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Body Composition in Infants of Different Ethnicities Living at High Altitudes: A Systematic Review

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ABSTRACT The objective of this systematic review was: to identify the main results achieved by research evaluating body composition in children of different ethnicities living at high altitudes. A systematic review was carried out using the prism method, searching for information in databases such as PUDMED, SCOPUS, and SCIELO. The elements used for the search were: population, children, adolescents, obesity, overweight, ethnic groups, altitude and characteristics of body composition. Among the main results, it was found that 4345 (78.8%) boys and girls had normal weight, while 15.43 percent were overweight and obese. Concluding that, in indigenous populations with age groups from 0 to 14 years, there was a predominance of normal weight, observing high values of overweight and obesity in preschool ages.

INTRODUCTION

Childhood obesity and overweight have increased in recent years, which has generated the interest of many researchers in this subject, leading to an increase in articles and research on this topic, which is still a worldwide health problem. Among these studies, analyses of gender, different populations, and body composition variables' behavior according to geographic location and age groups have been verified.

Likewise, it has been seen how morphological values have been manifested in children of different ethnicities, among the research with indigenous population the study conducted by Bruneau et al. (2015) who analyzed Mapuche children; Barrio et al. (2018) who focused their research on Aymara children population. Benítez et al. (2014) and Díaz and Espinoza (2012) likewise referred to the behavior of body composition and somatotype in children of different ethnicities.

Likewise, evidence of studies covering the characteristics of body composition and somatotype in children according to geographic location and conditions, socioeconomic status, politics and purchasing power, and their impact on anthropometric variables is also contemplated in the literature (Bruneau et al. 2015; Thurber et al. 2018; Shypailo 2020).

However, despite finding numerous articles that highlight the behavior of body composition and somatotype, there is no consensus as to which all these studies have arrived, so it is necessary to conduct this systematic review to identify the most important results evidenced in the

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national and international literature, concerning body composition and somatotype in children of different ethnicities and latitudes.

Objectives

To identify the main results obtained by the different researches that evaluate body composition and somatotype in children of different ethnicities living at high altitudes.

METHODOLOGY

A bibliographic search was carried out throughout June, July, and August 2020, collecting research data found in the PUDMED, SCOPUS, SCIELO, and GOOGLE ACADEMIC databases. The elements on which this review focused were: population, children, altitude, adolescents, gender, obesity, altitude, ethnicity, body composition characteristics, and somatotype. The review was carried out by gathering publications of scientific articles published in peer-reviewed journals that sampled child populations of different ethnicities, considering morphological characteristics and the altitude in which they resided.

Bibliographic Search Strategy

A systematic review was carried out, where a compilation of scientific articles published in peer-reviewed journals was made. This search was carried out over three months, executed by three reviewers.

The following components were used for this search: languages (Spanish, English, and Portuguese), population (children, adolescents, obesity, altitude, ethnicity, body composition characteristics, and somatotype).

Inclusion Criteria

- Ethnicity.
- Body mass index, weight, height, body composition.
- Studies investigated that were related to somatotype.
- Nutritional status in inhabitants living more than 1,000 meters above sea level.
- National and international studies were included.
- Studies in both sexes.
- The researchers included studies where a quantitative analysis was applied and related to the subject of our research.
- The date of publication was also considered: from 2010 to 2020.
- Studies in Spanish, English, and Portuguese were included.
- The researchers considered studies that included age groups from 0 to 14 years old.
- Studies conducted in rural or urban areas were included.

Exclusion Criteria

- Date of publication: before 2010.
- Individuals or samples that did not belong to any ethnic group and that lived below 1,000 meters of altitude.
- Those articles that, despite talking about the subject, did not include the variable somatotype.
- Those articles that were intended for a different age group.
- Research without a defined research question was excluded.

Information Flow

Information flow diagram with its different phases through the Prisma method and the related literature search was carried out (Fig. 1).

The information flow diagram allowed the identification of studies without added value to improve the performance of the process, facilitated the number of the research record, the number of duplicated or eliminated citations, and the number of excluded articles, thus, being more transparent with the research performed.

