OVERWEIGHT/OBESITY IN COLLEGE STUDENTS: A SYSTEMATIC REVIEW

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ABSTRACT: This article aims to characterize the prevalence and the factors associated with overweight/obesity in college students, through a systematic review. For doing so, the PRISMA protocol has been utilized. Articles about overweight/obesity were selected in college students on the databases of the National Library of Medicine (PUBMED), Scientific Electronic Library Online (SciELO), *Biblioteca Virtual em Saúde* (BVS), Web of Science and Scopus, it was considered the publication period from 2014 to 2019. We found 4,740 articles and 28 met the eligibility criteria. The overweight/obesity prevalence in college students varied from 9.5% to 47.0%. The Odds Ratio was the most used association measure (comparison) in studies. As characteristics that favor overweight/obesity, inadequate diet, income, male gender, low level of physical activity and family history of overweight/obesity are mentioned. The factors associated with protection against overweight/obesity were a healthy diet, regular physical activity and screen time. Finally, this review showed that university students are prone to overweight/obesity, as they have behavioral factors related to inadequate diet, low level of physical activity, income, being male, and sociocultural and family aspects due to a history of overweight/obesity. In counterpart, this review argues that healthy diet and physical activity and reduced screen time represent a health maintenance factor against overweight/obesity.
KEYWORDS: Epidemiology; Students; Overweight; Obesity; Literature review.

EXCESSO DE PESO/OBESIDADE EM ESTUDANTES UNIVERSITÁRIOS: UMA REVISÃO SISTEMÁTICA

RESUMO: Este artigo tem como objetivo caracterizar a prevalência e os fatores associados ao sobrepeso/obesidade em universitários, por meio de uma revisão sistemática. Para isso, foi utilizado o protocolo PRISMA. Foram selecionados os artigos sobre sobrepeso/obesidade de universitários nas bases de dados da *National Library of Medicine* (PUBMED), *Scientific Electronic Library Online* (SciELO), Biblioteca Virtual em Saúde (BVS), *Web of Science* e *Scopus*, considerou-se o período de publicação de 2014 a 2019. Dos 4.740 artigos encontrados, 28 atenderam aos critérios de elegibilidade. A prevalência de sobrepeso/obesidade em universitários variou de 9,5% a 47,0%. Dentre as medidas de associação (comparação), houve maior utilização do *Odds Ratio*. Como destaques os fatores associados com o sobrepeso/obesidade, cita-se a dieta inadequada, renda, sexo masculino, baixo nível de atividade física e o histórico familiar de sobrepeso/obesidade. Os fatores associados como proteção ao sobrepeso/obesidade

foram a dieta saudável, prática regular de atividade física e o tempo de tela. Por fim, esta revisão mostrou que os universitários são propensos ao sobrepeso/obesidade, por apresentarem fatores comportamentais relacionados a dietas inadequadas, baixo nível de atividade física, renda, ser do sexo masculino e aspectos socioculturais e familiares em função de histórico de sobrepeso/obesidade. Em contrapartida, esta revisão sustenta que a dieta saudável e atividade física e a redução do tempo de tela representam um fator de manutenção da saúde contra o sobrepeso/obesidade.

PALAVRAS-CHAVE: Epidemiologia; Estudantes; Sobrepeso; Obesidade; Revisão de literatura.

SOBREPESO/OBESIDAD EN ESTUDIANTES UNIVERSITARIOS: UNA REVISIÓN SISTEMÁTICA

RESUMEN: Este artículo pretende caracterizar la prevalencia y los factores asociados al sobrepeso/obesidad en estudiantes universitarios, a través de una revisión sistemática. Para ello se ha utilizado el protocolo PRISMA. Se seleccionaron artículos sobre sobrepeso/obesidad en estudiantes universitarios en las bases de datos de la National Library of Medicine (PUBMED), Scientific Electronic Library Online (SciELO), Biblioteca Virtual em Saúde (BVS), Web of Science y Scopus, se consideró el periodo de publicación de 2014 a 2019. Se encontraron 4.740 artículos y 28 cumplieron los criterios de elegibilidad. La prevalencia de sobrepeso/obesidad en estudiantes universitarios varió del 9,5% al 47,0%. El Odds Ratio fue la medida de asociación (comparación) más utilizada en los estudios. Como características que favorecen el sobrepeso/obesidad se mencionan la dieta inadecuada, los ingresos, el sexo masculino, el bajo nivel de actividad física y los antecedentes familiares de sobrepeso/obesidad. Los factores asociados a la protección contra el sobrepeso/obesidad fueron la dieta saludable, la actividad física regular y el tiempo de pantalla. Por último, esta revisión mostró que los estudiantes universitarios son propensos al sobrepeso/obesidad, ya que tienen factores de comportamiento relacionados con la dieta inadecuada, el bajo nivel de actividad física, los ingresos, el hecho de ser varones y aspectos socioculturales y familiares debido a una historia de sobrepeso/obesidad. En contrapartida, esta revisión sostiene que la dieta y la actividad física saludables y la reducción del tiempo de pantalla representan un factor de mantenimiento de la salud contra el sobrepeso/obesidad.

PALABRAS CLAVE: Epidemiología; Estudiantes; Sobrepeso; Obesidad; Revisión de la literatura.

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1. INTRODUCTION

The overweight/obesity is a complex health disorder that is arising from the interaction between hereditary and genetic, social-environmental, and socioeconomic factors, and an increase in physical inactivity due to the increasingly sedentary nature of many forms of work (HRUBY; HU, 2015; WORLD HEALTH ORGANIZATION-WHO, 2021). In adults, the overweight/obesity is defined as the sum of overweight (BMI: 25.0 to 29.9 kg/m²) and obesity (BMI: ≥30.0 kg/m²) (WHO, 2021). In the last decades, overweight/obesity increased the burden of a group of chronic diseases (WHO, 2021), such as diabetes mellitus, chronic renal disease, cancers, and cardiovascular diseases, and it represents the leading cause of preventable death in the world (HRUBY; HU, 2015; WHO, 2021).

