INDIVIDUAL AND COMBINED EFFECTS OF LIFESTYLE BEHAVIORS ON THE HEALTH-RELATED QUALITY OF LIFE OF ADOLESCENTS

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Abstract: Background: Identifying lifestyle behaviors that can influence health-related quality of life (HRQoL) in the young population is necessary for the design and implementation of more effective educational and public health interventions. Objective: To investigate the individual and combined effects of a set of lifestyle behaviors, including physical activity, sedentary behavior, sleep and food consumption, on the HRQoL of a sample of Brazilian adolescents. Methods: It is a school-based observational study with the participation of 308 adolescents aged 14 to 18 years. A questionnaire with structured questions was applied to gather demographic and lifestyle behavior data. A healthy lifestyle index was created including positive scores for each individual behavior. HRQoL was measured using the KIDSCREEN-27 questionnaire. Analysis of covariance and linear regression models were used for statistical analysis of the data. Results: Adolescents who reported ≤ 2 hours/day of screen-based sedentary behavior ($F = 5.496$; $p = 0.016$) and sleep duration between 8-10 hours/night ($F = 6.542$; $p = 0.009$) had significantly higher HRQoL. Adolescents who reported simultaneous adhesion in ≥ 3 healthy lifestyle behaviors demonstrated approximately two [OR = 2.12; 95%CI 1.27 – 4.79] to three times [OR = 3.04; 95%CI 1.93 – 5.62] more odds to have higher perceptions of HRQoL compared to those fulfilling none. Conclusion: Although healthy lifestyle behaviors had a positive individual effect on HRQoL, simultaneous adhesion to healthy behaviors enhances the cumulative effect. The findings reinforce the importance of promoting a healthy lifestyle to ensure HRQoL and well-being in adolescence, with repercussions throughout adulthood.

Keywords: Adolescent behavior, health behaviors, health habits, health-promoting behaviors, well-

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being, youth.

Introduction

Although there may be differences in their conceptual structure, there is agreement that quality of life, more specifically health-related quality of living (HQV), is considered a multidimensional construct, which includes self-perception of well-being in the physical, emotional, psychological and social fields influenced by the individual's experiences, expectations and beliefs. (Ravens-Sieberer U et al, 2014). In this context, when it comes to young people, the dimensions equivalent to QVRS are especially suitable for monitoring the state of health, considering the lowest likelihood of identifying serious and diagnosing chronic diseases in this population group (Hays R et al, 2010).

Data relating to the QVRS of the young population is also a relevant alternative in the monitoring of specific interventions and public health programmes (Valderas JM et al, 2008). In primary health care actions, young people's perception of QVRS can help in identifying subgroups with greater risk for well-being (Varni J et al, 2005). Furthermore, the follow-up of QVRS in childhood and adolescence stands out because of its future impact on the quality of life of the adult (Palacio-Vieira JA et al, 2008). Therefore, dimensions equivalent to QVRS should receive special attention in healthcare from a young age.

Findings made available in the literature seek to show that the QVRS of young people is closely related to lifestyle behavior. Sufficient practice of physical activity (Wu XY et al, 2017), longer duration of sleep (Matos MG and al, 2017) and use of healthy diet (Wo XY and others, 2019) have been positively associated with QVRS, while screen time has been shown to be inversely linked to QWRS (Gopinath B et al, 2012). However, although the lifestyle behaviors analyzed in isolation in these studies have shown close identification with QVRS, young people tend to adhere simultaneously to a conglomerate of conduct (Burdette AM et al, 2017), which can modify the individual effect of each of the conduct. In fact, previous studies have suggested that simultaneous adherence to multiple

lifestyle behaviors can potentiate individual health impact by interacting synergistically with each other. (Pronk NP et al, 2004).

