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ANALYSIS OF BODY COMPOSITION AND AUTONOMIC FUNCTION OF THE HEART OF SCHOOLS FROM NORTHERN MEXICO BY GENDER

Análisis de composición corporal y función autonómica del corazón de escolares del norte de México por género

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KEYWORDS

Body Composition
Body mass index
Autonomic profile
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Children
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ABSTRACT

Normative values of body composition (CC) and autonomic profile of Mexican schoolchildren are presented. The design corresponds to a study with a quantitative, descriptive approach. The CC was determined using the Poortmans and Slaughter equation, the HRV was in records of short duration. Significant differences were found in muscle mass when comparing: 13.13 ± 3.57kg for women vs 15.79 ± 3.50kg for men with a significance of p = .01. The autonomic profile did not show significant differences, the mean of the mean R-R intervals (MRR) was 616.16 ± 81.52 ms in girls and 611 ± 72.27 ms in boys.

PALABRAS CLAVE

Composición corporal
Índice de masa corporal
Perfil autonómico
Variabilidad de la frecuencia cardiaca
Valores referenciales
Niños
Género

RESUMEN

Se presentan valores normativos de composición corporal (CC) y perfil autonómico de escolares mexicanos. El diseño corresponde a un estudio de enfoque cuantitativo, descriptivo. La CC se determinó empleando la ecuación de Poortmans y Slaughter, la VFC fue en registros de corta duración. Se encontraron diferencias significativas en la masa muscular al comparar: 13.13 ± 3.57kg las mujeres vs 15.79 ± 3.50kg los hombres con una significancia de p = .01. El perfil autonómico no mostró diferencias significativas, el promedio de la media de los intervalos R-R (MRR) fue de 616.16 ± 81.52ms en niñas y 611 ± 72.27ms en niños.

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1. Introduction

Around 44 million (6.7%) of the world's children aged less than five years were overweight (OW) or obese (OB) in 2012 (Pan American Health Organization [PAHO], 2014). Furthermore, the rapid rise in childhood obesity is one of the most serious public health challenges of the 21st century, with the number of children and adolescents affected by obesity increasing more than ten times from 11 million in 1975 to 124 million in 2016 (World Health Organization [WHO], 2020). Indeed, a study estimate that between 42.5 and 51.8 million children and adolescents 0–18 years in Latin America classified as OW or OB, representing 20–25% of the total population of all children and adolescents in the region (Rivera et al., 2014). Particularly in Mexican context children aged between 5 to 11 years the prevalence of OW an OB was 32.8% for girls and 33.7% for boys respectively, as well as adolescent population that was classified between 39.2% for girls and 33.5% for boys (Shamah et al., 2018). Owing to the statistics the mentioned context, result very important identify body composition children to explore the status of health, because there is an established link between OW and OB during childhood and its persistence into adolescence and adulthood (Dietz, 1998). In addition to being linked to several morbidities for example cardiovascular disease, and reduced autonomic cardiac modulation (Brich et al., 2012; Dietz, 1998; Farah et al., 2018; Santos et al., 2015).

Previous research pointed out that in children the body mass index (BMI) is highly correlated with body fat mass and widely used as a valid indirect measurement of adiposity in children, thus BMI is a simple internationally accepted method to assess weight- related health as it is strongly associated with adiposity, disease risk and cardiovascular mortality (Hernández *et al.*, 2017; Subramanian *et al.*, 2013). Nevertheless, in childhood and adolescence it is acknowledged that BMI is a rather poor indicator to show the distribution of the body composition, because it does not differentiate between lean body mass and body fat mass, which are very important markers of malnutrition impacting in diagnosis (Calcatera *et al.*, 2019). Hence, is necessary to complement the body composition profile in children, where the anthropometry, allows to reach more information than BMI, being fat mass and muscle mass leading useful results, in that sense the equations implemented in children by the scientific community (Curilem *et al.*, 2016) are the equation proposed by Poortmans *et al.* (2005) to quantify the muscular component and the equation of Slaughter *et al.* (1998) to estimate body fatness. In relation to the distribution of the body fat, skinfold thickness from subscapular and tricipital region, the waist-to-hip ratio provides interesting information about how body fat is distributed (Rodríguez *et al.*, 2004).

