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Research article

Usefulness of self-rated single items for health-related factors assessments among adolescents: Evidence of convergent validity from a cross-sectional study

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Abstract: The aim of the present study was to analyze the reliability and evidence of convergent validity of self-rated single items for specific health assessments among adolescents. A cross-sectional study was performed involving 650 Brazilian adolescents who answered a questionnaire containing 12 self-rated single items for specific health assessments. In addition, the respective measures of health were estimated using validated questionnaires or multi-item scales. The health measures were diet, physical activity, sedentary behavior, musculoskeletal symptoms, alcohol consumption, tobacco use, daytime sleepiness, duration of sleep, and mental health. The reliability of the single items was analyzed using a seven-day test-retest. The Kappa coefficient of agreement (k) and prevalence ratios (PR) obtained by Poisson regression were adopted. Self-report single items presented acceptable reliability (k = 0.50–0.78) and absolute agreement values varying from 80.6 to 88.9%. Self-rated diet was associated with consumption of salads, vegetables and greens (PR = 1.53 and 1.77) and any vegetable intake (PR = 1.30) ($P < 0.05$). Self-rated sedentary behavior was associated with TV and internet use on weekdays (PR = 1.17–1.73) and TV use (PR = 1.36–1.59) on the weekend, but the associations were dependent on the volume analyzed. Poor self-rated physical activity (PR = 1.44–4.16), alcohol consumption (PR = 2.04–2.45), tobacco use (PR = 1.54–1.56), sleep-related variables (PR = 1.28–1.81), musculoskeletal health (PR = 1.28–1.73), and mental health (PR = 1.51–3.43) were significantly and consistently associated with their respective health measure ($P < 0.05$), even when multiple outcomes were tested. The self-rated single items analyzed presented acceptable reliability and evidence of convergent validity. Although these single items do not substitute complete questionnaires, multi-item scales, or

objective measures of health, they can be used as an additional tool for adolescent self-rated health assessments in different contexts.

Keywords: health risk behaviors; reliability; self-assessment; youth

1. Introduction

Historically, single-item measures have been widely criticized, mainly in psychological science, due to their limitations regarding reliability and accuracy when the target measurement is complex [1,2]. Despite these concerns, more recent evidence has demonstrated that most single-item measures are often valid and reliable as multi-item instruments [1,3], mainly when the adoption is carefully analyzed based on the construct to be investigated, item measure quality, study context, sample characteristics, and available resources [3].

With regard to health assessments, one of the most commonly used measures worldwide is self-rated health, an indicator of general health status assessed by a single item [4]. Since general health assessments do not allow the estimation of specific health characteristics [4], single item self-rated measures have also been adopted to assess health indicators (physical fitness [5], respiratory [6], bone [7], and oral health [8]), health-related behaviors (sleep and diet quality [9,10]), and psychological variables of mental health [11]. The literature demonstrates that these items generally present acceptable evidence of reliability and validity in the overall population [9–11], although contrary results have also been reported [12].

When analyzing the literature on the use of single items among adolescents, some gaps remain evident. First, most of the previous studies aiming to analyze the validity and reliability of single-item measures were conducted among the adult population, limiting the generalization of the results for adolescents. Second, when the sample was composed of adolescents [8,13,14], single items were tested in isolation, preventing knowledge of the performance of single items encompassing different health characteristics in the same sample, as described previously among adults [3]. Third, the most commonly used single items among adolescents are those aimed at quantifying health-related behaviors or a health indicator (e.g., physical activity volume and musculoskeletal pain). It is important to state that this type of estimation is conceptually different from self-rated assessments. In the first case, the adolescent is only required to quantify a health variable, which does not require any decision-making or interpretation; in the second case, the adolescents are required to rate their health, which imply knowledge about what health is [4], the specific variables associated with heath [15], and what levels should be adopted to represent an optimal value to classify each health variable as “good” or “bad”. Despite the well-known psychometric properties of single items aimed at quantifying health behaviors [13,14], information regarding the validity and reliability of specific self-rated health variables is scarce.

Investigating evidence on the convergent validity of self-rated single items for assessing different health characteristics could broaden the use of tools for health assessments with low cost and administration time, fast application and data processing, and higher satisfaction for study participants [1]. This might be helpful in clinical practice, risk stratification and monitoring in pediatric surveillance, epidemiological studies, and school settings. Furthermore, the use of self-rated single items could expand the analysis of self-assessments for specific health variables, providing evidence for interventions by improving understanding of possible distortions related to self-rated health among adolescents [12].

In view of the aforementioned, the aim of the present study was to analyze the reliability and evidence of convergent validity of self-rated single items for specific health assessments among adolescents.

2. Materials and methods

2.1. Study design and ethical aspects

This methodological study is part of a cross-sectional project entitled "Health risks among adolescents: association with the type of course in high school", conducted in Boituva city, São Paulo, Brazil, in 2019 [16]. The project was approved by the Ethics Research Committee of the Federal Institute of Education, Science and Technology of São Paulo (protocol 06438418.1.0000.5473, approved in March 2019). All participants and their guardians signed an assent and consent form prior to data collection.

