

Sedentary behavior among university students: a systematic review

Comportamento sedentário em universitários: uma revisão sistemática

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Abstract – Studies on sedentary behavior (SB) among university students have been published, and the knowledge about the methods adopted in surveys is important for science, and the characterization of prevalence and associated factors are essential in the context of health policies for this population group. Thus, the aim of the present study was to describe prevalence, associated factors, and the methodological characteristics used in SB research among university students. A search in the National Library of Medicine (PUBMED), Scientific Electronic Library Online (SciELO), Virtual Health Library (VHL) and SCOPUS databases was performed. This study adopted the items and recommendations of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), and the articles selected were analyzed according to their methodological characteristics, as well as prevalence and factors associated with SB. Of the 1,740 articles found in databases, 23 were included in this review. The prevalence for sitting time was from 34.0% to 90.2%. The use of operational definitions and cutoff points diversified, as well as the use of various instruments to estimate SB. The lack of standardization between cutoff points for SB determination and operational definitions, such as the use of non-validated instruments, was observed. Among factors associated with higher prevalence, the most prominent were overweight and depressive symptoms. It was concluded that the prevalence of SB was high in domains not related with the time devoted to studies and biological and psychological characteristics represented attributes more associated with SB.

Key words: Health behavior; Sedentary lifestyle; Students.

Resumo – Estudos sobre o tema do comportamento sedentário (SB) em universitários têm sido publicados, diante disso o conhecimento sobre os métodos adotados torna-se importante para a ciência, e a caracterização das prevalências e fatores associados a esse atributo são essenciais no âmbito das políticas de saúde para esse grupo. Assim, o objetivo do presente estudo foi descrever as prevalências e os fatores associados, e as características metodológicas empregadas nas pesquisas sobre o SB em universitários. Uma busca nas bases de dados National Library of Medicine (PUBMED), Scientific Electronic Library Online (SciELO), Biblioteca Virtual em Saúde (BVS) e SCOPUS foi realizada. Este estudo adotou os itens e recomendações do Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA), e os artigos selecionados foram analisados conforme as características metodológicas, além das prevalências e os fatores associados ao SB. Dos 1.740 artigos encontrados nas bases de dados, 23 fizeram parte dessa revisão. Foram observadas prevalências para o tempo sentado de 34,0% a 90,2%. O uso de definições operacionais e pontos de corte foram diversificados, além do uso de variados instrumentos para estimar o SB. Foi observada a falta de padronização entre os pontos de corte para determinação do SB e das definições operacionais, como uso de instrumentos não validados. Dentre os fatores associados com maiores prevalências, destacaram-se o excesso de peso e os sintomas depressivos. Conclui-se que as prevalências de SB foram elevadas em domínios não relacionados ao tempo dedicado aos estudos e características biológicas e psicológicas representaram atributos mais associados ao SB.

Palavras-chave: Condutas de saúde; Estilo de vida sedentário; Estudantes.

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Received: April 23, 2018

Accepted: December 11, 2018

How to cite this article

Franco DC, Ferraz NL, Sousa TF. Sedentary behavior among university students: a systematic review. Rev Bras Cineantropom Desempenho Hum 2019, 21:e56485. DOI: <http://dx.doi.org/10.5007/1980-0037.2019v21e56485>

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INTRODUCTION

High SB time is considered to be harmful to health¹, regardless of complying with recommended guidelines for moderate to vigorous physical activity². In the last decade, studies have concluded that SB is a public health problem³. Furthermore, in a meta-analysis, which systematized information from 54 countries between 2002 and 2011, it was shown that 3.8% of all-cause deaths, about 433,000 deaths, were caused by the high time spent on sedentary activities⁴. Another meta-analysis also observed association between time watching television and type 2 diabetes, cardiovascular disease, and all-cause mortality in adults⁵.

In the university population, the prevalence of this behavior is not clear, since review studies on the subject were not found in databases. On the other hand, among studies on this population, Lourenço et al.⁶ showed prevalence of 83.7% for screen time in Brazilian university students and in the study by Feng et al.⁷ in Chinese university students, prevalence of 72.7% for screen time was found. Studies on this subject in university students presented greater exposure to screen time among women⁸, and associated with sitting time⁹ and high use of Internet¹⁰ among university students with higher body mass index (BMI), as well as those who presented inadequate nutrition¹⁰.

It is important to note that SB has become a relevant topic in research in recent years, and due to this broadening of focus, measurement instruments and health risk cutoff points have become diversified¹¹. This variety of tests and criteria used to measure health risks is also observed in studies on physical activity in adolescents¹² and university students¹³. Such diversity can be observed when analyzing the study by Lourenço et al.⁶, who used cutoff point of 2 hours or more as a health risk estimator, considering as SB the total screen time on one day of the week, in contrast, Peltzer and Apidechkul¹⁴ considered cutoff point equal to or greater than 6 hours of internet use per day, both of which were cross-sectional studies and that measured information through questionnaires.

