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Cresp-Barria, M; Machuca-Barria, C; Carter-Thullier, B; Gallardo-Fuentes, F; Hernandez-Mosqueira, C; Peña-Troncoso, S. (**2023)** Anthropometric indicators, nutritional status and cardiometabolic risk in schoolchildren with Mapuche and non-Mapuche ethnic groups, Chile. *Journal of Sport and Health Research.* 15(Supl 1):59-70. https://doi.org/10.58727/jshr.102699

Original

INDICADORES ANTROPOMETRICOS, ESTADO NUTRICIONAL Y RIESGO CARDIOMETABOLICO EN ESCOLARES DE ETNIA MAPUCHE Y NO MAPUCHE, CHILE.

ANTROPOMETRIC INDICATORS, NUTRITIONALSTATUS AND CARDIOMETABOLIC RISK IN SCHOOLCHILDREN WHIT MAPUCHE AND NON. MAPUCHE ETHNIC GROUPS, CHILE.

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Received: 06/11/2023
Accepted: 30/11/2023

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RESUMEN

Objetivos: Identificar, a través de la asociación de variables antropométricas, estado nutricional y físicas, el riesgo cardiometabólico en escolares mapuche y no mapuche de la Región de la Araucanía.

Material y métodos: Es un estudio descriptivo, transversal, utilizándose las pruebas estadísticas Kolmogorov-Smirnov, U de Mann-Whitney y H de Kruskal-Wallis. Los datos fueron analizados con el programa SPSS, versión 22.0 ($p < 0,05$). Los participantes fueron 250 escolares: 185 mapuche y 65 no mapuche. Se evaluaron pruebas antropométricas de peso y talla para la edad, índice de masa corporal (IMC), circunferencia de cintura (CC), índice cintura-altura (WSR), y la prueba de capacidad aeróbica Course Navette (VO2max), índice de Ruffier. y frecuencia cardíaca en reposo (RHR).

Resultados: Escolares mapuches y no mapuches presentaron tallas similares; Su peso y circunferencia de cintura difirieron según sus clasificaciones de índice de masa corporal, sin embargo, no hubo diferencias estadísticamente significativas entre los grupos étnicos.

Conclusiones: Para el presente estudio la variable talla no determina la presencia o ausencia de riesgo cardiometabólico en escolares con ascendencia étnica mapuche y no mapuche a través del indicador WSR. Sin embargo, el estudio demostró que las variables peso y CC influyen directamente en la presencia de riesgo cardiometabólico en los escolares de la muestra diagnosticada con sobrepeso y obesidad.

Palabras clave: Antropometría, Escolares, Grupo étnico, Riesgo cardiometabólico.

ABSTRACT

Objectives: To identify, through the association of anthropometric, status nutritional and physical variables, the cardiometabolic risk in Mapuche and non-Mapuche schoolchildren in the Araucanía Region.

Material and methods: It is a descriptive, cross-sectional study, using the Kolmogorov-Smirnov, Mann-Whitney U and Kruskal-Wallis H statistical tests. The data were analyzed with the SPSS program, version 22.0 ($p < 0.05$). The participants were 250 schoolchildren: 185 Mapuche and 65 non-Mapuche. Anthropometric tests of weight and height for age, body mass index (BMI), waist circumference (WC), waist-height ratio (WSR), and the Course Navette aerobic capacity test (VO2max), Ruffier index were evaluated and resting heart rate (RHR).

Results: Mapuche and non-Mapuche schoolchildren presented similar sizes; Their weight and waist circumference differed according to their body mass index classifications, however there were no statistically significant differences between the ethnic groups.

Conclusions: The size variable does not determine the presence or absence of cardiometabolic risk in schoolchildren with Mapuche and non-Mapuche ethnic ancestry through the WSR indicator. However, the study demonstrated that the weight and WC variables directly influence the presence of cardiometabolic risk in the schoolchildren of the sample diagnosed with overweight and obesity.

