

DIFFERENCES IN BODY FRACTIONATION BETWEEN INDIGENOUS AND NON-INDIGENOUS CHILEAN SCHOOLCHILDREN

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ABSTRACT

Introduction: The Mapuche is the more represented ethnic group (87%) among the Chilean indigenous population. However, the research examining body composition in aboriginal groups is scarce. **Aim:** To determine differences in anthropometric and body fractionation between indigenous (Mapuche) and non-indigenous students from Chile. **Methods:** The sample included 109 indigenous students and 122 non-indigenous male students. The body fractionation was estimated through the protocol described by the International Society for the advancement of Kinanthropometry (ISAK). One-way analysis of variance (ANOVA) was used to estimate statistical significance of differences among variables. **Results:** The Mapuche children exhibited lower values of body weight ($p < 0,001$), height ($p < 0,01$) and all the skinfolds, body perimeters and bone diameters assessed compared to non-Mapuche, excepting for the forearm circumference ($p < 0,05$) and transverse thorax diameter ($p < 0,05$). Regarding body composition, the indigenous students showed lower values of fat mass ($p < 0,001$), residual mass ($p < 0,05$) and epithelial mass ($p < 0,001$). However, they achieve higher percentages for muscle mass ($p < 0,01$) and bone mass ($p < 0,01$) than the non-indigenous students. **Conclusion:** The Mapuche students show better muscle and bone mass scores, while showing lower percentages of fat and residual epithelial mass with respect to non-Mapuche students from the same area of residence.

Key words: Anthropometry. Body Composition. Ethnicity and Health. Indigenous Population.

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RESUMO

Diferenças no fracionamento corporal entre escolares chilenos indígenas e não-indígenas

Introdução: Os mapuche é o grupo étnico mais representado (87%) na população indígena chilena. Entretanto, a pesquisa que examina a composição corporal em grupos aborígenes é escassa. **Objetivo:** Determinar as diferenças no fracionamento antropométrico e corporal entre estudantes mapuche e não-mapuche do Chile. **Métodos:** Foram incluídos 109 alunos mapuche e 122 estudantes não-mapuche. O fracionamento corporal foi estimado através do protocolo descrito pela Sociedade Internacional para o Avanço da Kinanthropometry (ISAK). A análise de variância unidirecional (ANOVA) foi utilizada para estimar a significância estatística das diferenças entre as variáveis. **Resultados:** As crianças mapuche apresentaram menores valores de peso corporal ($p < 0,001$), altura ($p < 0,01$) e todas as dobras cutâneas, perímetros corporais e diâmetros ósseos avaliados em relação aos não-mapuche, exceto para a circunferência do antebraço ($p < 0,05$) e o diâmetro transversal do tórax ($p < 0,05$). Quanto à composição corporal, os alunos Mapuche apresentaram menores valores da massa gorda ($p < 0,001$), massa residual ($p < 0,05$) e massa epitelial ($p < 0,001$). Contudo, obtêm maiores percentuais de massa muscular ($p < 0,01$) e massa óssea ($p < 0,01$) do que os não-mapuche. **Conclusão:** Os estudantes mapuche apresentaram melhores escores de massa muscular e óssea, apresentando menores porcentagens de gordura e massa epitelial residual em relação a estudantes não-mapuches da mesma área de residência.

Palavras-chave: Antropometria. Composição Corporal. Etnia e Saúde. População Indígena.

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INTRODUCTION

Changes in world's population lifestyles have been accompanied by significant nutritional, demographic and epidemiological changes (Popkin, 1993; Rivera and collaborators, 2002; Vio and Albala, 2004), a phenomenon that has not been strange to ethnic groups, it has been the case of the Mapuche in Chile (Araneda and collaborators, 2010; Vio and Albala, 2004).

This ethnic group is the most represented (87%) of the Chilean aboriginal groups. Although the habits and dietary behaviors of Chileans of Mapuche origin are similar to the non-Mapuche, the formers consume more native foods (García, Amigo and Bustos, 2002).

However, the indigenous students are acquiring unhealthy habits by the consumption of western foods with high caloric density, high content of sugar and saturated fat (Araneda and collaborators, 2010).

On the other hand, there has been a widespread study of more specific anthropometric variables such as somatotype and body composition, and due to the need to give greater certainty to the physical constitution of people (Ross and collaborators, 1988).

Concepts were coined by Orbach and collaborators (1963) and Carter (1975), with the intention of numerically describe the current morphological configuration of a person, when being studied. Elements that through the body fractionation method of the five components devised by Kerr (1988), allow us to understand in more didactic way the results of the evaluation of body composition.