According to WHO, in 2016, the worldwide overweight/obesity estimative in adults (≥18 years) was 39% (WHO, 2021). In Brazil, the Ministry Health monitors the magnitude of overweight/obesity via inquiries of the Surveillance System for Risk and Protective Factors for Chronic Diseases by Telephone Survey (VIGITEL) (BRASIL, 2021). In the first year of investigation (2006) the prevalence of overweight/obesity in adults was 43.2%; however, in the last inquiry (2020), more than half of the Brazilian adults were overweight (57,5%) (BRASIL, 2021).

Among the diverse population groups that have been extensively researched in relation to overweight/obesity, undergraduate students stand out, regardless of gender or country (PELTZER et al., 2014), presenting a profile inappropriate behaviors that favor a noticeable increase in this health condition (PELTZER et al., 2014; SOUSA; BARBOSA, 2017; VADEBONCOEUR; TOWNSEND; FOSTER, 2015) A meta-analysis estimated that majority of first year university students who gain weight, gain on average 1.36 kg (VADEBONCOEUR; TOWNSEND; FOSTER, 2015).

The results of a study carried out in Brazil, with samples of undergraduate students from the same institution in different years (2010, 2012 and 2014), showed an increasing prevalence of

overweight/obesity over time in men and not in women. However, in both groups, this increasing as evidenced in different categories of sociodemographic characteristics, connection with the university, and health behavior such as eating habits and physical activity in their leisure time (SOUSA; BARBOSA, 2017).

This study addresses a topic of great magnitude, due to the great risks that overweight/obesity can bring to adults (HRUBY; HU, 2015), especially university students, as the literature provides robust evidence to address this outcome (PELTZER et al., 2014; SOUSA; BARBOSA, 2017; VADEBONCOEUR; TOWNSEND; FOSTER, 2015), since it is already known internationally, and by more that a global, regional and local appeal strategy be carried out to improve diets and physical activity patterns at the population level (WHO, 2021). It is known that in different categories of sociodemographic characteristics, link with the university and health behaviors such as eating habits and leisure time physical activity can contribute to the increase in the development of overweight/obesity (SOUSA; BARBOSA, 2017), but for that, it is important that the students themselves can be engaged in this process, as they also need to be involved in promoting and living a healthy life (PELTZER et al., 2014).

Furthermore, it is noted the lack of synthesized information in indexed databases about overweight/obesity that deal not only with the prevalence, but with the different methodological characteristics, and determinant factors of this attribute in research with undergraduate students are essential. This review to know:

- What is the prevalence of overweight/obesity in college students?

- How are studies that analyzed the outcome of overweight/obesity in college students, associated factors and their methodological structure carried out?

Reviewing this issue will favor the knowledge of the theme, and it will contribute to the development of future studies on this subject. Therefore, we conducted this systematic review to characterize the prevalence and factors associated with overweight/obesity in university students.

2. METHODS

This systematic review follows the recommendation items from the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (PAGE et al., 2021). We have done a prior registration of this systematic review protocol in the International Prospective Register of Systematic Reviews (PROSPERO) under number: CRD42019129725.

2.1 Data sources and search strategy

The papers were selected simultaneously and independently by two revisors to avoid possible bias during the selection of the studies. Each researcher registered and agreed with the inclusion or non-inclusion of the articles; the consent of a third evaluator solved the cases in disagreement. The PRISMA statement has been designed primarily for systematic reviews of studies that evaluate the effects of health interventions, irrespective of the design of the included studies, and many items are applicable to systematic reviews with objectives other than evaluating interventions (such as evaluating a etiology, prevalence, or prognosis) (PAGE et al., 2021).

Advanced searches were done on April 27, 2019, out in a standardized way in five electronic databases in English Language. Medical Subject Headings (MeSH) "students", "teenager", "children", "aged", "obesity", "overweight" and "body mass index" and this MeSH can be used directly to search the National Library of Medicine (PUBMED) e os Health Sciences Descriptors (DeCS) "students", "teenager", "children", "aged", "obesity", "overweight", "body mass index" and "adiposity" that can be used directly in the *Biblioteca Virtual em Saúde* (BVS) and Scientific Electronic Library Online (SciELO) databases. The keywords "university students" and "undergraduate student" were also used, taking into account that this form can be used in the Web of Science and Scopus databases. To standardize the searches, the following combinations were used, as a way of refining the number of articles: "students" OR "university students" OR "undergraduate student" OR "college students" NOT "teenager" NOT

"children" NOT "aged" AND "obesity" OR "overweight" OR "body mass index" OR "adiposity". The Boolean operators AND, OR and NOT were used between terms and keywords, as well as the truncation symbol ($) was also used to find words in both singular and plural, and/or variations in writing.

2.2 Study selection

The eligibility criteria to be included in the review were: a) authentic articles; b) publications in the English, Portuguese and Spanish Languages; c) an 18-year-old or older undergraduate population; d) studies that measured overweight/obesity via BMI, as a dependent variable, through assessed and self-reported measures of body mass and height; e) observational studies (cross-sectional and longitudinal); f) publications from 2014 to 2019. As exclusion criteria: a) validation study; b) review study; c) case studies; d) essays and theses; e) annual summaries.

2.3 Data extraction and risk of bias assessment

Firstly, we read articles headlines, and duplicates were eliminated. Secondly, among the identified headlines, the summaries were read. Subsequently, the articles which were chosen by the abstracts were read fully and selected for the review. After selecting the articles, we read the references, and the articles which met the eligibility criteria were selected (regardless of the database). Finally, we used the software Zotero to store the articles.

