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Brief Communication

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Symptoms of depression and lifestyle in adolescents: a network analysis

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Abstract

Purpose: Life experiences that could either promote or attenuate depression have primarily been studied in adults. Therefore, we investigated the association between lifestyle factors and symptoms of depression in adolescents.

Design and setting: A cross-sectional study was carried out in Brazilians.

Subjects: Data from 93 individuals were analyzed out of the 150 invited participants (age 14.2±1.8, 67.74% girls).

Measures: Lifestyle habits (SMILE-C), physical activity and sitting time (IPAQ), as well as symptoms of depression (DASS-21) were evaluated.

Analysis: A network analysis was performed using the EBIC-LASSO model, with the expected influence as a centrality parameter.

Results: The lifestyle domains with the highest expected influence were diet and nutrition (1.423), walking (1.126) and Stress Management (1.015). The variables with the highest direct partial negative correlation with depression were social support (-0.307) and moderate-vigorous physical activity (-0.244), suggesting a bidirectional relationship between these variables with lower symptoms of depression.

Conclusion: Specific lifestyle areas such as social support, physical activity and nutrition appear to impact other healthy habits while reducing teen depressive symptoms.

Keywords: Lifestyle; Physical Activity; Depression; Adolescents; Network analysis.

INTRODUCTION

Adolescence is characterized by rapid physiological, sexual, neurological and behavioral changes, corresponding to the transition period between childhood and adulthood(1). It is an important phase for developing healthy habits that can generate significant short-term and long-term impacts (2,3). In addition, it is associated with greater vulnerability and the emergence of psychological disorders(4).

Depression is a mental health concern affecting a significant proportion of adolescents worldwide

According to data from a systematic review and meta-analysis, the prevalence of depressive symptoms in adolescents increased from 24% between 2001 and 2010 to 37% between 2011 and 2020, showing greater vulnerability to depression in girls compared to boys (5). **Despite the growing body of literature dedicated to understanding the factors contributing to this condition, there remains a gap in the literature regarding the relationship between lifestyle factors and depression symptoms in this population.**

The rationale for this study stems from the recognition that lifestyle plays a crucial role in influencing mental health outcomes, including depression symptoms. Evidence suggests that a healthy lifestyle can be beneficial in preventing and assisting in the treatment of illnesses related to mental health, indicating that there could be a bidirectional relationship between these variables (6,7).

Therefore, this study aimed to investigate the association between lifestyle factors and depression symptoms in adolescents using network analysis. **Through this research, we hope to contribute to the existing literature by providing a more comprehensive understanding of the links among these factors. This knowledge could have significant implications for the development of targeted interventions and strategies aimed at promoting mental well-being and preventing depression symptoms in this vulnerable population.**

METHODS

This cross-sectional study was conducted with students of both sexes aged between 11 and 17 years living in Porto Alegre-RS/Brazil. Data were collected from May to July 2022. To participate in the study, students had to agree to participate, as well as their legal guardians. Furthermore, individuals

did not have a previous diagnosis of any mental disorder. This research met the criteria relating to guidelines and regulatory standards for research with human beings in accordance with Resolution 466/12 of the National Health Council. The Research Ethics Committee accepted under number CAAE55138122.2.0000.5336.

Those responsible authorized the students' participation through the free and informed consent form, and the adolescents signed the assent form. In addition, the participants filled out the sociodemographic data form, a questionnaire developed to collect data such as age, sex, race, place of residence, education, profession, socioeconomic level, among other variables. Data collection took place in person during the participants' morning classes. Soon after, they underwent anthropometric weight and height assessment and filled out questionnaires related to lifestyle, mental health and physical activity.

The Short Multidimensional Inventory Lifestyle Evaluation (SMILE-C), a questionnaire consisting of 27 items, was used to evaluate the seven domains of lifestyle (diet and nutrition, physical activity, restorative sleep, stress control, substance use, social support and screen time). **This scale was developed to assess lifestyle during COVID-19 (8) and showed high internal consistency in the original version ($\alpha = 0.90$) and in the recent brief version of the instrument ($\alpha = 0.73$) (9).** To assess mental health, especially depression rates, the **Depression, Anxiety, and Stress Scale (DASS-21) was used. Specifically, the version adapted and validated for Brazilian adolescents, consisting of 21 questions (10).** This scale aims to measure and differentiate symptoms of depression, anxiety and stress in clinical and non-clinical conditions, **presenting good internal consistency (e. g., 0.90 for depression).** Furthermore, participants were invited to answer the International Physical Activity Questionnaire (IPAQ), a global instrument to determine the population's physical activity levels.

The collected data were analyzed using the JASP 0.14.1.0 software. For all analyses, an α value of 0.05 was adopted. Three steps were performed to analyze the data: (1) descriptive statistics, (2) network estimation, and (3) network stability. First, after the normality test, the distribution of variables was described as **median and interquartile range or frequency and proportion, and comparisons between groups of boys and girls were performed using the Mann-Whitney test for continuous variables and chi-square for discrete variables, considering non-**

parametric data. Associations between variables were also performed using the Spearman test.