2.2. Sample

The population of the study was estimated at 2460 adolescents enrolled in high school, distributed in 3 schools in the public municipal education system. Inclusion criteria were being enrolled in a public high school and not having any limitations that would prevent the completion of the questionnaire. We adopted complete case analysis for missing values in each outcome. For this reason, the exclusion criterion was the presence of a high amount of missing data that prevented the conduction of statistical analysis (absence of independent variable, covariate, or outcome). The sample size estimation was performed adopting the following parameters: N = 2460, prevalence of 50%, precision of 5%, design effect of 1.5, and confidence interval of 95%, using the software Open Epi, OpenEpi Project (Atlanta, U.S.A.), version 3.01. The minimum sample size to conduct the cross-sectional study was 499. All schools in the municipal system (n = 3) were invited, and two agreed to participate in the study. The schools are located within a 3 km distance in the central region of the city. The participants were randomly selected within each classroom, stratified by school type (vocational high school or conventional high school), sex, and grade of study [16]. The final sample was composed of 675 participants: 466 from the school with a conventional high school course (69%) and 209 from the school with a vocational high school course (31%). The participation rate among eligible students was 77.0% and 83.6% in each school.

We also estimated post hoc sample size for reliability analysis and power to detect statistically significant associations. Forty participants completed a seven-day test-retest, allowing the detection of a kappa index of 0.75, with precision ranging from 0.54 (moderate agreement) to 0.96 (almost perfect), considering an outcome with a prevalence of 50%, according to previously described procedures [17]. A post hoc estimation sample for the associations was calculated using a confidence interval of 95%, power = 80%, ratio of non-exposed/exposed participants, and prevalence of outcome in each group (exposed and non-exposed) for each outcome. Since the values varied according to each variable, the estimation was done for all using the software Open Epi, OpenEpi Project (Atlanta, U.S.A.), version 3.01. The sample size was sufficient to detect associations of at least 1.4, with a minimum sample size varying from 194 to 526.

2.3. Procedures

Item development procedures were performed according to previous guidelines [18], adapted to the specific characteristics of the single items.

a) Item identification and generation: Each domain of self-rated specific health was defined, and a literature search was conducted to assess existing scales. The questions were developed based on the standard characteristics of a general self-rated health assessment [4].

b) Content validity: Three independent experts from health sciences who were familiarized with scale administration were consulted to assess whether the items represented each health domain of interest, clarity of wording and response options, and appropriateness for use among adolescents. Experts could accept, reject, or suggest modifications for each item.

c) Pre-testing: The items were administered to a sample of 10 adolescents; after completing the printed form, participants were interviewed to assess item comprehension, clarity, and the specific information they considered when answering. During this phase, it was observed that the provision of the instructions described in section 2.4 improved the comprehension of several items.

d) Survey administration: A cross-sectional study was conducted [16].

e) Reliability: A seven-day test-retest was performed with 40 participants (Table 1).

f) Validity: Convergent validity was assessed, enabling the analysis of how different measures on the same concept yield similar results [18].

2.4. Independent variables

The independent variables were 12 self-rated single items to assess health indicators (musculoskeletal health of neck, upper limbs, lower limbs, upper back, and lower back), health-related behaviors (diet, physical activity, sedentary behavior, alcohol consumption, tobacco use, and sleep-related variables), and psychological variables (mental health). Each single item was constructed based on a classical single-item self-rated health indicator: "How do you rate your…" with the following response options: "very poor", "poor", "fair", "good", or "very good" [3]. For analysis purposes, each self-rated item was coded as "good", by clustering the response options "very good" and "good", or "poor", by clustering the responses "very poor", "poor", and "fair". The complete description of each question is provided in Table 1. Before the application, some information was provided to ensure the participant's understanding of health components and to ensure they did not answer the questions arbitrarily [3,15]. The participants were instructed to think about their health and self-rate each specific health aspect or the behavior mentioned in the question. It was made clear that there are no right or wrong answers and that the participant should answer each item honestly. It was also reinforced that for some variables, the relationship with health was positive (i.e., a greater amount of physical activity, duration of sleep, and consumption of healthy foods) while, for others, the relationship was negative (i.e., greater consumption of alcohol, tobacco use, sedentary behavior, unhealthy foods, and the presence of musculoskeletal or psychosomatic disorders).

2.5. Dependent variables

The dependent variables (criterion measures) of the study were divided into three categories: a) health indicators: musculoskeletal symptoms on neck, upper limbs, lower limbs, upper back, and lower

back; b) health-related behaviors: diet, physical activity, sedentary behavior, alcohol consumption, tobacco use, and sleep-related variables; c) psychological variables: symptoms and suspicions of common mental disorders.

a) Health indicators: Musculoskeletal symptoms in the previous 12 months were assessed by the Brazilian version of the Nordic musculoskeletal questionnaire [19].

