys reported lower values for moderate-to-vigorous physical activity, self-esteem and adherence to MD, and higher values of screen time. Regarding adherence to an MD, a high adherence was associated with lower weight, BMI, percentage of body fat, and waist circumference. Children with high adherence to an MD demonstrated greater physical fitness in all tests ($P < 0.001$) except in the VO_2 max test ($P = 0.069$). Children with high adherence to an MD also reported higher levels of moderate-to-vigorous physical activity, self-esteem and self-concept ($P < 0.001$), and less screen time ($P < 0.000$) compared with children with low adherence to the MD.

Table 2 reports the percentage of affirmative responses to each item on the KIDMED questionnaire as a function of BMI, physical activity, and self-esteem. A healthy BMI was associated with higher consumption of fruit, vegetables, fish, pulses, and

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