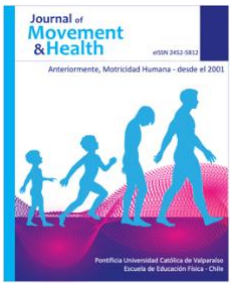
Journal of Movement and Health 2022,19(1):1-12.

DOI: https://doi.org/10.5027/jmh-Vol19-Issue1(2022)art136



eISSN: 2452-5812
http://jmh.pucv.cl/

**Recibido:** 13/07/2021
**Aceptado:** 29/09/2021
**Disponible:** 13/10/2021
**Publicado**: 01/01/2022

# Original article

## Blood pressure differences between American ethnic schoolchildren and European ascendants groups

Diferencias en la presión arterial entre escolares americanos de grupos étnicos y pares con ascendencia Europea

**Andrade-Mayorga, O[1]; Delgado-Floody, P[2], Cristian Alvarez[3]**

Correspondencia✉
Cristian Alvarez
Area Prioritaria de Investigación en Calidad de Vida y Bienestar Humano.
Departamento de Salud, Universidad de Los Lagos, Chile.
cristian.alvarez@ulagos.cl

## Abstract

**Objective:** To compare the blood pressure levels between Chilean schoolchildren ascendants from Mapuches and European at different blood pressure classifications. A second aim was to compare other cardiometabolic (anthropometric/body composition, cardiovascular, and muscle strength) risk factors for hypertensive blood pressure (HTN) between groups. **Methods:** A cohort study. Participants were (*n*=540) Chilean schoolchildren from public primary schools. The sample of schoolchildren was analyzed by categorization of normotension (NT), prehypertension (PreHTN), and HTN blood pressure state and by Mapuche and European Chilean ascent. The primary outcomes were systolic and diastolic blood pressure. **Results:** There were significant differences by ethnicity in diastolic blood pressure at the NT state blood pressure classification, but not at PreHTN and HTN states (Mapuche [78.6 (69.5, 84.3) mmHg] *vs*. European schoolchildren [66.5 (63.6, 68.5) mmHg] at $p<0.000$). There were no differences between Mapuches and European in body mass and body mass index, but significant differences in height. There were significant differences in resting heart rate and handgrip strength of the dominant and non-dominant arm between groups. **Conclusion:** Under a similar blood pressure state of criteria classification as normotension, Mapuches' schoolchildren's ascendants showed higher diastolic blood pressure levels than European peers. These findings suggest future more complex studies to corroborate ethnic differences.

**Palabras clave:** blood pressure; schoolchildren; ethnicity; risk factors.

## Resumen

**Objectivo:** Comparar los niveles de presión arterial entre escolares chilenos de ascendencia étnica Mapuche versus aquellos de ascendencia Europea. Un segundo objetivo fue comparar otros factores de riesgo cardiometabólico (antropometría/composición corporal, cardiovascular, y fuerza muscular) para desarrollar hipertensión arterial entre grupos. **Método:** Estudio de cohorte, que se desarrolló en una escuela primaria pública de Los Lagos con (*n*=540) niños escolares participantes. La muestra de niños escolares fue categorizada en niños de acuerdo a su nivel de presión arterial con estado de normotensión (NT), prehipertensión (PreHTN), e hipertensión arterial (HTN), así como dividida de acuerdo a la etnicidad ascendente de Mapuches o Europeos. Las mediciones principales fueron presión arterial sistólica y diastólica. **Resultados:** Existieron diferencias significativas mediante la etnicidad en la presión arterial diastólica en el estado de NT, pero no en el estado de PreHTN y HTN (Mapuche [78.6 (69.5, 84.3) 1mHG] *vs*. escolares Europeos [66.5 (63.6, 68.5) 1mHG], $p<0.000$). No existieron diferencias estadísticas entre escolares Mapuches y Europeos en la masa corporal, índice de masa corporal, pero existieron diferencias significativas en la talla en esta clasificación de presión arterial. Existieron diferencias significativas en la frecuencia cardiaca de reposo, y en la fuerza de agarre de la mano dominante y no dominante. Adicionalmente, existieron otras diferencias en variables de composición corporal. **Conclusión:** Bajo una misma clasificación de la presión arterial como la normotensión, escolares chilenos ascendentes de Mapuches reportan una elevada presión arterial diastólica

DOI: https://doi.org/10.5027/jmh-Vol19-Issue1(2022)art136

versus aquellos pares ascendentes de Europeos. Estos hallazgos sugieren la realización de futuros y más complejos estudios para corroborar estas diferencias étnicas.

**Keywords:** presión arterial; escolares; etnicidad; factores de riesgo.

## Highlighted points

- There was investigated the blood pressure of schoolchildren of ethnic and European ascendants.
- There was used standard blood pressure criteria classification to both ethnic and European ascendants.
- Under a similar blood pressure classification as normotensive state, ethnic groups show a higher diastolic blood pressure than European peers.
- The study suggests future more complex studies for exploring mechanisms.