b) Health-related behaviors: Diet was estimated by a self-reported questionnaire with the question "In the past 7 days, on how many days did you eat the following foods or drinks?" with answer options "none", "1 day", "2 days", "3 days", "4 days", "5 days", "6 days", and "7 days" in the week. A list of 11 foods was displayed, and the cutoff adopted was the consumption of each food on 5 or more days [20]. Physical activity was assessed using the Brazilian version of the International Physical Activity Questionnaire [21], and only leisure-time physical activity was considered for this study. Sedentary behavior was estimated by the number of hours in a day that the participants used the television and the internet, both on weekdays and the weekend [22]. Two variables of alcohol consumption were adopted in the study [23]: binge drinking ("How often do you drink 6 or more doses at once?", with response options "Never", "Less than once a month", "Monthly", "Weekly", "Every or almost every day") and any alcohol consumption ("How often do you drink alcohol?", with response options "Never", "once a month or less", "2–4 times a month", "2–4 times a week", "4 or more times a week"). Researchers described the dose volume for beer, wine, and distilled drinks. The variables current tobacco use and experimentation were related to tobacco use. Experimentation was assessed by the question "Have you ever smoked a cigarette, even one or two puffs?", with response options "Yes" and "No". Current use was considered by the report of any use in the past 30 days, through the question "In the past 30 days, on how many days have you smoked cigarettes?", with the response options "None", "1 or 2", "3–5", "6–9", "10–19", "20–29", and "Every day" [23]. Sleep-related variables were daytime sleepiness, estimated using the Brazilian version of the Pediatric Daytime Sleepiness Scale [24], and duration of sleep, assessed by an open question regarding bedtime and wake-up time [25]. The cutoff adopted for daytime sleepiness was 15 points [26].

c) Psychological variables: mental health was assessed by the Brazilian version of the Self-Report Questionnaire (SRQ-20) [27]. The questionnaire contains 20 dichotomous questions related to symptoms in the previous 30 days, distributed into four dimensions: depressive-anxious mood, decrease in vital energy, somatic symptoms, and depressive thoughts. Suspicion of common mental disorders was considered when the participant reported a positive answer to eight or more items on the questionnaire [28].

2.6. Covariates

The covariates of the present study were sex, age, and socioeconomic status. Sex and age were self-reported with an open question. Socioeconomic level was estimated using the questionnaire proposed by the Brazilian Market Research Association [29].

2.7. Statistical analysis

Descriptive statistics were performed using absolute and relative frequencies. The reliability of each single-item-specific self-rated health variable was evaluated by Kappa statistics, and values were interpreted according to the cutoffs proposed by Landis and Koch [30]: 0.00, poor; 0.00–0.20, slight;

0.21–0.40, fair; 0.41–0.60, moderate; 0.61–0.80, substantial; and 0.81–1.00, almost perfect. The Gwet's AC1 statistic was also applied to complement the agreement analysis to deal with the Kappa paradox [31]. The crude and multiple associations between each single-item-specific self-rated health variable (independent variables) and their respective measured health variable (dependent variables) were analyzed by Poisson regression with robust standard error estimations, to estimate prevalence ratios (PR) and the respective confidence intervals of 95% (CI 95%). Initially, the significance level was set at $P < 0.05$. However, the risk of false positive significant associations due to the high number of regression models tested for the same outcome was controlled using Bonferroni correction (α / number of models). The analysis was conducted using the software jamovi project, version 2.6.44, using the module GAMLj3 (https://www.jamovi.org).

Table 1. Seven-day test-retest reliability of each self-rated single-item question.

Item	(%)	Kappa index	Gwet's AC1 statistics[1]
1) How do you rate your mental health?	88.9	0.77 (0.57–0.97)*	0.78 (0.56–0.99)*
2) How do you rate your sleep?	80.6	0.65 (0.39–0.92)	0.68 (0.43–0.93)
3) How do you rate your physical activity?	88.9	0.75 (0.52–0.97)	0.80 (0.59–1.00)
4) How do you rate your diet?	88.9	0.76 (0.54–0.98)	0.79 (0.58–1.00)
5) How do you rate your sedentary behavior (sitting time)?	80.6	0.50 (0.18–0.85)	0.68 (0.43–0.93)
6) How do you rate your alcohol consumption?	88.9	0.70 (0.43–0.99)	0.82 (0.63–1.00)
7) How do you rate your consumption of tobacco and other cigarettes?	88.9	0.68 (0.37–0.98)	0.83 (0.65–1.00)
8) How do you rate your musculoskeletal health in the neck?	83.3	0.64 (0.36–0.92)	0.69 (0.44–0.93)
9) How do you rate your musculoskeletal health in the upper limbs?	83.3	0.65 (0.39–0.92)	0.68 (0.43–0.93)
10) How do you rate your musculoskeletal health in the lower limbs?	80.6	0.60 (0.33–0.89)	0.61 (0.34–0.88)
11) How do you rate your musculoskeletal health in the upper back?	88.9	0.78 (0.57–0.99)	0.77 (0.56–0.99)
12) How do you rate your musculoskeletal health in the lower back?	86.1	0.71 (0.47–0.96)	0.73 (0.49–0.96)

Note: In all cases, $P < 0.001$; [1]Gwet's AC1 Statistics was adopted to deal with the Kappa Paradox.

3. Results

Data collection was conducted in 675 participants, and the final sample was composed of 650 students, with complete data varying from 597 to 650 according to the outcome analyzed. Missing data rates for each outcome, compared by school, were as follows: food consumption (9.2% vs. 6.7%, $P = 0.275$); alcohol consumption (9.0% vs. 16.3%, $P = 0.006$); mental health (11.2% vs. 12.4%, $P = 0.630$); physical activity (4.5% vs. 2.9%, $P = 0.316$); tobacco use (12.2% vs. 8.6%, $P = 0.167$), sleep-related variables (6.7% vs. 9.1%, $P = 0.263$); and musculoskeletal symptoms (11.8% vs. 10.0%, $P = 0.505$).