In this case, surveys conducted in the adult population have pointed out that adhering to the highest amount of healthy lifestyle behaviour repercussions on body weight (May AM et al, 2012), physical capacity (Atallah N et Al, 2018) and mortality rates (Veronese N et al, 2016). However, studies seeking to investigate the combined impact of lifestyle behaviour in QVRS on young people are rare, and the few studies existing have involved samples of children and adolescents from European and Asian countries, sociocultural context far from Brazilian reality (Qin Z et al, 2021).

Another aspect to be observed is the use of different instruments to identify the QVRS, sometimes through concepts and operationalization of its rather divergent dimensions. This reminds us of the importance of addressing as comprehensive as possible spectrum of the quality of life dimensions of the target population and of incorporating a widely accepted definition of QVRS, which can be perceived and expressed by the participants in the different surveys. (Wu XY et al, 2017).

In this particular, most of the instruments currently available to monitor the quality of life of young people have been generated to be used in specific populations, and subsequently translated and adapted to other languages and cultures (Burdette AM et al, 2017). An exception is the Kidscreen, originally developed to simultaneously address various cultural spectrum from different regions of the world (Ravens-Sieberer U et al, 2006), thus contributing to providing a broad perspective on the understanding and interpretation of the dimensions of QVRS, and has been translated and adapted for use in several countries.

Therefore, it is interesting to expand the scarce knowledge about the effect of selected lifestyle behaviors on the QVRS of members of the young population, by using an instrument of measurement that is internationally recognized. This understanding could help to formulate more effective public health policies and provide information for the adequate allocation of resources for health promotion and prevention of harm to young people's current and future health. Thus, the aim of the study was to identify the individual and combined effects of a set of lifestyle behaviors, including physical activity,

sedentary behavior, sleep and food consumption, in the QVRS of a sample of Brazilian adolescents.

Methods

It is a shortcut of the Health Promoter School Project, ideated and implemented by the Federal Institute of Santa Catarina, Campus of São Miguel do Oeste. It was chosen to involve adolescents enrolled only in this school unit, due to the longitudinal characteristics of the project (experimentation of health education programs), and for its representativity in the universe of high school pupils in the southwestern region of the state of Santa Catarina, Brazil. The intervention protocols were approved by the Research Ethics Committee of the University of the West of Santa Catarina – Plataforma Brazil (Opinion 3.412.665/2019).

Sample and selection of participants

The sample was made up of schoolchildren of both sexes, aged between 14 and 18, enrolled in secondary school. The participation of the schoolchildren in the study was due to the desire to participate in the experiment and with the permission of the parents or guardians. To this end, all schoolchildren enrolled in the academic year 2019, together with their parents or guardians, were contacted and informed of the nature and objectives of the project, in addition to the principle of confidentiality, not influence on school performance, and invited to participate in the data collection. Refusal to participate in the study or failure to respond to the invitation after three contact attempts at different days and times were considered sample losses.

The criteria adopted for excluding some school from the study were: (a) absence from class on the scheduled day for data collection; (b) any health problem that could temporarily or permanently prevent participation in the study; (c) use of some kind of drug that could induce changes in study variables; (d) being subjected to some type of specific diet; (e) pregnancy; (f) inadequate filling of

measurement instrument items (more than one response to the same item or item not responded); and (g) age below 14 years or over 18 years. Thus, of the 418 schoolchildren enrolled in the school, the final sample consisted of 306 teenagers (179 girls and 127 boys). The rights of all participants were safeguarded through a Free and Clear Consent Agreement signed by the school and its supervisor.

Measuring instrument

For data collection, a questionnaire consisting of three sections was applied: demographic data, health-related quality of life and lifestyle behaviour. As for the demographic data, items were included on gender, age, year of study, degree of schooling of the parents and family economic class, based on housing conditions, possession of household appliances, cars and the number of domestic employees, according to the Brazil Classification Criterion, recommended by the Brazilian Association of Research Companies (ABEP, 2019).