A network analysis was performed between lifestyle variables (sum of variables from each SMILE-C domain), IPAQ data (moderate-vigorous physical activity, walking time and sitting time) and depression score (DASS-21). The JASP 0.14.1.0 was used, based on the Extended Bayesian Information Criteria (EBIC) model, combined with the Least Absolute Shrinkage and Selection Operator (LASSO) model, in which the edges represent partial correlations to estimate nodes in the Regularized Gaussian Graphical Model (GGM). In the end, nine variables (nodes) were included in the network analysis: Six healthy behavior variables (social support, stress management, restful sleep, diet and nutrition, walking, and moderate to vigorous physical activity); Two unhealthy behavior variables (sitting time and screen time); and a variable from the sum of questions regarding depression in the DASS-21.

To examine the importance of each variable (node) in the network, the network centrality measure used was Expected Influence (EI). Furthermore, we also used measures of proximity and centrality of strengths to verify the variables with the greatest number of edges within the network (variable with the greatest connectivity) and with the greatest strength between the connections (edges) (11).

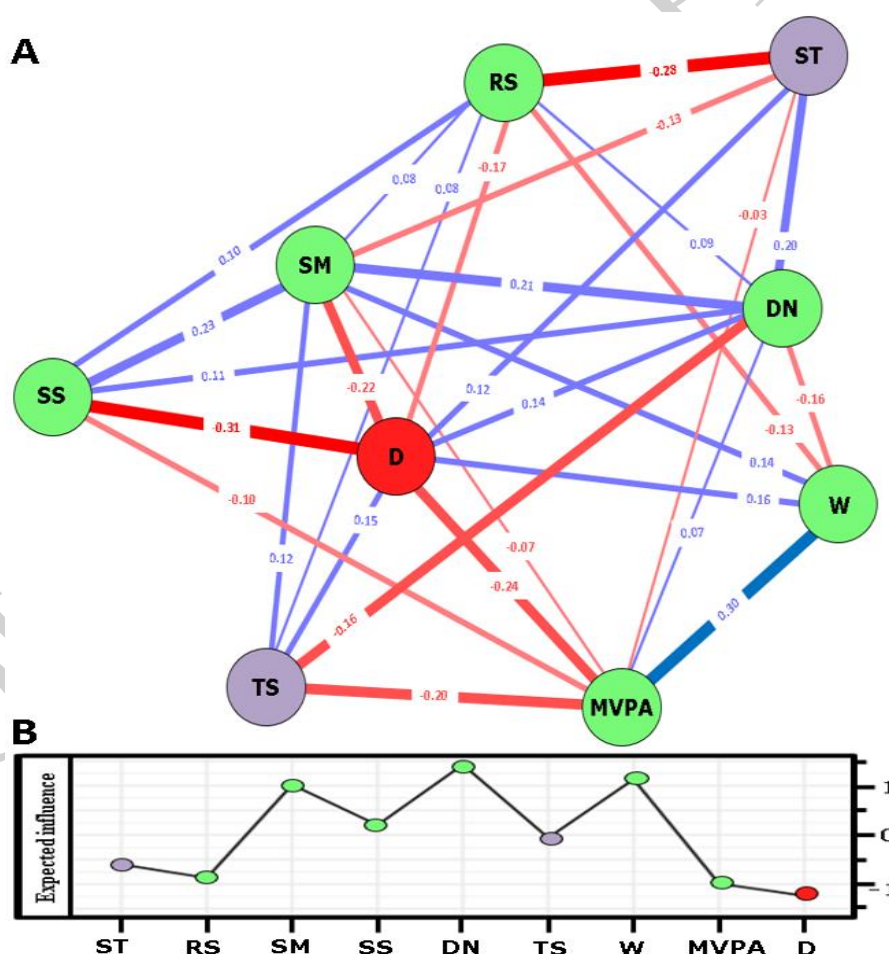
To calculate the stability estimates of the centrality and edge indices, each centrality index was initialized 1,000 times with non-parametric samples with a 95% confidence interval (12). The centrality stability coefficient varies from 0 to 1, with values > 0.25 indicating moderate stability and values >0.50 indicating strong stability.

RESULTS

The final sample comprised 93 adolescents (aged 14.2 ± 1.8 years old). Participants were classified into two groups: boys and girls. Approximately 67.74% (n=63) of participants were girls. Significant differences were observed in weight ($U=673.0$, $p= .025$) and height ($U=454.5$, $p< .001$). There were also significant differences in moderate-vigorous physical activity (MVPA), **where boys practice a median of 165.00 minutes per week (interquartile range, 100 to 220) and girls 90 minutes per week (IQR, 45 to 180) ($U=743.0$, $p= .010$) and weekly walking, boys of median 30 minutes per week (IQR, 20 to 98.75) and girls 20 (IQR, .00 to 30) ($U=678,5$, $p= .003$).**

Figure 1 presents the network analysis. The nodes represent the variables. It is possible to observe positive and negative partial correlations, which vary from 0.07 to 0.30 (blue edges) and -0.03 to -0.31 (red edges), respectively. The strongest positive links were between MVPA and walking (edge=0.297), social support (SS) and stress management (SM) (0.230), SM and diet and nutrition (DN) (0.210). The main negative links were between restorative sleep and screen time (-0.280), MVPA and time sitting (-0.201). It is worth highlighting that the variables that showed the highest direct partial negative correlation with the depression score were SS (-0.307) and MVPA (-0.244). Where MVPA and healthy social relationships appear to be related to lower symptoms of depression in adolescents. Furthermore, even if very weak, MVPA seems directly associated with DN (0.074), the variable with the highest EI in the network.