Regarding missing data by sex, a higher proportion was found in girls for alcohol consumption (13.6% vs. 8.6%, P = 0.039) and sleep-related variables (9.4% vs. 5.1%, P = 0.031), with no statistically significant differences found for the remaining outcomes.

The characteristics of the sample are described in Table 2. The sample was composed of 346 (53.4%) males and 302 (46.6%) females, studying on a part-time high school course (69.0%), with the following age distribution: 14 years (16.2%), 15 years (26.3%), 16 years (31.5%), 17 years (22.6%), and 18 years (3.4%). With regard to poor self-rated health according to the health variables analyzed, the prevalence varied from 26.8% for tobacco use to 68.9% for sedentary behavior. The frequency of the sample self-rated single-item responses, according to the measured health variables, is described in Tables 3, 4, and 5.

Table 1 presents the results of the seven-day test-retest reliability of each single item analyzed. All items presented acceptable reliability, with Kappa values varying from 0.50 (moderate agreement) for sedentary behavior to 0.78 (substantial agreement) for musculoskeletal health in the upper back (all P < 0.001). Due to suspicions of Kappa paradox effects in some variables, we calculated Gwet's AC1 statistic. This adjustment increased the coefficients of agreement from 0.61 for self-rated musculoskeletal health in lower limbs (substantial) to 0.83 for self-rated tobacco use (almost perfect).

Table 2. Sociodemographic and self-rated health characteristics of the study participants (n = 650).

Variables	n (%)
Sex	
Male	346 (53.4)
Female	302 (46.6)
Age	
14	105 (16.2)
15	171 (26.3)
16	205 (31.5)
17	147 (22.6)
18	20 (3.4)
Socioeconomic level	
Low	231 (35.6)
Medium	226 (34.9)
High	191 (29.5)
High school course	
High school (part-time)	448 (69.0)
High school vocational course (full-time)	202 (31.0)
Poor self-rating of:	
Diet	268 (41.2)
Physical activity	345 (53.1)
Sedentary behavior	448 (68.9)
Musculoskeletal (neck)	340 (52.3)
Musculoskeletal (upper limbs)	309 (47.5)
Musculoskeletal (lower limbs)	295 (45.4)
Musculoskeletal (upper back)	343 (52.8)
Musculoskeletal (lower back)	368 (56.7)
Alcohol consumption	204 (31.4)
Tobacco and other cigarette use	174 (26.8)
Sleep	315 (48.4)
Mental health	245 (37.7)

Table 3. Associations between self-rated health-related behavior (diet, physical activity, sedentary behavior, alcohol consumption, tobacco use, and sleep) with the respective measured health variable.

Variables	%[1]	PR (CI 95%)	
		Crude	Adjusted[2]
Food consumption ≥5 days a week (n = 618)		Good self-rated diet [a]	
Raw salad	29.4	**1.33 (1.05–1.67)**	**1.53 (1.19–1.98)**
Milk or yogurt	46.6	1.08 (0.89–1.30)	1.09 (0.89–1.33)
Cooked vegetables and greens	13.5	1.39 (0.99–1.93)	**1.77 (1.20–2.60)**
Dried or fruit salad	16.8	1.31 (0.98–1.76)	1.39 (1.02–1.90)
Beans	68.4	1.18 (0.98–1.43)	1.25 (1.02–1.52)
Fried potatoes and snacks	14.3	1.15 (0.90–1.48)	1.20 (0.93–1.55)
Burgers and sausages	19.3	0.89 (0.69–1.15)	0.94 (0.71–1.25)
Salted cookies and crackers	28.0	0.99 90.80–1.22)	0.98 (0.78–1.23)
Sweet cookies and crackers	35.0	1.12 (0.92–1.36)	1.11 (0.91–1.35)
Soft drinks	27.2	0.99 (0.80–1.22)	0.95 (0.75–1.20)
Any vegetable intake	40.6	1.23 (1.01–1.50)	**1.30 (1.07–1.59)**
Any junk food intake	54.0	1.00 (0.83–1.21)	1.01 (0.83–1.23)
Low vegetable and high junk food intake	32.3	**0.82 (0.67–0.99)**	0.79 (0.65–0.96)
Physical activity volume (n = 648)		Poor self-rated physical activity [b]	
LPA < 100 min/week	55.9	**1.50 (1.27–1.76)**	**1.44 (1.23–1.67)**
LPA < 200 min/week	67.5	**1.70 (1.40–2.06)**	**1.58 (1.32–1.91)**
LPA < 300 min/week	78.9	**2.01 (1.54–2.61)**	**1.78 (1.38–2.30)**
LPA ≤ 420 min/week	84.5	**1.92 (1.42–2.60)**	**1.64 (1.22–2.20)**
MVPA < 100 min/week	57.6	**2.53 (2.08–3.09)**	**2.22 (1.79–2.75)**
MVPA < 200 min/week	68.0	**3.24 (2.47–4.25)**	**2.90 (2.16–3.89)**
MVPA < 300 min/week	73.4	**3.83 (2.75–5.34)**	**3.76 (2.61–5.42)**
MVPA ≤ 420 min/week	78.0	**4.17 (2.82–6.16)**	**4.16 (2.73–6.34)**
Sedentary behavior variables (n = 599)		Poor self-rated sedentary behavior [c]	
Sedentary behavior during the week			
TV use (≥2 h/day)	16.4	**1.77 (1.49–2.12)**	**1.73 (1.42–2.11)**
Internet use (≥2 h/day)	62.6	**1.18 (1.05–1.32)**	**1.17 (1.05–1.31)**
TV use (≥3 h/day)	6.0	1.32 (0.97–1.80)	1.30 (0.93–1.83)
Internet use (≥3 h/day)	50.1	**1.13 (1.02–1.26)**	1.14 (1.03–1.26)
Sedentary behavior on the weekend			
TV use (≥2 h/day)	28.9	**1.38 (1.15–1.66)**	**1.36 (1.10–1.68)**
Internet use (≥2 h/day)	80.0	1.07 (0.93–1.23)	1.03 (0.90–1.19)
TV use (≥3 h/day)	11.0	**1.54 (1.24–1.90)**	**1.59 (1.25–2.03)**
Internet use (≥3 h/day)	68.4	**1.13 (1.01–1.28)**	1.14 (1.01–1.29)
Alcohol consumption (n = 599)		Poor self-rated alcohol consumption [d]	
Binge drinking [e]	31.8	**2.01 (1.60–2.53)**	**2.45 (1.89–3.16)**
Alcohol consumption [f]	25.3	**1.78 (1.41–2.25)**	**2.04 (1.57–2.65)**
Tobacco use (n = 599)		Poor self-rated tobacco use [d]	
Experimentation	34.0	**1.58 (1.21–2.07)**	**1.54 (1.14–2.09)**
Current tobacco use [g]	28.3	**1.63 (1.25–2.13)**	**1.56 (1.14–2.12)**
Sleep-related variables (n = 625)		Poor self-rated sleep [d]	
Daytime sleepiness	32.6	**1.89 (1.49–2.29)**	**1.81 (1.44–2.28)**
<8 h of sleep/day	53.9	**1.25 (1.07–1.47)**	**1.28 (1.10–1.51)**