Thus, it is necessary that the evidences on SB in university students be systematized in order to better observe how this topic has been designed and implemented in researches so that the characterization of the quality of such researches regarding the sampling forms, instruments and SB classification can contribute to the implementation of other researches with the same topic, since this group can undergo changes in relation to lifestyle, such as eating habits¹⁵, reduced physical activity¹⁶ and increased time spent in sedentary activities¹⁷, and the use of appropriate techniques to collect information becomes important. Thus, this study sought to systematically review articles on SB among university students, showing prevalence and associated factors, as well as the methodological characteristics used in these studies.

METHOD

For the present systematic review, the items and recommendations

of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)¹⁶ were adopted. The work was registered in the International Prospective Register of Systematic Reviews (PROSPERO-CRD42018085891), titled “Sedentary behavior in university students: a systematic review”.

An advanced search was conducted in the English language, since the selected databases present the publication of articles or information of titles, abstracts and keywords in that language. The electronic databases chosen were: National Library of Medicine (PUBMED), Scientific Electronic Library Online (SciELO), Virtual Health Library (VHL) and Scopus. The descriptors used were: “sitting time”, “sedentary behavior”, “sedentary lifestyle” and “screen time”, along with “undergraduate”, “college students”, “academics” and “university student” (check supplement 1). The logical operators available in databases, AND and OR, were used for the combination of terms and the truncation symbols (“”, * and \$) for searches of variations of terms.

The eligibility criteria for inclusion in the review were: a) original articles; b) published in English, Portuguese and Spanish; c) presentation of SB cutoff point (total sitting time, screen time, internet time, cell phone time, videogame time, television time, and others); d) university population without age restriction; d) cross-sectional or longitudinal observational studies; e) information on methodological procedures, operational definition of SB and instruments used for SB measurement. There was no restriction of the year of publication.

The selected databases were searched on December 6, 2017. Initially, the reading of the titles of articles found in databases was performed. From those identified, abstracts were read. Subsequently, articles chosen from abstracts were read in full and selected according to the established inclusion criteria. From these, a manual search was performed by reading the references and studies that met the criteria were included. All stages of the study selection process were performed in pairs and disagreements were resolved in a consensus meeting. The Zotero software was used for storing articles and deleting duplicates, and Excel software was used for tabulating extracted data.

The following information from the articles that met the inclusion criteria of this review were considered and extracted for analysis: a) author; b) year of publication; c) study design; d) sample size; e) sex of participants; f) age group of participants; g) country where the study was conducted; h) SB cutoff point; i) SB definition; j) instruments used to measure SB; k) SB prevalence; and l) factors associated with SB.

The evaluation of the quality of each article was performed based on the methods of Loney et al.¹⁹ for cross-sectional and cohort studies, with consideration of eight items referring to methods, sample, measuring instruments, interpretation and applicability of results. For each item, score 1 was assigned if the article presented the necessary quality, and 0 otherwise.

RESULTS

A total of 1,740 articles were found from searches in the selected databases, of which 187 were excluded by duplicate, remaining 1,553 articles for more detailed analysis through titles, abstracts and reading in full. Thirty-one articles were excluded after reading in full (references listed in Supplementary material 2), and 22 articles were selected to compose the review, since they met the pre-established inclusion criteria, and one ($n = 1$) article was manually included based on references of selected articles, making a total of 23 articles that composed this systematic review (Figure 1).