Keywords: Anthropometry, Schoolchildren, Ethnic group, Cardiometabolic risk.

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INTRODUCTION

The United Nations Food and Agriculture Organisation (FAO), in conjunction with the Pan American Health Organisation (PAHO), claims that obesity and overweight have increased in Latin America and the Caribbean; their figures show that nearly 58% of the population are overweight (360 million people). Overweight and obesity are also increasing rapidly among children over 5 years of age and adolescents in the region. More than 30% are affected by overweight, which means that 50 million children and adolescents live with this condition. (FAO, 2020). In Chile, the National Study of Physical Education applied to eighth grade primary school students (2017) showed that 45% of schoolchildren presented malnutrition due to excess (25% overweight and 20% obese). These figures represent an increase compared to the previous study (2014; with 16% obesity). Cardiovascular and metabolic risk (25%) also presented an increase of 5%-age points compared to 2014 (20%); Therefore, it is stated that 72% of the schoolchildren evaluated need to improve their aerobic potential, regardless of the socioeconomic level to which the family belongs (ENEF, 2015). This condition has currently been associated with low levels of physical activity in the Chilean population in children between 11-17 years of age, especially in the population of women. Women have lower levels of physical activity than men (MINDEP, 2021).

Recent studies carried out in 8,840 educational centers in Chile (80% of regular school education) reported that 54% are overweight and obese (JUNAEB, 2020). Very large-scale population studies have revealed strong associations between physical activity (PA), obesity, and cardiometabolic risk factors in children (Andersen, et al., 2006; Ortega, et al., 2005). The negative effects of excess malnutrition (MNE) have been associated with psychological and behavioral comorbidities, impaired neurocognitive function, musculoskeletal and cardiometabolic complications, while, in the long term, the effects of childhood obesity have shown a strong relationship. causal with medical complications, such as cardiovascular, cancer and other chronic diseases (Reinehr, 2018). Excess adiposity in youth is a marker of increased cardiometabolic risk (CMR) in adolescents and adults. Several longitudinal studies confirm the strong association of pediatric obesity with the persistence of adult obesity and the future development of cardiovascular disease, diabetes, and increased risk of death (Chung et al., 2018). According to the results of the last population census (INE, 2017), Chile has a total population of 17,574,003 inhabitants, of whom 13% belong to autochthonous peoples. The Mapuche represent 79.8% of the indigenous population of the country. The Araucanía Region contains the highest percentage of indigenous inhabitants in Chile, around 29,2% (Ribotta, 2012).

Authors like Martínez et al., (2012) report a broad distribution of Mapuche settlements in the Araucanía Region, as well as migration of Mapuche individuals from the countryside to urban environments; this change leads to modifications in their lifestyles, with an increase in the prevalence of overweight and obesity in children. Epidemiological studies have shown a positive association between adiposity, metabolic markers and inflammation markers, which point to an increased risk of metabolic diseases, such as cardiovascular disease (CVD) and diabetes mellitus type 2 (Batineni et al., 2021; Kim- Choi, 2020). Studies in Chilean schoolchildren with ethnic diversity indicated for the nutritional status variable that 43.94% of all schoolchildren are classified as overweight or obese, but when relating the variables Body mass index (BMI) with waist circumference (WC) the correlation of variables in the Mapuche population was higher, compared to the non-Mapuches (Cresp et al., 2018). Other national reports that ethnic schoolchildren who have a low level of physical activity have a higher risk of being obese and have a higher cardiometabolic risk than their non-ethnic peers (Alvarez et al., 2019), as well as a lower body mass. In ethnic male schoolchildren compared to non-ethnic ones and a higher level of physical activity in ethnic female schoolchildren in the vigorous-low category and in total weekly energy expenditure compared to non-ethnic female schoolchildren (Gallardo et al.,2022). However the majority of studies focusing on obesity have been carried out mainly in the non-Mapuche population (Liberona et al., 2011).

