Full text open access online (Since 2007)

Ethno Med, 18(1): 1-9 (2024)
PRINT: ISSN 0973-5070 ONLINE: ISSN 2456-6772 **DOI: 10.31901/24566772.2024/18.01.660**

Obesity and Arterial Hypertension in Children: Systematic Review

D. León Valladares[1*], L. A. Barrio Mateu[1], A. Hernández[2], J. Sanhueza[2], Í.Warner[2], A. M. Cabanas Plana[3], S. Helena Godoy[1], C. Lagos Olivos[1], D. Henriquez Villarroel[1] and A. G. Ávila-Montiel[4]

[1]Faculty of Education and Humanities, Department of Physical Activity and Sport Sciences, University of Tarapaca, Chile
[2]Faculty of Education and Humanities, Department of Physical Activity and Sport Sciences, University of Tarapaca, Chile
[3]Faculty of Sciences, Department of Physics, University of Tarapaca, Chile
[4]Medical Hospital San Luis de Buin, Autonomous University of Chile

KEYWORDS Body Composition. Childhood Obesity. Hypertension. Overweight. Pre- Hypertension

ABSTRACT Overweight, obesity, and arterial hypertension in children have become a serious and growing public health problem in this group. However, there is a lack of updated data to determine whether these conditions correlate. This systematic review was designed and developed following the "Preferred Reporting Items in Systematic Reviews and Meta-Analyses" (PRISMA) statement, performed through a bibliographic search in the SciELO (Scientific Electronic Library Online), MEDLINE (National Library of Medicine), and LILACS (Latin American and Caribbean Health Sciences Literature) databases. Finally, 7 studies were included in the quantitative analysis based on 5,364 subjects considered, and 14 studies were used for the qualitative analysis contributing to the discussion on the investigated topic. The presence of pre-AHT and early-stage AHT was high in all the studies, mostly in overweight and obese children, which, through the results, demonstrate that these values and the increase in BP are closely related to the increase in BMI (SciELO Scientific Electronic Library Online), MEDLINE (National Library of Medicine); LILACS (Latin American and Caribbean Health Sciences Literature).

Overweight and obesity in children contribute to a serious health problem. Being necessary to verify the opinions of the authors in recent years in relation to the relationship between these variables and the presence of hypertension in children. A systematic review was designed following the statement "Preferred Reporting Items in Systematic Reviews and Meta-Analyses" (PRISMA). A search was carried out in the Scielo, Google academic, PubMed, Latindex databases. Finally, 7 studies were included in the quantitative analysis based on 5,364 topics considered. Concluding that the presence of pre-HBP and HBP in the early stage was high in all the studies, mainly in overweight and obese children, which, through the results, demonstrates that these values and the increase in BP are closely related to the increase in BMI.

INTRODUCTION

Obesity is a chronic disease with multiple underlying causes (Muros 2016; Alba 2016; Erzurum-Alim et al. 2022; Padilla-Vinueza 2022); it exhibits different contributing elements, among which are age, demographic, socioeconomic components, and factors related to nutritional intake, in addition to lifestyles (Atalah 2012; Rivadeneira et al. 2021; Núñez-Rivas et al. 2022).

Raimann and Verdugo (2012), Vio del Río (2021) and Padilla-Vinueza et al. (2022), pointed out, in a study conducted on twins, siblings, and relatives, that boys are more likely to be overweight than girls, adding gender as another influential cause.

Another factor to consider is the physical activity percentage in which children and young people engaged, as this is an active component in energy regulation and the prevention of obesity. Lifestyles that include inadequate eating habits and physical inactivity are risk factors for cardiovascular and metabolic endocrine diseases, among which arterial hypertension (Crovetto et al. 2016; Santana et al. 2020; Martos-Moreno and Argente 2022; León et al. 2022) and diabetes mellitus (González et al. 2015) are the most prominent. Additionally, obesity predisposes to other conditions such as cancer (Viscardi et al. 2021). In the social and psychological sphere, stereotypes and prejudices toward people with obesity have

Address for correspondence:
Dayneri León Valladares
Dirección: Oscar Vildoso 2315,
Arica y Parinacota, Chile
CP: 1000000
Phone: +56951966235
E-mail: daynerileon1@gmail.com

been visualized (Guardabassi and Tomasetto 2020; Bastias-González et al. 2022).

On the other hand, the lack of physical activity and therefore the increase in sedentary lifestyle increased with the COVID-19 pandemic, thus being a predisposing element of diseases such as arterial hypertension (Ferrero et al. 2022; Leiva et al. 2022; Molina et al. 2022).

