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Intake of milk, but not total dairy, yogurt, or cheese, is negatively associated with the clustering of cardiometabolic risk factors in adolescents

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ABSTRACT

Epidemiologic studies have reported an inverse association between dairy product consumption and cardiometabolic risk factors in adults, but this relation is relatively unexplored in adolescents. We hypothesized that a higher dairy product intake is associated with lower cardiometabolic risk factor clustering in adolescents. To test this hypothesis, a cross-sectional study was conducted with 494 adolescents aged 15 to 18 years from the Azorean Archipelago, Portugal. We measured fasting glucose, insulin, total cholesterol, high-density lipoprotein cholesterol, triglycerides, systolic blood pressure, body fat, and cardiorespiratory fitness. We also calculated homeostatic model assessment and total cholesterol/high-density lipoprotein cholesterol ratio. For each one of these variables, a z score was computed using age and sex. A cardiometabolic risk score (CMRS) was constructed by summing up the z scores of all individual risk factors. High risk was considered to exist when an individual had at least 1 SD from this score. Diet was evaluated using a food frequency questionnaire, and the intake of total dairy (included milk, yogurt, and cheese), milk, yogurt, and cheese was categorized as low (equal to or below the median of the total sample) or "appropriate" (above the median of the total sample).The association between dairy product intake and CMRS was evaluated using separate logistic regression, and the results were adjusted for confounders. Adolescents with high milk intake had lower CMRS, compared with those with low intake (10.6% vs 18.1%, P = .018). Adolescents with appropriate milk intake were less likely to have high CMRS than those with low milk intake (odds ratio, 0.531; 95% confidence interval, 0.302-0.931). No association was found between CMRS and total dairy, yogurt, and cheese intake. Only milk intake seems to be inversely related to CMRS in adolescents.

Abbreviations: BMI, body mass index; BP, blood pressure; CI, confidence interval; CMRS, cardiometabolic risk score; CRF, cardiorespiratory fitness; FFQ, food frequency questionnaire; HDL-c, high-density lipoprotein cholesterol; HOMA, homeostatic model assessment; MetS, metabolic syndrome; OR, odds ratio; SES, socioeconomic status; TC, total cholesterol; TG, triglyceride.

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1. Introduction

Cardiometabolic risk is characterized by a cluster of risk factors that includes obesity, abnormal glucose homeostasis, dyslipidemia, and hypertension [1,2]. In adults, the positive association between the clustering of cardiometabolic risk factors and cardiovascular disease and type 2 diabetes is clearly established, and a similar relationship has been described in children and adolescents [3,4]. Furthermore, it has been described that the clustering of cardiometabolic risk factors is a better measure of cardiovascular health in children than single-risk factors [5].

Irrespective of the impact of genetic factors, such modifiable lifestyle elements as dietary intake are generally considered to contribute to both the development and subsequent course of cardiometabolic risk [6]. In this context, scientific investigation has focused on understanding the role of diet in the development of cardiometabolic risk. It has been proposed that the intake of dairy products protects against cardiometabolic risk or several of its risk factors [1,7,8]. Evidence, mostly in adults, has indicated that increased dairy intake may decrease the risk of high blood pressure (BP) [8,9], central obesity [10,11], and hyperinsulinemia [12]. It has been established that such dairy components as calcium, medium-chain fatty acids, and bioactive peptides may play an important role in the prevention of cardiometabolic risk and its complications via the exertion of mechanisms that include the satiety response and the regulation of insulinemia levels and BP [13].

Although evidence points out that dairy intake may help guard against cardiometabolic risk, gaps remain in the literature on the relationship between dairy intake and cardiometabolic risk in the adolescent population. However, previous studies have shown inverse associations between milk or dairy product intake and selected cardiometabolic risk factors [11,14–16]. In addition, questions remain as to whether different types of dairy products exert distinct effects against cardiometabolic risk. Hence, we have hypothesized that a higher dairy product intake is associated with lower cardiometabolic risk factors clustering in adolescents. In addition, the aim of this study was to identify the association between dairy product intake and the clustering of cardiometabolic risk factors in a sample of Portuguese adolescents.

2. Methods and materials

2.1. Sampling

Data for the present cross-sectional study came from a 2008 longitudinal school-based study—The Azorean Physical Activity and Health Study II—which aimed to evaluate physical activity, physical fitness, overweight/obesity prevalence, dietary intake, health-related quality of life, and other factors in 15- to 18-year-old adolescents. This study was conducted in 6 of the 9 Azorean Islands (S. Miguel, Terceira, Faial, Pico, S. Jorge, and Graciosa), where 95% of the Azorean population lives [17].

All participants in this study were informed of its goals, and the parent or guardian of each participant provided written informed consent for his/her child to participate. The study was approved by the Faculty of Sport, University of Porto, and the Portuguese Foundation for Science and Technology Ethics Committee; it was conducted in accordance with the World Medical Association's Helsinki Declaration for Human Studies.

The population was selected by means of a proportionate-stratified random sampling, taking into account the location (island) and the number of students, by age and sex, in each school. Baseline data were collected for 1515 adolescents in the fall of 2008, and 850 subjects were reevaluated 1 year later (mean ± SD follow-up length, 11.5 ± 2.0 months). In view of the fact that blood samples were only taken in 2009, we just considered data from that year in this study. Of the 850 adolescents who participated in the 2009 data collection, 297 refused to undergo blood sampling, 36 were excluded because of lack of information on several variables, and 23 were excluded because of lack of information on dietary intake. Therefore, the final sample included in our cross-sectional analysis comprised 494 adolescents (208 boys). The subjects who were excluded from this study did not significantly differ from those who were included, with regard to age, parental education, and sex (data not shown). Finally, the sample was weighted in accordance with the distribution of the Azorean population in schools and so as to guarantee the real representativeness of each group (by age and sex).

2.2. Anthropometric measures

Body height and weight were determined using standard anthropometric methods [18]. Height was measured to the nearest millimeters in bare or stocking feet, with adolescents standing upright against a Holtain portable stadiometer (Crymych, Pembrokeshire, UK); weight was measured to the nearest 0.10 kg, with participants lightly dressed (underwear and t-shirt) and with the use of a portable digital beam scale (Tanita Inner Scan BC 532, Tokyo, Japan).

Body mass index (BMI) was calculated using the ratio of weight/height^2 (in kilograms per meter squared). Subjects were classified as normal weight, overweight, or obese, according to age- and sex-specific cutoff points that were specified by the International Obesity Task Force [19,20]. Underweight subjects (3.2%) were combined with subjects in the normal-weight category, owing to the fact that they represented a small proportion of the sample. Percentage body fat was assessed using bioelectric impedance analysis (Tanita Inner Scan BC 532).

Waist circumference measurements were taken midway between the 10th rib and the iliac crest and recorded to 0.1 cm. A nonelastic flexible tape measure was used, with subjects standing erect—arms by sides, feet together, and abdomen relaxed—as well as without clothing covering the waist area.

2.3. Blood pressure

Blood pressure was measured using Dynamap vital signs monitors, model BP 8800 (Critikon, Inc, Tampa, FL, USA). Measurements were taken by trained nurses, and all adolescents were required to sit and rest for at least 5 minutes before BP measurement. Participants were in a seated, relaxed