The characteristics mentioned above, in situations of physical inactivity, sedentarism and overweight or obesity with a tendency towards metabolic

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symptomatologies deserves study, since ethnic groups of Mapuche origin present a greater susceptibility to cardiovascular disease than the non-Mapuche population (Celis et al., 2011; Riffo et al., 2012). There are simple ways of measuring adiposity which are used in the classification and evaluation of risk groups, for example body mass index (BMI), waist circumference (WC) and percent body fat (%BF); these are useful in epidemiological studies and clinical practice (Borruel et al., 2014; Gonzalez et al., 2011). Nutritional indicators are alternative methods with the advantages of presenting low cost, easy execution and availability in clinical practice. Among anthropometric techniques, the use of the waist-stature ratio (WSR) as an easily available index could help to prevent or detect chronic diseases in a greater proportion of the Chilean population (Ketel, 2007). Use of BMI and WC are sufficient for issuing a preventive nutritional diagnosis in the school-age population. These two measurements serve to predict cardiometabolic risk at early ages (Kriemler, 2010). Koch (2011) says that the best anthropometric index for predicting metabolic risk factors and mortality is WSR, followed by WC. Ketel (2007) proposes that the addition of the height factor increases its precision, since adjusting the waist as a function of the height gives a risk index for boys and girls (estimated at 0.55). Height and body mass index (BMI) are anthropometric measures of the quality of nutrition and the healthiness of the living environment during childhood and adolescence and are highly predictive of health and developmental outcomes throughout life (Rodríguez-Martínez et al.,2020).

The objective of the present study was to identify, through association of anthropometric variables weight, height, waist circumference, waist-to-height ratio, status nutritional, Vo2max physical tests and cardiac recovery, the cardiometabolic risk of schoolchildren with Mapuche and non-Mapuche ethnic ancestry from the Araucania region, Chile.

METHODS

Design and Participants:

This was a quantitative, descriptive, cross-sectional study, with non-probabilistic, non-random convenience sampling. The sample consisted of 250 schoolchildren (125 girls and 125 boys), aged between 6 and 12 years. Of the total sample, 185 belonged to the Mapuche ethnic group (one or both parents with Mapuche surname, records provided by the National Indigenous Development Corporation, (CONADI) mean age 8.86±2.97 years; and 65 were not Mapuche (neither parent with Mapuche surname) mean age 9.42±3.14 years. The sample was evaluated during the periods from November to December 2019, in rural schools in the Araucanía Region, Chile, a part of the country with high poverty rates. The variables analysed were ethnic descent and anthropometric indices. Differences were established by ethnic group (Mapuche/non-Mapuche), total body weight (kilograms), height or stature (centimetres), waist circumference (centimetres). Body mass index (BMI), Waist circumference (WC) and Waist-stature ratio (WSR) were recorded.

Statistical treatment:

The normality of the sample was assessed by the Kolmogorov-Smirnov test. To test for non-parametric results the Mann-Whitney U test was used when two groups were compared and the Kruskal-Wallis H test for more than two. The analyses were done with the SPSS programme, version 22.0, with margin of error 5% ($p < 0.05$).

Instruments and data-collection:

Professional nutritionists who had been trained and standardised collected the data, which were recorded on sheets. Weight was measured with an OMRON hand-foot digital monitor, model HBF-514, with the children bare-footed and wearing the smallest possible amount of clothing; height was measured with a SECA® height measure, graduated in mm. BMI was determined to estimate the degree of obesity (kg/m2), determining the body weight status of the participants by BMI cut-off points (low weight: <18.5kg/mt2; normal weight: 18.5kg/mt2 to 24.9kg/mt2; overweight: 25kg/mt2 to 29.9kg/mt2; and obesity: >30kg/mt2). The waist circumference was measured with a non-stretch tape measure, using the average of three measurements taken by internationally validated techniques.