According to the "Fourth report on the diagnosis, evaluation, and treatment of elevated blood pressure in children and adolescents," blood pressure is considered hypertension when the value is > 95th percentile (p). "Prehypertension," indicated as blood pressure between p90 and p94, is not officially recognized, but there is research that points it out. The average blood pressure is determined when the value is lower than p90.

The prevalence of arterial hypertension in children and adolescents in Latin America, according to the systematic review carried out by Sánchez et al. (2022) showed a higher estimate of hypertensive children and adolescents, with values above those found in studies carried out in other continents.

According to Álvarez et al. (2022) and Pazmiño (2022) state that for the diagnosis of arterial hypertension in children and adolescents, it is necessary to evaluate blood pressure, and therefore, it is necessary to carry out this procedure in these age groups.

Elevated blood pressure causes structural changes in the arterial system that affect organs such as the brain, heart, and kidneys. Determining the main complications of arterial hypertension, which according to the order of frequency, are: cerebrovascular accident, coronary heart disease, heart failure, and chronic kidney disease (Tagle 2018; Bartkowiak et al. 2021).

High blood pressure is a polygenic disease, interrelated with environmental factors, which has seen its increase due to modern sedentary lifestyles and eating habits that lean towards fast foods and foods classified as "junk" with little nutritional value, excess salt, fats, and sugars (Pineda et al. 2020).

Based on the authors' considerations mentioned above, obesity and arterial hypertension are diseases that correlate with each other, both of a multifactorial nature in which environmental, genetic, and behavioral factors have an influence and are directly related to life habits inconvenient for health.

During the childhood and adolescence stages, which represent an important stage for the balanced development of health, it is necessary to detect bad habits or lifestyles to correct and help prevent mainly cardiovascular diseases, which originate during infancy and are consolidated in adulthood (Bancalari et al. 2011; Bitew et al. 2020; García et al. 2022; Pompa et al. 2022).

Hypertension was once considered rare in children; however, current studies demonstrated its increased prevalence, which is associated with a marked increase in childhood overweight and obesity rates in the last decade (Sánchez et al. 2017; Estragó et al. 2018).

Arterial hypertension in children and the relationship with obesity is a topic that, despite having been studied, continues to be of current interest, motivating the authors of the present work to inquire about the consensus to which various authors have arrived regarding this problem, highlighting the similarities and discrepancies, criteria and conclusions reached by researchers in the last 5 years.

Therefore, the researchers have decided to conduct the present study to investigate the literature on studies conducted in Latin America and the Caribbean between 2011 and 2019 on obesity rates, overweight, and hypertension in pediatric children aged 5 to 13 years, to reach a consensus on the results of the research reviewed.

Objectives

To identify the main results achieved by the different investigations that evaluate body composition and arterial hypertension in the child population.

METHODOLOGY

In July 2020, a literature search was conducted on studies on obesity and hypertension and their relationship in school children or pediatric ages between 5 and 13 years of age.

Eligibility Criteria

This systematic review was designed and performed in accordance with the "Preferred Reporting Items in Systematic Reviews and Meta-Analyses" (PRISMA) statement.

For the selection of the papers, three reviewers worked independently and then the results of the chosen proposals were compared.

Inclusion Criteria

1) Studies or surveys with blood pressure measurements and reports of the prevalence of arterial hypertension defined.
2) Studies or surveys including information on nutritional status based on body mass index according to World Health Organization (WHO) 2007 criteria.
3) Studies conducted on children in Latin American and Caribbean countries (5 to 13 years of age).
4) Studies in which the diagnosis of arterial hypertension had been established according to the "Fourth Report on the Diagnosis, Assessment, and Treatment of High Blood Pressure or Arterial hypertension in Children and Adolescents" (blood pressure values $\geq$ the 95th percentile).
5) Studies executed and published between the years 2011-2019.

Exclusion Criteria

1) Participants who were restricted to special populations and not in a schooling context.
2) Duplicate publications.
3) Inconspicuous or incomplete publications.

Information Sources

The analysis was based on a bibliographic search in SciELO (Scientific Electronic Library Online), Google academic, Latindex, PubMed (Medical Publications) databases.

Search Strategy

Search patterns included the following keywords: arterial hypertension, blood pressure, childhood obesity, and childhood overweight.

The following data were extracted from the selected studies for analysis and description: authors, year of publication, gender, degree of obesity and hypertension, number and distribution of the sample, and main results and conclusions of the study.