## Introduction

Arterial hypertension (HTN) is one of the major risk factors for cardiovascular disease in adults, but today, it is regularly diagnosed in schoolchildren at primary care[1]. Although pediatric HTN is generally defined as ≥95$^{th}$ to age, sex, and height percentile[2], the ranges into each normotensive, prehypertensive, and hypertensive stage can show wide variation by percentile. High blood pressure and HTN are highly conditioned by physical inactivity, obesity, and new cardiometabolic risk factors in schoolchildren (*i.e.*, video games, screen exposure, light exposure, and sleep time)[3,4]. Similarly, genetic/epigenetic modifications can also play a role[5]. Worryingly, pediatric high blood pressure prevalence is increasing in some South American countries such as Chile, where schoolchildren with European ancestry reported an 11.1% prevalence of prehypertension and an 18.6% prevalence of HTN[6]. These findings are in coherence with previous increases rates of metabolic syndrome [MetS] (*i.e.*, high blood pressure, high fasting glucose, low high-density lipoprotein, and high triglycerides in addition to high abdominal obesity) and insulin resistance in Latin American ethnic schoolchildren[7].

More recently, for example, South Asians have been shown to have high adiposity, high blood glucose, and thus more type 2 diabetes mellitus (T2DM) risk at significantly lower body mass indexes (*i.e.*, BMI; 22 kg/m$^2$) than the normal nutritional state for South American (*i.e.*, BMI ≤25 kg/m$^2$)[8]. Likewise, the clinical cut-off points for obesity in these groups were changed (*i.e.*, decreased BMI from 25 to 22 kg/m in the prevention of early obesity), and T2DM development[8]. Thus as the risk for acquiring T2DM is higher for ethnics groups at BMI 25 kg/m$^2$, some researchers have claimed specific physical activity recommendations for these ethnics groups (*i.e.*, more than the international 150 min·week$^{-1}$ amount recommended)[9,10].

Likewise, due to there is little information regarding blood pressure values at the same range of blood pressure classification such as the normotensive, prehypertensive, or hypertensive state in Chilean ethnic groups, this study aimed to compare the blood pressure levels between Chilean schoolchildren ascendants from Mapuches and European at different blood pressure classification. A second aim was to compare other cardiometabolic (anthropometric/body composition, cardiovascular, and muscle strength) risk factors for HTN between groups.

## Methods

In a descriptive and cross-sectional study, a population of schoolchildren, including girls and boys from 6–13 years old, of primary public education, was invited to participate in the study by parent's information. Participants signed a written ascent, and parents/guardians signed written consent.

DOI: https://doi.org/10.5027/jmh-Vol19-Issue1(2022)art136

The inclusion criteria were as follows: a) schoolchildren with adherence to more than 70% at school, b) under the food program of the Scholar and Scholarship Auxiliary National Joint, c) parents receiving educational information regarding the study, d) signed informed consent provided by the parents, e) possessed one or two familial surnames to (Mapuche) or any ethnic surname to (European) ascendance, and f) between 6 and 13 years old. The exclusion criteria were as follows: a) did not have musculoskeletal disorders, b) did not have metal or intra-abdominal devices that can be affected by the bio-impedance meter for body composition analyses, and c) did not refuse be measured on the day of the evaluation. The first enrolment included (*n*=604) participants.

After the inclusion/exclusion criteria, a total of 64 individuals were excluded for several reasons [(*n*=33) in the Mapuche and (*n*=31) in the European ascendants]. Thus, the sample was divided into two main groups, Mapuches and European, as well as after the appropriate blood pressure screening (please to see blood pressure measurements section), both groups were divided into three subgroups according to their blood pressure classification (Mapuches; total sample *n*=119; 'normotensive' [NT], *N*=68, 'prehypertensive' [PreHTN], *n*=16; and 'hypertensive' [HTN], *n*=35), and the European group (European; total sample *N*=421; 'normotensive' [NT], *n*=314, 'prehypertensive' [PreHTN], *n*=37; and 'hypertensive' [HTN], *n*=70). The study was developed following the Declaration of Helsinki and was approved by the Ethics Committee of the Family Healthcare Centre Tomas Rojas of Los Lagos N° 03062016. The study design is described in Figure 1.