In Chile, there is still a small number of research examining some anthropometric profile in aboriginal groups; some studies in Mapuche can be found, most of them regarding the somatotype (Bruneau-Chávez and collaborators, 2015; Martínez and collaborators, 2012; Valdés-Badilla and collaborators, 2015), one study in Huilliche (Arcay and Valeria del Río 1995) and one in Aymara (Espinoza-Navarro and collaborators, 2009).

These publications reflect a meso-endomorphic somatotype predominance in children of these ethnic groups (Arcay and Valeria del Río 1995; Bruneau-Chávez and collaborators, 2015; Espinoza-Navarro and

collaborators, 2009; Martínez and collaborators, 2012; Valdés-Badilla and collaborators, 2015). Regarding this, studies have described significant differences among Chilean ethnic groups (Araneda and collaborators, 2010; Arcay and Valeria del Río 1995; Bruneau-Chávez and collaborators, 2015; Martínez and collaborators, 2012) but several authors agree that there are genetic and environmental factors and changes in lifestyles that would impact on body composition in each ethnic group (Cardel and collaborators, 2012; Martínez and collaborators, 2012), a situation which eventually has influenced new physical activity behaviours and food which directly interfere in the overweight and obesity rates in this population group (Martínez and collaborators, 2012).

In this context, this research aims to determine the differences in body fractionation between Mapuche and non-Mapuche students from Chile, through the method of the five components.

MATERIALS AND METHODS

Subjects

The population consisted of all male students belonging to the second primary cycle in four schools of Temuco, La Araucanía, Chile ($n = 420$), the students were distributed between two schools of Mapuche ethnicity ($n = 180$) and two from non-Mapuche students ethnicity ($n = 240$).

The sample was selected under a non-probabilistic criterion for convenience, which included 109 (60,5%) Mapuche students and 122 (50,8%) non-Mapuche students. Inclusion criteria consisted of: a) be within the range of 11 to 13 years 11 months of age, b) be enrolled in the selected schools, c) the signing of an informed parental consent and assent of subjects authorizing the use of information for scientific purposes, d) for subjects of Mapuche ethnicity, having both surnames (mother and father) with aboriginal origin declared in its national identity card. Subjects that were excluded: a) those who did not attend the evaluations, b) those who presented acute inflammatory conditions by musculoskeletal injury or any condition that affects the skin and alter the evaluation process, and c) those who would not undergo evaluations. The study was

approved by the Scientific Ethics Committee of the local University (Acta 037-15) and it was developed following what it is stated in the Declaration of Helsinki.

All evaluations were performed during regular class time in their respective educational institutions, using a heated room at a temperature of 20° C and 50% of relative humidity. All measurements were obtained through a certified appraiser with level III of the International Society for the Advances of Kinanthropometry (ISAK), and obtaining a technical measurement error in folds of 2%, 0,6% in perimeters and 1,0% in diameters, respectively.

Anthropometric evaluations

To carry out body assessment, the protocol described by the ISAK was followed (Marfell-Jones and collaborators, 2006). Body weight was evaluated using a digital scale (Scale-Tronix, USA), the bipedal stature was measured through a stadiometer (Seca 220, Germany), the diameters with anthropometers (Rosscraft, Canada), the perimeters with measuring tape (Rosscraft, Canada) and skinfold thickness was measured through calliper (Harpenden, England). All the instruments have an accuracy of 0,1 kg, 0,10 cm, 0,1 mm, 0,1 mm and 0,2 mm, respectively.

Regarding the measures used to determine body composition, these consisted in those proposed by Marfell-Jones and collaborators (2006), six skinfolds (triceps, subscapularis, supraspinatus, abdominal, medial thigh, calf), and the seven perimeters (head, relaxed arm, maximum forearm, mesoesternal chest, minimum waist, maximum thigh, maximum calf) and six diameters (biacromial, transverse chest, anteroposterior chest, biiliocrestideo, humeral [biepicondylar], femoral [biepicondylar]).

Statistical analysis

The data was organised using Microsoft Excel version 7.0 spreadsheet to be exported to the statistical program Statistical Package for Social Science (SPSS) version 20.0. The values are presented as mean, standard deviation, minimum and maximum value.

The normal distribution of the variables was studied using the Kolmogorov-Smirnov

test. Analysis of variance was included (ANOVA) using ethnicity variable (Mapuche vs. non-Mapuche) as a fixed factor for age strata established and the minimum level of significance at $p < 0,05$ was agreed.

RESULTS

Table 1 indicates that the Mapuche students evaluated showed significant differences in body weight when compared with non-Mapuche children (42,6 kg vs. 45,3 kg, $p < 0,001$), besides, they achieved a bipedal stature significantly lower (145 cm vs. 150,4 cm, $p < 0,01$).