To examine the dimensions of QVRS used the use of Kidscreen-27, translated, adapted and validated for use in the young Brazilian population (Farias Júnior JC et al, 2017). In general, Kidscreen-27 consists of a scale of 27 items aimed at the perception of five dimensions equivalent to QVRS specifically of children and adolescents: (a) health and physical well-being; (b) psychological well-bye; (c) autonomy and relationship with parents; (d) social support and peer group; and (e) school environment. The answer options of the items are formatted on a Likert scale of one to five points, which seeks to identify, scale and order the frequency of behaviors/feelings (1 = Never; 2 = Nearly Never; 3 = Sometimes; 4 = Almost Always; 5 = Always) and the intensity of specific attitudes (1 = Nothing; 2 - A bit; 3 - Moderately; 4 - Much; 5 - Totally), with a one-week recall period prior to the application of the questionnaire.

The scores of each dimension are computed using a syntax, which takes into account the answers of the group of questions that make up the QVRS dimension, with the items being equally weighed. The final scores equivalent to each dimension are recoded on a measurement scale with

variations between zero and 100, with zero being the lowest perception and 100 the highest QVRS perception of that dimension in question. Also, additional indicator resulting from the 27 items together is computed to dispose of inferences related to the global QVRS. Participants who presented a global QVRS score above the gender-specific normative value originally proposed by the Kidscreen questionnaires idealizers (girls = 49; boys = 51) were rated as having a highQVRS (Ravens-Sieberer U et al, 2006).

Lifestyle-equivalent information was obtained from items equivalent to physical activity, sedentary behavior, sleep and food consumption. The practice of physical activity was identified by the formulation of the question: "Over the last seven days, how often have you performed moderate to vigorous physical activity for at least 60 minutes (consider any physical activity that increased your heart rate and respiratory rate, such as fast walking, running, cycling, swimming, or other similar activities; and the total time, i.e. it is not necessary that it has been 60 minutes in a row, can add the times of the day when you have performed some kind of physical activities)? The answer options for the question ranged from "none" to "7 days". Following international public health guidelines were considered sufficiently active those adolescents who responded to frequency of moderate to vigorous physical activity for at least 60 minutes in ≥ 5 days/week (WHO, 2020).

Sedentary behavior was addressed through screen time through the question: In a typical or usual week, how many hours do you watch TV and/or use your computer, tablet, smartphone for activities that are not related to some kind of work or school task? For response, a predefined time scale was provided in which respondents marked their choice between six categories, ranging from "none" to "≥ 5 hours/day". The issue considered separately the use of equivalent screen devices on weekdays and on weekends (Saturday and Sunday). Weighted average involving weekday and weekend data was used to identify screen time per day. In this case, according to bodies and scientific societies linked to youth health, adolescents who pointed average screen time ≤ 2 hours/day were considered the least sedentary behavior (American Academy of Pediatrics, 2011).

Data equivalent to sleep duration were also collected taking into account weekdays and

weekends, taking as reference a typical or usual week, using the questions: On weekends and on weekends (Saturday and Sunday): (a) what time do you usually sleep? (b) And what time do you wake up? Based on the reports submitted by the participants, the sleep time was calculated in weekdays and weekends. A weighted average involving weekdays and weekends data was used to identify sleep duration per night. For analysis, sufficient amount of sleep was assigned to those adolescents who duration of 8-10 hours/night (Chaput JP et al, 2016).

With regard to food consumption, the study participants positioned themselves how often they consumed fruit/vegetables through the question: (a) "In the last seven days, how often have you eaten fruit and/or vegetables (not considering fruit juices)?". The response options ranged from "none" to "seven days". Adequate fruit/vegetable intake was assigned to those adolescents who responses equivalent to ≥ 6 days/week (WHO, 2003).

The overall index of healthy lifestyle behavior was then generated by combining the four health behaviors considered in the study (physical activity, sedentary behaviour, sleep and food consumption). Thus, adolescents were awarded one point for each healthy behaviour: (a) physical activity ≥ 5 days/week; (b) ≤ 2 hours/day of screen-based sedentary behavior; (c) sleep duration between 8-10 hours/night; and (d) fruit/vegetable consumption ≥ 6 days/ week. Thus, the overall Healthy Lifestyle Conduct Index score ranged from zero to 4, where zero represents the absence of any of the health conduct and the remaining scores represent the number of conductes present simultaneously, where a higher score indicates a healthier lifestyle.