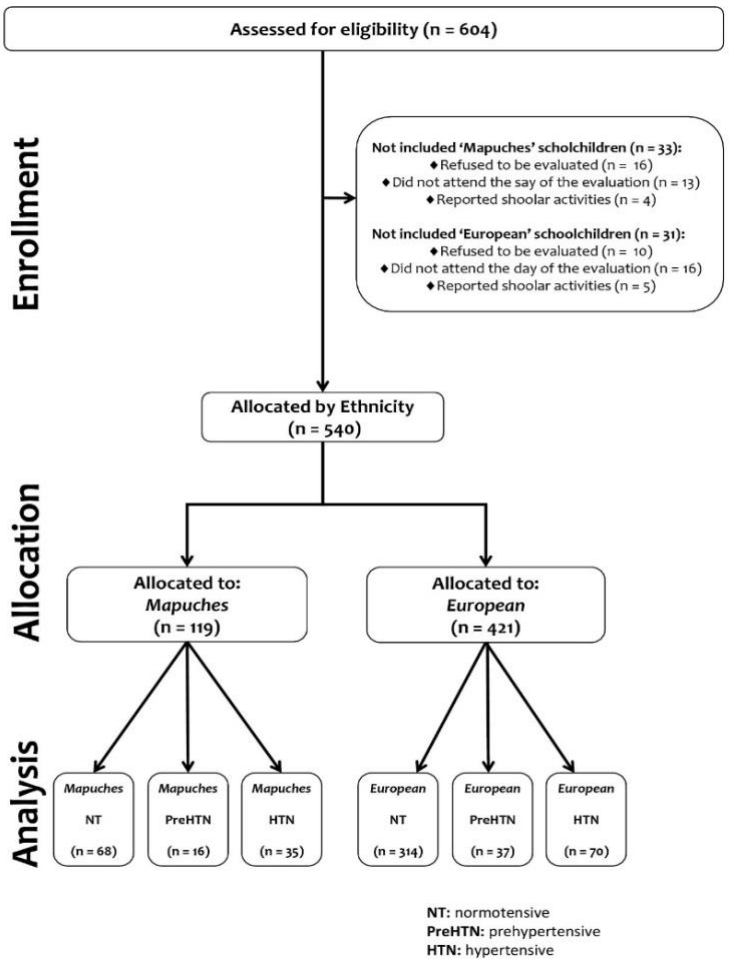



**Figure 1.** Study design.

DOI: https://doi.org/10.5027/jmh-Vol19-Issue1(2022)art136

*Procedures*

*Ethnicity classification*

The classification of ethnicity ascent was carried out using the two Chilean family surnames (*i.e.*, maternal or paternal) that in the major part of the South of Chile correspond to Mapuche – *people of the Land* – (*i.e.*, in Mapudungun language) ethnic origin[11]. Likewise, using the surnames, the participants who had one of the two ethnic Mapuche surnames that are particularly characteristic and different from the European were classifying into the Mapuche group, or by contrast, who did not have any of the ethnic surnames were classified in the European ascendant group. This classification has been reported previously[6,12].

*Anthropometric measurements*

Height was measured by a standard stadiometer (Health o Meter Professional, Sunbeam Products, Inc., Chicago, IL, USA) with an accuracy of 0.1 cm, and the BMI was calculated from the measured weight and height (kg/m$^2$). The prevalence of obesity was calculated using standard tables used in the Chilean public health system according to the age and percentile classification of girls and boys [13]. This procedure was consisted of 30-s to be each child was measured over the equipment without shoes, and the body composition data were automatically stored into the specific equipment software, being this procedure developed into a fitting room (15 ºC). Body mass index (BMI, kg/m$^2$) was used to be determined accordingly to the Chilean public nutritional classification norm using age, gender, and the respective percentile[14]. Thus, the participants were classified as underweight (BMI; <10$^{th}$ percentile), normal weight (10$^{th}$ to <85$^{th}$ percentile), obesity risk (85 to <95$^{th}$ percentile), and obesity (>95$^{th}$ percentile)[14].

Waist circumference was measured with an inextensible tape with 0.1 cm accuracy (Hoechstmass, Sulzbach, Germany). The body composition outcomes of body mass, fat mass (in percentage), and muscle mass (in kilograms) was measured using an electrical bioimpedance meter InBody120$^{TM}$, tetrapolar 8-point tactile electrodes system (model BPM040S12F07, Biospace, Inc., Seoul, Korea) with 0.1 kg precision, as used previously[15]. The measurements were carried out in an appropriate room between 9 in the morning and 1 in the afternoon.

*Muscle strength measurement*

Handgrip strength in the dominant (HGSd) and non-dominant arm (HGSnd) were measured as determined elsewhere[16] with an adjustable grip (model Jamar$^{TM}$, PLUS+, Sammons Preston, Patterson Medical, IL, USA). Schoolchildren were instructed to gradually and continuously tighten their grip for at least 5 seconds of maximal effort while receiving verbal motivation, performing the test twice (alternately with both hands).

*Blood pressure and cardiorespiratory measurements*

The blood pressure was assessed by a digital sphygmomanometer based on standard criteria procedures[17], considering; 'normotension' systolic (SBP)/or diatolic blood pressure (DBP) <90$^{th}$ percentile, 'prehypertension' SBP/DBP ≥90$^{th}$ percentile and <95$^{th}$ percentile, and 'hypertension' SBP/DBP ≥95$^{th}$ percentile including age, sex, and height percentiles. The prevalence of HTN was described by each normotensive or obesity degree (Table 1). The measurements were applied in triplicate, with a 2-min interval between measures, and using electronic devices (Omron HEM 7114$^{TM}$, Omron Healthcare, Inc., Japan) previously used[18]. Additionally, the intra-class coefficient (ICC) was calculated among measurements reporting high reliability (ICC; 0.93). The characteristics of the participants are summarized in (Table 1).

DOI: https://doi.org/10.5027/jmh-Vol19-Issue1(2022)art136

By a pulse-led capillary scatterometer (model CMS50M, Therapeutics Goods, ARTG Inc., AUS), the oxygen saturation (SpO2) was measured in participants during 15-30 s with a precision of 70 to ~100 ± 2%. Additionally, and using the same electronic device, we obtained the heart rate at rest.

*Statistical analyses*

Data are presented as the mean and 95% confidence interval (95%CI) for continuous variables in Table 1, Figure 2, Figure 3, and as a percentage for categorical variables in Table 1. The General Linear Model (by Univariant analyses) was used to test the blood pressure differences among the different NT, PreHTN, and HTN blood pressure state classifications by ethnicity (*i.e*., Mapuches *vs*. European); furthermore, using SBP, DBP, and all the other cardiometabolic anthropometric/body composition, cardiovascular and muscle strength outcomes, the factors ethnicity and BP classification were compared in these outcomes. Additionally, Sidak's *post hoc* was used for identifying group differences. For categorical variables, the chi-square test was used to identify differences between groups. Multivariable analyses were carried out for continuous outcomes between groups. Effect size (ES) for interaction (Time x Group) was assessed by $\eta^2$ obtained from the ANCOVA with small ($\eta^2$=0.01), medium ($\eta^2$=0.06), and large ($\eta^2$=0.14) effects. Data were analyzed in SPSS version 23 software, using an alpha level of $p$<0.05.