Three researchers participated in the data selection, carrying out individual analysis and individual analysis and then confrontation of the selection of the studies.

The «medical subject headings» were considered for the selection of the papers, defining as the topic or peak question "Relationship between body composition and arterial hypertension in the child population", a MeSH search was carried out according to the following components of the question Peak «body composition», «childhood obesity», «overweight», «hypertension», «pre- hypertension» (Fernández-Altuna et al. 2016).

The methodology of finding the MeSH available according to the Peak question was used as a search method. And once the research question had been defined and its elements were specified through the Peak strategy, the search was initiated through the Digital Medical Library.

Assessment of Risk of Bias of Individual Studies

The quality assessment according to the type of study selected was based on the following scales:

- Newcastle-Ottawa (NOS): For cross-sectional and cohort studies, which are commonly used to evaluate non-randomized research. The following criteria were used: selection, comparability and result. Quality assessments were interpreted based on the following categories: very high risk of bias (0-3 points), high risk of bias (4-6 points), and low risk of bias ($\leq$7 points).
- STROBE Guide: guide for evaluation of the development of observational studies. It has 22 items considering the title, abstract, introduction, methods, results and discussion of the papers. It has specific evaluation items in the case of case-control studies, cohort or cross-sectional studies. Quality assessment for each study was performed by two separate authors.

Effect Measures

For the tabulation process from the information, a table was made with the results obtained

after data collection. Statistical data were presented in tabular form with the aim of making it easy to read and understand.

Ethical Considerations in the Search

At all times, during the search and collection of information, the ethical standards of data confidentiality have been followed.

Bibliographic Search Strategy

A systematic review was performed based on variables correlating childhood obesity and arterial hypertension. This study was conducted according to the considerations collected in the research by Díaz and Calandra (2017).

The following search terms in Spanish and English language were used: "adolescents", "pediatrics", "hypertension", "high blood pressure", "prevalence", "obesity". The results were supplemented with a manual search of relevant references quoted in the analyzed papers derived from the bibliographic search.

Four reviewers extracted each study's data following a standard protocol; a data collection form with a checklist was employed. The researchers selected the studies, extracted the data independently, cross-checked the data, and disagreements were resolved by consensus (Fig. 1).

Being selected 8 works from the following databases which met the inclusion and exclusion criteria. Among the selected databases were found: Scielo, Google academic, PubMed, Latindex (Table 1).

Eight articles were selected which met the established requirements as inclusion and exclusion criteria. The articles were extracted from the