Data collection

The data collection took place between September and November 2019 and was carried out by a team of researchers familiar with the instrument and trained in its procedures. The questionnaire was answered at a single time, individually by each of the participants and at the very place and time of the classes. Study participants received the questionnaire with instructions and recommendations

for self-filling, with no time limit for completion. Any doubts expressed by respondents were promptly clarified by the researcher who accompanied the data collection.

After completion, the questionnaire was stored by the respondent in an urn together with all the others, thus ensuring anonymity. The average self-filling time for the questionnaire was 30 minutes. The reliability of the questionnaire was analyzed by seven-day application replication in 10% of schoolchildren selected for study. All items had a Cohen index of coincidence ≥ 0.80.

Statistical processing

The data analysis was carried out using the IBM® SPSS® Statistics for Windows package, version 25 (IBM Corporate, Armonk, New York, USA). Demographic characterization of the sample was carried out using relative frequency of the data. As for the five-dimensional scores and the overall QVRS, the frequency distribution was initially analyzed using the Kolmogorov-Smirnov test. Since they showed normal frequency distribution, the resources of parametric statistics were used by calculating average and standard deviation. Subsequently, to establish comparisons between both genres was used Student's t test for non-matched data. For lifestyle behaviors, punctual proportions and confidence intervals (IC95%) were identified, stratified according to gender. Statistical differences between strata under investigation were analyzed using contingency tables and non-parametric qui-square ($\chi 2$) test.

As preliminary analyses did not identify significant gender interactions with lifestyle behaviors in relation to QVRS dimensions, the statistical procedures were subsequently carried out involving the data set of both genders. Comparisons between the global QVRS-equivalent scores categorized in the layers of each lifestyle behavior were carried out using covariance analysis (ANCOVA), adjusted by gender, age, year of study, degree of schooling of the parents and family economic class. Also, ANCOVA accompanied by Bonferroni's post-hoc test was used to identify specific differences in global QVRS scores among the five indices of healthy lifestyle behavior. The partial square eta

(η2p) was calculated to analyze the size of the effect (Field A, 2005).

Linear regression analyses were conducted to identify associations between individual lifestyle behaviors and overall QVRS. In addition, procedures of logistical regression analysis, adjusted for gender, age, year of study, degree of schooling of the parents and family economic class, were employed to estimate the likelihood of teenage schoolchildren showing high QVRS according to healthy lifestyle behavior indices. Statistical significances were pre-established at $p < 0.05$.

Results

The study participants had an average age equivalent to 16.34 ± 1.21 years. The demographic data for the selected sample are shown in Table 1.

Table 1 – Demographic data of the sample selected in the study (n = 306).

		n (%)			n (%)
Gender			Parents' education		
	Girls	179 (58.5%)		≤ 5 years	62 (20.3%)
	Boys	127 (41.5%)		6 – 11 years	129 (42.2%)
Age				≥ 12 years	115 (37.5%)
	14 – 15 years old	80 (26.1%)			
	16 – 18 years old	226 (73.9%)	Economic class		
Year of Study				Low	37 (12.1%)
	1st Year	117 (38.2%)		Average	209 (68.3%)
	2nd Year	106 (34.6%)		High	60 (19.6%)
	3rd year	83 (27.2%)			

Table 2 provides statistical information equivalent to QVRS dimensions and lifestyle behaviour separately by gender. The boys attributed significantly higher scores in the QVRS dimensions related to Health/Physical Well-being ($p < 0.001$), Psychological Welfare ($p = 0.023$) and Autonomy/ Relation with Parents ($p= 0.011$). However, average scores identified in the Social Support/Couple Group and School Environment dimensions were similar in both sexes. In relation to the overall QVRS index, boys also scored more than girls ($p = 0.048$). Regarding exposure to lifestyle behavior,

both sexes similar behaviors of sedentary behaviour based on screen and sleep duration. However, a significantly higher proportion of boys were more physically active ($p < 0.001$), while a higher percentage of girls showed more favourable fruit/vegetable consumption ($p = 0.007$).