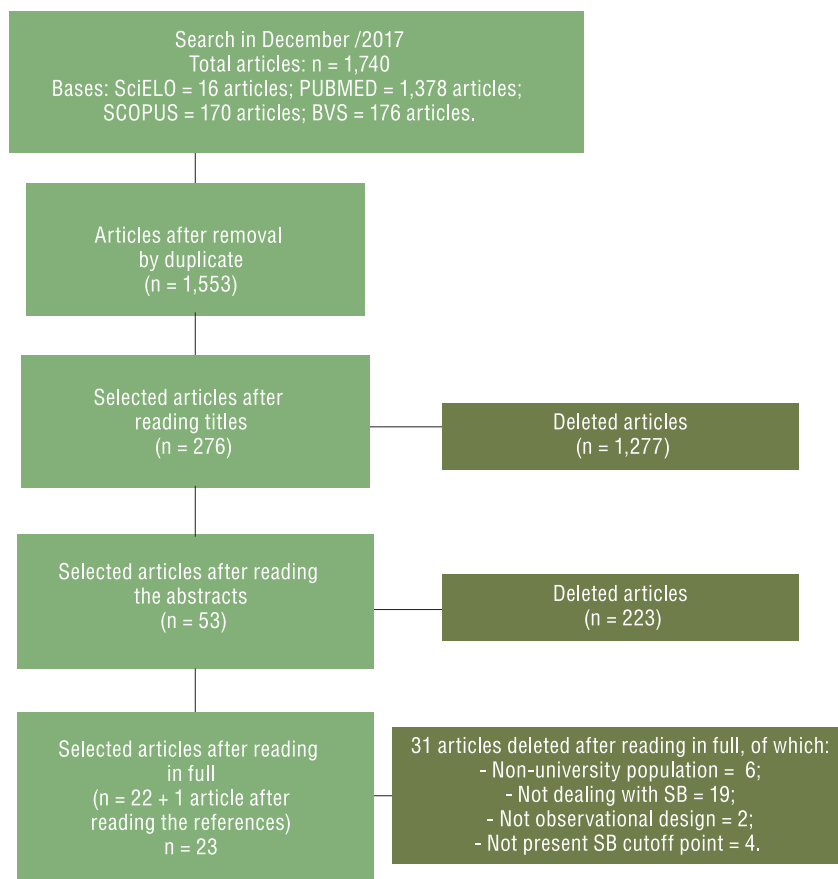


Figure 1. Organization chart of the selection process of SB articles

Table 1 shows that among the 23 articles, the smallest number of publications that met the quality criteria referred to the sampling methods and measurement instruments. Only one ($n = 1$) had maximum evaluation score³¹ and six presented score 7^{6,7,14,20,33-35}, and the lowest evaluation score (score = 3) occurred in one ($n = 1$) study²⁵.

Regarding the characteristics of selected studies, articles were published between 2009 and 2017, with 14 publications between 2014 and 2017^{6-8,14,21,22,24,28,33-35}. Regarding the study design, predominance of cross-sectional studies was observed^{6,7,9,14,20-34}, with only two longitudinal

Table 1. Guidelines used for the critical evaluation of SB studies in university students and scores obtained by selected articles. Evaluation criteria proposed by Loney et al.¹⁶.

Criterion	n/N (%)									
Are the study methods valid?										
A1. Are the stud design and sampling method appropriate for the research question?	11/23 (47.8)									
A2. Is the sampling frame appropriate?	12/23 (52.2)									
A3. Is the sample size adequate?	18/23 (78.3)									
A4. Are the objective, suitable and standard criteria used for measurement of the health outcome?	11/23 (47.8)									
A5. Is the health outcome measured in an unbiased fashion?	23/23 (100.0)									
A6. Is the response rate adequate? Are the refusers described?	14/23 (60.9)									
What is the interpretation of the results?										
B7. Are the estimates of prevalence or incidence given with confidence intervals and in detail by subgroup if appropriate?	17/23 (73.9)									
What is the applicability of the results?										
C8. Are the study subjects and the setting described in detail and similar to those of interest to you?	20/23 (86.9)									
Selected articles (1 st author)	Evaluation items									
	A1	A2	A3	A4	A5	A6	B7	C8	E*	
Ballard et al. ⁹	Na	Na	Na	Na	S	S	S	S	4	
Banks et al. ²⁰	S	S	S	S	S	Na	S	S	7	
Caballero Sánchez e Delgado ²¹	S	S	S	S	S	Na	S	Na	6	
Claumann et al. ²²	Na	S	Na	Na	S	S	S	S	5	
Farinola e Bazán ²³	Na	Na	S	S	S	S	S	Na	5	
Felez-Nobrega ²⁴	Na	Na	S	S	S	Na	Na	S	4	
Feng et al. ⁷	S	S	S	Na	S	S	S	S	7	
Kim et al. ²⁵	Na	Na	Na	S	S	Na	S	Na	3	
Kim et al. ¹⁰	Na	Na	S	Na	S	S	S	S	5	
Lourenço et al. ⁶	S	S	S	Na	S	S	S	S	7	
Mathur et al. ²⁶	S	S	S	Na	S	S	Na	S	6	
Musaiger et al. ²⁷	S	S	S	S	S	Na	Na	S	6	
Musaiger et al. ⁸	Na	Na	S	S	S	S	Na	S	5	
Pelletier et al. ²⁸	Na	Na	S	S	S	Na	S	S	5	
Peltzer e Apidechkul ¹⁴	S	S	S	Na	S	S	S	S	7	
Pires et al. ²⁹	Na	Na	Na	S	S	Na	S	S	4	
Pullman et al. ¹⁷	Na	Na	Na	S	S	Na	S	S	4	
Hidalgo-Hasmussen et al. ³⁰	Na	Na	S	Na	S	S	S	S	5	
Seo et al. ³¹	S	S	S	S	S	S	S	S	8	
Tayem et al. ³²	S	S	S	Na	S	Na	Na	S	5	
Wu et al. ³³	S	S	S	Na	S	S	S	S	7	
Wu et al. ³⁴	S	S	S	Na	S	S	S	S	7	
Xu et al. ³⁵	Na	Na	S	Na	S	S	Na	S	4	

Note. n = articles that met the criterion; N = total articles; % = percentage; * Score referring to the sum of criteria met by each article; S = Yes, met the item; Na = Did not meet the item.