Regarding skinfolds, the Mapuche students had significantly lower values compared to non-Mapuche children in the folds of the triceps (8,7 mm vs. 11,7 mm, $p < 0,001$), subscapularis (11,5 mm vs. 14,1 mm, $p < 0,001$), supraspinatus (16,2 mm vs. 17,6 mm, $p < 0,05$), abdominal (18,3 mm vs. 19,3 mm, $p < 0,05$), medial thigh (11,6 mm vs. 13,6 mm, $p < 0,01$) and calf (8,4 mm vs. 9,8 mm, $p < 0,01$).

Several differences were reported in the body circumferences. The Mapuche students had significantly lower perimeters in all values, such as waist (67,7 cm vs. 73,8 cm, $p < 0,001$), chest (76,5 cm vs. 78,3 cm, $p < 0,001$), medial thigh (40,7 cm vs. 43,6 cm, $p < 0,05$) and calf (30,6 cm vs. 31,2 cm, $p < 0,05$) compared to non-Mapuche. However, the forearm perimeter of the Mapuche students was higher than the non-Mapuche (21,6 cm vs. 21,2 cm, $p < 0,05$).

As for the bone diameters, Mapuche students reached higher values for the transverse thorax (23,7 cm vs. 23,4 cm, $p < 0,05$), and lower in the diameters of the femur (7,8 cm vs. 7,9 cm, $p < 0,05$) and anteroposterior chest (15,7 cm vs. 16,3 cm, $p < 0,001$) compared to non-Mapuche students.

Table 2 presents the results of body composition, through fractionation of the five components. In this evaluation, the Mapuche students get lower values of fat mass (31% vs. 32,4%, $p < 0,001$), residual mass (12,3% vs. 12,6%, $p < 0,05$) and epithelial mass (6,1% vs. 6,5%, $p < 0,05$).

On the contrary, they get higher percentages for muscle mass (38,1% vs. 36,7%, $p < 0,01$) and bone mass (12,5% vs. 11,8%, $p < 0,01$) compared to non-Mapuche students.

Table 1 - Anthropometric characteristics in Mapuche and non-Mapuche students evaluated.

	Mapuche (n=109)		Non Mapuche (n=122)	
	Minimum	Mean (SD)	Mean (SD)	Maximum
Weight (kg)	23	42,6 (6,1)	45,3 (8,8) ^c	77
Height (cm)	128	145 (5,5)	150,4 (8,1) ^b	177
Skinfolds (mm)				
Triceps	6	8,7 (1,5)	11,7 (2,6) ^c	23
Subscapularis	6	11,5 (1,7)	14,1 (2,7) ^c	25
Supraspinal	10	16,2 (2,4)	17,6 (3,5) ^a	29
Abdominal	10	18,3 (2,6)	19,3 (3,5) ^a	28
Thigh	7	11,6 (2,5)	13,6 (3,7) ^b	22
Calf	4	8,4 (2,3)	9,8 (3,4) ^b	17
Body perimeters (cm)				
Head	52	54,1 (1,1)	54,5 (1,7) ^a	59
Relaxed arm	21	24 (1,1)	24,1 (1,3)	28
Forearm	17	21,6 (1,0)	21,2 (1,7) ^a	25
Thorax	60	76,5 (7,4)	78,3 (6,7) ^c	98
Waist	57	67,7 (5,1)	73,8 (6,6) ^c	93
Thigh	32	40,7 (4,3)	43,6 (4,8) ^a	60
Calf	25	30,6 (4,4)	31,2 (4,7) ^a	36
Diameters (cm)				
Biacromial	30	34,2 (1,5)	34,7 (2,1)	40
Thorax transverse	21	23,7 (1,0)	23,4 (1,1) ^a	28
Billiocrestideo	21	24,3 (1,3)	24,2 (1,7)	30
Humerus	4,9	5,7 (0,4)	5,6 (0,4)	7
Femur	7	7,8 (0,5)	7,9 (0,8) ^a	10
Antero-posterior thorax	14,5	15,7 (0,6)	16,3 (1,1) ^c	19

Legend: SD: Standard Devian; ^a p<0,05; ^b p<0,01; ^c p< 0,001.

Table 2 - Body composition of Mapuche and non-Mapuche students evaluated.