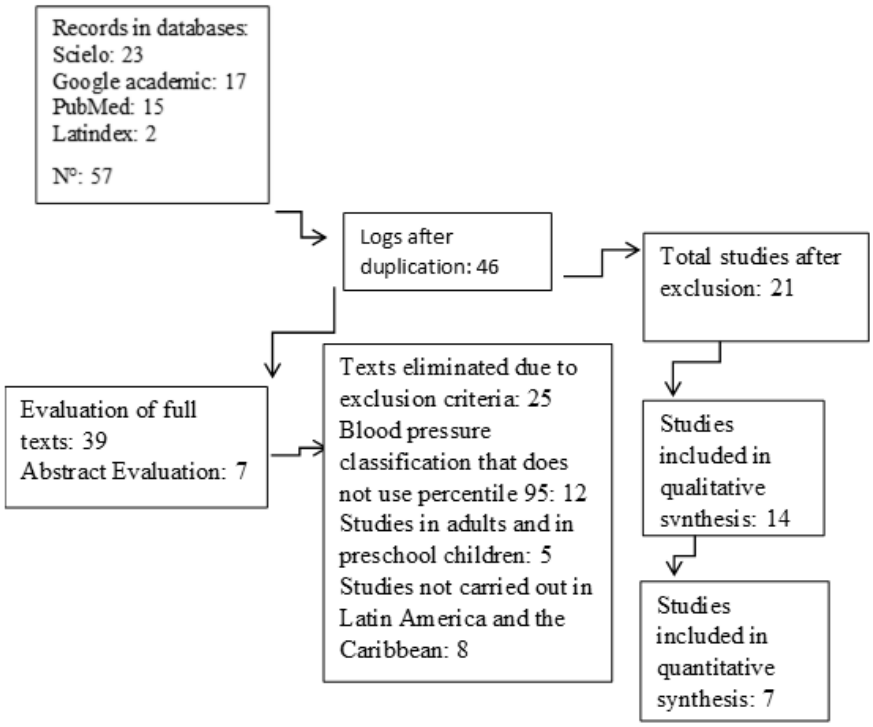

Fig. 1. Study selection flow for systematic review

Table 1: Characteristics of the studies selected for the study

Authors (year)	*N° sample*	*Age range (N°=years)*	*Nutritional state (IMC)**	*PA** state*	*Conclusions*
Estragó et al. (2018)	1.302	10-13	N:783 S:347 O: 148	OS:24 N:1.120 Pre-HT:79 HTA:98	This age group has a statistically significant association of pre-HTA and HT with overweight and obesity.
Bancalari et al. (2011)	2.980	6 a 14 N:1.593 S:720 O:622	BP:45	HTA: 405	The prevalence of HT increases as BMI increases.
de la Torre, Castellanos and Sagastume (2011)	144	9 a 12	BP: 6N: 63 S:22 O: 53	N: 117 Pre-HT: 8 HTA: 19	In this population of schoolchildren, there is a significant association between obesity and the prevalence of hypertension.
Garretto, Mena (2016)	489	6 a 11 O:111	BP:37 N:26	N: 463 HTA: 26 0S:81	The statistically significant association between obesity and altered blood pressure.
Sánchez, García, González, Naranjo (2017)	39	5 - 12	BP: 1 N: 16 S:8 O: 14	N: 28 Pre-HT:9 HTA: 2	A high percentage of children are obese and are at high risk of developing hypertension early in life.
Escudero, Morales, Valverde, Ocaña, Velasco (2014)	100	6 – 15	O: 100	N:89 HTA: 11	This study found that 11% of obese children with HBP while 89% are below the percentile.
González et al. (2013)	310	5 - 11	BP: 15 N: 214 S: 39	N: 278 Pre-HTA: 13 HTA: 19 O: 42	This study found that 10.3% of children with blood pressure figures above normal.

Legend:
*RBP: Underweight risk; BP: Underweight; N: Normal weight; S: Overweight; O: Obesity; OS: Severe obesity
**N: Normo tense; Pre-HTA: Pre-hypertension; HTA: Hypertension

databases: Scielo, Google academic, PubMed, Latindex (Table 1).

RESULTS

The preliminary bibliographic search identified 57 studies. In the second phase of the search, 11 titles and abstracts were excluded because of the lack of descriptive data on the population under study, missing specificity in the nutritional status or BP index of the participants, or data that could not be compared with other studies. In the third phase, the full texts of 39 studies and 7 abstracts were analyzed, of which 25 were excluded (according to the exclusion criteria). Finally, a total of 7 studies were included in the quantitative analysis based on 5,364 subjects, and 14 studies were used for the qualitative analysis, contributing to the discussion on the investigational topic. Table 2 shows the characteristics of each study considered for the quantitative analysis, such as the number of participants, mean age, overall nutritional status of the sample, blood pressure indices, and overall results and conclusions of the studies. The number of participants in each study ranged from 39 to 2980 subjects.

According to the analysis of the texts and studies, this comparative work considered 5,364 samples; the age range of the participants ranged from five to 15 years old. The mean reported age of the participants was 9.5 years, considering 85 percent of the studies.

In the studies, five (71%) of the subjects' sample was divided into men and women, whereas 2 studies (Bancalari et al. 2011; de la Torre et al. 2011) presented a higher number of men in their sample. Three studies were found that measured mostly women (Escudero et al. 2014; Sánchez et

al. 2017; Estragó et al. 2018). Of these five studies (71%), too coincide and evidence a higher prevalence of HTA in men than women. In comparison, three studies ensure that the evidence does not represent a significant value to make it an influential variable in the suffering of arterial hypertension.

The nutritional status of the sample was based on body mass index, 104 children (1.94%) were classified as underweight, 2,929 children (54.6%) as normal weight, 1,217 children (22.69 %) as overweight, 1,090 children (20.32%) as obese and 24 children (0.45%) as severely obese.

A significant percentage of the total (43.46%) showed excess malnutrition, confirming the prevalence of obesity and overweight in this age group.

A total of 2,784 children's blood pressure status was measured, a figure correlated with the nutritional status of the total sample. The analyzed study data indicated that 2095 children (75.25 %) had standard blood pressure indexes. At the same time, 109 children (3.92%) were diagnosed with pre- arterial hypertension, and 580 (20.83%) presented indices of arterial hypertension.

It was found that 6 (85%) of the 7 studies analyzed highlighted a correlation between overweight and obesity and arterial hypertension, suggesting the various issues associated with this condition.