Note: Bold values denote statistical significance after Bonferroni correction ([a] 0.05/13 = 0.004; [b] 0.05/8 = 0.006; [c] 0.05/4 = 0.012; [d] 0.05/2 = 0.025). PR: prevalence ratio. CI 95%: confidence interval of 95%. LPA: low-intensity physical activity. MVPA: moderate to vigorous physical activity. [e] More than 6 doses at once in the previous month. [f] (≥2 times in a month). [g] Any amount of tobacco in the previous month. [1] Relative frequency of sample according to each variable. [2] Multiple models adjusted for age, sex, socioeconomic level, and school type.

The associations between single-item self-rated health-related behavior and the respective measured health variable are described in Table 3. In the adjusted analysis and after Bonferroni correction, a good self-rated diet was associated with higher consumption of raw salad (PR = 1.53), cooked vegetables and greens (PR = 1.77), and any vegetable intake (PR = 1.30). No statistical association was found for the other seven diet variables analyzed.

With regard to physical activity, consistent significant associations were observed between poor self-rated physical activity and lower physical activity practice of both low (PR = 1.44–1.78) and moderate to vigorous intensities (PR = 2.22–4.16), independently of the volume analyzed. For sedentary behavior variables, adolescents who reported poor self-rated sedentary behavior presented higher prevalence ratios for TV use ≥2 h/day (PR = 1.73) and internet use ≥2 h/day during the week (PR = 1.17), and higher TV use ≥2 h/day or ≥3 h/day (PR = 1.36 and 1.59) on the weekend (all $P < 0.01$).

Adolescents who reported poor self-rated alcohol consumption presented a higher prevalence of binge drinking and alcohol consumption (PR = 2.45 and 2.04), and those who reported poor self-rated tobacco use presented higher tobacco experimentation and current tobacco use (PR = 1.54 and 1.56). Poor self-rated sleep was positively associated with both daytime sleepiness and <8 h of sleep/day (PR = 1.81 and 1.28) (all $P < 0.02$) (Table 3).

The results for musculoskeletal health are described in Table 4. Poor self-rated musculoskeletal health in the neck, upper limbs, lower limbs, upper back, and lower back was associated with higher musculoskeletal symptoms in the corresponding regions (PR = 1.48, 1.33, 1.28, 1.79, and 1.73, respectively).

Table 4. Associations between self-rated health indicators (musculoskeletal health on neck, upper limbs, lower limbs, upper back, and lower back) and the respective musculoskeletal symptoms.

Variables	%[1]	PR (CI 95%)	
		Crude	Adjusted[2]
Musculoskeletal symptoms (n = 599)		Poor self-rated musculoskeletal health in each body region	
Symptoms in the neck	44.9	**1.34 (1.09–1.64)**	**1.48 (1.17–1.88)**
Symptoms in the upper limbs	60.4	**1.24 (1.03–1.49)**	**1.33 (1.07–1.64)**
Symptoms in the lower limbs	65.4	**1.27 (1.09–1.47)**	**1.28 (1.08–1.52)**
Symptoms in the upper back	43.1	**1.58 (1.36–1.83)**	**1.79 (1.50–2.14)**
Symptoms in the lower back	48.9	**1.59 (1.37–1.84)**	**1.73 (1.44–2.06)**

Note: Bold values denote statistical significance at $P < 0.01$ (Bonferroni-corrected significance level: 0.05/5 = 0.01). PR: prevalence ratio. CI 95%: confidence interval of 95%. [1] Relative frequency of the sample according to each variable. [2] Multiple models adjusted for age, sex, socioeconomic level, and school type.