WSR was used to estimate the accumulation of fat in the central zone of the body; it was obtained by dividing the waist circumference by the height. A ratio greater than or equal to 0.55 indicates increased cardiometabolic risk (CMR). The data recorded enabled us to use methods recognised by WHO, such as BMI, height for age (H/A) and BMI for age

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(BMI/A); also WC and its indicator for cardiovascular risk, WSR, used to identify the presence or absence of cardiometabolic risk in Mapuche and non-Mapuche schoolchildren. In order to determine the VO2max of the students, the Navette Course test was used, which consists of running between 2 lines separated by 20 m in both directions, round trip as long as possible. At the end of the fatigue test, the time the subject was able to keep running is recorded and its VO2max is calculated using the following proposed formula for children from 6 to 17.9 years: 31.025+ (3.288xVFA) - (3.248xE) + (0.1536xVFAxE), where VFA = Speed in km / h (speed = 8 + 0.5 * stage number) and E = age (Leger et al., 1988, cited in Garcia, & Secchi, 2014). Ruffier test was used in order to evaluate cardiorespiratory capacity and physical state of the students; it's carried out as follows: the student must remain at rest for five minutes and then measure their heart rate (P1), then they must do 30 complete squats in 45 seconds, and finish by measuring the heart rate (P2) again; then after one minute of finishing the squats, the pulse (P3) is measured again. With these three heart rate measurements, the Ruffier Index (IR) is obtained by applying the following formula: (P0 + P1 + P2) -200) / 10, then with the IR, the cardiorespiratory capacity According to the following scale: 0 = Excellent; 1-5 = Very good; 6-10 = Good; 11-15 = Insufficient; 16-20 = Weak. The protocols

complied with the Helsinki Declaration 2019. This research has been authorized by the Ethics Committee of the Universidad Catolica de Temuco, through document decree 13/20, of June 2020. The parents or guardians of the participants were informed of the research objectives and signed a consent allowing the child to participate in the study. As well, an assent for the evaluations carried out was signed with each of the participating schoolchildren.

RESULTS

TABLE 1. Nutritional Diagnosis of School children Mapuches and non-Mapuches in the Araucanía.

	Low (n=5) 2%	Normal weight (n=133) 53.2%	Over weight (n=59) 23.6%	Obese (n=53) 21.2%	Value P
Age (years)	8.00 ±3.54	9.33 ±2.87	8.64 ±3.25	8.67 ±3.09	0.352
Weight (kg)	23.84 ±7.10	34.11 ±11.7	37.47 ±15.48	48.76 ±20.55	<0.001
Height (cm)	127.9 ±14.1	134.6 ±15.8	131.83 ±19.6	135.27 ±17.9	0.533
BMI (kg/m)	14.26 ±1.62	18.15 ±2.19	20.40 ±2.71	25.37 ±5.22	<0.001
WC (cm)	54.90 ±5.26	63.59 ±7.75	68.00 ±10.90	79.03 ±14.06	<0.001

Table 1 shows the determination of the nutritional state by BMI (kg-/height2) and WC (cm) of the schoolchildren studied, Araucanía Region. Chile. Values are shown as mean ± standard deviation. Results with $p < 0.05$ are statistically significant. Post Hoc nutritional status. BMI: Body Mass Index; WC: Waist Circumference. The table shows a significant difference between the nutritional diagnoses in schoolchildren in comparisons of their Weight, BMI

and WC.

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TABLE 2. Cardiometabolic Risk in Mapuche and Non-Mapuche Schoolchildren. Araucanía Region.