DISCUSSION

Arterial hypertension in children has been associated with predisposing factors such as obesity and overweight, the foregoing was shown by Lapur et al. (2009), those who verified a prevalence of arterial hypertension in children of approximately 3 to 5 percent, noting that these values have increased in recent years due to obesity rates, these results coincide with those exposed by the authors Garretto and Mena (2016) and Sánchez et al. (2017), whose investigations were valued in the present study.

Increases and alterations in blood pressure (prehypertension or arterial hypertension) have also been found in adolescents by up to 10 to 15 percent, these findings being more frequent in obese people, with a probability of 3 to 5 times greater than in people non-obese, in relation to this approach Estragó et al. (2018) pointed out a statistically significant relationship between overweight and obesity with the presence of prehypertension and arterial hypertension in this population, coinciding with the results shown in the papers analyzed in this research.

For their part, Bancalari et al. (2011) showed that the risk of arterial hypertension is greater as the body mass index increases, evidenced in their research values of overweight of 24.4 percent, obesity of 20.7 percent, and a prevalence of arterial hypertension of 13.6 percent, which coincides with the results obtained by Bancalari et al. (2011), authors who were analyzed in this research and who made an assessment of a total of 2,980 children, showing among their main results an increase in the prevalence of arterial hypertension in children with increases in body mass index.

In the study conducted by Cho et al. (2018), Korean teenagers had a high incidence of metabolic risk factors and a prevalence of overweight, obesity, severe obesity, and extremely severe obesity of 5.6 percent. On the other hand, systolic blood pressure behaved greater than or equal to 130 mg/dL, increasing significantly as body weight increased, which is consistent with the conclusions reached by the authors evaluated in this review.

Taking into account the results of the studies analyzed and the review carried out, it is considered necessary to prevent the appearance of predisposing factors for arterial hypertension, among them, a sedentary lifestyle, obesity or being overweight, since these are predisposing to hypertension or predisposing to hypertension or prehypertension at an early age, both in childhood and adolescence. On the other hand, an early diagnosis is necessary, which would allow the implementation of strategies aimed at modifying the natural history of this condition, reducing cardiovascular pathologies, increased risk of stroke, risk of acute myocardial infarction, chronic kidney disease, peripheral arterial disease, among others, each closely related to arterial hypertension (Tagle 2018), the authors of this study agree with what was stated by Tagle (2018).

For their part Raina et al. (2022) state that early diagnosis and treatment (in children and adolescents) of high blood pressure are essential to improve long-term cardiovascular health and prevent long-term morbidity and mortality, which coincides with the conclusions reached by au-

thors such as de la Torre et al. (2011), Estragó et al. (2018) those who were analyzed in the present study.

Caro-Bustos et al. (2021) highlight in their systematic review that the reviewed studies show the consolidation of obesity as an acquired risk factor for the appearance of metabolic diseases; likewise, some of these investigations reflect the direct relationship between obesity and arterial hypertension in children and youth populations, coinciding with the results evidenced in this paper.

CONCLUSION

The prevalence of childhood obesity and hypertension is high according to the analysis of each study, and current trends indicate that the prevalence of these diseases will continue to increase in the future. The seven studies claim to have shown a high percentage of childhood overweight and obesity, where no significant difference between sex or age range is observed In addition, the seven studies showed a high presence of arterial pre-hypertension, mainly in overweight and obese children, demonstrating through the results that these values and the increase in blood pressure are closely related to the increase in body mass index. The information obtained reached a consensus on the need to know, diagnose, control, and regulate children's nutritional status on a preventive and periodic basis to avoid arterial hypertension and other conditions that have been increasing in parallel with obesity.

RECOMMENDATIONS

Develop similar studies that allow for information gathering with a higher number of literary references. Also, consider including different age groups and genders.

ACKNOWLEDGMENTS

The paper is part of the Research Project Innovation in Higher Education UTA 2022. Entitled: Semillero de Investigación. Semillas que germinan. From the Universidad de Tarapacá, pertaining to the Department of Sciences of the Physical Activity and the Sport of the Faculty of Education and Humanities of the Universidad de Tarapacá.

CONFLICT OF INTERESTS

The authors of this study do not declare any type of conflict of interest.

AVAILABILITY OF DATA, CODES AND OTHER MATERIALS

The data obtained in this information have been obtained from different online information search sites and each paper analyzed can be viewed by checking the data of bibliographical references. Templates for data extraction forms, data from the studies that were included, data utilized for all analyses, analytic code, and any additional materials used in the review, is under the responsibility of the corresponding author, who taking care of the principles of etic y bioethical has stored this information in a secure place.