Table 2 – Descriptive characteristics of health-related quality of life dimensions and lifestyle behaviors according to gender of adolescents participating in the study.

	Both genders	Girls	Boys	P
Health-Related Quality of Life (Mean ± Standard Deviation[1]				
Health/physical well-being	57.10 ± 13.51	54.34 ± 13.57	60.98 ± 13.64	< 0.001
Psychological well-being	61.07 ± 17.05	59.43 ± 16.78	63.39 ± 19.39	0.023
Autonomy/relationship with others	65.28 ± 18.86	63.65 ± 21.51	67.57 ± 17.32	0.011
country	71.60 ± 16.32	71.89 ± 16.49	71.20 ± 16.83	ns
Supportsocial/peer group	57.61 ± 15.59	58.50 ± 15.68	56.37 ± 15.87	ns
School environment	62.53 ± 16.37	61.56 ± 16.21	63.90 ± 16.61	0.048
Global index				
Lifestyle Behaviors (%[IC95%]) two				
Physical activity ≥ 5 days/week	21.2 [19.1 – 23.7]	15.6 [14.4 – 17.2]	28.3 [25.1 – 31.9]	< 0.001
Sedentary behavior ≤ 2 hours/day	22.2 [20.0 – 24.9]	24.0 [21.6 – 26.9]	19.7 [17.7 – 21.8]	ns
Sleep duration 8-10 hours/night	34.3 [30.5 – 38.8]	33.0 [29.4 – 37.2]	36.2 [31.5 – 40.9]	ns
Fruit/vegetable consumption ≥ 5 days/week	29.7 [26.7 – 33.0]	33.5 [29.8 – 37.5]	24.4 [22.0 – 27.3]	0.007

[1]Comparison between both genders using Student's t test.
[1][2]Comparison between both genders using the chi-square test.

Results of covariance analysis, by statistical adjustment by gender, age, year of study, schooling of the parents and family economic class, comparing the scores equivalent to the global QVRS according to strata of individual lifestyle behaviour are available in table 3. Adolescents who scored ≤ 2 hours/day of screen-based sedentary behavior ($F = 5,496$; $p = 0,016$) and sleep duration between 8-10 hours/night ($F= 6,542$; $p= 0,009$) showed significantly higher overall QVRS equivalent scores. However, in the strata that gathered adolescents who being more physically active or eating fruit/ve-

getables more frequently, no significant effect on overall QVRS scores was identified.

Table 3 – Individual effects of lifestyle behaviors on global health-related quality of life (Global HRQoL) in adolescents.

Lifestyle Behaviors	Global HRQoL	F Test
Physical activity		
< 5 days/week	60.97 ± 15.75	F = 3.075; p = 0.061
≥ 5 days/week	64.13 ± 16.99	
Screen-based sedentary behavior		
> 2 hours/day	59.78 ± 15.57	F = 5.496; p = 0.016
≤ 2 hours/day	65.28 ± 17.09	
Sleep duration		
< 8 hours/night	59.15 ± 15.49	F = 6.542; p = 0.009
8-10 hours/night	65.91 ± 17.25	
Fruit/vegetable consumption		
< 6 days/week	61.90 ± 16.20	F = 1.213; p = 0.185
≥ 6 days/week	63.16 ± 16.54	

Analysis of covariance adjusted for gender, age, year of study, parental education level and family economic class.