## Results

There were no differences between Mapuches and European in the anthropometric outcomes of body mass and BMI (Table 1). There were significant differences in height in the PreHTN between Mapuches [mean (95%CI)] [158 (144.0, 171.0)] and European [146.0 (138.0, 153.0)], as well as in the HTN state [132 (122.0, 141.9) and144.0 (138.0, 149.0), respectively] between Mapuches and European (Table 1). In cardiovascular parameters, there were significant differences in heart rate at rest between Mapuches [99 (86.0, 112.0) bests/min] and European [88.0 (83.0, 93.0) beats/min] at $p$<0.05 in the NT blood pressure state (Table 1). No ethnic differences were found in oxygen saturation between groups (Table 1). Mapuches schoolchildren showed more obesity at the PreHTN state 6 (37.5%) *vs*. European peers 8 (20.5%), but, by contrast, at the HTN state, these showed less obesity 8 (21.1%) *vs*. European 33 (43.4%) (Table 1). At HTN prevalence, Mapuches showed to be more prevalent at 38 (31.1%) *vs*. European peers 76 (17.5%) (Table 1).

Regarding muscle strength, there were significant differences in the HGSd in the NT state between Mapuches [19.4 (15.3, 24.0) kg] and European [14.8 (13.3, 18.8) kg] at $p$<0.05; and in the HGSnd between these groups [18.7 (14.7, 22.6) and 14.1 (12.5, 15.6) kg, respectively] (Table 1). Similarly, in the PreHTN state, there were significant differences in the HGSd between Mapuches [24.9 (19.8, 29.9) kg] and European [18.8 (16.0, 21.8) kg] at $p$<0.05; there were also differences in the HGSnd [23.0 (18.4, 27.5) and 16.3 (13.4, 18.7) kg, respectively] at $p$<0.05 between Mapuches and European (Table 1).

DOI: https://doi.org/10.5027/jmh-Vol19-Issue1(2022)art136

**Table 1.** Characteristics of the sample.

| Variables | Mapuches (*n* = 122) | | | European (*n* = 433) | | | *p*-value interaction groups[#] |
|---|---|---|---|---|---|---|---|
| | NT (*n* = 68) Mean (95%CI) | PreHTN (*n* = 16) Mean (95%CI) | HTN (*n* = 38) Mean (95%CI) | NT (*n* = 318) Mean (95%CI) | PreHTN (*n* = 39) Mean (95%CI) | HTN (*n* = 76) Mean (95%CI) | |
| ***Anthropometric*** | | | | | | | |
| Age (y)* | 10.5 (8.8–12.1) | 12.0 (10.0–13.9) | 8.8 (7.4–10.1) | 8.4 (7.8–9.1) | 11.2 (10.1–12.3) | 10.3 (9.5–11.1) | *p*=0.014, ES 0.13 |
| Body mass (kg)* | 36.1 (24.5–47.6) | 60.5 (47.2–73.8) | 36.5 (27.0–45.9) | 33.6 (29.0–38.2) | 50.2 (42.5–57.9) | 46.3 (40.8–51.7) | *p*=0.087, ES 0.08 |
| Height (cm)* | 1.42 (130–153) | 158 (144–171) | 132 (122–141) | 132 (127–137) | 146 (138–153) | 144 (138–149) | *p*=0.011, ES 0.14 |
| BMI (kg/m$^2$)* | 17.8 (14.3–21.2) | 24.2 (20.2–28.1) | 20.6 (17.8–23.4) | 18.9 (17.5–20.2) | 23.0 (20.7–25.2) | 21.8 (20.2–23.4) | |
| ***Prevalence of obesity*** | | | | | | | |
| Normoweight, *n*=(%)¶ | 25 (36.8%) | 7 (43.8%) | 13 (34.2%) | 140 (44.0%) | 14 (35.9%) | 17 (22.4%) | *p*=0.816 |
| Obesity Risk, *n*=(%)¶ | 32 (47.1%) | 3 (18.8%) | 14 (36.8%) | 110 (34.6%) | 15 (38.5%) | 20 (26.3%) | |
| Obesity, *n*=(%)¶ | 11 (16.2%) | 6 (37.5%)† | 8 (21.1%)† | 64 (20.1%) | 8 (20.5%) | 33 (43.4%) | |
| ***Cardiovascular*** | | | | | | | |
| Systolic BP (mmHg)* | 113 (100–125) | 130 (114–139) | 131 (119–138) | 108 (103–112) | 129 (123–130) | 138 (133–144) | *p*=0.485 |
| Diastolic BP (mmHg)* | 80 (69–89) | 82 (69–94) | 88 (74–102) | 67 (62–71) | 80 (74-90) | 82 (78–92) | |
| Heart rate rest (b/min)* | 99 (86–112) | 82 (66–97) | 90 (79–100) | 88 (83–93) | 88 (79–96) | 90 (83–96) | |
| Oxygen saturation* | 98 (94–100) | 92 (88–95) | 98 (95–100) | 95 (94–97) | 97 (95–99) | 98 (96–99) | |
| ***Prevalence of HTN (%)*** | | | 38 (31.1) | | | 76 (17.5) | |
| ***Muscle strength*** | | | | | | | |
| HGSd (kg)* | 19.4 (15.3–24.0)† | 24.9 (19.8– 29.9)† | 15.2 (11.6–18.7) | 14.8 (13.3–18.8) | 18.8 (16.0–21.8) | 18.5 (16.4–20.5) | *p*=0.053, ES 0.08 |
| HGSnd (kg)* | 18.7 (14.7–22.6)† | 23.0 (18-4–27.5)† | 16.7 (12.5–18.9) | 14.1 (12.5–15.6) | 16.3 (13.4–18.7) | 17.8 (15.9–19.6) | *p*=0.050, ES 0.08 |