Table 5 presents the associations between self-rated mental health and psychological variables (20 items of the self-report questionnaire and suspicions of common mental disorders). Poor self-rated mental health was associated with 17 of the 20 symptoms analyzed, with prevalence ratios varying from 1.51 (hands shaking) to 2.96 (feeling unhappy) (all $P < 0.05$). The prevalence ratio increased 3.43 times when the outcome analyzed was the suspicion of common mental disorders (≥8 positive items on the Self-Report Questionnaire). Three psychosomatic symptoms were not related to poor self-rated

mental health: one in the first stage of analysis (poor digestion, PR = 1.25, P > 0.05) and two after Bonferroni's correction (easily tired, PR = 1.37; poor appetite, PR = 1.34).

Table 5. Associations between self-rated single-item mental health and psychological variables (20 items of the Self-Report Questionnaire and suspicions of common mental disorders).

Variables	%[1]	PR (CI 95%)	
		Crude	Adjusted[2]
Self-Report Questionnaire items (n = 597)		Poor self-rated mental health	
1. Headaches	37.9	**1.79 (1.46–2.19)**	**1.53 (1.21–1.94)**
2. Poor appetite	28.1	**1.43 (1.17–1.76)**	1.34 (1.08–1.67)
3. Sleep badly	42.7	**2.05 (1.66–2.53)**	**1.97 (1.56–2.49)**
4. Being frightened easily	41.4	**1.84 (1.50–2.26)**	**1.52 (1.19–1.95)**
5. Hands shaking	29.8	**1.59 (1.30–1.94)**	**1.51 (1.22–1.88)**
6. Feeling nervous, tense, or worried	70.2	**2.42 (1.76–3.33)**	**2.03 (1.41–2.93)**
7. Poor digestion	18.1	**1.44 (1.15–1.79)**	1.25 (0.98–1.60)
8. Can't think clearly	46.6	**1.69 (1.37–2.09)**	**1.62 (1.28–2.04)**
9. Feeling unhappy	54.1	**3.18 (2.41–4.18)**	**2.96 (2.18–4.02)**
10. Cry more than usual	37.2	**2.20 (1.79–2.69)**	**1.94 (1.52–2.49)**
11. Difficulty performing daily activities with satisfaction	48.9	**2.40 (1.90–3.03)**	**2.34 (1.79–3.05)**
12. Difficulty making decisions	65.3	**1.99 (1.51–2.61)**	**1.81 (1.34–2.45)**
13. Difficulty working or performing school activities	28.0	**1.90 (1.57–2.31)**	**1.83 (1.48–2.26)**
14. Unable to play a useful part in life	32.0	**1.94 (1.60–2.36)**	**1.84 (1.49–2.27)**
15. Lost interest in things	55.1	**2.89 (2.21–3.79)**	**2.78 (2.05–3.75)**
16. Feeling of being a worthless person	37.2	**2.59 (2.10–3.18)**	**2.43 (1.94–3.05)**
17. Has been thinking of ending life	25.1	**2.49 (2.08–3.00)**	**2.26 (1.86–2.75)**
18. Feeling tired all the time	54.8	**2.31 (1.80–2.95)**	**1.95 (1.48–2.58)**
19. Easily tired	52.9	**1.64 (1.32–2.04)**	1.37 (1.06–1.76)
20. Uncomfortable feelings in the stomach	32.7	**1.75 (1.44–2.14)**	**1.56 (1.25–1.95)**
Suspicions of common mental disorders (≥8 positive items on SRQ)	32.7	**3.53 (2.63–4.74)**	**3.43 (2.46–4.77)**

Note: Bold values denote statistical significance at P < 0.002 (Bonferroni-corrected significance level: 0.05/21 = 0.002). PR: prevalence ratio. CI 95%: confidence interval of 95%. SRQ: Self-Report Questionnaire. [1] Relative frequency of sample according to each variable. [2] Multiple models adjusted for age, sex, socioeconomic level, and school type.

4. Discussion

The main findings of the present study are that all single items analyzed presented acceptable reliability and were associated with the respective measured health indicator, health-related behavior, or psychological variables, providing evidence of convergent validity. However, some concerns emerged about the reliability of sedentary behavior and the convergent validity of diet and sedentary behavior self-rated single items.