Average QVRS-equivalent scores according to the global index of healthy lifestyle behaviour are shown in Figure 1. The analyses noted significant differences in QVRS scores between the layers of the overall index of healthy lifestyle behaviour ($F(4; 306) = 8,472$; $p < 0,001$; $2p = 0,09$), after adjustment for gender, age, year of study, parental education and family economic class. Specifically, adolescents with overall healthy lifestyle 3 and 4 scores had higher QVRS scores than their peers with a global healthy lifestyle index equivalent to 0 (65,52 ± 17,12 versus 58,67 ± 15,38; $p < 0,001$; and 63,78 ± 16,80 versus 58,57 ± 15:38; $p = 0,037$; respectively).

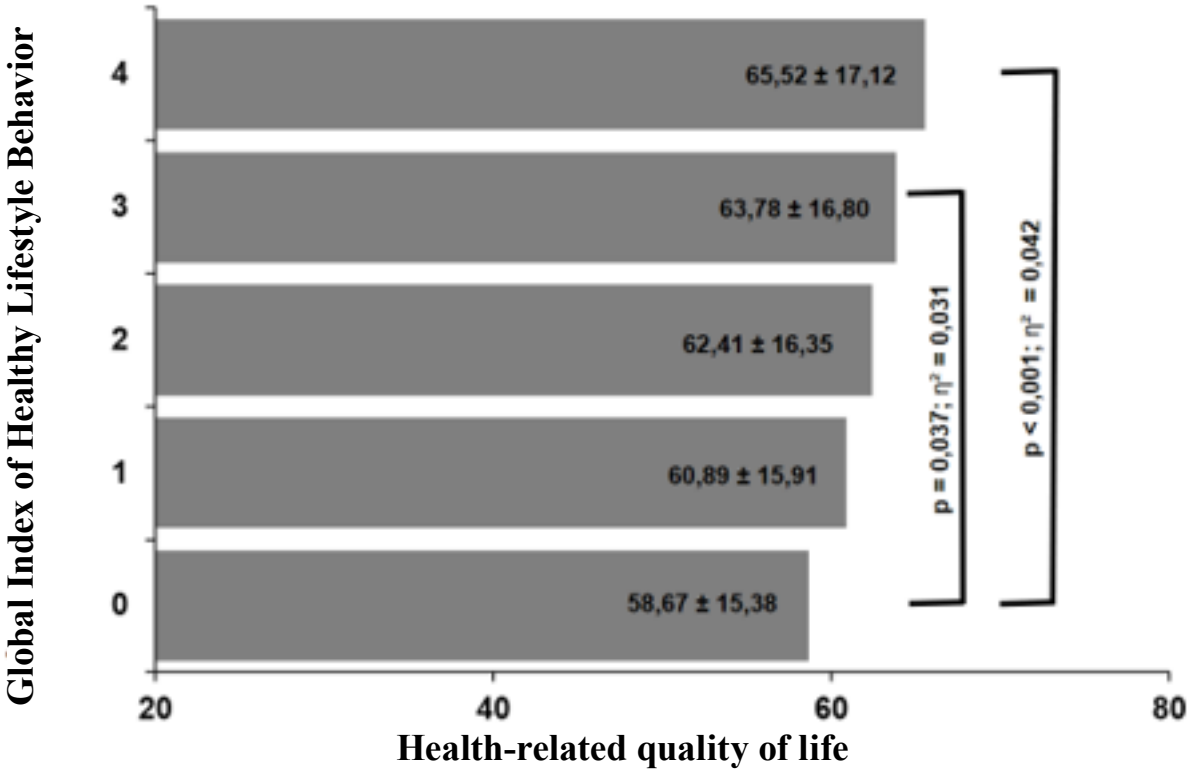

Figure 1 - Health-related quality of life according to the global index of healthy lifestyle conduct

Table 4 shows the associations between lifestyle behavior and global QVRS, adjusted by gender, age, year of study, parental schooling and family economy class. Linear regression analyses indicated that fruit/vegetable intake ($p = 0.011$) and sleep duration ($p < 0.001$) were individually and significantly associated with the overall QVRS of adolescents. On the other hand, physical activity and screen-based sedentary behavior did not demonstrate individual associations with global QVRS.

Table 4 – Associations between lifestyle behaviors and quality of life related to global health in adolescents.