Data are presented as mean and 95%confidence interval (95%CI) to continuous (*), and as *N*= and % percentage (¶) to categorical outcomes. The General Linear Model by Univariant analyses was used to analyse the continuous and Chi-square for categorical outcomes comparisons. (BMI) body mass index, (NT) normotension state, (PreHTN) prehypertensive state, (HTN) hypertensive state, (HGSd) handgrip strength test of the dominant hand, (HGSnd) handgrip strength test of the non-dominant hand. (#) Univariant ANOVA test. (†) Denotes significant difference at $p<0.05$ *vs*. the same blood pressure state of the European group by Sidak's *post hoc*. ES: denote Lakens $\eta^2$ Effect Size.

DOI: https://doi.org/10.5027/jmh-Vol19-Issue1(2022)art136

Comparing Mapuches and European peers, there were no differences in the waist circumference and BMI in the NT, PreHTN, or HTN blood pressure state (Figure 2 panel A and B). There were significant differences in the fat mass values at the NT state [17.8 (15.5, 20.2) *vs.* 27.2 (25.9, 28.1)] in Mapuches *vs*. European (Figure 2 panel C). There were no differences in fat mass between ethnic groups in the PreHTN or the HTN blood pressure state (Figure 2 panel C). There were significant differences in muscle mass between groups in the PreHTN state [Mapuches 22.5 (20.2, 24.3) kg *vs*. European 17.1 (16.2, 18.3) kg] (Figure 2 panel D).

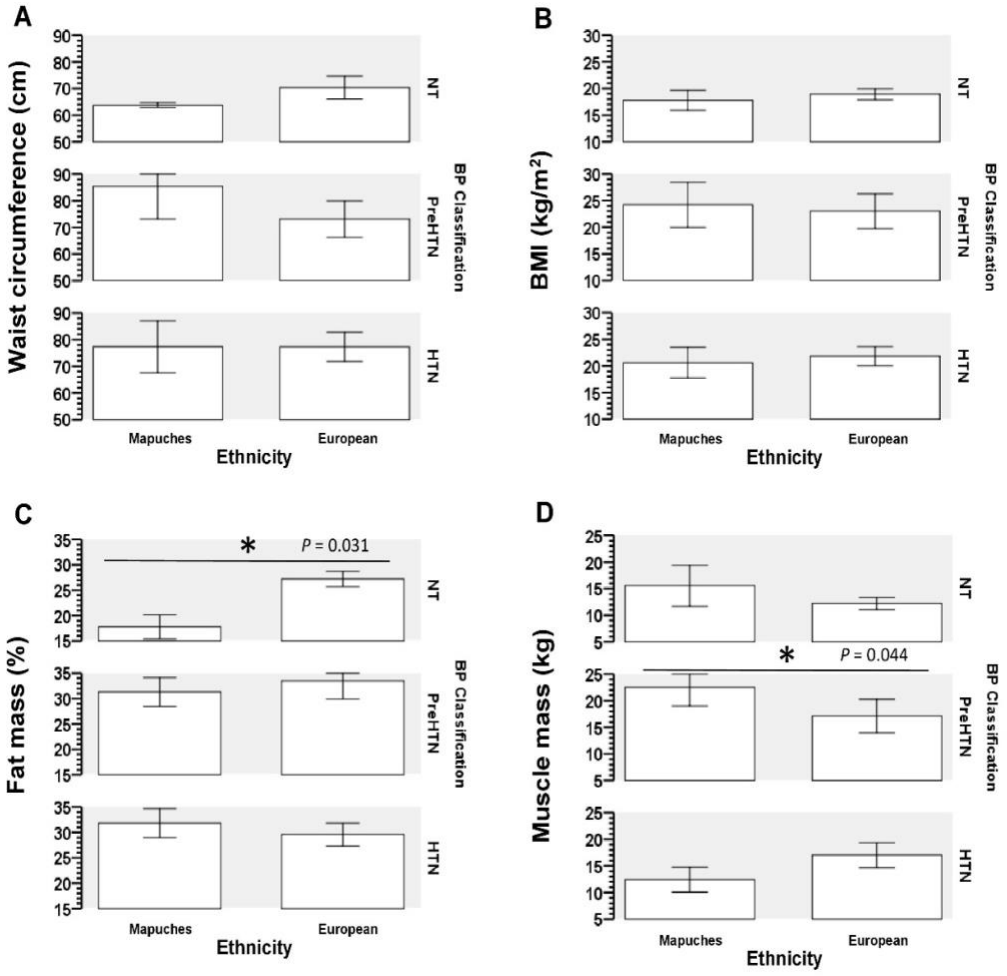



**Figure 2.** Body composition differences at the level of **A**) waist circumference, **B**) BMI, **C**) fat mass, and **D**) muscle mass in schoolchildren Mapuches and European ascendants. (BMI) body mass index. (*) Denotes significant differences at $p<0.05$ between ethnics groups at one (normotensive or prehypertensive) blood pressure state classification.