The quality assessment of each article was executed individually, according to Loney's et al. (1998) criteria, for cross-sectional and longitudinal studies, through eight items which analyzed the methods, sample, measurement instruments, interpretation and applicability of results. It was assigned "Y", representing 1 point, to the article that presented the necessary quality and "N", scoring 0, whether it did not meet the criteria previously mentioned; the maximum score was 8. We used this method to investigate the quality of the studies and not as a method of exclusion.

This assessment criterion considers three blocks (A, B, and C), as follows. In block A – Item 1. Are the study design and sampling methods appropriate for the research question? Item 2. Is the sampling frame appropriate? Item 3. Is the sample size adequate? Item 4. Are objective, suitable and standard criteria used for measurement of the health outcome? Item 5. Is the health outcome measured in an unbiased fashion? Item 6. Is the response rate adequate? Are the refusers described? In block B - Item 7. Are the estimates of prevalence or incidence given with confidence intervals and in detail by subgroup, if appropriate? In block C – Item 8. Are the study subjects and the setting described in detail and similar to those of interest to you?

For each publication selected on this study, the following information was systematized into an Excel spreadsheet, version 2013: authors, year of publication, the study delineation, size of the sample, sex of participants, the local where the study was conducted, age, way of measuring body mass and height, cutoff, overweight/obesity prevalence, measures of association (comparison) used in the main analysis and overweight/obesity associated risk factors or overweight/obesity associated protective factor.

3. RESULTS

The searches identified 4,740 articles on databases, and we excluded 1,903 since they were duplicates, and subsequently, 2,291 articles were excluded after reading the headings, and 546 remained for their reading abstracts. We also excluded 429 articles after such reading, and finally, 25 articles remained. Three manuscripts were found in the references from the selected papers, reaching the amount of 28 articles selected. (Figure 1).

Figure 1 - Flow chart of the process of identification and selection of the articles included in the systematic review about overweight/obesity in undergraduate students in the period between 2014 and 2019.
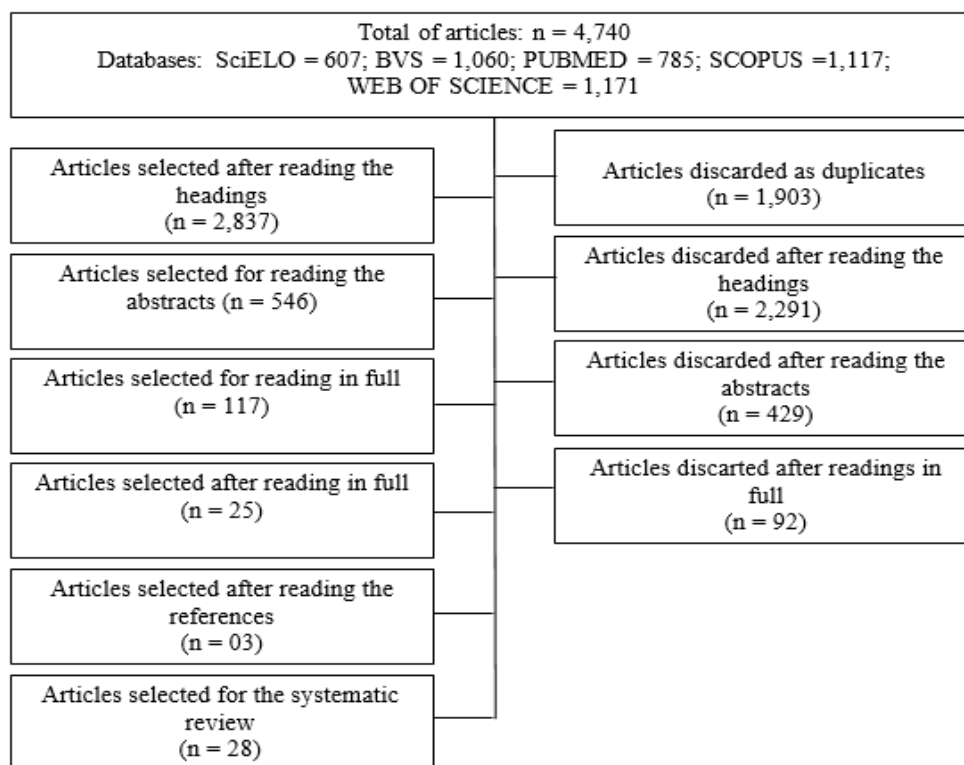

Table 1 shows the critical assessment criteria according to the scores established by Loney et al. (1998). Among 28 articles, none of them met the maximum score, and the studies that scored 6 points were the most recurrent ones in this review, presenting a total of 9 articles.

Table 1 - Guidelines used for the studies critical assessment on overweight/obesity in undergraduate students and scores obtained from the selected articles. Assessment criteria proposed by Loney et al. (1998).

Criteria	nº/Nº
A. Are the study methods valid?	
1. Are the study design and sampling method appropriate for the research question?	14/28
2. Is the sampling frame appropriate?	11/28
3. Is the sample size adequate?	18/28
4. Are objective, suitable and standard criteria used for measurement of the health outcome?	26/28
5. Is the health outcome measured in an unbiased fashion?	11/28
6. Is the response rate adequate? Are the refusers described?	7/28
B. What is the interpretation of the results?	
7. Are the estimates of prevalence or incidence given with confidence intervals and in detail by subgroup, if appropriate?	7/28
C. What is the applicability of the results?	
8. Are the study subjects and the setting described in detail and similar to those of interest to you?	28/28

Authors	Assessment itens								
	A1	A2	A3	A4	A5	A6	B7	C8	S*
Moretti et al. (2014)	N	Y	Y	Y	Y	N	Y	Y	6
Santos et al. (2014)	N	N	N	N	Y	N	N	Y	2
Fernandez et al. (2014)	N	N	N	Y	Y	N	N	Y	3
Pengpid e Peltzer (2015)	Y	Y	Y	Y	Y	N	N	Y	6
Al-Otaibi et al. (2015)	N	N	N	N	N	N	N	Y	1
Ren et al. (2015)	N	N	Y	Y	Y	N	N	Y	4
Cardozo et al. (2016)	N	N	N	Y	Y	N	N	Y	3
Mokhtari et al. (2015)	Y	N	Y	Y	N	N	N	Y	4
Rangel Caballero et al. (2015)	Y	N	Y	Y	N	N	N	Y	4
Pope et al. (2016)	N	N	N	Y	N	N	N	Y	2
El-Kassas e Ziade (2016)	N	N	Y	Y	Y	N	N	Y	4
Ukegbu et al. (2017)	Y	Y	Y	Y	Y	Y	N	Y	7

Sa et al. (2016)	N	N	N	Y	N	N	Y	Y	3
Mahfouz et al. (2016)	Y	Y	Y	Y	Y	Y	N	Y	7
Basu et al. (2016)	N	N	N	Y	N	N	N	Y	2
Yang et al. (2017)	Y	Y	Y	Y	N	N	Y	Y	6
Choukem et al. (2017)	Y	Y	Y	Y	Y	N	N	Y	6
Múnera-Gaviria et al. (2017)	Y	Y	N	Y	Y	Y	N	Y	6
Mori et al. (2017)	N	N	N	Y	N	N	N	Y	2
Ramos et al. (2017)	Y	Y	Y	Y	N	N	Y	Y	6
Jaoua et al. (2017)	Y	N	Y	Y	N	N	N	Y	4
Vieira et al. (2017)	Y	N	Y	Y	N	Y	N	Y	5
Hamam et al. (2017)	Y	N	N	Y	N	N	N	Y	3
Qin et al. (2018)	N	N	Y	Y	N	N	Y	Y	4
Concha-Cisternas et al. (2018)	N	N	Y	Y	N	Y	N	Y	4
Jiang et al. (2018)	Y	Y	Y	Y	N	N	Y	Y	6
Infante et al. (2018)	N	Y	Y	Y	N	Y	Y	Y	6
Gómez-Landeros et al. (2018)	Y	Y	Y	Y	N	Y	N	Y	6

nº = Articles that met the criteria; Nº = Total of articles; % = Percentage; S* = Score referring to the sum of the criteria met per each article; Y = Yes, it met the item; N = No, It did not meet the item.

We verified that 28.6% of the articles were published in 2017 (Table 2). About the research delineation, 92.9% of the articles were cross-sectional studies, and the samples varied from 82 to 11,673 participants. The countries that most published on the theme were: Brazil, Saudi Arabia, China, and Colombia, averaging out at 14.3% of the publications for each country.

Table 2 - Characteristics of the studies on overweight/obesity in undergraduate students.

Author	Year	Delineation	Sample	Sex	Local where the study was conducted
Moretti et al. (2014)	2014	Cross-sectional	1,104	M/F	Rio Branco/Acre/Brazil
Santos et al. (2014)	2014	Cross-sectional	164	M/F	Jequié/Bahia/Brazil
Fernandez et al. (2014)	2014	Cross-sectional	159	M/F	India
Pengpid e Peltzer (2015)	2015	Cross-sectional	860	M/F	Thailand
Al-Otaibi et al. (2015)	2015	Cross-sectional	276	F	Riyadh/Saudi Arabia
Ren et al. (2015)	2015	Cross-sectional	2,617	M/F	China
Cardozo et al. (2016)	2015	Cross-sectional	82	M/F	Bogotá/Colombia
Mokhtari et al. (2015)	2015	Cross-sectional	310	M/F	Malaysia
Rangel Caballero et al. (2015)	2015	Cross-sectional	306	M/F	Bucaramanga/Colombia
Pope et al. (2016)	2016	Longitudinal	1° year: 117 4 ° year: 86	M/F	NO
El-Kassas e Ziade (2016)	2016	Cross-sectional	369	M/F	Libanon
Ukegbu et al. (2017)	2016	Cross-sectional	1,610	M/F	Owerri/Nigeria
Sa et al. (2016)	2016	Cross-sectional	268	M/F	Maryland/The United States
Mahfouz et al. (2016)	2016	Cross-sectional	436	M/F	Jazan/Saudi Arabia
Basu et al. (2016)	2016	Cross-sectional	278	M/F	Calcutá/Índia
Yang et al. (2017)	2017	Cross-sectional	11,673	M/F	China
Choukem et al. (2017)	2017	Longitudinal	2,226	M/F	Duala/Camaroon
Múnera-Gaviria et al. (2017)	2017	Cross-sectional	171	M/F	Medellín/Colombia.
Mori et al. (2017)	2017	Cross-sectional	172	M/F	Praia Grande/São Paulo/Brazil
Ramos et al. (2017)	2017	Cross-sectional	378	M/F	Colombia
Jaoua et al. (2017)	2017	Cross-sectional	1,200	M/F	Saudi Arabia
Vieira et al. (2017)	2017	Cross-sectional	550	M/F	Picos/Piauí/Brazil
Hamam et al. (2017)	2017	Cross-sectional	228	M/F	Saudi Arabia
Qin et al. (2018)	2018	Cross-sectional	790	M/F	Gansu/China
Concha-Cisternas et al. (2018)	2018	Cross-sectional	358	M/F	Talca/Chile
Jiang et al. (2018)	2018	Cross-sectional	11,673	M/F	China

| Infante et al. (2018) | 2018 | Cross-sectional | 369 | M/F | Mexico |
| Gómez-Landeros et al. (2018) | 2018 | Cross-sectional | 1,168 | M/F | Mexico |

M = Male; F = Female; NO = It does not present.

Table 3 presents the age description, method of measuring body mass and height, overweight/obesity prevalence, and the measure of association (comparison) used in the analyses. Participants ages range from 18 to 51 years. In 20 articles (71.4%), body mass and height were measured to BMI calculation. The cutoff more used was ≥25 kg/m^2. The prevalence of overweight/obesity varied from 9.5% to 47.5%. There was more substantial use of Odds Ratio among the measures of association (comparison).

Table 3 - Description of age, method of measuring body mass and height and statistical analyses of studies on overweight/obesity in undergraduate students

Authors	Age (years)	BMI measurement	Cutoff	Overweight/ obesity Prevalence	Statistical analyses
Moretti et al. (2014)	24±7.2	Measured	≥25.0 kg/m² (WHO)	GP= 35.6% M=43.6% F=29.7%	Prevalence ratio
Santos et al. (2014)	22.28±3.47	Self-referred	≥25.0 kg/m² (WHO)	GP= 22.6% M= 28.9% F= 12.5%	Prevalence ratio
Fernandez et al. (2014)	F=19±0.76; M= 19.12±0.86	Measured	≥85th Percentile (CDC)	GP= 13.2% M= 10.75% F=16.6%	Student's T-Test
Pengpid e Peltzer (2015)	20.1±1.3	Measured	≥23.0 kg/m² (WHO-WPR)	GP= 20.8% OW: 7.8% OB: 13%	Prevalence ratio
Al-Otaibi et al. (2015)	18 to 25	Measured	≥25.0 kg/m² (WHO)	GP= 29.7%	Odds ratio
Ren et al. (2015)	19 to 23	Measured	≥24.0 kg/m² (WGO) and ≥25.0 kg/m² (WHO)	M= OW: 11.5% OB: 2.5% F= OW: 2.4% OB: 0.3%	NO
Cardozo et al. (2016)	18 to 31	Measured	≥25.0 kg/m² (SEEDO)	M= 20.9% F= 46.67%	Mann–Whitney U test
Mokhtari et al. (2015)	≥18	Measured	≥25.0 kg/m² (WHO)	M= OW: 39.6% OB: 4.9% F= OW: 8.8% OB: 2.7%	Chi-square
Rangel Caballero et al. (2015)	18 to 25	Measured	≥25.0 kg/m² (NHANES)	GP= 26.47% OW: 20.26% OB: 6.21% M=41.48% F=16.47%	Odds ratio
Pope et al. (2016)	NO	Measured	≥25.0 kg/m² (WHO)	1º year: GP= 23% 4º year:	Odds ratio

				GP= 41%	
El-Kassas e Ziade (2016)	18 to 25	Measured	≥25.0 kg/m² (WHO)	GP= 32.2% M= OW: 34% OB: 8% F= OW: 26.6% OB: 4.1%	Odds ratio
Ukegbu et al. (2017)	18 to 30	Measured	≥25.0 kg/m² (WHO)	OW: 13.4% OB: 6.5% M= OW: 8.4% OB: 4.2% F= OW: 17.7% OB: 8.4%	Chi-square
Sa et al. (2016)	18 to 25	Self-referred	≥25.0 kg/m² (NO)	GP= 47.5% M= 46.7% F= 48%	Odds ratio
Mahfouz et al. (2016)	19 to 25	Self-referred	≥25.0 kg/m² (WHO)	GP= 34% M= OW: 24.5% OB: 13% F= OW: 15.6% OB: 14.3%	Chi-square
Basu et al. (2016)	18 to 23	Measured	≥25.0 kg/m² (WHO)	OW: 19.07% OB: 8.63%	Odds ratio
Yang et al. (2017)	<20 and ≥23 year	Self-referred	≥24.0 kg/m² (CDC-China)	GP= 9.5% M= 9.4% F= 5.7%	Prevalence ratio
Choukem et al. (2017)	18 to 38.7	Measured	≥25.0 kg/m² (NO)	2009: GP= 13.1% 2012: GP= 20.9%	Chi-square
Múnera-Gaviria et al. (2017)	20 to 24	Measured	≥25.0 kg/m² (WHO)	GP= 32.70% OW: 25.1% OB: 7.6%	Odds ratio
Mori et al. (2017)	27.6±8.6	Measured	≥25.0 kg/m² (WHO)	GP= 47.1% M= 54.2% F= 38.1%	NO
Ramos et al. (2017)	21±3.6	Self-referred	(NO)	GP= 22.3% OW: 19.8% OB: 2.5%	Prevalence ratio
Jaoua et al. (2017)	19 to 29	NO	≥25.0 kg/m² (WHO)	OW: 25% OB: 16%	Odds ratio
Vieira et al. (2017)	18 to 51	Measured	≥25.0 kg/m² (WHO)	GP= 20.4%	Odds ratio
Hamam et al. (2017)	≥18	Measured	≥85th Percentile (CDC)	GP= 36.8% OW: 25.9% OB: 10.9% M= OW: 33.8% OB: 16.3% F= OW: 21.6% OB: 8.1%	Prevalence ratio
Qin et al. (2018)	18 to 27	Self-referred	≥24,0) (WGOC)	GP= 11.1% M= 18.4% F= 4%	Odds ratio
	<21 and	Measured	≥25.0 kg/m²	M= 58.6%	Odds ratio

Concha-Cisternas et al. (2018)	≥21		(WHO)	F= 41.4%	
Jiang et al. (2018)	<20 to 23	Self-referred	≥24.0 kg/m² (CDC - China)	GP= 9.5% M=13.9% F=6.1%	Prevalence ratio
Infante et al. (2018)	≥18	Measured	≥25.0 kg/m² (WHO)	M= 44.2% F= 23.2%	Odds ratio
Gómez-Landeros et al. (2018)	≥18	NO	≥25.0 kg/m² (NO)	OW: 26.03% OB: 10.36% M= OW: 29.23% OB: 10.38% F= OW: 23.45% OB: 10.34%	Chi-square

OB = Obesity; OW = Overweight; BMI = Body mass index; WM = Way of measurement; NO = It does not present; GP = General Prevalence; M = Male; F = Female; WHO = World Health Organization; WHO-WPR = World Health Organization Western Pacific Region; WGO = Working Group on Obesity references in China; SEEDO = Spanish Society for the Study of Obesity; NHANES = National Health and Nutrition Examination Survey; CDC-China = Chinese Center for Disease Control and Prevention (briefly as China CDC); WGOC = Working Group for Obesity in China.

About the overweight/obesity associated risk factors, we observed that an inadequate hypercaloric diet, income, being male, low level of physical activity and overweight/obesity in family history. It was observed that a healthy diet, screen time ≤2 hours a day and regular practice of physical activity was highlighted as an overweight/obesity associated protective factor (Tabela 4).

Table 4 - Presentation of factors associated with overweight/obesity in undergraduate students.

Authors	Overweight/obesity associated risk factors	Overweight/obesity associated protective factors
Moretti et al. (2014)	Male sex: to be married or into a common-law marriage; widower, separated or divorced; to be hypertensive; to watch TV every day. Female sex: self-perception of the regular, bad or very bad health condition; to be hypertensive; alcohol consumption during the last month.	Male sex: up to 3 minimum wages
Santos et al. (2014)	Being male; age ≥ 21 years old;	NO
Fernandez et al. (2014)	Daily calorie intake; lack of daily physical activity; daily consumption of tea or coffee or fruit juices; outdoor games; socio-economic status; obesity in the family history.	NO
Pengpid et al. (2015)	Low level of physical activity. Male sex: advanced age; attempts to eat fiber; attempts to lose weight. Female sex: attempts to lose weight; depression symptoms; regular sleep duration.	NO
Al-Otaibi et al. (2015)	Fast food intake; going regularly to fast food places 2 to 3 times a week.	NO
Ren et al. (2015)	NO	NO
Cardozo et al. (2016)	NO	NO
Mokhtari et al. (2015)	Being male; carbohydrate intake; smoking; anxiety; age; education level; to be single; to have a higher income.	Regular physical activity.

Rangel Caballero et al. (2015)	Body fat; sedentary lifestyle.	NO
Pope et al.(2016)	NO	NO
El-Kassas e Ziade (2016)	Parental obesity; the craving for foods high in sugar or high percentage of fat; increased appetite; binge - eating disorder; stress induced eating.	Healthy food
Ukegbu et al. (2017)	Being female; first-year students; snack intake	NO
Sa et al. (2016)	Obesity in the family history; to skip breakfast; caffeinated drink intake; low family income; smoking pipe, cigar or cigarrete on a daily basis.	NO
Mahfouz et al. (2016)	NO	NO
Basu et al. (2016)	Family history; soda intake over 2 liters per week; fast & junk food intake more than twice a week; alcohol consumption.	Fruit intake; watching TV for ≤2 hours a day; using a computer ≤2 hours a day; habit of exercising.
Yang et al. (2017)	Family income; <10.000; ≥10.000 RMB; month expenses (RMB): ≥ 1.500; smoking on a daily basis; being from counties and cities; higher GDP in provinces; higher GPD in university towns.	Being female; being from oriental, central, southeast and northwest regions; university: low and middle levels.
Choukem et al. (2017)	Male sex; time (years).	NO
Múnera-Gaviria et al. (2017)	Overweight in the family history; unhealthy eating habits.	NO
Mori et al. (2017)	NO	NO
Ramos et al. (2017)	Being male; age ≥23 years old; perception of na overweight and obese body image.	Waist-to-hip ratio with no risk; no partners; having abdominal perimeter; women <80 cm; men <100 cm.
Jaoua et al. (2017)	Being male; advanced age; high-fat eating habits in the family; low level of physical activity; they used to practice sports; intake of cereal bars for those who reported low income..	NO
Vieira et al. (2017)	Time, regarding each year of life; high- and middle-socioeconomic status	NO
Hamam et al. (2017)	Lever intake.	NO
Qin et al. (2018)	Being male; to have breakfast evey day, 4 to 6 times and 1 to 3 times per week; meal time up to 5 minutes (min.), 6 to 10 min and >20 min.; they practiced <90 of exercise.	1 to 3 hours and 5 to 8 hours watching TV or using a computer; going to bed until 10 p.m.
Concha-Cisternas et al. (2018)	Being male; low level of physical activity; presence of musculoskeletal injuries; smoking.	NO
Jiang et al. (2018)	Male sex: higher family income, up to 20.000 RMB per person; self-perception of stress; GPD from the region of origin; unemployment. Female sex: unemployment	NO
Infante et al. (2018)	Low level of physical activity	NO
Gómez-Landeros et al. (2018)	Chronic disease in the family history (SBP and T2DM).	NO

NO = It does not present; GPD = Gross Domestic Product; RMB = Renminbi (China's currency); cm = Centimeter; min = Minutes; SBP = Systolic blood pressure; T2DM = Type 2 diabetes mellitus; WHO = World Health Organization.

4. DISCUSSION

This study showed the growth of the number of publications related to overweight/obesity in undergraduate students, mainly between the years of 2015 and 2017. The cross-sectional studies were predominant in this review. Behavioral and genetic tendencies as precursors of overweight/obesity were observed, and good habits can reduce this propensity. The prevalence of overweight/obesity among undergraduate students varied among the studies.

The smallest overweight/obesity prevalence in undergraduate students was found in studies performed in China, 9.5% (JIANG et al., 2018; YANG et al., 2017), and the largest prevalence was 47.5% (SA et al., 2016) in the United States of America. The Chinese college students were less stricken (JIANG et al., 2018; YANG et al., 2017) by overweight/obesity than the adult population of the country, according to a national rate of 32.3% observed in 2016, which is still inferior to other developed countries such as Australia, Canada, and Russia (WHO, 2022). The college students from the United State of America presented a higher overweight/obesity rate, and they gained weight throughout university education with an estimated average of 3.38 kg (VADEBONCOEUR; TOWNSEND; FOSTER, 2015); thus following the trend of the country of having high prevalence of overweight/obesity in adults with 18 years of age or older (WHO, 2021). Possibly, the consumption of diets dense in energy and poorly nutritious, and low level of physical activity in their leisure time represent (WHO, 2021), this difference was observed in parallel analyzes in two large samples of teenagers living in Los Angeles, California and in Wuhan, China, to make direct comparisons of the risks of overweight and obesity in western and eastern cultural settings (JOHNSON et al., 2006), to the Americans, aspects that favor this profile (JOHNSON et al., 2006; WHO, 2021). However, the Chinese, in their turn, still keep their local eating culture and also their regular practices of physical activity, which minimize overweight/obesity (JOHNSON et al., 2006).

This review found that income (FERNANDEZ et al., 2014; JIANG et al., 2018; MOKHTARI; JAMALUDDIN; SAAD, 2015; VIEIRA et al., 2017; YANG et al., 2017) was one of the risk factors for overweight/obesity among university students, whether higher (JIANG et al., 2018; MOKHTARI; JAMALUDDIN; SAAD, 2015; VIEIRA et al., 2017; YANG et al., 2017) or lower (JAOUA, 2017; SA et al., 2016; YANG et al., 2017). In the overweight/obese condition, an energy imbalance can arise between the calories consumed and the calories expended in this way, creating an energy surplus and a state of positive energy balance, resulting in this condition (HRUBY; HU, 2015). The responsibility to fight overweight/obesity is individual (WHO, 2021), but far beyond individual control, profound social and economic changes are needed (HRUBY; HU, 2015) to occur when people have access to a healthy lifestyle (WHO, 2021). Income can favor the individual, better economic conditions to have better food available for consumption, however, the availability of abundant, cheap and often nutrient-poor food is more accessible to people with low income, regardless of their country of origin (HRUBY; HU, 2015).

It is worth mentioning that in this study, it was observed that an inadequate hypercaloric diet, such as the intake of foods with fat and high in sugar, was very prevalent in the analyzed studies (AL-OTAIBI; BASUNY, 2015; BASU et al., 2016; EL-KASSAS; ZIADE, 2016; FERNANDEZ et al., 2014; JAOUA, 2017; MOKHTARI; JAMALUDDIN; SAAD, 2015; MÚNERA GAVIRIA et al., 2017; UKEGBU et al., 2017). This eating behavior has been researched, as it has a strong relationship with the outcome of overweight/obesity in university students (PELTZER et al., 2014). Educational environments, particularly in universities, require healthy lifestyle interventions, especially nutrition education programs to reduce the prevalence of overweight/obesity (QUILICHE CASTAÑEDA et al., 2021). On the other hand, in this study it was found that a healthy diet, such as fruit consumption, appears as a protective factor against overweight/obesity among university students. Peltzer et al. (2014) report that because those university students in the condition of overweight/obesity often end up adopting healthier eating behaviors, as a focus of losing weight and in some cases to be accepted in a certain group.

It is important to highlight that male sex was associated as a risk factor to overweight/obesity (CHOUKEM et al., 2017; JAOUA, 2017; MOKHTARI; JAMALUDDIN; SAAD, 2015; QIN et al., 2018; SANTOS et al., 2014). According to VIGITEL, 58.9% of men and 56.2% of women presented

overweight/obesity in Brazil in the year of 2020, and among those who had 12 years or more of schooling, the overweight/obesity prevalence was 54.6% (men 63.2%; women 47.8%) (BRASIL, 2021). The male sex is prone to overweight/obesity due to socio-cultural factors (HRUBY; HU, 2015), that favor the excessive alcohol intake compared to women (BRASIL, 2021) and/or intake of processed and unprocessed red meats (HRUBY; HU, 2015), and both of them may favor weight gain (BRASIL, 2021; HRUBY; HU, 2015). On the other hand, higher level of education among women may make them less affected by overweight/obesity (BRASIL, 2021).

Following this review, overweight/obesity is highlighted as an associated risk factor for the low level of physical activity (CONCHA-CISTERNAS et al., 2018; FERNANDEZ et al., 2014; JAOUA; WOODMAN; BALAIAN, 2017; PENGPID; PELTZER, 2015; QIN et al., 2018) in children, teenagers, and adults (WHO, 2021). A systematic review (SOUSA, 2011) showed that insufficient physical activity is a serious health problem among university students, regardless of the domain leisure, domestic or occupational activities (SOUSA, 2011).

The study of Sousa et al. (2017) showed that 150 minutes of physical activity at leisure time a week of moderate and vigorous intensities were predictors of absence of overweight/obesity in undergraduate students. Physical activity contributes positive impacts to minimize/control BMI increase, due to the adipose tissue use in metabolic processes of energy production (SOUSA, 2011; SOUSA; BARBOSA; COELHO, 2017; WHO, 2021).

Another overweight/obesity associated risk factor was family history. The heredity may favor overweight/obesity, and it acts as a persistent effect on the adiposity during adulthood (HRUBY; HU, 2015). However, the family environment and eating habits may influence the development of overweight/obesity since childhood (HRUBY; HU, 2015; WHO, 2021). Both the genetic elements and the heredity are markers that lead to overweight/obesity and gain of weight (HRUBY; HU, 2015) and are not controllable; however, it's expression may be maximized by behavioral factors (HRUBY; HU, 2015).

Thus, this review could verify that the regular practice of physical activity stands out as an overweight/obesity protective factor. Regular physical activity time has been observed consistently showing that, ≥ 150 minutes per week of moderate intensity activity is required to prevent weight gain, or aid in weight loss in undergraduate students and in the general population (HRUBY; HU, 2015; SOUSA; BARBOSA; COELHO, 2017). As a result, plans and strategies have been developed worldwide to improve population health and reduce the global prevalence of insufficient physical activity among adolescents and adults until 2030 (WHO, 2021).