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studies^{17,35}. Sample size ranged from 108¹⁷ to 74,981²⁰ participants. In two studies, there was a wide variation in age, from 15 to 87 years²⁰ and from 17 to 66 years²³, with the others focusing on age groups between 18 and 35 years, and in only two studies, samples were exclusively composed of men^{9,17}. Surveys were carried out in 13 different countries (United States^{9,26,28}, Thailand^{14,20}, Colombia²¹, Brazil^{6,22,29}, Spain²⁴, China^{7,10,33-35}, Argentina²³, South Korea²⁵, Bahrain - Persian Gulf²⁷, Sudan⁸, Canada¹⁷,

Mexico³⁰ and West Bank³²), and one study (n = 1) was conducted with samples from the United States, Costa Rica, India and South Korea³¹.

The methodological characteristics of studies are presented in Table 2. Regarding the operational definition of SB, several ways of considering risk in relation to different types of research contexts were observed, such as in relation to screen time (n = 16)^{6-9,17,20,22,25-27,30-35}, sitting time (n = 5)^{20,21,23,28,29} and internet time (n = 2)^{10,14}. The instruments used were questionnaires, some of them validated such as IPAQ^{21,29}, GPAQ²³, SIT-Q-7d²⁴, ISAQ-A⁶ and YRBS³¹, or by specific questions developed for the purpose of the study, being a characteristic associated to 14 studies^{7,10,14,17,22,26-28,30,32-35}. The cutoff points used were also diverse, with nine studies using cutoff point of ≥ 2 hours^{6,7,17,26,27,30,32,33,34} per day and one study using ≥ 10 hours²³ (≥ 600 min) per day.

In relation to SB prevalence (Table 2), values for sitting time of 34.0% (cutoff point: ≥ 10 h / day)²³, 48.4% (cutoff point: ≥ 5 h / day)²⁸ and 82.5% (cutoff point: ≥ 3 h / day)²⁹ were found. Prevalence values observed for television and computer time were 16.5% (cutoff point: ≥ 4 h / day)³⁵, 20.8% (cutoff point > 2 h / day)³³, 48.2% (cutoff point > 2 h / day)³⁴, and for screen time (computer, videogame and television) of 83.7% (cutoff point > 2 h / day).

In Table 3, attributes that were positively associated with SB such as screen time (videogame and internet) and sitting time in a great number of studies were excess body weight^{10,20,21} and depressive symptoms^{7,10,33,34}. The practice of physical activity was the characteristic most inversely associated with SB (screen time: internet and video game)^{6,9,10}.

DISCUSSION

It was possible to observe that studies on the subject are recent, with the first articles selected having been published about nine years ago^{17,9,24,31,35}. There was predominance of publications between 2014 and 2017^{6-8,14,21,22,24-26,28,33-35} and predominance of studies performed in the Asian continent^{7,10,14,20,25,31,33-35}. Among selected articles, most had cross-sectional design, with the exception of two studies, with longitudinal design^{17,35}. The methodological discrepancy among studies in relation to the definition and the cutoff point used to determine SB was highlighted. The instruments used for SB measurement were also diverse; however, all studies used questionnaires for this purpose. Excess body weight, depressive and psychopathological symptoms, and anxiety were the characteristics of studies most associated with SB.

It was observed that of the 23 articles, there was poor quality of publications with only one study (n = 1) presenting higher evaluation score³¹, followed by six publications with score 7^{6,7,14,20,33-35}. In view of these characteristics, it is necessary to present the methodological information, so that it is possible to replicate studies and also to analyze the quality of studies regarding the procedures adopted. On the other hand, the lower quality of most publications also demonstrates lack of studies that meet satisfactory levels regarding sampling aspects, with many studies not presenting

Table 2. Characteristics of studies on sedentary behavior in university students according to methodological criteria and prevalence.