Figure 3 panels A, B, and C show that regarding SBP values, there were no differences by ethnicity in the three NT, PreHTN, and HTN blood pressure states. Regarding DBP, there were significant differences between Mapuche [78.6 (69.5, 84.3) mmHg] and European schoolchildren [66.5 (63.6, 68.5) mmHg] at $p<0.0001$ in the NT blood pressure state (Figure 3 panel A). On the other hand, in the PreHTN and HTN blood pressure state, there were no differences in DBP by ethnic group (Figure 3, panels B and C).

DOI: https://doi.org/10.5027/jmh-Vol19-Issue1(2022)art136

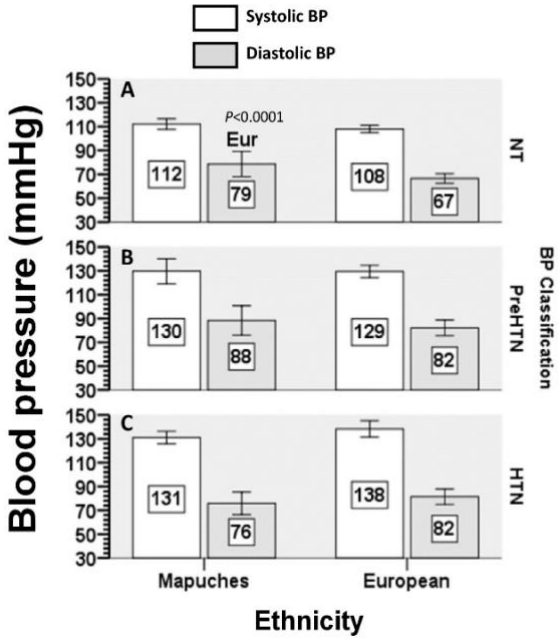



**Figure 3.** Blood pressure differences at the level of **A**) normotension, **B**) prehypertension, and **C**) hypertension state of classification in schoolchildren Mapuches and European. (NT) Normotension, (PreHTN) Prehypertension, (HTN) Hypertension. ([EUR]) Denotes significant ($P$<0.0001) differences between Mapuches *vs*. European schoolchildren at normotension in diastolic blood pressure.

## Discussion

The main findings of this study are that at the normotensive BP state, Mapuche schoolchildren show higher levels of DBP than European peers (Figure 3). Despite WHO has proposed the use of percentiles including age, sex, and height for children blood pressure screening, there are several concerns at the level of anthropometric (i.e., height, adiposity) and the westernized environments that can change the cardiometabolic health in schoolchildren by continent or country.

In this line, although the normotensive, prehypertensive, and HTN states have an established range as a cut-off among these, the mean data in each of these categories of SBP and DBP can be worsened (*i.e.*, increased) an vary by ethnic group, and due to the environment. Thus, although there is widely described that hypertensive transmitted high blood pressure to their children (*i.e.*, 20% of children with high blood pressure have parents with HTN)[19], in other diseases such as obesity, some organizations have recommended the use of different cut-off points, for example, by the use of different waist circumference cut-off points according to ethnicity/continent (*i.e.*, European [≥102 to ♂, and ≥88 cm to ♀], South American [≥90 to ♂, and ≥80 cm to ♀])[20].

In this study, we found a prevalence of HTN of 17.6% in Europe and 31.1% in Mapuche schoolchildren. Other authors such as Bancalari et al.[21] in a sample of 2,980 teenagers, showed a mean HTN prevalence of 13.6%, in which girls showed lower HTN prevalence (12.2%) than boys (14.9%), and normal-weight boys also showed lower HTN prevalence (8.9%) than obese boys (26.1%). Approximately forty years ago, Norero et al.[22] reported that the HTN prevalence in a sample of urban Chilean schoolchildren was 11.8% in SBP and 5.2% in DBP. In contrast, other South American studies, for example, Anglony et al.[23], in a sample of 112 urban schoolchildren, reported a low HTN prevalence of 2.7% and 3.6% to prehypertension. Others, as Barja et al.[24] showed an HTN prevalence of 21% in children

DOI: https://doi.org/10.5027/jmh-Vol19-Issue1(2022)art136

with severe obesity. By the present, in our Mapuche sample, we are showing a non-necessary obesity-dependent association for high blood pressure, wherein each normotensive, prehypertensive, and HTN state we have compared blood pressure mean data. We speculate that around the world, there are new cardiometabolic risk factors, such as sedentary behavior, physical inactivity, video game use, electronic devices as screens, and short sleep duration, for increased SBP and DBP, leading thus to an early HTN risk in schoolchildren, but this can vary by specific non-explored ethnic groups. Additionally, it is also presumably, that genetic factors can exacerbate the effect of all these new cardiometabolic risk factors in Mapuche schoolchildren compared to their European pairs.