	Mapuche (n=109)		Non-Mapuche (n=122)	
	Minimum	Mean (SD)	Mean (SD)	Maximum
Body fat (%)	24	31 (4,5)	32,4 (4,1) ^c	39
Muscle mass (%)	34	38,1 (5,0)	36,7 (5,3) ^b	41
Bone mass (%)	10	12,5 (1,5)	11,8 (1,7) ^b	15
Residual mass (%)	8,5	12,3 (1,4)	12,6 (1,5) ^a	13
Epithelial mass (%)	5	6,1 (1,5)	6,5 (1,3) ^a	8,5

Legend: SD: Standard Deviation; ^a p<0,05; ^b p< 0,01; ^c p<0,001.

DISCUSSION

This study showed several statistically significant differences between Mapuche and non-Mapuche students in the variables of weight, height, skinfolds, body perimeters and bone diameters. In comparing our results with those of Espinoza-Navarro and collaborators (2009), whose work compared Aymara children and non-Aymara, finding lower skinfolds values in the Aymara children, similar to what it was found in Mapuche students versus non-Mapuche. Nevertheless, the study of

Anderson and collaborators (2010) and the Kagawa and collaborators (2009) reported higher values of skinfolds in the aboriginal ethnicity than in the Caucasians, the former in Canadian Aboriginal children and the latter in indigenous Australian children. Moreover, when comparing the values of this study with those reported by Kagawa and collaborators (2009) the latter were higher than those results found in the Mapuche group and non-Mapuche.

Regarding the body circumferences, the indigenous students reached lower values compared to non-indigenous group except for

the forearm. Waist circumference corresponds to a measurement factor that helps distinguish abdominal obesity in children and adults, such as cardiovascular risk (World Health Organization 2008).

In this case, the Mapuche children had lower values than non-Mapuche. This fact indicates a lower metabolic and cardiovascular risk in Mapuche (Vargas and collaborators, 2011).

In addition, according to the study of Diaz and Espinoza-Navarro (2012) where assessed 705 students in the city of Arica considering similar age groups to the present study, were determined differences in waist circumference between boys and girls, with higher values than the Mapuche group here evaluated and less than non-Mapuche.

Although the differences found between Mapuche and non-Mapuche for the body diameters were lower than in the case of body perimeters and skinfolds, the indigenous students presented the highest values for transverse thorax diameter.

The values found in the Mapuche students for humeral and femoral diameters were similar to those reported by Marrodán, Aréchiga and Moreno-Romero (2001) in a Mexican population and Tobal and Monasterio (2005) in athletes.

In relation to body composition, here was observed that the tendency to obesity remains with 25,3% in non-Mapuche and 21,1% in the case of the Mapuche.

Similar percentages to those observed in children from municipal schools in the region of "La Araucanía" in Chile (Martinez and collaborators, 2008).

Moreover, the Mapuche school children have lower adipose tissue values (31%) compared to non-Mapuche group (32,4%), similar values to those reported by Arcay and Valeria del Río (1995) in an investigation about the Huilliche ethnicity.

In addition, the study of Martinez and collaborators (2012) presented that a 77% of non-Mapuche school children and a 49,5% of Mapuche students both had high percentage of fat (> 32%) and about an average value of 26,8% of fat mass, being this value lower than what it was found in the two groups evaluated in our study.

As for muscle mass, Mapuche students achieve higher results (38,1%) regarding non-Mapuche students (36,7%),

these records are in line with high records of muscle mass (41%) found in previous research with Mapuche students (Martinez and collaborators, 2012).

Non-Mapuche students have an average 11,8% in bone mass, while the Mapuche students have on average 12,5%, being lower than those exposed previously by Martínez and collaborators (2012).

Apparently, the ethnic groups studied in Chile and particularly the Mapuche have similar classification, suggesting that there might be in these groups similarity regarding the skeletal muscle developing, with a lower presence of fat, probably derived from common genetic factors or link to geographical and cultural backgrounds (Bruneau-Chávez and collaborators, 2015), which could result in a more robust body structure with respect to non-Mapuche Chilean subjects.

Among the main strengths of this research it can be mentioned the number of pure ethnic Mapuche subjects studied, which is due to miscegenation that exists in Chile and the assessment protocol used, which has a large normative database. It is recommended for future research, keep track of morphological changes that could suffer the students during adolescence and contrast body composition with other variables to enrich comparisons.

CONCLUSIONS

The Mapuche students achieved better muscle and bone mass scores, while exhibiting lower percentages of fat mass, residual and epithelial mass with respect to non-Mapuche students from the same area of residence.

Therefore, comparisons between ethnic groups should be treated with caution, given the differences in the genetic load and varied geographical context in which they develop. These is data that suggest the study of dietary, genetic and environmental patterns as well as other background history that may be affecting the body composition of students from Chile.

Finally, this study represents an important contribution to the research about the body composition on Mapuche children useful to establish future standard references of this indigenous population.

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