Author	Definition	Instruments	Cutoff points	SB prevalence %
Ballard et al. ⁹	Play videogames, read, watch television	Questionnaire on the frequency of weekly use of videogame, television and reading	> 5 times a week	Videogame: 22.4 TV/DVS: 49.1 Reading: 19.0
Banks et al. ²⁰	Screen and sitting time	Thai Questionnaire Cohort Study	>8 h/day	Total: 41.9
Caballero Sánchez e Delgado ²¹	Sitting time	IPAQ Questionnaire – short version	>8 h/ day	Women: 83.1 Men: 90.2
Claumann et al. ²²	Screen time in the context of leisure, study and work	Questionnaire developed for the study	≥4 h/ day	Leisure: 40.6 Study/work: 29.2
Farinola e Bazán ²³	Time spent sitting or reclining	GPAQ Questionnaire	≥10 h/ day	Total: 34.0
Felez-Nobrega ²⁴	Sedentary behavior in different domains	SIT-Q-7d Questionnaire	>3 h/ day	Week day: 22.7 Weekend day: 52.1
Feng et al. ⁷	Screen time on weekdays and weekends	Questionnaire developed for the study	>2 h/ day	Total: 72.7
Kim et al. ²⁵	High use of Smart phone	SAPS Addiction Prone-ness Scale	High risk: ques-tionnaire score ≥44	Total: 19.1
Kim et al. ¹⁰	High use of internet	Questionnaire developed for the study	>4 h/ day	Total: 14.8
Lourenço et al. ⁶	Screen time for computer, televi-sion and videogame	ISAQ-A Questionnaire	≥2 h/ day	Computer: 56.1 Television: 30.3 Videogame: 3.8 Total screen: 83.7
Mathur et al. ²⁶	Screen time not related to work / studies	Questionnaire developed for the study	>2 h/ day	Television time: 45.6 Videogame: 48.9
Musaiger et al. ²⁷	Screen time for television, cell phone and internet	Questionnaire developed for the study	Television and cel-lular: >2 h/ day Internet: >3 h/ day	Television: 54.7 Cell phone: 87.5 Internet: 79.8
Musaiger et al. ⁸	Screen time for television and internet	Questionnaire developed for the study	>3 h/ day	Television: 37.2 Internet: 58.7
Pelletier et al. ²⁸	Sitting and lying time	Questionnaire developed for the study	≥5 h/ day	Total: 48.4
Peltzer e Apidechkul ¹⁴	Screen time for Internet	Questionnaire developed for the study	≥6 h/ day	Total: 35.3
Pires et al. ²⁹	Sitting time	IPAQ Questionnaire	≥3 h/ day	Total: 82.5
Pullman et al. ¹⁷	Screen time for computer, study and television	Questionnaire developed for the study	≥2 h/ day	Computer: 45.0*; 82.0**; Study: 32.0*; 60.0** Television: 28.0*; 22.0**
Hidalgo-Hasmussen et al. ³⁰	Screen time (television, com-puter) in leisure	Questionnaire developed for the study	>2 h/ day	Total: 53.2
Seo et al. ³¹	Television time	Youth Risk Behavior Survey (YRBS)	≥3h/ day	Total: 23.7
Tayem et al. ³²	Screen time (television, internet and videogame)	Questionnaire developed for the study	>2h/ day	Total: 57.7
Wu et al. ³³	Screen time (television and computer)	Questionnaire developed for the study	>2h/ day	Total: 20.8
Wu et al. ³⁴	Screen time (television and computer)	Questionnaire developed for the study	>2 h/ day	Total: 48.2
Xu et al. ³⁵	Screen time (television and computer)	Questionnaire developed for the study	≥4 h/ day	Total: 16.5

Note. % = Percentage; QDE = Questionnaire developed for the study; h / day = hours per day; min / day = minutes per day. IPAQ = International Questionnaire of Physical Activity; GPAQ = Global Physical Activity Questionnaire; SIT-Q-7d = Sedentary behavior questionnaire; ISAQ-A = Health Indicators and Quality of Life of university students; * Summer before entering university (approximate value); ** End of the first year after entering uni versity (approximate value).

Table 3. Factors associated with sedentary behavior of university students among selected studies.

Variables and categories	Associated as risk factor*	Associated as protection factor**
Overweight	Videogame ⁹	-
Obesity	Sitting and screen time ²⁰	-
Excess weight (overweight and obesity)	Sitting time ²¹ , internet ¹⁰	-
Higher levels of physical activity	-	Videogame ⁹ ,Internet ¹⁰
Lower levels of physical activity	Screen time ²² , smart phone time ²⁵	-
Non practitioners of physical activity	-	Screen time ⁶
No work	Leisure screen time ²²	-
With work	Screen time at work / study ²²	-
Female	Internet ²⁷ , Screen time ⁸	Screen time ⁶
Age range from 24 to 54 years	-	Screen time ⁶
Marital status with partner	-	Screen time ⁶
Night study shift	-	Screen time ⁶
Longer university time	Screen time ⁶	-
Better academic performance	-	Total sedentary time ²⁴
Lower memory capacity	Total sedentary time ²⁴	-
Poor sleep quality	Screen time ^{7,33}	-
Use of illicit drugs	Internet ¹⁴	-
Depression	Screen time ^{7,33,34} , internet ¹⁰	-
Anxiety	Screen time ^{33,34}	-
Psychopathological symptoms	Screen time ^{33,34}	-
Inadequate nutrition	Internet ¹⁰	-
Seeking medical care when diseased	-	Internet ¹⁰
Trying to improve hygiene	-	Internet ¹⁰
Try to rest more	-	Internet ¹⁰
Try to reduce stress	-	Internet ¹⁰