	Mapuche (n=185) 74%	Non-Mapuche (n=65) 26%	Value P
Age (years)	8.86±2.97	9.42±3.14	0.224
Weight (kg)	37.48±16.11	38.82±15.68	0.433
Height (cm)	133.26±17.06	136.13±17.34	0.275
BMI(kg/m2)	20.12±4.27	20.16±4.61	0.889
WC (cm)	67.82±11.90	67.35±11.89	0.879
WSR	0.51±0.06	0.50±0.07	0.059

Table 2 shows results by the body mass index (BMI), waist circumference (WC) and waist-stature ratio (WSR) for Mapuche and non-Mapuche schoolchildren, Araucanía Region, Chile. Values are shown as mean ± standard deviation. Results with p <0.05 are statistically significant. BMI: Body Mass Index; WC: Waist Circumference.

TABLE 3. VO2max indicator and Ruffier index test, study population Mapuche and Non-Mapuche Schoolchildren.

	Mapuche (n=185) 74%	Non-Mapuche (n=65) 26%	Value P
Age (years)	8.86±2.97	9.42±3.14	0.224
Height (cm)	133.26±17.0	136.13±17.3	0.275
VO2max (ml)	43,28 ± 4,34	46,10 ± 4,10	0,004
Ruffier index	5,02 ± 1,34	5,38 ± 2,15	0,415
RHR	75, 30 ± 2,30	74, 32 ± 3,30	0.210

Table 3 The VO2max variable shows significant differences (p = 0.004), with non-Mapuche students obtaining higher VO2max in relation to Mapuche students. Regarding the Ruffier Index, students non-Mapuches have higher rates, although there were no statisticall significant differences (p = 0.415), as for the variable Resting Heart Rate (RHR)

FIGURE 1. Cardiometabolic risk Mapuche students and non- Mapuche students

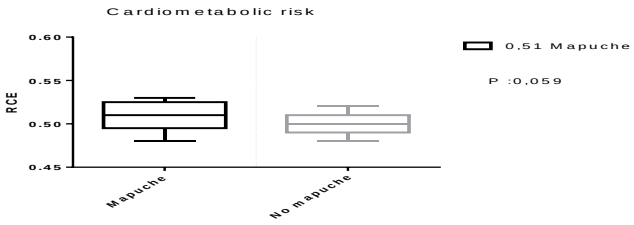

Figure 1 the results show that the cardiometabolic risk variable does not present significant statistical differences between the compared school populations.

DISCUSSION

The obesity problem in Chile affects the Mapuche ethnic group. Mapuche individuals who migrate from rural to urban environments adapt to the characteristic changes of modern society and develop behaviours and lifestyles typical of urban and industrialised areas, where an obesogenic environment predominates (Martínez et al., 2012). This is apparent when the results are compared between the Mapuche and the non-Mapuche children, revealing that ethnic origin does not affect the nutritional diagnosis and that there is no significant difference in the BMI indicator (p=0.889); similar results were found for the same variable in another study in the same region of Chile (Bruneau-Chavez et al., 2015). Investigations in children of differing ethnic origin found a close association between WC and serum concentrations of lipids and insulin (Steinberger & Daniels, 2003). When WC is compared between Mapuche and non-Mapuche children, no difference is observed (p=0.879), and the same is true of WSR (p=0.059). The present research

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confirms malnutrition due to excess (overweight and obesity) among the school population, affecting 44.8% (n=112) of our sample (n=250). These figures agree with international reports (WHO, 2016), showing that more than 340 million children and adolescents (aged 5 to 19 years) presented overweight or obesity.

In height development (height for age), according to the growth patterns by age in boys and girls (Technical Standard for Nutritional Assessment, 2016), no significant differences were observed between Mapuche and non-Mapuche schoolchildren ($p=0.275$). Research in a sample of Chilean schoolchildren showed that ethnic descent determines or affects stature (Amigo et al, 2000). UNICEF (2015) proposes that height is related with alterations in nutritional state and health over the long term. This implies that height comparison in this sample of schoolchildren by their classification as low weight, normal weight, overweight and obesity, diagnosed by BMI, would show a statistical difference; however, no statistical difference was found ($p>0.05$), from which it may be supposed that the presence of feeding and nutrition programmes in Chile, through the Complementary Feeding Programme, ensures that all the nutritional energy needs of Chilean children are covered (PNAC, 2011).

