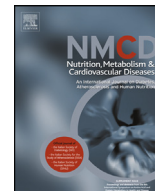Available online at www.sciencedirect.com

Nutrition, Metabolism & Cardiovascular Diseases

journal homepage: www.elsevier.com/locate/nmcd

Associations of multiple unhealthy lifestyle behaviors with overweight/obesity and abdominal obesity among Brazilian adolescents: A country-wide survey

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Abstract *Background and Aims:* Physical inactivity, unhealthy diet, smoking and heavy drinking are four key unhealthy lifestyle behaviors (ULB) that may influence body weight and obesity development. More recently, sedentary time has been recognized as another potentially emerging ULB related to obesity. We therefore investigated the association of multiple ULB with overweight/obesity and abdominal obesity among Brazilian adolescents.
Methods and Results: This cross-sectional study involved 62,063 students (12−17 years). Physical inactivity, high screen time, low fiber intake, binge drinking and smoking were self-reported and combined to a ULB risk score, ranging from zero to five. Participants were classified as overweight/obese or with abdominal obesity using sex and age-specific cut-off points for BMI and waist circumference, respectively. Poisson regression models were used to examine the associations between ULB with overweight/obesity and abdominal obesity, adjusted for sociodemographic variables. Overall, 2.3%, 18.9%, 43.9%, 32.3% and 2.6% of participants reported zero, one, two, three and four/five ULB, respectively. Higher ULB risk score was associated with overweight/obesity and abdominal obesity in a dose−response gradient. Among 32 possible combinations of ULB, the three most prevalent combinations (physical inactivity + low fiber intake; high screen time + low fiber intake; physical inactivity + high screen time + low fiber intake) were positively associated with general and abdominal obesity.
Conclusions: Our findings suggest a synergistic relationship between ULB and general and abdominal obesity. Preventive efforts targeting combined ULB should be sought to reduce the prevalence of general and abdominal obesity in Brazilian youth.
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Introduction

The increase in prevalence of overweight and obesity worldwide [1], especially in children and adolescents, may have adverse health consequences through the life-course [2,3]. In Brazil, the prevalence of overweight and obesity in adolescents increased from 3.7% to 25.5% during the last four decades [4,5], similar to observations in developed countries [6,7]. This situation represents an important public health concern [8], since adolescents with obesity are more likely to maintain their weight status into adult life [9] and because adolescence is a critical period for developing a healthy lifestyle [10].

Although physical inactivity and unhealthy diet are generally recognized as the main lifestyle risk behaviors for general and abdominal obesity [11], additional lifestyle behaviors may also contribute [12,13]. Recently, epidemiological evidence suggests that sedentary time (i.e., prolonged sitting or screen time, which is a construct different from lack of physical activity) is directly associated with overweight/ obesity [14] and inversely associated with ideal cardiovascular health [15] in adolescents. Furthermore, alcohol consumption and binge drinking are also prevalent behaviors in adolescence [16,17] and the energy content of alcohol may contribute to weight gain, especially among those who present a heavy drinking pattern [18]. Smoking may also be positively associated with adiposity, especially abdominal obesity, in adolescents and adults [19–21]. Such association, however, could be confounded by socio-economic status.

Several studies have examined the isolated prevalence of unhealthy lifestyle behaviors (ULB) and their association with overweight/obesity among adolescents [14,22,23]. However, ULB tend to cluster within individuals [24–26]. Evidence from high-income countries suggests an association between multiple ULB and overweight/obesity in youth [27,28]. Brazil is characterized by large socio-economic inequality and a rapid nutritional and epidemiologic transition paralleled by major changes in the people's lifestyle, especially in more urbanized areas. However, associations between ULB and overweight and obesity have not been sufficiently examined on a population level in Brazilian youth.

Some previous studies have investigated a combination of ULB among adolescents and included overweight/ obesity as a lifestyle risk factor [26,29]. However, general and abdominal obesity can be considered as an intermediate health outcome, associated with impaired health prognosis later in life [3], and being strongly influenced by ULB [30]. Hence, although isolated ULB are previously associated with overweight/obesity, the joint association of modifiable ULB on general overweight/obesity and abdominal obesity in adolescents remains unknown. This knowledge is important for public health policy and informing large scale population-based interventions.

Thus, we aimed to evaluate the co-occurrence of ULB (physical inactivity, high screen time, low fiber intake, binge drinking and smoking) and their association with general overweight/obesity and abdominal obesity among Brazilian adolescents.

Methods

Study population and sample

The Study of Cardiovascular Risks in Adolescents ("ERICA") is a national, school-based, cross-sectional multicenter study aimed at examining the prevalence of cardiovascular risk factors in Brazilian adolescents (12–17 years). Data collection took place between February 2013 and November 2014 and was conducted in a representative sample of Brazilian municipalities with more than 100,000 inhabitants (n = 121 cities).

Originally, the calculation of sample size in ERICA was performed using the prevalence of metabolic syndrome in adolescents [31]. For this study, the statistical power of the sample was calculated *a posteriori*. The analyzed sample (n = 62,063) allowed to estimate the prevalence of overweight/obesity (25%) with an acceptable error of 1.3%. For the association measures, the sample had a power of 80% and 95% confidence level to detect prevalence ratios (PR) greater than 1.05 as significant (e.g. considering the association of the ULB risk score, as a continuous variable, with the prevalence of overweight/obesity).

Schools were selected with a proportional probability based on the number of students and inversely proportional to the distance between the municipality and the capital of the state. We selected three classes per school with different combinations of scheduled time at school (morning and afternoon) and grade (seventh, eighth and ninth grade of Elementary and first, second and third grade of High School). All students in the selected classes were invited to participate in ERICA. The participation rate for adolescents who complete the questionnaires, anthropometric measures and dietary recall was 70%. The adolescents who did not participate in ERICA were mostly males between 15 and 17 years [32]. A thorough description of the study design, sampling procedures and losses or refusals in the ERICA is available elsewhere [31–33].

All adolescents agreed in writing to participate in the study; five states have also requested an informed consent signed by the parent or legal guardian, according to the determination of the local Research Ethics Committees. ERICA was approved by the Research Ethics Committees in all 27 Federation Units in Brazil.

Lifestyle unhealthy behaviors

Physical inactivity, high screen time, smoking and alcohol consumption were assessed by a structured questionnaire and stored in a Personal Digital Assistant (LG® GM750Q). Time spent in moderate to vigorous physical activity was evaluated using the Self-Administered Physical Activity Checklist [34], which consists of a list of 24 activities (leisure-time and commuting) and allows the adolescent to report the frequency (days) and the duration (hours and minutes) that he/she participated in these activities during the last seven days. This questionnaire was previously validated for Brazilian adolescents [35]. Screen-based sedentary time was assessed using a single question: