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Prevalence of metabolic syndrome among university students: A systematic review

Prevalencia de síndrome metabólico en estudiantes universitarios, una revisión sistemática

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Abstract

Introduction: Metabolic syndrome (MS) is defined as a set of conditions including high blood pressure, dyslipidemia, glucose intolerance and visceral obesity. In recent years, an increase of obesity in university students has been observed, although the accurate prevalence of MS is unknown.

Objective: To determine the prevalence of MS in university students between January 2000 and January 2016.

Materials and methods: A systematic review of studies published in the PubMed, LILACS, ScienceDirect, UpToDate, Imbiomed, SciELO and Google Scholar databases was performed. To ensure the highest number of papers, different combinations of words related to MS were used in Spanish, English, and Portuguese.

Results: A total of 16 studies met the inclusion criteria. Students from different health, social and human sciences careers from America, Asia and Europe participated in said studies. The prevalence of MS ranged from 0% to 19.2% according to NCEP-ATP III.

Conclusions: The prevalence of MS varies widely across studies. It is important to expand MS research, as this would allow designing specific interventions for high-risk groups in the university context.

Keywords: Prevalence; Metabolic Syndrome X; Students; Universities; Review (MeSH).

Introduction

Today, metabolic syndrome (MS) is one of the biggest public health concerns worldwide. (1) The International Diabetes Federation states that the frequency of this syndrome is high in the global context, and is also parallel and congruent with the high frequency of type 2 diabetes and cardiovascular disease in the general population. (1,2)

MS is also known as plurimetabolic syndrome, insulin resistance syndrome, or metabolic X syndrome and is defined as the presence or coexistence of high blood pressure, dyslipidemia, insulin resistance, glucose
intolerance and visceral obesity. (3) This set of risk factors significantly increases the likelihood of long-term cardiovascular disease. (4)

In the past years, university students have shown higher obesity figures. (4,5) Young adults starting college are at a transition age, which is critical to the consolidation of health-related behaviors or habits. (6) For example, first-year college students experience faster weight gain than the average adult at another stage of life. (7) This relates to lifestyle choices, including poorly balanced diet, lack of physical activity or regular exercise, tobacco use, and excessive consumption of alcoholic beverages. (8) It has been fully established that these factors, together with obesity, contribute to increased risks of suffering from MS, regardless of age and educational or vocational level. (9)

Early detection of MS in young adults in the university context may guide the design of preventive programs or specific interventions to reduce the onset of the syndrome and associated medical and psychosocial complications that often become chronic. (10)

It is important to know the prevalence of MS in university students in order to take measures from a public health perspective and design strategies for early identification. This design is done using different screening techniques of possible cases in the academic context, and aims to reduce or minimize the problems associated with MS and the subsequent deterioration in the quality of life once current students are part of the country’s productive system. (11,12)

To date, there is no systematic review summarizing the observed prevalence of MS in university students in different contexts. Systematic reviews in other age groups showed striking values and a systematic review including obese adolescents revealed a mean prevalence of 31.2% ranging from 2.1% to 58.3%. (13) A similar review, including adults aged between 18 and 65 years, apparently healthy, from Latin American countries, found an adjusted prevalence of 24.9%, with a range between 18.8% and 43.3%. (14)

The objective of this systematic review was to establish the prevalence of MS in the university population as reported in studies published between January 2000 and January 2016.

Materials and methods

A systematic review of studies published in the PubMed, LILACS, ScienceDirect, UpToDate, Imbiomed, SciELO and Google Scholar databases between January 2000 and January 2016 was carried out to review the prevalence of MS in university students.

“Metabolic syndrome”, “Cardiovascular risk factors”, “University students” and “Students” were included as keywords. In order to ensure the largest number of publications, different word combinations were used in Spanish, English and Portuguese. This process was complemented by a manual review of the references of articles initially identified in the database search. Studies that evaluated the presence of MS according to the criteria of the National Cholesterol Education Program and the Adult Treatment Panel III (NCEP-ATP III) were included. (15) Figure 1 presents the flowchart of the selection of the reviewed studies.

![Flowchart of research inclusion](source)
NCEP-ATP III defines MS as the coexistence of at least three of the following factors: increased abdominal perimeter (≥102 cm in men and ≥88 cm in women), hypertriglyceridemia (≥150 mg/dl), decreased HDL (<40 mg/dl in men and <50 mg/dl in women), fasting hyperglycemia (≥110 mg/dl) and altered blood pressure (systolic blood pressure ≥130 mm Hg or diastolic blood pressure ≥85 mm Hg). (15,16) Narrative reviews, graduation projects, theses and studies carried out in the university context in which professors or administradors were mixed and the prevalence in the student group that could not be discriminated were excluded.

First, the titles were reviewed, then the abstracts and finally the full version of the articles that met all the inclusion criteria. A descriptive analysis of the publications was carried out and the country in which the study was conducted, year of publication, sample size, major/program, academic level of the population studied, and observed prevalence of MS in percentages were specified. For a more accurate observed prevalence, 95% confidence intervals were found for each of the studies.

The quality of the studies was evaluated using the questionnaire for observational analytical studies proposed by du Prel et al. (17). This instrument consists of 12 points that collect the most important aspects of the design and non-experimental observational studies analysis, as proposed by the instrument Strengthening the Reporting of Observational Studies in Epidemiology. (18)

**Results**

148 titles were identified, of which 120 were discarded since 106 did not include all the components of the MS and 14 were theses, graduation projects, meta-analyses or systematic reviews. Of the 28 pre-selected abstracts, 7 investigations that did not use biochemical tests to define MS were eliminated, as well as 3 that used criteria other than NCEP-ATP III, finally 1 study that did not clearly specify the criteria used to define MS, and 1 duplicated were also excluded. 16 studies met all the criteria for this review. (19-34) Regarding the quality of study reports, all met at least 11 of the 13 criteria assessed (10 met 13, 5 met 12, and 1 met 11). The articles with the lowest scores usually had smaller samples.

In general, studies conducted in different parts of the world, most of them from Latin America or Brazil, were included. In terms of the major or program to which the students were enrolled, the largest selection was made randomly from all programs (10 studies). The age of the participants ranged approximately between 17 and 26 years, and both men and women participated. The prevalence range of MS varied from 0% to 19.2%. Table 1 summarizes the information on the findings of the studies in chronological order.

**Discussion**

This study shows a high variation in the prevalence of MS in university students, which is between 0% and 19.2% according to the NCEP-ATP III criteria. In this sense, 10 studies found a prevalence of MS of <5.0%, 3 between 5.1% and 15%, and 3 of >15%, and this is somehow different from what has been reported in other systematic reviews in children, adolescents and adults.

Friend et al. (35) made a systematic review with 85 published studies in children and adolescents between 2003 and 2010 and found an average prevalence of MS of 3.3%. Other systematic reviews of findings in adult populations show a substantially higher prevalence. For example, Oguoma et al. (36), in 32 published studies between 2002 and 2013 worldwide, with a total sample of 10 854 subjects, found that the average prevalence is 27.9% according to NCEP-ATP III. De Carvalho-Vidigal et al. (37) reviewed 10 articles in Brazilian subjects, published until May 2013, with a total participation of 8 505 people, and found an average prevalence of MS of 28.9% according to the same criteria.

**Table 1.** Prevalence of metabolic syndrome in university students (NCEP-ATP III).

| Authors, year            | Country | n   | Sampling  | Prevalence % (CI95%) |
|--------------------------|---------|-----|-----------|----------------------|
| Huang et al. (19), 2004  | USA     | 163 | Random    | 0.6 (0.0-1.7)        |
| Palomo et al. (20), 2006 | Chile   | 783 | Random    | 1.0 (0.3-1.7)        |
| Oviedo et al. (21), 2008 | Venezuela | 120 | Non-random* | 3.3 (0.1-2.6)        |
| Nillakupt & Vravathana (22), 2010 | Thailand | 96 | Non-random* | 1.0 (0.0-3.1)        |
| Fernandes & Lofgren (23), 2011 | Jamaica  | 189 | Random    | 3.7 (1.0-6.4)        |
| Dalleck & Kjelland (24), 2012 | USA     | 207 | Non-random* | 6.8 (3.3-10.3)       |
| de freitas et al. (25), 2012 | Brazil  | 702 | Random    | 1.7 (0.7-2.6)        |
| Martínez et al. (26), 2012 | Chile   | 385 | Random    | 4.9 (2.7-7.1)        |
| Topé & Rogers (27), 2013 | USA     | 376 | Random    | 16.0 (12.2-19.8)     |
| Maldonado-Villalón et al. (28), 2013 | Mexico  | 141 | Random*   | 7.8 (3.4-12.2)       |
| Arnold et al. (29), 2014 | USA     | 109 | Non-random† | 0.0                  |
| Zea-Robles et al. (30), 2014 | Colombia | 193 | Random    | 16.6 (11.3-21.9)     |
| Vilarrusca-da Silva et al. (31), 2014 | Brazil   | 550 | Random    | 3.5 (2.0-5.0)        |
| de Carvalho et al. (32), 2015 | Brazil  | 968 | Random    | 19.2 (16.7-21.7)     |
| Alarcón et al. (33), 2015 | Colombia | 177 | Random    | 9.6 (5.2-14.0)       |
| Mee-Kyung et al. (34), 2015 | Korea   | 151 | Random    | 4.0 (0.9-7.1)        |

Source: Own elaboration.  
* Medical students only.  
† African-American students only.

Certainly, the differences in the prevalence percentages and variables associated with MS observed between the studies reviewed in this research and previous systematic reviews may be explained by the variety of demographic and cultural characteristics of the participants. (38) Likewise, social and economic inequalities should be considered, not only those that occur between countries, but also those that are found in different regions of the same country. The prevalence of obesity and, consequently, of MS tends to be higher in developed or high-income countries. (4)

It is relevant to know the prevalence of MS in university youth, both for education and public health. This information about the frequency in university institutions is fundamental to encourage, based on the best evidence, the promotion of healthy lifestyles that include non-pharmacological measures such as diet and exercise at this stage of life. (39) Moreover, these measures may need to be implemented at elementary and secondary education levels (40-42) due to the increasing prevalence of obesity in the early years of life, which is the main component of MS. (43-45)

From a public health perspective, this prevalence is relevant for promoting metabolic disorders, and control and reducing associated long-term morbidity and mortality. (46) It is important to promote preventive actions based on a healthy lifestyle that include a balanced...
diet—for example, the Mediterranean diet, which has demonstrated to be helpful to reduce and prevent metabolic disorders—and habits such as regular physical activity. (47) These actions can be included in the curricular and extracurricular components of vocational training programs as ways to promote self-care. (48,49) Similarly, it is necessary to work for the promulgation of public policies more aligned with a healthy lifestyle from the early stages of life. (50-52)

The strength of this systematic review is that it summarizes the research done in the university population of the last years to date, which were not included in any systematic review. The search also included articles in Spanish and Portuguese that are not usually considered in English-language publications. However, there are some limitations, including that the participating populations showed high heterogeneity in their characteristics and in the quality of the studies, which greatly limits the generalization of any conclusion.

Conclusion

Prevalence of MS in university students is high when compared to that observed in children and adolescents; therefore, further research with more representative or stratified samples is needed to know the frequencies in different sectors or subgroups of university populations, which will allow the design of specific interventions for high-risk groups in the university context.

Conflicts of interest

A preliminary analysis of this work was presented at the IV Congreso de Salud Integral, Universidad del Magdalena, held in Santa Marta on October 28 and 29, 2016 and appears in the form of a summary in the report of said event.

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References

1. Zimmer P, Alberti KGMM, Serrano-Ríos M. Una nueva definición internacional del síndrome metabólico propuesta por la Federación Internacional de diabetes: Fundamento y resultados. Rev Esp Cardiol. 2005;58(12):1371-6. http://doi.org/bsszbp.

2. International Diabetes Federation. The IDF Consensus Worldwide Definition of the Metabolic Syndrome. Berlin: IDF; 2005.

3. Duperly J. Sedentarismo vs ejercicio en el síndrome metabólico. Acta Med Colomb. 2005;30(3):133-6.

4. Ng M, Fleming T, Robinson M, Thomson B, Graetz N, Margono C, et al. Global, regional, and national prevalence of overweight and obesity in children and adults during 1980-2013: a systematic analysis for the Global Burden of Disease Study 2013. Lancet. 2014;384(9945):766-81. http://doi.org/ezv.

5. Rodríguez-Soriano NY, Martínez-Stack J, Murguía-Romero M, Herrera-Rueda JA, González-Quintero RD, Mata-Gómez AD, et al. Prevención de síndrome metabólico en estudiantes universitarios. Urriachi Revista de Psicología. 2012;9(20):111-25.