Note. * Associated with higher prevalence or effect than the reference category; ** Associated with lower prevalence or effect than reference category.

random selection process^{8-10,17,22,23,28- 30,35}.

Variation of SB prevalence from 34.0%²³ to 90.2%²¹ for sitting time was observed in this review. Screen time (television, computer, internet, cell phone, videogame time), was the definition most used by studies, which corroborates the review of Guerra, Farias Junior and Florindo³⁶, with a focus on children and adolescents, a population with study regime and permanence in educational institutions that approach university students. Of studies included in this review, the one showing 90.2% for the total sitting time in Colombian men²¹ was highlighted in relation to the other studies, because although researchers used an expressive cutoff point, 8 hours or more of SB per day, the prevalence value was high, being one of the studies that presented quality assessment score 6, lacking in questions related to the adequate response rate (item A6) and the presentation of information that better allows replicating the study (item C8).

Among Brazilian studies included in this review, close prevalence values were found between studies of Lourenço et al.⁶, with 83.7% screen time and those of Pires et al.²⁹, with 82.5% for the sitting time, while in the other study with Brazilian university students, lower prevalence values

were found; however, screen time was divided between leisure (40.6%) and study / work (29.2%)²². The diversity of prevalence values, both in Brazilian and international studies, derives from the differentiation of methods used and represent a recurrent characteristic in studies on SB, as also observed in other systematic descriptive reviews with children and adolescents³⁶ and in the elderly³⁷. In the present review, as in reviews with populations other than university students^{36,37}, lack of standardization of the SB definition was observed, such as the use of total time spent sitting and lying down, screen time (watching television, playing videogames, internet, cell phone time), study and reading time, which in fact represents the variety of contexts to which SB can be investigated. However, establishing a set of information about the same events becomes difficult.

Regarding the cutoff point used to estimate SB as a promoter of potential health risks, lack of consensus among studies was observed. Cutoff points varying from ≥ 2 hours^{6,7,17,26,27,30,32-34} per day to ≥ 10 hours²³ (≥ 600 min) per day were observed, which was also observed in previous reviews with children and adolescents, and in the elderly, regarding the distinction of the adopted risk criteria^{36,37}. These findings highlight the need for future studies to estimate the SB time that best predicts the deleterious health effects in university students.

Regarding SB measurement instruments, all studies analyzed used the self-report to measure these characteristics, which is an alternative used in health surveys³⁸, and questionnaires are the most used instruments in epidemiological studies³⁹. However, there was lack of standardization of these instruments, since different questionnaires, whether national, international, or questionnaires developed for the study were used, which were also found in other systematic review studies on SB^{36,37}. This may contribute to results that are not comparable, as well as biased information that may induce inappropriate institutional policies. The lower quality of SB publications in this review was related to the use of unsuitable instruments, which was observed in 12 articles, with special characteristic for the use of instruments without previous presentation of the psychometric qualities of these measures.

In addition, lack of longitudinal studies on this subject in university students was also observed, since only two longitudinal studies were systematized^{17,34}. Studies with prospective characteristic could contribute with the presentation of other information that would allow the establishment of causal relationships between different characteristics of link with the University and SB⁴⁰.

Among factors associated with SB, overweight was one of the main characteristics associated with different types of SB and with the highest amount of articles presenting this relation. The association of these attributes was also shown in a systematic review in children and adolescents³⁷. The associated factor, inversely proportional to SB, with emphasis among studies, was the level of physical activity, with active individuals being less likely to present high time of use of videogame⁹ and internet¹⁰. It is

necessary to emphasize that these different constructs coexist as behaviors that are part of the daily life of populations, so that it is possible to concomitantly present recommended levels of physical activity and high time of exposure to SB. Other studies with university students that can better demonstrate potential mediators of the relationship between these two behaviors represent an important path for future publications.

As limitations of this review, the impossibility of establishing comparisons among different studies due to the amplitude of SB types, as well as the variety of procedures of adopted methods stand out, with special differentiation between measurement instruments and cutoff points. On the other hand, the scope of studies of different countries and years of publication, which allows understanding the characteristics of these studies on SB of university students, as well as the use of an instrument for the evaluation of research quality in order to highlight the relevance of information on this theme, are strengths.