Interestingly, some ethnic groups showed more T2DM risk at a more early BMI (*i.e.*, 22 kg/m$^2$), some adult studies have claimed specific physical activity recommendations for this ethnic populations[10]. However, although we also recognize differences in adults and children, there is unexplored information yet in schoolchildren regarding the etiology/epidemiology of HTN in how these new cardiometabolic risk factors such as the television exposure[25], sedentary behavior[26], video games, and a low sleep time artificial[27], and light exposure[28] among others can provide less/more detrimental effects in their cardiometabolic health. For example, regarding muscle strength, there is a need for acquired knowledge of cut-off values for different regions and countries regarding how the handgrip strength can predict HTN or high blood pressure at early ages, due to handgrip is a practical and easy test for performing in schoolchildren[29].

Some limitations of this study are that a) we did not assess biological maturation, b) the Mapuche sample was less than European, c) we did not measure official ethnic Mapuche community, d) we did not measure physical activity by accelerometers, e) we do not include familial HTN history. A strength of the present study was that we included additional risk factors such as body composition, astrometry, and muscle strength.

## Conclusions

In conclusion, under a similar blood pressure state of criteria classification as normotension with their range, Mapuches' schoolchildren's ascendants showed higher diastolic blood pressure levels than European peers. These findings suggest the development of future more complex studies to corroborate ethnic differences at a similar blood pressure state.

## References

1. Gilbert N, Hage A. [Treatment of arterial hypertension in children and adolescents--Update of therapeutic options]. *Med Monatsschr Pharm* 2015; 38(4): 120-131; quiz 33-4. PMID: 26364380
2. Flynn JT. High blood pressure in the young: why should we care? *Acta Paediatrica* 2018; 107(1): 14-19. DOI: 10.1111/apa.14110
3. Burrows R, Correa-Burrows P, Reyes M, Blanco E, Albala C, Gahagan S. Healthy Chilean Adolescents with HOMA-IR ≥ 2.6 Have Increased Cardiometabolic Risk: Association with Genetic, Biological, and Environmental Factors. *J Diabetes Res* 2015; 2015: 2018. DOI: 10.1155/2015/783296
4. Burrows R, Correa-Burrows P, Reyes M, Blanco E, Albala C, Gahagan S. High cardiometabolic risk in healthy Chilean adolescents: associations with anthropometric, biological and lifestyle factors. *Public health nutrition* 2016; 19(03): 486-493. DOI:10.1017/S1368980015001585
5. Richard MA, Huan T, Ligthart S, et al. DNA methylation analysis identifies loci for blood pressure regulation. *The American Journal of Human Genetics* 2017; 101(6): 888-902. DOI: 10.1016/j.ajhg.2017.09.028

DOI: https://doi.org/10.5027/jmh-Vol19-Issue1(2022)art136


6. Álvarez C, Ramírez-Campillo R, Martínez-Salazar C, et al. Hipertensión en relación con estado nutricional, actividad física y etnicidad en niños chilenos entre 6 y 13 años de edad. *Nutrición Hospitalaria* 2016; 33(2): 220-225. DOI:10.20960/nh.93
7. Romero PE, Gutiérrez BC, Gil NÁ, Martín-Frías M, Blanco MA, Castellanos RB. Influencia étnica en la prevalencia de síndrome metabólico en población pediátrica obesa. Anales de pediatria; 2013: Elsevier; 2013. p. 75-80. DOI: 10.1016/j.anpedi.2012.04.010
8. Ntuk UE, Gill JMR, Mackay DF, Sattar N, Pell JP. Ethnic-Specific Obesity Cutoffs for Diabetes Risk: Cross-sectional Study of 490,288 UK Biobank Participants. *Diabetes Care* 2014; 37(9): 2500-2507. DOI: 10.2337/dc13-2966
9. Iliodromiti S, Ghouri N, Celis-Morales CA, Sattar N, Lumsden MA, Gill JMR. Should Physical Activity Recommendations for South Asian Adults Be Ethnicity-Specific? Evidence from a Cross-Sectional Study of South Asian and White European Men and Women. *PLOS ONE* 2016; 11(8): e0160024. DOI: 10.1371/journal.pone.0160024
10. Gill JMR, Celis-Morales CA, Ghouri N. Physical activity, ethnicity and cardio-metabolic health: Does one size fit all? *Atherosclerosis* 2014; 232(2): 319-333. DOI: 10.1016/j.atherosclerosis.2013.11.039
11. García F, Moraga M, Vera S, et al. mtDNA microevolution in Southern Chile's archipelagos. *American Journal of Physical Anthropology: The Official Publication of the American Association of Physical Anthropologists* 2006; 129(3): 473-481. DOI: 10.1002/ajpa.20297
12. Morgan RO, Wei II, Virnig BA. Improving Identification of Hispanic Males in Medicare: Use of Surname Matching. *Medical Care* 2004; 42(8): 810-816. DOI: 10.1097/01.mlr.0000132392.49176.5a
13 Pizarro Q, Rodríguez H, Benavides M, et al. Norma técnica de evaluación nutricional del niño de 6 a 18 años. Año 2003. *Rev chil nutr* 2004; 31(2): 128-317. DOI: 10.4067/S0717-75182004000200007
14. Minsal. Norma Técnica para la supervisión de niños y niñas de 0 a 9 años en la Atención Primaria de Salud: Programa Nacional de Salud de la Infancia. Santiago; 2014. p. 1-398. http://www:2014_Norma Técnica para la supervisión de niños y niñas de 0 a 9 en APS_web(1).pdf
15. Montgomery MM, Marttinen RH, Galpin AJ. Comparison of Body Fat Results from 4 Bioelectrical Impedance Analysis Devices vs. Air Displacement Plethysmography in American Adolescent Wrestlers. *International Journal of Kinesiology and Sports Science* 2017; 5(4): 18-25. DOI:10.7575/aiac.ijkss.v.5n.4p.18
16. Ramírez-Vélez R, Correa-Bautista JE, Ramos-Sepúlveda JA, et al. Aerobic capacity and future cardiovascular risk in Indian community from a low-income area in Cauca, Colombia. *Italian journal of pediatrics* 2017; 43(1): 28. DOI: 10.1186/s13052-017-0347-y
17. Falkner B, Daniels SR, Flynn JT, et al. The fourth report on the diagnosis, evaluation, and treatment of high blood pressure in children and adolescents. *Pediatrics* 2004; 114(2 III): 555-576. DOI:10.1542/peds.114.2.S2.555
18. Stergiou GS, Yiannes NG, Rarra VC. Validation of the Omron 705 IT oscillometric device for home blood pressure measurement in children and adolescents: the Arsakion School Study. *Blood pressure monitoring* 2006; 11(4): 229-234. DOI: 10.1097/01.mbp.0000209074.38331.16
19. Chadha S, Tandon R, Shekhawat S, Gopinath N. An epidemiological study of blood pressure in school children (5-14 years) in Delhi. *Indian Heart Journal* 1999; 51(2): 178-182. PMID:10407546
20. Alberti K, Eckel R, Grundy S, Zimmet P, Cleeman J, Donato K. Harmonizing the metabolic syndrome. A joint interim statement of the IDF Task Force on Epidemiology and Prevention; NHL and Blood Institute; AHA; WHF; IAS; and IA for the Study of Obesity. *Circulation* 2009; 120(16): 1640-1645. DOI: 10.1161/CIRCULATIONAHA.109.192644