REFERENCES

Alba M 2016. Prevalence of childhood obesity and eating habits in primary education. *Global Nursing,* 15(42): 40-51.

Álvarez J, Aguilar F, Lurbe E 2022. The measurement of blood pressure in children and adolescents: Key element in the evaluation of arterial hypertension. *Annals of Pediatrics,* 96(6): 536.e1:536.e7.https://doi.org/10.1016/j.anpedi.2022.04.015.

Atalah E 2012. Epidemiology of obesity in Chile. *Las Condes Clinic Medical Journal,* 23(2): 117-123.

Bancalari R, Díaz C, Martínez A, Aglony M, Zamorano J, Cerda V, Fernández M, Garbin F, Cavada G, Valenzuela M, García H 2011. Prevalence of arterial hypertension and its association with obesity in children. *Chilean Medical Journal,* 139(7): 872-879.

Bastias-González F, Jorquera C, Matamala C, Aguirre P, Escandón-Nagel N, Marileo L, Viscardi S 2022. The weight stigma of nutrition and dietetics students towards people with obesity. *Rev Chil Nutrition,* 49(3). http://dx.doi.org/10.4067/s0717-75182022000300378

Bitew ZW, Alemu A, Ayele EG, Tenaw Z, Alebel A, Worku T 2020. Metabolic syndrome among children and adolescents in low and middle income countries: A systematic review and meta-analysis. *Diabetol Metab Syndr,* 12(1): 93. https://doi.org/10.1186/s13098-020-00601-8

Bartkowiak J, Spitzer E, Kurmann R, Zürcher F, Krähenmann P, Garcia-Ruiz V et al. 2021. El impacto de la obesidad en la hipertrofia ventricular izquierda y la disfunción diastólica en niños y adolescentes. *Informes científicos,* 11: 13022. https://www.nature.com/articles/s41598-021-92463-x

Caro-Bustos D, Uribe-Barra M, López-Alegría F 2021. Pediatric obesity and early onset of cardiometabolic syndrome: Systematic review. *Rev Chil Nutr,* 48(3). http://dx.doi.org/10.4067/s0717-75182021000300447

Cho WK, Han K, Ahn MB, Park YM, Jung MH, Suh BK 2018. Metabolic risk factors in Korean adolescents with severe obesity: Results from the Korea National Health and Nutrition Examination Surveys (K-NHANES) 2007-2014. *Diabetes Res Clin Pract*, 138: 169-176.

Crovetto M, Henríquez C, Parraguez R 2016. Relationship between the institutional feeding of Kindergartens and the Home with the nutritional status of preschoolers who attend two Kindergartens in Valparaíso, Chile. *Spanish Journal of Human Nutrition and Diet*, 20(1): 4-15.

The Fourth Report on the Diagnosis, Evaluation, and Treatment of Elevated BP in Children and Adolescents 2004. *Pediatrics* (2 Suppl 4th Report), 114: 555-576.

De la Torre MJV, Castellanos JLV, Sagastume RC 2011. Arterial Hypertension in Overweight and Obese School Children. *Public Health and Nutrition Magazine*, 12(3). http://respyn.uanl.mx/index.php/respyn/article/view/292/0 (Retrieved on 22 January 2022).

Díaz A, Calandra L 2017. Elevated blood pressure in school children and adolescents in Argentina in the last 25 years: systematic review of observational studies. *Argentine Archives of Pediatrics*, 115(1): 5-11.

Erzurum- Alim N, Yuksel A, Tevfikoglu- Pehlivan L, Karakaya RE, Besler ZN 2022. Risk of eating disorders and factors associated with obesity prejudice in college students: A descriptive cross-sectional study. *Spanish Journal of Human Nutrition and Diet*, 26(2): 104–113. https://doi.org/10.14306/renhyd.26.2.1492

Escudero-Lourdes GV, Morales-Romero L V, Valverde-Ocaña C, Velasco-Chávez JF 2014. Cardiovascular Risk in Children Aged 6 to 15 with Exogenous Obesity. Rev Med Inst Mex Seguro Soc, 52(S1). From <ttps://www.medigraphic.com/cgi-bin/new/resumen.cgi> (Retrieved on 22 January 2022).

Estragó V, Tabárez A, Muñoz M, González G et al. 2018. Overweight, obesity and arterial hypertension in children, an approach to the problem. *Archives of Pediatrics of Uruguay*, 89(5): 301-310.