The results for bodyweight express statistically significant values ($p<0.05$); this variable influences the nutritional diagnosis, however it should be stressed that weight (kilograms) does not reveal body composition. Indicators like BMI, WC and WSR are needed to make nutritional diagnoses in schoolchildren. Waist circumference, waist-to-height ratio and waist-to-hip ratio have also been considered as indicators of central obesity, appearing to be slightly better predictors than BMI (Golagi et al.,2021) and complement the identification of cardiovascular risk factors (Ferrero et al.,2023).Research has reported negative trend values in anthropometric variables and cardiorespiratory fitness variables as predictors of cardiovascular risk in both urban and rural schoolchildren (Cresp & Quilaman, 2017). The cardiometabolic risk expressed through WSR shows that obese schoolchildren present a higher waist circumference than those with normal weight for their height (Delgado et al., 2015). National reports on Mapuche schoolchildren that found a high relationship between BMI, WC and WHR, with the WHR being higher in Mapuche children (Cresp et al., 2018). The present study evidenced risk parameters in Mapuche (0.51) and non-Mapuche schoolchildren evaluated (0.50).

Some Chilean studies report that schoolchildren in the Araucanía Region who suffer from obesity presented a significantly larger waist circumference than groups with normal weight (Campos et al., 2016); the results show that the 59 schoolchildren diagnosed with overweight (23.6% of the sample) presented a waist circumference 5cm greater than those diagnosed with normal weight, while the obese schoolchildren presented a WC 16cm greater than normal children, prevention remains the best approach to halt and reverse the current childhood obesity epidemic (Aggarwal & Jain, 2018). It is of interest for local investigations to obtain data describing populations of different geographical locations and ethnic origins, since studies in schoolchildren report that individuals who present the same waist circumference would be exposed to the same cardiovascular risk, regardless of differences in height. However this hypothesis is not valid, since the variables percent body fat and cardiometabolic risk are higher for shorter individuals than for taller individuals with the same BMI (López et al., 2003). Therefore, investing in the nutrition of school-age children and adolescents is critical to a healthy transition to adulthood (Rodríguez-Martinez et al.,2020).

CONCLUSIONS

The investigation reflected the fact that schoolchildren (Mapuche and non-Mapuche) diagnosed by BMI and classified as normal weight, compared with schoolchildren (Mapuche and non-Mapuche) diagnosed with obesity, present similar heights, and therefore that variable is not considered to influence the presence or absence of cardiometabolic risk in these children through the WSR indicator. However the study showed that the variables weight and WC have a direct influence on the presence of cardiometabolic risk in in children in the sample diagnosed with overweight and obesity. The waist circumference measurement is a very sensitive predictor and allows health risks to be identified in the short, medium and long term, the

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more so if related with height as an indicator of cardiometabolic risk. We may therefore conclude that a relation exists between the state of malnutrition due to excess (overweight and obesity) and the presence of cardiometabolic risk in Mapuche and non-Mapuche schoolchildren belonging to rural districts of the Araucanía Region, Chile.

Limitations and fortresses

One of the strengths of the study is the type of sample investigated, since in Chile there is a high percentage of studies focused on nutritional status and cardiometabolic risk, but carried out in populations without ethnicity. The application of anthropometric instruments or indicators of easy applicability and establishing their relationships, provide reliable data that is positively related to gold standard instruments. These types of assessments allow national government authorities to use easily accessible tests in school populations to improve nutritional quality of life and physical activity levels regardless of ethnicity. In terms of the limitations of the study, it is important to point out that the results analyzed are indirect indicators, so more technology and a greater number of participants are necessary to be conclusive. It is necessary to add some analysis variables that could be conclusive, such as 24-hour food intake reminders, physical activity levels, etc.

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