	β	IC95%	P
Physical activity	0.029	0.017 – 0.072	0.538
Screen-based sedentary behavior	0.094	0.037 – 0.162	0.095
Sleep duration	0.328	0.255 – 0.629	< 0.001
Fruit/vegetable consumption	0.174	0.892 – 0.241	0.011

Standardized regression coefficient (β) and 95% confidence interval (CI) data.

Estimates of the probability of adolescents showing high QVRS according to healthy lifestyle behavior indices are shown in Table 5. The odds ratio values found indicated that adolescents who joint adherence to three or four healthy behaviors (indices 3 and 4) were more likely to have high QVRS than their peers who not adhering to any of the four healthy lifestyle conduct (indice 0). Adolescents stratified in indices 3 and 4 of healthy lifestyle behavior showed approximately two [OR = 2.12; IC95% 1.27 – 4.79] to three times [OR= 3.04; IC 95% 1.93 – 5.62] higher chances of having high perception of QVRS compared to their peers with index 0.

Table 5 –*Odds ratio* and 95% confidence interval (OR [95% CI]) for the association between high HRQoL and the index of healthy lifestyle behaviors in adolescents.

Healthy lifestyle behavior indices		High health-related quality of life	
	n	OR (95%CI)	P
0	23	Reference	
1	62	1.58 (0.62 – 3.34)	0.106
2	87	1.84 (0.96 – 4.08)	0.078
3	74	2.12 (1.27 – 4.76)	0.024
4	60	3.04 (1.93 – 5.62)	< 0.001

Values adjusted for gender, age, year of study, parental education and family economic class

Discussion

To our knowledge, this was the first study to investigate the individual and combined effects

of four classical lifestyle behaviors in QVRS of school-age adolescents in Brazil. The main results revealed that the combination of the set of lifestyle behaviors, including increased frequency of moderate to vigorous physical activity for at least 60 minutes/day, average screen time ≤ 2 hours/ day, sleep duration between 8-10 hours/night and daily consumption of fruit/vegetables, positively influenced the QVRS of the adolescents participating in the study. Additionally, the higher the amount of healthy behavior by adolescents, the more likely they are to have higher QVRS. These findings seek to contribute with the scarce scientific literature on the subject, suggesting that the combination of multiple healthy lifestyle behaviors tends to have a more prominent impact on QVRS than their respective individual effects.

When treating each of the lifestyle behaviors separately, moderate to vigorous physical activity did not show independent association with QVRS. However, previous studies have pointed out significant associations between the usual practice of physical activity and QVRS (Wu XY et al, 2017) besides, adolescents who show themselves more physically active tend to have a lower risk for depressive symptoms (Hrafnkelsdottir SM and al, 2018), better cardiometabolic status (Tarp J et al., 2018), restoration of sleep and psychological condition (Brand S et al. 2017), which in principle can influence QVSS. Thus, although no individual association has been found between moderate and vigorous physical activity and QVRS, it is likely that, in combination with other investigated healthy lifestyle behaviors, it may also impact QVSS (Prochaska JJ et al, 2008). Therefore, based on previous evidence, this lifestyle behavior has been included in the Global Healthy Lifestyle Behavior Index to examine the combined association with QVRS.

In line with data available in the literature (Gopinath B et al, 2012), the study results showed that adolescents who ≤ 2 hours/day screen time showed higher perception of QVRS. However, no significant association between total screen time and QVRS was identified in the sample of adolescents collected in the study. These results may be related to passivity and the lonely context of screen activities, which may restrict or replace social cohabitation with peers and do not involve situations that require problem-solving, cognitive or physical challenges (Iannotti RJ et al, 2009). This behavior can

influence the degree of life satisfaction, psychological well-being and physical health, which in turn negatively influences the perception of QVRS (Page AS et al, 2010).