DOI: https://doi.org/10.5027/jmh-Vol19-Issue1(2022)art136

21. Bancalari R, Diaz C, Martinez-Aguayo A, et al. Prevalence of hypertension in school age children and its association with obesity. *Revista medica de Chile* 2011; 139(7): 872-879. DOI: /s0034-98872011000700007
22. Norero V, Vargas C, Mayne D, et al. Cifras tensionales en poblacion escolar chilena urbana: I. Parte. *Revista chilena de pediatría* 1980; 51(3): 184-193. DOI: 10.4067/S0370-41061980000300005
23. Aglony I M, Arnaiz G P, Acevedo B M, et al. Perfil de presión arterial e historia familiar de hipertensión en niños escolares sanos de Santiago de Chile. *Revista médica de Chile* 2009; 137: 39-45. DOI:10.4067/S0034-98872009000100006
24. Barja Y S, Arteaga Ll A, Acosta B AM, Hodgson B. MI. Resistencia insulínica y otras expresiones del síndrome metabólico en niños obesos chilenos. *Revista médica de Chile* 2003; 131: 259-268. DOI:10.4067/S0034-98872003000300003
25. Salmon J, Campbell KJ, Crawford DA. Television viewing habits associated with obesity risk factors: a survey of Melbourne schoolchildren. *Medical Journal of Australia* 2006; 184(2): 64-66. DOI: 10.5694/j.1326-5377.2006.tb00117.x
26. Wu T-Y, Rose SE, Bancroft JM. Gender differences in health risk behaviors and physical activity among middle school students. *The Journal of School Nursing* 2006; 22(1): 25-31. DOI: 10.1177/10598405060220010501
27. Van den Bulck J. Television viewing, computer game playing, and Internet use and self-reported time to bed and time out of bed in secondary-school children. *Sleep* 2004; 27(1): 101-104. DOI: 10.1093/sleep/27.1.101
28. Touitou Y, Touitou D, Reinberg A. Disruption of adolescents' circadian clock: the vicious circle of media use, exposure to light at night, sleep loss and risk behaviors. *Journal of Physiology-Paris* 2016; 110(4): 467-479. DOI: 10.1016/j.jphysparis.2017.05.001
29. Dodds RM, Syddall HE, Cooper R, Kuh D, Cooper C, Sayer AA. Global variation in grip strength: a systematic review and meta-analysis of normative data. *Age and Ageing* 2016; 45(2): 209-216. DOI: 10.1093/ageing/afv192

## Affiliations

[1] Department of Preclinical Sciences, Faculty of Medicine, Universidad de La Frontera, Temuco, Chile.
[2] Department of Physical Education, Sport, and Recreation, Universidad de La Frontera, Temuco, Chile.
[3] Quality of Life and Wellness Research Group, Department of Health, Universidad de Los Lagos, Chile.

## Author contributions

Contributions of the authors: O.A.M., and C.A., study design, and methodology. C.A., fundings and methodology contribution. O.A.M., P.D.F., and C.A., writing and final approval of the manuscript.

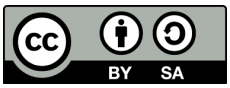
## Conflict of interest

All the authors declared no conflict of interest

## Fundings

This study was funded partially by the public Family Healthcare Centre T.R.V, by the Universidad de Los Lagos research project R01/18, and by private funding.

DOI: https://doi.org/10.5027/jmh-Vol19-Issue1(2022)art136



Copyright (c) 2022 Journal of Movement and Health. Este documento se publica con la política de Acceso Abierto. Distribuido bajo los términos y condiciones de Creative Commons 4.0 Internacional https://creativecommons.org/licenses/by-sa/4.0/.