Fernández-Altuna MA, Martínez del Prado A, Arriarán – Rodríguez E et al. 2016. Use of MeSH: A practical guide. *Medical Educ Research*, 5(20). https://doi.org/10.1016/j.riem.2016.02.004

Ferrero HP, Marcial AD, Muñoz VD 2022. Effects of a remote physical exercise program for overweight and obese people on anthropometric and psycho-emotional indicators: proposal for a pilot intervention protocol in the context of COVID-19. *Archives of the Chilean Society of Sports Medicine*, 67(1): 3-11.

García SA, Ninatanta-Ortiz JA, Abanto MV, Pérez KM et al. 2022. Lifestyle school-based intervention to increase the proportion of adolescents free of components of the metabolic syndrome in an andean region of Peru. *Rev Peru Med Exp Salud Pública*, 39(1). https://doi.org/10.17843/rpmesp.2022.391.9986

Garretto-Guardabassi M, Mena M, Barbero L, Scruzzi G 2017. Nutritional status and blood pressure in school children from Alta Gracia, Córdoba 2016. *Magazine of the Faculty of Medical Sciences of Córdoba*, 1-70. https://doi.org/10.31053/1853.0605.v0.n0.18331

González R, Llapur R, Díaz M, Illa M, Yee E, Pérez D 2015. Lifestyles, arterial hypertension and obesity in adolescents. *Cuban Journal of Pediatrics*, 87(3): 273-284.

González R, Llapur R, Díaz ME, Moreno V, Pavón M 2013. Arterial hypertension and obesity in schoolchildren from five to eleven years of age. *Cuban Journal of Pediatrics*, 85(4): 418-427.

Guardabassi V, Tomasetto C 2020. Weight status or weight stigma? Obesity stereotypes-Not overweight-Reduce working memory in school-age children. *J Exp Child Psychol*, 189: 104706.

Leiva LE, Vásquez-Guillén M, Vásquez-Guillén A, Contreras M, Carrero Y 2022. Obesity-associated complications of Covid-19: Review. *Investigative Nursing*, 7(2): 80 – 86.

León ML, González LH, Morffi A, Figueredo A, Ramírez E, Fernández L 2022. Pathophysiological Relationships between Cardiovascular Hyperreactivity, Obesity and Sedentary Lifestyle. Rev Finlay, 12 (1). From <http://scielo.sld.cu/scielo.php?pid=S22212434202200 0100077 &script=sci_arttext&tlng=en> (Retrieved on 20 January 2022).

Llapur- Milián JR, González-Sánchez R, Betancourt- Pérez A, Rubio Olivares DY 2009. Left Ventricular Hypertrophy and Cardiovascular Risk Factors in Hypertensive Children and Adolescents. Cuban Journal of Pediatrics, 81(2). From <http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S0034- 75312009000200004 &lng=es&tlng=es.> (Retrieved on 20 January 2022).

López - Galisteo JP, Gavela - Pérez T, Mejorado - Molano FJ et al. 2022. Prevalence and risk factors associated with different comorbidities in obese children and adolescents. *Endocrinology, Diabetes and Nutrition*, 69(8): 566-575. https://doi.org/10.1016/j.endinu.2021.10.013

Martos-Moreno GA, Argente J 2022. Monogenic obesity in childhood: Towards precision medicine. *Rev Esp Endocrinol Pediatr*, 13(2): 23-32. Doi. 10.3266/RevEspEndocrinol Pediatr.pre2022.Apr.733

Moher D, Altman DG, Liberati A, Tetzlaff J 2011. PRISMA statement. *Epidemiology*, 22(1): 128.

Molina- Avilez DL, Guzmán- Ortiz E, Díaz-Manchay RJ 2022. Childhood obesity during the COVID-19 pandemic: Challenge for the health professional and the family. *Rev Cubana Pediatr*, 94(1): 1-14.

Muros J 2016. Relationship between physical condition, physical activity and different anthropometric parameters in school children from Santiago (Chile). *Hospital Nutrition*, 33(2): 314-318.

Norman FR 2016. Evaluation of nutritional status, eating habits and physical activity in 1st grade schoolchildren on Easter Island in Chile in the last decade. *Chilean Nutrition Magazine*, 43(4): 375-380.

Núñez-Rivas HP, Holst-Schumacher I, Roselló-Araya M, Campos-Saborio, N, Guzmán-Padilla S 2022. Duration of breastfeeding, combined feeding and health risk in young Costa Ricans. *Andes Pediatric*, 93(1). http://dx.doi.org/10.32641/andespediatr.v93i1.3645

Padilla-Vinueza VE, Tisalema-Tipan HD, Acosta-Gavilánez RI, Jerez-Cunalata EI, Moreno-Carrión AA, Salvador-Aguilar AD 2022. Childhood Obesity and Intervention Methods; Rev Domain of Sciences, 8(1). From <https://www.dominodelasciencias.com/ojs/index.php/es/article/view/2534> (Retrieved on 22 January 2022).