RESULTS

In the initial bibliographic compilation, 263 studies were identified, of which 5 studies were excluded in the second phase of data collection due to duplicate citations. In the third phase, 206 studies were discarded because they did not specify the nutritional status of inhabitants living above 1,000 meters of altitude. In the fourth phase, 31 studies were considered, of which 26 were excluded because they did not contemplate

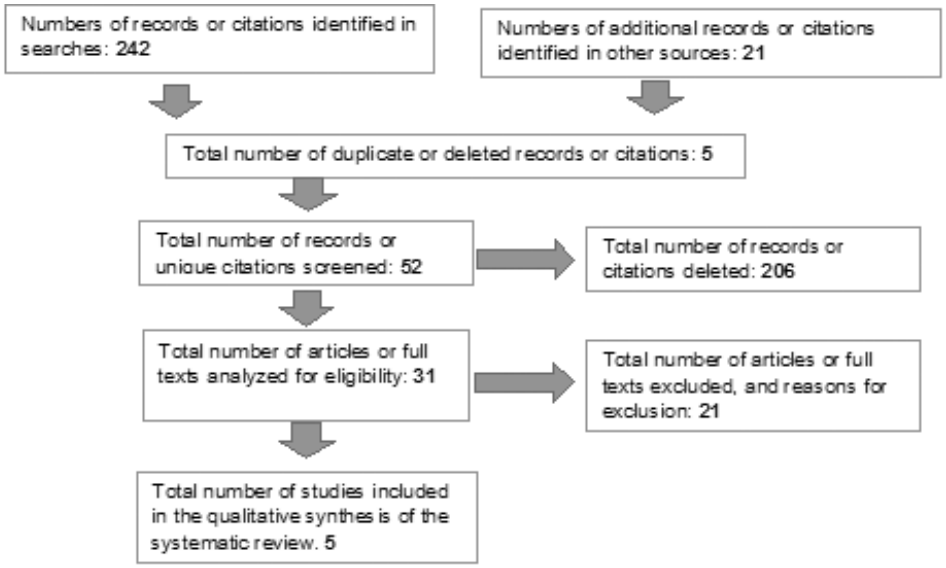

Fig. 1. Flow diagram- Phases of the systematic review
Source: Authors

the age range of 0 to 14 years. Thus, the study finally consisted of 5 studies, with a sample of 5,512 children living at high altitudes and belonging to different ethnic groups.

Table 1 shows each study characteristics analyzed, such as the authors and place of research, the number of the sample with both genders, the studied subjects age range, the type of ethnicity they belong to, the altitude where they lived, the nutritional status of the subjects and the conclusion of each study.

In the analysis of the studies, a total sample of 5,512 subjects with age ranges from 0 to 14 years of age was determined.

The minimum altitude between studies ranged from 1,000 meters above sea level, while the maximum altitude was 4,290 meters above sea level.

Four of the five studies specified samples separated by gender, three studies (Benítez et al. 2014; Espinoza and Morocho 2017; Valle et al. 2018) presented a higher number of females, while the study by Mamani et al. (2019) established measurements mainly to the male gender. With regard to nutritional status, for the selection of the sample, those studies that had contemplated the assessment or classification of According to the Body Mass Index (BMI) given by the World Health Organization, 316 children (5.73%) were classified as underweight; 4,345 (78.8%) of the children were classified as standard weight; 449 (8.14%) of the children were evaluated as overweight, and 402 (7.29%) of the children were classified as obese. Thus, it was recorded that overweight and obesity were more prevalent than malnutrition by default, although normal-weight predominated in these studies.

Finally, the review also points out as a decisive factor the latitude where they live, considering that 100 percent of the sample studied live above 1000 meters above sea level.

Among the significant characteristics found during the systematic review, it is highlighted that the problem or cause of malnutrition by default, overweight, and obesity are caused mainly by inadequate dietary intake in the population, whether urban or rural.

DISCUSSION

The results of the analysis or review have allowed the researchers to know the main char-

Table 1: Summary of articles selected for review

Author (s)/ Place	*Sample*	*Age range*	*Ethnicity/ Altitude*	*Nutritional condition*	*Conclusion*
Benítez et al. (2014) México	100 children 19 boys y 31 girls rural area 27 boys y 23 niñas zonaurbana	6-14 years	Tarahumara, 1.500M.A.S.L	RuralBP:2N: 42S:2O:4 UrbanBP: 2N:32S: 10O:6	Tarahumara students from the urban area showed slightly higher values in body size, adipose, and higher % of overweight and obesity, with no statistically significant difference in nutritional status.
Espinoza and Morocho (2017) Ecuador	130 children 60 boys 70 girls	5-11 years	Kumpas and Cumbatza 4.290 M.A.S.L	BP:28N:99S: 10:2	The nutritional status in both ethnic groups showed that 21.5% of children aged 5 to 11 years were undernourished by default.
Valle et al. (2018) Ecuador	156 children 74 boys 82 girls	0-12 years	Shuar 1.597 M.A.S.L	BP:44N: 109S:3	Of the total number of children, 28.2% showed malnutrition by default due to inadequate dietary intake with low nutritional values.
Vallejo et al. (2016) Colombia	241 children The figure by gender is not specified in the study.	0-5 years	Inga 2.800 M.A.S.L	BP:8N:145S: 61O:27	There were problems of excess malnutrition, which were reflected in the high 27.4% overweight values of the sample.
Mamani et al. (2019)Bolivia	4.885 children 2.560 boys 2.325 girls	0-5 years	Quechuas and Aimara 2.574 M.A.S.L	BP:232 N:3.918S: 372O:363	Extreme malnutrition in children was observed, with 16.5% being overweight and obese.