On the other hand, the association observed between longer sleep (8-10 hours/night) and higher self-reporting QVRS supports results from previous studies and confirms positive individual effect of sleep duration on QVSS of adolescents (Matos MG et al, 2017). These findings can be partly explained by the direct consequence that insufficient sleep has on the occurrence of daytime drowsiness (Moore M et al, 2008). Daytime drowsiness can induce reduced alertness and impair functional capacity, including fatigue, mood swings, reduced performance in everyday tasks, memory impairment and difficulty dealing with adversities (Bruce ES et al, 2017). Thus, daytime damage resulting from reduced sleep duration influences cognitive, physical and emotional performance throughout the day, which can in turn impact on QVRS in adolescents (Owens J et al, 2014).

As for food consumption, the results of this study agree with evidence provided in previous surveys that also showed that adherence to a healthier diet was positively associated with QVRS (Wu XY et al, 2019). However, no significant differences were identified between adolescents who daily consumption of fruit/vegetables and those who did not report this dietary pattern. Possible justification for the association found may be based on the assumption that fruits/vegetables are foods rich in nutrients, fiber, minerals and vitamins responsible for protective actions for physical and mental health (Albani V et al, 2018), which allows to hypothesize that it can translate into better QVRS.

The combined effect analysis revealed that adolescents with overall healthy lifestyle behavior index ≥ 3, compared to those with global index equivalent to 0, had higher average QVRS scores with moderate effect, as denoted by the size of the effect obtained. In addition, a cumulative effect of healthy lifestyle conduct was found in QVRS. Although the findings may suggest that not all healthy lifestyle behaviours included in the current study show the same impact on adolescent QVRS, combined effect analyses revealed that the higher adherence to healthy behaviour, the higher QVSS.

To our knowledge, so far, there have been few studies that have analyzed the combined effects of multiple lifestyle behaviors on QVRS of adolescents. (Qin Z et al, 2021). The studies provided

included in their delineation lifestyle behaviors similar to those employed in the present study and identified that adolescents with healthy lifestyle habits self-reported significantly higher QVRS. Therefore, our results corroborate these findings, confirming that adherence to multiple healthy lifestyle patterns is closely associated with higher levels of QVRS. However, the present study added unprecedented finding by revealing increased probability of self-reporting higher perception of QVRS as the amount of adherence to healthy lifestyle behaviors also increases. In principle, these findings can be explained by the interaction of the positive effects that some healthy lifestyle behaviors present, which potentiates the cumulative effect on QVRS of adolescents.

In the present study there was an attempt to combine four lifestyle behaviors into a global index of healthy lifestyle behaviour in order to provide a better understanding of the effects of these health behaviours on adolescent QVRS. Given the cumulative effect of adopting multiple healthy behaviors, it would be advisable for public health strategies to focus on promoting multi-behavioral health policies. In this context, this is especially relevant in adolescence, considering it is a stage of the life of young people especially conducive to adherence to healthy lifestyle behaviour, with important repercussions for later ages, thus influencing the current and future health of the adult (Burdette AM et al, 2017).

The main strengths of the study are related to the design, outline and conduct of the Health Promoter School project. The project provides robust and up-to-date data on lifestyle behaviour and QVRS from a homogeneous sample of teenagers of similar age and representative of the universe of Brazilian high school pupils. In the methodological aspect, possible seasonal interference in the reports of adolescents was minimized considering that the data collection was carried out in a short period of time (three months) and at the same season of the year (spring), which together with a minimum rate of refusal to participate in the study ensures greater reliability to the findings.

In conclusion, the study results showed that sleep duration between 8-10 hours/night and sedentary behavior based on screen time ≤ 2 hours/day had an individual positive effect on QVRS in adolescents. However, the combined effect of healthy lifestyle behaviors associated with physical

activity, screen time-based sedentary behavior, sleep and food consumption demonstrated a stronger influence on QVRS. Therefore, educational and public health interventions aimed at promoting adolescent QVRS should focus on multiple actions related to healthy lifestyle behaviour. The importance of the findings of the study is highlighted due to the fundamental role ofining high QVRS from the earliest ages and throughout life.

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