It is important to highlight that screen time ≤2 hours a day, as observed as a protective factor against overweight/obesity. Screen time has been considered an important public health problem in the world, when it comes to the reduction/prevention of overweight/obesity and other diseases related to this behavior (MARSH et al., 2014). However, interventions to reduce screen time seem to be effective in reducing screen time and preventing overweight/obesity (WU et al., 2016). Screen time analyzed in the systematic review and meta-analysis by Wu et al. (2016) carried out through a joint analysis of eight studies, showed that performing interventions to reduce screen time had a significant effect on the reduction of BMI (mean difference -0.15 kg/m^2, 95%CI - 0.23 – - 0.08), with no evidence of heterogeneity ($I^2 = 0$ %).

Regarding methodological aspects of the publications, only half of the studies used the random sampling (CHOUKEM et al., 2017; GÓMEZ-LANDEROS et al., 2018; HAMAM et al., 2017; JAOUA; WOODMAN; BALAIAN, 2017; JIANG et al., 2018; MAHFOUZ et al., 2016; MOKHTARI; JAMALUDDIN; SAAD, 2015; MÚNERA-GAVIRIA et al., 2017; PENGPID; PELTZER, 2015; RAMOS et al., 2017; RANGEL CABALLERO; SÁNCHEZ; DELGADO, 2015; UKEGBU et al., 2017; VIEIRA et al., 2017; YANG et al., 2017) when implementing the selection procedures of the participants. This procedure allows the representativeness of the population and minimizes the potential bias of the sample selection process (LONEY et al., 1998).

The criteria for choosing the participants are essential to infer the information. The sampling structure of the studies was appropriate (CHOUKEM et al., 2017; GÓMEZ-LANDEROS et al., 2018; INFANTE; GURROLA; REYNA, 2018; JAOUA; WOODMAN; BALAIAN, 2017; JIANG et al., 2018; MAHFOUZ et al., 2016; MORETTI et al., 2014; MÚNERA-GAVIRIA et al., 2017; PENGPID; PELTZER, 2015; RAMOS et al., 2017; UKEGBU et al., 2017; VIEIRA et al., 2017; YANG et al., 2017), and the size of the sample was adequate in most of the studies (CHOUKEM et al., 2017; CONCHA-CISTERNAS et al., 2018; EL-KASSAS; ZIADE, 2016; GÓMEZ-LANDEROS et al., 2018; INFANTE; GURROLA; REYNA, 2018; JAOUA; WOODMAN; BALAIAN, 2017; JIANG et al., 2018; MAHFOUZ et al., 2016; MOKHTARI; JAMALUDDIN; SAAD, 2015; MORETTI et al., 2014; PENGPID; PELTZER, 2015; QIN et al., 2018; RAMOS et al., 2017; RANGEL CABALLERO; SÁNCHEZ; DELGADO, 2015; REN et al., 2015; UKEGBU et al., 2017; VIEIRA et al., 2017; YANG et al., 2017), thereby showing the strength of these publications (LONEY et al., 1998).

In the critical assessment of the studies, most of the articles used analysis methods that permit robust analyses, for instance, the regression for the estimate of Odds Ratio, which favors the understanding of overweight/obesity associated characteristics regardless of potential factors of confusion. In six studies, overweight/obesity was determined via reported measures of body mass and height. This king of measure shows good applicability and satisfactory validation, being fundamental for application in epidemiological inquiries with undergraduate students and the general population (BRASIL, 2021; SOUSA; BARBOSA, 2017; SOUSA; BARBOSA; COELHO, 2017).

It was noticed that the number of longitudinal studies was low, however, this type of study can provide a higher level of evidence regarding risk factors for the outcome. Thus, it is better to observe overweight/obesity over time, even in terms of life expectancy (HRUBY; HU, 2015). On the other hand, cross-sectional studies were predominant in this review, as observed in other studies of review (SOUSA, 2011), this kind of research presents has as a limitation, it is not possible to be sure if the exposure is previous or outcome, that is, it is not possible to establish causality; nevertheless, such studies have a short time for data collection as a facility. There were only two longitudinal studies, and studies of this nature were used in different countries and can observe changes and perceive alterations that occurred over time, such as the development of overweight/obesity (HRUBY; HU, 2015).

In this review, the studies substantially used the Odds Ratio as a measure of association (comparison). The Odds Ratio has been used in cross-sectional studies to estimate the risk of determining an outcome (The Odds Ratio tends to be overestimated in cross-sectional studies with frequent outcomes, such as prevalence greater than 30%, and presents approximation with the values of the association measure by the prevalence ratios, when the outcome presents prevalence lower than 10% As observed in different prevalence of studies comprising this review the values were high. In view of this, caution is cited with the analysis of associated factors such as risks, and protection characterized in this study. Alternatively, it is suggested that other studies use the measure of association prevalence ratios in cross-sectional studies with binary outcomes (COUTINHO; SCAZUFCA; MENEZES, 2008).

A strength of this review was the use of a broad search strategy in the main databases aiming to minimize the absence of publications on the theme. In addition, it was used to analyze the quality of publications to better characterize the evidence on the topic. However, this review also presents a limitation: the non-inclusion of literature such as theses and dissertations. We believe that these writings could expand the scope of the review.

5. CONCLUSION

Finally, this review analyzed observational studies from different countries, and it showed that undergraduate students are susceptible to present overweight/obesity with high prevalence. Behavioral factors related to inadequate diet, income, low level of physical activity, socio-cultural, and family aspects were associated with overweight/obesity. On the other hand, this review argues that a healthy diet, regular

physical activity and reduced screen time stood out as protective factors associated with overweight/obesity.

We suggest that studies should explore the biological mechanisms linked with overweight/obesity as well as include other potential factors that may minimize this health condition, like sedentary behavior. We recommend strengthening national planning of policy actions to encourage a healthy lifestyle among university students. Further studies are needed focusing on the mediator and moderator effects of sociodemographic and links with the university components, between the association of health-related behaviors and overweight/obesity in this group. In addition, as a suggestion, it may be interesting to conduct cohort studies (longitudinal), which may provide a higher level of evidence to the associations and, consequently, greater power of inference in health surveillance actions.

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