CONCLUSION

This review showed high prevalence of SB in university students from different countries. In addition, it was observed that overweight and depressive symptoms were the main factors associated with SB. Regarding methodological aspects, diversity of sampling procedures was observed. There was lack of standardization among cutoff points for health risk assessment as a result of SB, as well as the use of unvalidated instruments and low number of longitudinal studies.

Further SB-focused studies on university students should pay attention to the quality of methodological information (sampling procedure, instruments and cutoff points) in order to present information with satisfactory quality and thus help in establishing institutional policies for the health of university students. In a practical way, there is need for the health care of university students, with a view of transforming university spaces as a means of stimulating active and healthy lifestyle, focusing on the excess time exposed to SB in this group.

Acknowledgment

Assistance as a form of CAPES scholarship. This article composes the dissertation titled: Sedentary Behavior in university students: estimates of accuracy, prevalences and associated factors. Defended in the Post-Graduation Program in Physical Education of the Federal University of the Triângulo Mineiro.

COMPLIANCE WITH ETHICAL STANDARDS

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or non-profit sectors.

Ethical approval

Ethical approval was obtained from the local Human Research Ethics Committee – This research is in accordance with standards set by the Declaration of Helsinki.

Conflict of interest statement

The authors have no conflict of interests to declare.

Author Contributions

Developed the study: DCF and TFS. Performed data collection: DCF. Performed the selection of articles: DCF, NLF and TFS. Data analysis: DCF. Article Writing: DCF and TFS. Critical Article Review: TFS.

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SUPPLEMENTARY FILE 1

Descriptors used in electronic databases in the search of articles on sedentary behavior in university students.

Database	Descriptors
SciELO	(sitting time OR sedentary lifestyle OR sedentary behavior\$ OR screen time) AND (undergraduate OR college students OR academics OR university student)
Virtual Health Library	("sitting time" OR "sedentary lifestyle" OR "sedentary behavior" OR "screen time") AND (undergraduate OR "college students" OR academics OR "university students")
SCOPUS	("sitting time"OR"sedentary lifestyle" OR sedentary behavior*OR "screen time") AND(undergraduate OR "college students" OR academics OR "university students")
PUBMED	(sitting time OR sedentary lifestyle OR sedentary behavior* OR screen time) AND (undergraduate OR college students OR academics OR university student)

Boolean operator "AND" was used for combinations between descriptor groups. Boolean operator "OR" was used for the variation of descriptors of the same group. Truncation symbols ("", * and \$) specific to each database were used to find words in the singular or plural or composed words.

SUPPLEMENTARY FILE 2

Articles excluded after reading in full.