The seven-day test-retest reliability results indicated a kappa coefficient between 0.50 and 0.78 and an absolute agreement from 80.6 to 88.9. There is no fixed cutoff to determine if a measure is reliable or not, because statistical coefficients are graded according to the intensity of agreement, although it is expected that a measure will present at least a moderate agreement. Originally, the Kappa cutoff for moderate agreement was 0.41–0.60 [30]; however, later recommendations were more

conservative and suggested a minimum of 0.60 to be considered moderate [32]. Considering the conservative cutoff, all single items analyzed can be classified as presenting acceptable reliability, except self-rated sedentary behavior (k = 0.50), despite a high absolute agreement of 80.6%. After further investigation of this variable, we detected the kappa paradox, a situation when kappa values are low even with high absolute agreement [31]. For this variable, the kappa paradox can be justified by the high prevalence of adolescents who reported a bad sedentary behavior profile on the two occasions of test-retest (65%), exceeding an expected value, and not by a poor agreement. An alternative to the Kappa index to deal with this situation is the AC1 Statistic [31]. By performing this approach, agreement of sedentary behavior increased from 0.50 to 0.68, which makes self-rated sedentary behavior a reliable single-item variable among adolescents. Although the improvement was high for sedentary behavior, agreement indices increased for most variables when the AC1 statistic was applied.

The results regarding the association between self-rated diet and food consumption in a week were heterogeneous. While positive associations were observed between a good self-rated diet with raw salad, vegetables, and greens and any vegetable intake, no association was found for the other seven variables. Two hypotheses can explain these results. First, it is probable that students perceived a healthy diet mainly due to the presence of natural foods, and disregarded, were unaware of, or minimized the risks of ultra-processed foods. Second, the single items may be capturing perceived food healthiness rather than a general frequency of specific food consumption. The criterion measure contributed to these findings, as diet quality includes aspects beyond just the frequency of food consumption. The available literature also presents heterogeneous results; while there is evidence of incoherence between self-rated diet quality and the observed unsatisfactory diet scores [12], other authors found that adolescents adequately evaluate their food intake quality [10]. The present results demonstrate that the single-item self-rated diet should be used with caution: although this item provides a good estimation of natural vegetable food consumption, it fails to estimate the presence of overall diet quality.

Self-rated physical activity demonstrated consistent associations with physical activity, independently of volume and intensity (PR = 1.50–4.16). Higher magnitudes of associations were evidenced for moderate to vigorous physical activity (PR = 2.53–3.83), and the highest prevalence ratio was found for achieving the World Health Organization recommendation guidelines of 60 minutes of moderate to vigorous intensity per day (PR = 4.16) [33], representing relevant evidence of convergent validity. Adolescents' perceptions are in line with current physical activity guidelines, which state that although all physical activities are beneficial for health, those performed at moderate to vigorous intensities are recommended [33]. It is important to note that information on the cutoff points for the recommendation of moderate to vigorous physical activity was not given to the participants; despite this, adolescents with poor self-rated physical activity were more likely to be inactive. An aspect that can explain the associations found is the role of physical education classes in promoting physical activity and health knowledge [34]. A previous study also demonstrated that single items can be used to estimate physical activity; however, the included questions were designed to estimate the volume of physical activity, with moderate validity for self-report and objective criterion measures (r = 0.44, 95% CI = 0.24–0.63 and r = 0.50, 95% CI = 0.30–0.65) [13]. The present study expanded the physical activity assessment using single items since, in addition to previous studies that investigated self-report single items, the current results provide evidence for the use of self-rated physical activity.

To our knowledge, no previous studies have investigated the convergent validity of self-rated musculoskeletal health for assessing musculoskeletal symptoms in different body regions. As commonly used in the literature [35], the criterion measure for musculoskeletal health was self-reported musculoskeletal symptoms in five body regions. Results indicated positive associations between the five poor self-rated musculoskeletal health variables with the respective region symptoms, indicating that adolescents have a significantly higher probability of self-rating their musculoskeletal health correctly. The magnitude of the associations varied according to body regions (PR = 1.28–1.79), with higher values found for back regions (PR = 1.48–1.79). A possible reason for this finding is that musculoskeletal symptoms in the back regions are the most disabling [36] and probably easier to identify and remember in self-reported measures. Furthermore, the instrument adopted in the present study assesses any musculoskeletal symptoms in the previous 12 months, and it is probable that if the analysis considered only more severe symptoms (e.g., pain), a lower retrospective period, or symptoms that were disabling, the magnitude of associations would be higher compared to the values observed.

Self-rated mental health presented associations with 17 of the 20 questions related to a depressive-anxious mood, decrease in vital energy, somatic symptoms, and depressive thoughts. Furthermore, the magnitude of the association increased drastically when the outcome was the suspicion of common mental disorders, evidencing the convergent validity of the single item used. These results corroborate previous literature describing associations between single-item measures of self-rated mental health with measures of mental health and other health outcomes among the general adult population [11,37]. In line with mental health, self-rated sleep also presented acceptable convergent validity due to the associations with daytime sleepiness and sleep duration, corroborating the available evidence from the adult population [9]. Considering that research involving young people commonly uses both single-item self-rated mental health [38] and sleep [39] variables without reporting the quality of the measures, the present study improves the knowledge regarding the usefulness of single-item self-rated mental health and sleep among adolescents.