6. Mansilla ME. Etapas del desarrollo humano. Revista de Investigación en Psicología. 2000;3(2):105-16.

7. García-Laguna DG, García-Salamanca GP, Tapiero-Paipa YT, Ramos DM. Determinantes de los estilos de vida y su implicación en la salud de jóvenes universitarios. Hacia la Promoción de la Salud. 2012;17(2):169-85.

8. Holm-Denoma JM, Joiner TE, Vohs KD, Heatherton TF. The ‘freshman fifteen’ (the ‘freshmen five’ actually): Predictors and possible explanations. Health Psychol. 2008;27(15):S3-9. http://doi.org/csnv2p.

9. Cid P, Merino JM, Stiepovich J. Factores biológicos y psicosociales predictores del estilo de vida promotor de salud. Rev. Med. Chile. 2006;134(12):1491-9. http://doi.org/cz56ft.

10. De Ferranti SD, Gauvreau K, Ludwig DS, Neufeld EJ, Newburger JW, Rifai N. Prevalence of the metabolic syndrome in American adolescents: Findings from the Third National Health and Nutrition Examination Survey. Circulation. 2004;110(16):2494-7. http://doi.org/bp6c2m.

11. Goldman L. The decline in coronary heart disease: determining the pattern of success. Am J Med. 2004;117(4):274-6. http://doi.org/b58m9z.

12. López M, Sosa M, Paulo N, Labrousse M. Síndrome metabólico. Rev. Pongrado Via Catedra Med. 2007;174:1-4.

13. Gomes-Rodrigues L, Pombo N, Kofman S. Prevalencia de alterações metabólicas em crianças e adolescentes com sobrepeso e obesidade: uma revisão sistemática. Rev Paul Pediatr. 2011;29(2):277-88. http://doi.org/bjkh7vm.

14. Márquez-Sandoval F, Macedo-Ojeda G, Viramontes-Hörner D, Fernández-Ballart JD, Salas-Salvado J, Vizmanos B. The prevalence of metabolic syndrome in Latin America: A systematic review. Public Health Nutr. 2011;14(10):1902-13. http://doi.org/bpvknc.

15. Crepaldi G, Maggi S. El síndrome metabólico: Contexto histórico. Diabetes Voice. 2006;51:8-10.

16. Grundy S, Cleeman JI, Daniels S, Donato KA, Eckel RH, Franklin BA, et al. Diagnosis and management of the metabolic syndrome: an American Heart Association/National Heart, Lung, and Blood Institute Scientific Statement. Circulation. 2005;112(17):2735-52. http://doi.org/bdwavp.

17. du Prel JB, Röhrig B, Blettner M. Critical appraisal of scientific articles: part 1 of a series on evaluation of scientific publications. Deut. Arztebl. 2009;106(7):100-5. http://doi.org/cqhf.

18. Von Elm E, Altman DG, Egger M, Pocock SJ, Vandenbroucke JP, et al. Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. BMJ. 2007;335(7624):806-8. http://doi.org/dxsb3b.

19. Huang TT, Kempf AM, Strother ML, Li C, Lee RE, Harris KJ, et al. Overweight and components of the metabolic syndrome in college students. Diabetes Care. 2004;27(12):3000-1. http://doi.org/bq9bdr.

20. Palomo IF, Torres GI, Alarcón MA, Maragaño PJ, Leiva E, Mujica V. Alta prevalencia de factores de riesgo cardiovascular clásicos en una población de estudiantes universitarios de la región centro-sur de Chile. Rev Esp Cardiol. 2006;59(11):1099-105. http://doi.org/bbc3cb.

21. Oviedo G, Morón-de Salim A, Santos I, Sequera S, Soufrongt G, Suárez P, et al. Factores de riesgo de enfermedades crónicas no transmisibles en estudiantes de la carrera de Medicina, Universidad de Carabobo, Venezuela. Año 2005. Nutr. Hosp. 2008;23(3):288-93.

22. Villacís C, González-Velázquez A, Miranda JR, Quijano C, Vázquez-Alarcón J. Índice de masa corporal y diabetes tipo 2: prevalencia y factores de riesgo. Rev. Med. Chile. 2012;140(9):1219-25. http://doi.org/cz56ft.