Reference	Reason for exclusion
Adeyoyin RA, Balogun MO, Adekanla AA, Oyebami MO, Adebayo RA, Onigbinde TA. An assessment of cardiovascular risk among the people of a Nigerian university community. <i>Eur J Cardiovasc Prev Rehabil</i> 2006;13(4):551-4.	Does not address Sedentary Behavior.
Anding JD, Suminski RR, Boss L. Dietary intake, body mass index, exercise, and alcohol: are college women following the dietary guidelines for Americans? <i>J Am Coll Health</i> 2001;49(4):167-71.	Does not address Sedentary Behavior
Awadalla NJ, Aboelyazed AE, Hassanein MA, Khalil SN, Aftab R, Gaballa II, et al. Assessment of physical inactivity and perceived barriers to physical activity among health college students, south-western Saudi Arabia. <i>East Mediterr Health J</i> 2014;20(10):596-604.	Does not address Sedentary Behavior.
Caballero LGR, Zoraya LRS, Magaly GDE. Actividad física y composición corporal en estudiantes universitarios de cultura física, deporte y recreación. <i>Rev Univ Ind Santander Salud</i> 2015;47(3):281-90.	Does not address Sedentary Behavior
Carvalho CA, Fonseca PCA, Barbosa JB, Machado SP, Santos AM, Silva AAM. Associação entre fatores de risco cardiovascular e indicadores antropométricos de obesidade em universitários de São Luís, Maranhão, Brasil. <i>CiêncSaúde Colet</i> 2015;20(2):479-90.	Does not address Sedentary Behavior
Ceri E, Sit CHP, Huang YJ, Barnett A, Macfarlane DJ, Wong SS. Repeatability of self-report measures of physical activity, sedentary and travel behaviour in Hong Kong adolescents for the iHealth(H) and IPEN – Adolescent studies. <i>BMC Pediatrics</i> 2014;14(142):1-9.	Sample not composed of university students.
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Elliot CA, Kennedy C, Morgan G, Anderson SK, Morris D. Undergraduate physical activity and depressive symptoms: a national study. <i>Am J Health Behav</i> 2012;36(2):230-41.	Does not address Sedentary Behavior
Furukawa Y, Toji C, Fukui M, Kazumi T, Date C. The impact of sedentary lifestyle on risk factors for cardiovascular disease among Japanese young women. <i>Nihon Koshu Eisei Zasshi</i> 2009;56(12):839-48.	Does not present cutoff point for Sedentary Behavior.
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Reference	Reason for exclusion
García-Continente X, Allué N, Pérez-Giménez A, Ariza C, Sánchez-Martínez F, López MJ, et al. Eating habits, sedentary behaviors and overweight and obesity among adolescents in Barcelona (Spain). <i>An Pediatr (Barc)</i> 2015;83(1):3-10.	Sample not composed of university students
García-Gulfo MH, García-Zea JÁ. Prevalencia de factores de riesgo cardiovascular en jóvenes de una institución universitaria. <i>Rev Salud Pública</i> 14(5):822-30.	Does not address Sedentary Behavior.
Gasparotto GS, Moreira NB, Gasparotto LPR, Silva MP, Campos W. Associação entre fatores sociodemográficos e o nível de atividade física de universitários. <i>Rev Bras Ciên Mov</i> 2013;21(4):30-40.	Does not address Sedentary Behavior
Han H, Gabriel KP, Kohl HW. Application of the transtheoretical model to sedentary behaviors and its association with physical activity status. <i>PLoS ONE</i> 2017;12(4):1-13.	Does not present cutoff point for Sedentary Behavior.
Hardy LL, Dobbins T, Booth ML, Denney-Wilson E, Okely AD. Sedentary behaviours among Australian adolescents. <i>Aust N Z J Public Health</i> 2006;30(6):534-40.	Sample not composed of university students.
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Loprinzi PD, Nooe A. Executive function influences sedentary behavior: A longitudinal study. <i>Health Promot Perspect</i> 2016;6(4):180-4.	Does not present cutoff point for Sedentary Behavior
Martins MCC, Ricarte IF, Rocha CHL, Maia RB, Silva VB, Veras AB, et al. Blood pressure, excess weight and level of physical activity in students of a public university. <i>Arq Bras Cardiol</i> 2010;95(2):192-9.	Does not address Sedentary Behavior
Pepinosa NYG, Ortiz RFM, Martínez APM, Muñoz JVP, Sotelo DMR, Sánchez DS. Nivel de sedentarismo en los estudiantes de fisioterapia de la Fundación Universitaria María Cano, Popayán. <i>Promoción Salud</i> 2015;20(2):77-89.	Does not address Sedentary Behavior
Pilcher JJ, Morris DM, Bryant SA, Merritt PA, Feigl HB. Decreasing Sedentary Behavior: Effects on Academic Performance, Meta-Cognition, and Sleep. <i>Front Neurosci</i> 2017;11(219):1-8.	Does not present observational design.
Rodríguez FJR, Oteiza LRE, Carvajal JG, Kuthe NGM, Urra PS. Estado nutricional y estilos de vida en estudiantes universitarios de la Pontificia Universidad Católica de Valparaíso. <i>Univ Salud</i> 2013;5(2):123-35.	Does not address Sedentary Behavior.
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Silva GSF, Bergamaschine R, Rosa M, Melo C, Miranda R, Barra Filho M. Avaliação do nível de atividade física de estudantes de graduação das áreas saúde/biológica. <i>Rev Bras Med Esporte</i> 2007;13(1):39-42.	Does not address Sedentary Behavior.
Simchon Y, Turetsky O, Carmeli E. Characterization of physical activity in undergraduate students in Israel. <i>Int J Adolesc Med Health</i> 2016;29(6):1-6.	Does not address Sedentary Behavior.
Thompson AM, Campagna PD, Durant M, Murphy RJ, Rehman LA, Wadsworth LA. Are overweight students in Grades 3, 7, and 11 less physically active than their healthy weight counterparts? <i>Int J Pediatr Obes</i> 2009;4(1):28-35.	Does not address Sedentary Behavior
Weinstock J, Petry NM, Pescatello LS, Henderson CE. Sedentary college student drinkers can start exercising and reduce drinking after intervention. <i>Psychol Addict Behav</i> 2016;30(8):791-801.	Does not present observational design.
Yan H, Zhang R, Oniffrey TM, Chen G, Wang Y, Wu Y, et al. Associations among Screen Time and Unhealthy Behaviors, Academic Performance, and Well-Being in Chinese Adolescents. <i>Int J Environ Res Public Health</i> 2017;14(6):1-15.	Sample not composed of university students