Sedentary behavior, alcohol consumption, and tobacco use were the other three self-rated single items analyzed in this study. Results were heterogeneous for sedentary behavior, since the associations were not significant in all activities and volume on weekdays and the weekend. An aspect that could explain this fact is that there is no cutoff point for sedentary behavior [33], making this behavior difficult to self-rate and understand by adolescents. Furthermore, we adopted television and internet use as the criterion, whereas the single item described general sitting time. This difference may represent a partial mismatch between the variables. The literature demonstrates that despite single items being reliable and presenting acceptable concurrent validity, the criterion validity of single items to estimate sedentary behavior is low [40]. Another important point to note is that all self-rated items analyzed are subjective measures, and although some associations can be found, they cannot be used interchangeably. The same did not occur for alcohol consumption and tobacco use, since each item self-rated as poor was associated with the respective outcomes, regardless of the degree of consumption. The consistent associations found can be attributed to possible direct knowledge regarding the risk of these substances and health [41], as well as to the information provided before application of the self-rated items. Although specific knowledge is low among adolescents [41], the risks are commonly mentioned by them and managed by controlling consumption through an individual threshold, since perceived higher risks are often related to binge drinking [42]. In addition, different from sedentary behaviors that are beneficial for humans (e.g., sleep), there is no safe consumption of alcohol and tobacco for adolescents, which can also improve the performance of self-rated items, despite not changing these risk behaviors [41].

The comprehension of participants is an essential methodological aspect when applying single items specific to self-rated health, since it is directly related to performance regarding validity and reliability. In the general population, it is described that to self-rate general health correctly, an individual should recognize what constitutes health, which includes the relevant components of health and how to summarize these characteristics into a health concept assessment [4]. In addition, a recent study demonstrated that health literacy is the best predictor of self-rated general health among adolescents [15]. In the present study, we focused on self-rated single items for different health indicators, which may require even more knowledge about health, because the assessment is specific and not a single general assessment of health. For this reason, we standardized the instructions prior to the application to ensure the achievement of acceptable reliability values and consistent associations with the measured health variables for most of the self-rated single items analyzed. It is recommended that this procedure be adopted and also that more specific instructions (e.g., mentioning cutoff points) be investigated, which could improve item performance.

Practical implications and directions for future research also emerged from this study. The self-rated single items can be considered an additional tool for adolescent health risk stratification and monitoring, mainly when the application of other measures is unfeasible or when the objective is to assess how adolescents perceive their own health. However, despite the evidence of validity being demonstrated for most items, it was based on relationships between each self-rated item and the respective health criterion [18]. The convergent validity demonstrated that adolescents with poor self-rated health were more likely to exhibit an unfavorable health profile (health-related behaviors, indicators, or psychological variables) assessed by previous validated questionnaires. However, the present data do not provide evidence of diagnostic accuracy or agreement between self-rated health items and health and cannot be used to classify individuals.

Furthermore, certain methodological aspects can be improved in future studies. The results demonstrated stronger convergent validity for variables closely aligned with conceptual content. Conversely, a non-equivalence between the self-rated single item and the chosen outcome may explain the lower convergent validity observed for diet and sedentary behavior. For diet assessment, a more suitable criterion would be an instrument that assesses overall diet quality rather than food frequency [12]; for sedentary behavior, total sitting time may be a more appropriate measure, as it aligns more closely with the item's original statement. Other aspects to be considered to strengthen the evidence of these single items include using objective criterion measures, testing diagnostic accuracy and predictive validity, expanding investigation to test the validity in children, and assessing the performance of items in discriminating health status considering control and clinical populations.

The present results should be interpreted considering some limitations. The cross-sectional design prevents a confirmation of causality of the associations found between self-rating and measures of health. The reliability of the items was tested using a seven-day test-retest in a subsample of 40 participants, and the result may not be the same when analyzed over a different period or when stratified by age, sex, and other characteristics [3]. The sample of this study was composed of adolescents from a small Brazilian city; despite providing initial evidence of validity, external validity needs to be confirmed in representative samples. In addition, all measured health variables were self-reported, and the recall bias present in these types of instruments is widely known. To reduce measurement error, all measures were based on valid and reliable questionnaires, previously translated into Brazilian Portuguese, and suitable for use in adolescents. Another limitation when analyzing the association between self-report measures is the common method variance [43], which may have inflated the

associations, particularly for mental health variables, since they were derived from the same instrument. Finally, the potential influence of social desirability bias was not assessed, which may have impacted self-reported alcohol consumption, tobacco use, and mental health outcomes. Despite these limitations, the strengths of the present study include the original information regarding the usefulness of single items for specific self-rated health assessments, having certain characteristics that are a public health priority among adolescents as criterion measures.

5. Conclusions

The analyzed self-rated single items for specific health assessments presented acceptable reliability in the seven-day test-retest. Those related to physical activity, musculoskeletal symptoms, alcohol consumption, tobacco use, sleep, and mental health presented evidence of convergent validity through significant and consistent associations with the respective health criteria. Caution is suggested for self-rated diet and sedentary behavior single items, because associations were dependent on food category and volume of sedentary behavior. The single items described do not substitute the application of complete questionnaires, multi-item scales, or objective measures of health, but could represent an additional tool for adolescent health assessments in clinical practice, risk stratification and monitoring, epidemiological studies, school settings, or in situations that require the assessment of specific self-rated health.

Author' contributions

Author 1 contributed to the study conception and design, acquisition, analysis and interpretation of data, drafting, critical review, and final approval of the manuscript. Authors 2 and 3 contributed to acquisition of data, critical review, and final approval of the manuscript.

Use of AI tools declaration

The authors declare they have not used Artificial Intelligence (AI) tools in the creation of this article.

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Conflict of interest

The authors declare no conflict of interest.

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