23. Dalleck LC, Kjelland EM. The prevalence of metabolic syndrome among university students: 629-33

24. Duarte AV, de Souza CM, Silva AG, de Souza RC. Prevalência de alterações metabólicas em crianças e adolescentes com sobrepeso e obesidade: uma revisão sistemática. Rev. Paul. Pediatr. 2010;28(2):131-41. http://doi.org/dxb3b.

25. Palomo IF, Torres GI, Alarcón MA, Maragaño PJ, Leiva E, Mujica V. Alt prevalencia de factores de riesgo cardiovascular clásicos en una población de estudiantes universitarios de la región centro-sur de Chile. Rev Esp Cardiol. 2006;59(11):1099-105. http://doi.org/bbc3cb.

26. Martínez MA, Leiva AM, Sotomayor C, Victorianno T, Von Chrismar AM, Pineda S. Factores de riesgo cardiovascular en estudiantes de la
La prevalencia de la síndrome metabólica en estudiantes universitarios: una reflexión. Salud Publica Mex. 2008;50(60):530-47. http://doi.org/bhcs6w.

39. García-García E, De la Llata-Romero M, Kauffer-Hrwitz M, Tu-sié-Luna MT, Calzada-León R, Vázquez-Velázquez V, et al. La obesidad y el síndrome metabólico como problema de salud pública: una reflexión. Rev. Fac. Med. 2018 Vol. 66 No. 4: 629-33

40. Vande-Ploeg KA, McGavock J, Maximova K, Vengeleurs PJ. School-based health promotion and physical activity during and after school hours. Pediatrics. 2014;133(2):e371-8. http://doi.org/br7m.

41. van Grieken A, Renders CM, Veldhuis L, Looman CW, Hirasing RA, Raat H. Promotion of a healthy lifestyle among 5-year-old overweight children: health behavior outcomes of the 'Be active, eat right' study. BMC Public Health. 2014;14(1):59. http://doi.org/br7k.

42. King KM, Ling J. Results of a 3-year, nutrition and physical activity intervention for children in rural, low-socioeconomic status elementary schools. Health Educ Res. 2015;30(4):647-59. http://doi.org/br6k.

43. Keane E, Kearney PM, Perry IJ, Kelleher CC, Harrington JM. Trends and prevalence of overweight and obesity in primary school aged children in the Republic of Ireland from 2002-2012: a systematic review. BMC Public Health. 2014;14(1):974. http://doi.org/br6j.

44. Gomes TN, Katzmanyk PT, dos Santos FK, Souza M, Pereira S, Maia JA. Overweight and obesity in Portuguese children: Prevalence and correlates. Int J Environ Res Public Health. 2014;11(11):11398-417. http://doi.org/br6h.

45. He F, Liu J. Prevalence of obesity among primary students from 2009 to 2014 in China: an update meta-analysis. Int J Clin Exp Med. 2014;7(12):5348-52. http://doi.org/br6g.

46. Garza-Beenito F, Ferreira-Montero IJ, del Rio-Ligrit A. Prevención y tratamiento del síndrome metabólico. Rev Esp Cardiol. 2008;61(12):1198-206. http://doi.org/br6f.

47. Morales G, del Valle C, Soto Á, Ivanovic D. Factores de riesgo cardiovascular y su tratamiento del síndrome metabólico. Rev. Chil. Nutr. 2013;40(4):391-6. http://doi.org/br5f.

48. Lakka TA, Laaksonen DE. Physical activity in prevention and treatment of the metabolic syndrome. Appl Physiol Nutr Metab. 2007;32(2):76-88. http://doi.org/bz5zd.

49. Alberti KG, Zimet P, Shaw J. Metabolic syndrome a new world wide definition. A Consensus Statement from the International Diabetes Fede. Diabet Med. 2006;23(5):469-80. http://doi.org/cnrv9.

50. Galbraith-Emami S, Lobstein T. The impact of initiatives to limit the advertising of food and beverage products to children: a systematic review. Obes Rev. 2013;14(12):960-74. http://doi.org/br6d.

51. Gostin L. Why healthy behavior is the hard choice. Milbank Q. 2015;93(2):242-6. http://doi.org/br6c.

52. Kelly PM, Davies A, Greig AJ, Lee KK. Obesity prevention in a City State: lessons from New York City during the Bloomberg administration. Front Public Health. 2016;4:60. http://doi.org/br6b.