Figure 1 – Network analysis between the depression scores (DASS-21), SMILE-C, and IPAQ



Note: Figure 1A = Network analysis, in which the red edges indicate partial negative correlations, and the blue indicates positive. The green nodes refer to positive lifestyle habits, the purple to harmful habits, and the red to depression score. Caption: Moderate-vigorous physical activity (MVPA), walking (W), time sitting (TS), diet and nutrition (DN), stress management (SM), repairing sleep (RS), social support (SS), screen time (ST), and depression (D); Figure 1B = Measure of centrality (expected influence).

The lifestyle variables with the highest EI in the network are DN (1.423), walking (1.126) and SM (1.015). DN has the highest EI, suggesting that increasing the amount of MVPA could improve other variables. The same variables and in the same order presented the highest closeness and strength values: depression (closeness=2.162, strength=2.080), SM (0.520, 0.721), and DN (0.473, 0.469). This indicates that the nodes with the strongest connections also had the strongest partial correlations in the network.

The analysis of edge stability showed that the confidence interval between the bootstrap means and the sample results were broad and overlapping, so the data should be interpreted cautiously. In centrality measures, bootstrap analyses showed a drastic drop in centrality stability between strength and proximity measures, remaining below the acceptable average correlation cutoff between the initialization samples and the original sample (< 0.25).

DISCUSSION

The present study aims to investigate the association between lifestyle and **symptoms of depression** in adolescents using network analysis. **Girls had lower MVPA and walking rates than boys, corroborating previous findings (13–15). This low level of physical activity can be explained by the low opportunity due to sociocultural issues, since stimuli for games involving physical activity during childhood are often proposed to boys, rather than girls, which may have an effect of reduced physical activity in girls during adolescence and, probably, in adulthood as well (16,17), since it is known that patterns of physical activity and sedentary behavior during childhood and adolescence tend to continue into adulthood (18).**

The main findings **of this present study** reveal a negative correlation between MVPA and healthy relationships with **depressive symptoms**. SS is crucial for adolescent well-being, promoting a positive self-perception and reducing mental disorders. It also plays a vital role in motivating healthy behaviors like physical exercise. In addition, SS is a basic psychological need essential for encouraging healthy behaviors such as physical exercise (19).

Social support appears in this result as a probably important lifestyle domain to improve depressive symptoms. The previous literature reveals that considering SS as a necessity innate for human wellbeing, interventions aimed

at expanding healthy relationships between adolescents and their peers seem to be an important alternative, considering the relevance of social acceptance and the notion of belonging for health and well-being that occurs in this age group and how this can impact positive mental health outcomes in adulthood(20–22).

According to Khaw et al. (2008), factors related to a healthy lifestyle can be determined by physical and mental health, being able to directly impact the individual's general health status(6). These results suggest that good social support can positively influence the practice of physical activity and benefit the adolescent's mental health. Extensive literature supports the interaction between regular PA and its benefits in preventing and treating depression, considering its neurobiological, psychophysiological, and social effects (23,24).

Furthermore, MVPA presented, although weak, a direct partial positive correlation with the variable DN, and due to its high expected influence (highest variable, EI = 1.423), closeness (0.473), and strength (0.469), it was able to interfere in the other variables, reducing, together with other lifestyle domains, symptoms of depression (variable with greater closeness (2.162) and strength (2.080)). Through the results obtained by Recchia et al. (2023), who carried out a meta-analysis of 21 studies involving 2,441 participants, it was possible to observe that physical exercise interventions are associated with a reduction in depressive symptoms compared to control groups(23). The close relationship between **symptoms of depression** and lifestyle habits aligns with existing research on lifestyle medicine (25).

In conclusion, our study demonstrates the significance of lifestyle factors in influencing depression symptoms among adolescents. Specifically, we have determined that elements such as social support, physical activity, and nutrition play a vital role in fostering mental well-being and decreasing these symptoms. It is important to note that the results revealed differences in scores between boys and girls, with girls showing lower levels of physical activity and possibly in other dimensions.

Nonetheless, there are limitations to this study. First, the cross-sectional design and the small sample size. Furthermore, bootstrap analyses showed a drastic drop in centrality measures, falling below the cutoff point (< 0.25), which may reduce the reliability of the results (9). Despite these limitations, our results highlight the association between adolescents' lifestyle and depression symptoms. The practice of

moderate and vigorous physical activity, screen time, social support, and other aspects of the lifestyle can influence the mental health of these adolescents both positively and negatively. More research is needed to better elucidate this relationship.

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