Pazmiño MJ 2022. *Importance of Blood Pressure Screening in Children and Adolescents. Bibliographic Review.* UCE. Quito Edition.

Pineda B, Hernández P, Balanzar A, Legorreta J, Paredes S, Ponce J 2020. Overweight and obesity in primary school students from two municipalities on the Costa Chica de Guerrero, Mexico. *Current Nursing of Costa Rica*, (38): 151-162.

Pompa Y, Naranjo - Vázquez S, Casas - Núñez Y, Peña - Figueredo R, González - Rubio Z 2022. Clinical-epidemiological behavior of pediatric patients diagnosed with arterial hypertension. *Student Scientific Magazine*, 5(1): 268.

Raimann TX, Verdugo MF 2012. Physical activity in the prevention and treatment of childhood obesity. *Las Condes Clinic Medical Journal*, 23(3): 218-225.

Raina R, Khooblall A, Shah R, Vijayvargiya N, Khooblall P, Sharma B, Datla N, Narang A, Yerigeri K, Melachuri M, Kusumi K 2022. Implicaciones cardiovasculares en la hipertensión del adolescente y del adulto joven. *Rev Cardiovasc Medicina*, 23(5): 166. https://doi.org/10.31083/j.rcm2305166

Rivadeneira J, Soto A, Bello N, Concha M 2021. Parenting styles, childhood overweight and obesity: Cross-sectional study in the Chilean child population. *Rev Chil Nutr*, 48(1): 18–30.

Rodrigues PRM, Pereira RA, Gama A, Carvalhal IM, Nogueira H, Rosado-Marques V 2018. Body adiposity is associated with risk of high blood pressure in Portuguese school children. *Rev Port Cardiol*, 37: 285-292.

Sánchez BV, García K, González AE, Saura-Naranjo HC 2017. Overweight and Obesity in Children from 5 to 12 Years of Age. Rev Finlay, 7(1). From mhttp://scielo.sld.cu/cielo.php? script= sci_arttext&pid=s2221-24342017000100007> (Retrieved on 20 January 2022).

Sánchez CZ, Sánchez MZ, López PC, Angélica Delgado Beltrán AD et al. 2022. Prevalencia de hipertensión arterial en niños y adolescentes de América Latina: revisión sistemática y metaanálisis. *Rev Pediatr Aten Primaria*, 24: e275-e281.

Santana S, Perdomo MC, Oramas A, González A 2020. Cardiovascular Hyperreactivity. Its Relationship With Work Demands. A Field Study. Rev Cubana Salud Trabajo, 21(3). From <https://revsaludtrabajo.sld.cu/index.php/revsyt/article/view/165> (Retrieved on 20 January 2022).

Saw del Río F 2021. Obesity and coronavirus: the two pandemics. *Rev Méd Chile*, 149(4). http://dx.doi.org/10.4067/s0034-98872021000400648

Soto JR 2018. Non-pharmacological treatment of arterial hypertension. *Las Condes Clinic Medical Journal*, 29(1): 61-68.

Tagle R 2018. Diagnosis of arterial hypertension. *Las Condes Clinic Medical Journal*, 29(1): 12-20.

Vandenbroucke JP, Von Elm E, Altman DG, Gøtzsche PC, Mulrow CD, Pocock SJ 2007. Strengthening the reporting of observational studies in epidemiology (STROBE): Explanation and elaboration. *PLoS Med*, 4: e297.

Vicente B, García K, González A, Saura CE 2017. Overweight and obesity in children from 5 to 12 years of age. *Finlay Magazine*, 7(1): 47-53.

Vio JS 2014. Effect of an educational intervention on healthy eating in teachers and preschool and school children in the Valparaíso region, Chile. *Hospital Nutrition*, 29(6): 1294-1304.

Viscardi S, Quilodrán J, Escobar Y, Salazar B, Marileo L 2021. Nutritional education intervention for children with cancer and their parents. *Rev Chil Nutr*, 48: 782-788.

Wells G, Shea B, O'Connell D, Peterson J, Welch V, Losos M 2014. *Newcastle-Ottawa Quality Assessment Scale Cohort Studies*. Ottawa: University of Ottawa.

Paper received for publication in October, 2022
Paper accepted for publication July, 2023