* PB: underweight; N: normal-weight; S: overweight; O: obese; M.A.S.L.: meters above sea level.

acteristics of body composition and somatotype in 5 studies in infants from indigenous populations living at more than 1000 meters above sea level, with an age range of 0 to 14 years.

In the results of the 5 reviews, 4 studies were presented in which children were classified as obese, coinciding with what was evidenced in the study by Huerta et al. (2019), who pointed out that in the Aymara population living in Camiña, children with elevated cardiovascular and metabolic risks related to obesity were found.

On the other hand, in this analysis, the researchers found in the 5 articles reviewed children with underweight or malnutrition by default classification constituting 5.73 percent, also being the smallest group found, these results coincided with those found by Diaz et al. (2015) who concluded that in the indigenous population of the Peruvian Amazon there was a high prevalence of malnutrition by default.

The main result found was the classification of normal weight in the indigenous child population living at high altitude, finding a total of 4,345 boys and girls with normal-weight children in the 5 articles reviewed.

It is necessary to highlight that in the studies that included early ages such as 0 to 5 years, 823 children with overweight and obesity were found. The high number of children with this classification in preschoolers is striking, as previously stated in the study conducted by Mamani et al. (2020) evaluated body composition, weight and height in 1,122 healthy children from 2 to 21 years old, considering race and ethnicity as variables. In the analysis of body composition, they integrated the fat mass index (FMI) and the fat-free mass index (FFMI), concluding that the analysis of this variable increases the precision of the evaluation of the health and nutrition status of children. on generic race / ethnic references.

On the tropical island of Mauritius, the increase in obesity has accelerated in recent decades and could be due to low physical activity and increased sedentary lifestyle, which motivated Ramuth et al. (2020) to carry out an investigation in which the objective was to generate the first data set of total energy expenditure (TEE), to estimate physical activity in Mauritian children and to explore differences due to gender and ethnicity, suggesting in their conclusions about possible ethnic and gender differences in TEE and physical activity, noting that the foregoing favored the presence of obesity and sedentary behavior. The results of this study do not coincide with that evidenced in the present investigation, where it was found that children of different ethnicities living in high latitudes did not present levels of overweight and obesity, with children under 5 years of age being mostly obese.

For their part, Koo et al. (2021) evaluated the relationship between body composition and bone health in Malaysian schoolchildren, concluding that girls generally had significantly higher height, body fat percentage, fat mass, visceral fat, and Z-score compared to boys. In the research that concerns us, studies on both sexes were considered, highlighting in a general way unequal behavior between women and men, however, the presence of weight gain and fat mass in Malaysian schoolchildren shows differences with the predominant in the research that we have done.

Luizaga and Illanes (2019), who pointed out that in their study, the age group most affected by obesity was 1 to 3 years old (in indigenous populations). On the other hand, Espinoza and Morocho (2017) pointed out that malnutrition by default was mostly observed in the age groups of 5 to 11 years.

In this review, the formulas applied: Yuhasz, Heath, and Carter or Kappa, evidence a critical gap between the practical, theoretical soundness of the WHO-PAHO social determinants model and its limited methodological development for its realization. Moreover, the diversity of formulations for the analysis of body composition also conspires in the homogeneity of anthropometric studies, making it challenging to gather research that contemplates the same methodology.

For his part, Cardona (2017) pointed out that the social determinants of malnutrition include a low educational level, area of origin (greater in rural areas), gender (higher in women), and ethnicity, an element that the authors of the present study share. The researchers also add that they would have been interested in considering a more precise approach concerning the causes that affect nutritional status, for example, social inequalities and child undernutrition or obesity, that is, the causes according to social epidemiology. However, this element was not considered in the present study and will be considered in future studies.

CONCLUSION

After analyzing the literature, a consensus was reached that, in the indigenous populations with age groups from 0 to 14 years, there was a predominance of average weight, with high values of overweight and obesity in preschool ages. In addition, it was observed as a leading and coincident characteristic in the analyzed studies that malnutrition by default, overweight, and obesity were generated by inadequate food intake in the indigenous population, both urban and rural, living at high altitudes.

RECOMMENDATIONS

It is recommended to continue with studies that include the behavior of obesity and overweight in children of different ethnic groups living in high latitudes, including other elements such as family economic situation, morphological characteristics of the family, level of physical activity, among others.

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