Another important manifestation of obesity is impairment in the autonomic nervous system (ANS), where previous studies find BMI is significantly and inversely related to the square root of the mean of the sum of the squares of differences between adjacent NN intervals (rMSSD) if the BMI is high decrease the RMSSD, while the low frequency/ high frequency ratio appears higher in OB children, adolescents, and young people respectively (Farah *et al.*, 2018; Rossi *et al.*, 2015; Santos *et al.*, 2015). Therefore, one of the promising markers to assess the ANS balance is the heart rate variability (HRV), as a non-invasive method used to evaluate the modulation between sympathetic nervous system (SNS) and parasympathetic nervous system (PNS) on the cardiac sinus node, HRV describes the oscillations between consecutive electro-cardiogram R-R intervals (R-Ri; N-N), (Catai *et al.*, 2019; Malik *et al.*, 1996) some authors have considered it a good indicator of autonomic control related to cardiovascular health for clinical an non clinical purposes (Bobkowski *et al.*, 2017; Malik *et al.*, 1996; Medina *et al.*, 2012; Sassi *et al.*, 2015). For the analysis there are many mathematical methods applied to compute HRV and they may be grouped into statistical, spectral, graphical, nonlinear, or information based (Bobkowski *et al.*, 2017; Malik *et al.*, 1996; Medina *et al.*, 2012; Sassi *et al.*, 2015). Among all methods and parameters since the 1996 publication standards of measurement, physiological interpretation, and clinical use were related to time- and frequency-domain HRV analysis for short- and long-term recordings (Bobkowski *et al.*, 2017; Malik *et al.*, 1996; Sassi *et al.*, 2015) together with the Poincaré plot as the only common technique in the complex field of non-linear methods (Medina *et al.*, 2012).

On the other hand, it must not be forgotten that HRV is a very sensitive physiological marker. Thus scientific community has to contextualize those markers to the ethnicity, age, gender, the level of physical activity or even the health status likewise BMI, physical fitness (Malik *et al.*, 1996; Sassi *et al.*, 2015), hence the data from previous studies cannot be extrapolated to the rest of the Mexican population because the sample of those studies were homogeneous analyzed OB adolescents men (Guízar *et al.*, 2005), and also the target population for other studies was for young adults, active and athletes (Medina *et al.*, 2012; Miranda *et al.*, 2020). In consequence, according to the evidence and lack of local information in most part of México, particularly in the Region of Chihuahua, there is a knowledge gap about the body composition and autonomic profile in Mexican children by gender. Hence, the aim of this study was primarily to explore the values of body composition and the autonomic profile through HRV in 5º grade of primary school students of the north of Mexico and determine the possible differences by gender. In the second instance, generate tables of percentiles of body composition and autonomic profile of Mexican children.

2. Materials and Methods

2.1. Study Design and Participants

A transversal-correlational study has been made, prior to the lockdown caused by the Covid-19 pandemic. Eight 5th grade groups from federalized elementary schools be-longing to School Zone 46 in Chihuahua northern Mexico were invited to participate on the study, of which four of them agreed to participate. Initially, the study has had 122 volunteers. Non-probability sampling was the technique used in this study.

The exclusion criteria were those students who are cared for by the department of special education (USAER) and have a diagnosis of neurological disorder, this includes students who have Down syndrome, students who are undergoing medical treatment that interferes with the ANS response, students with cardiovascular diseases, or who suffer from childhood diabetes, students younger or older than 11 years old, were discarded from the investigation. Elimination Criteria were if during the measurements the student stated that he does not wont to participate in the measurement, due to fear or shame, her decision was respected and they were excluded from the study, as well as excluding all subjects does not meet the previous requirements for HRV assessment for example; prior to collection, have abstained from vigorous physical activity for at least 48 hours prior to the study, not having ingested stimulant substances such as coffee, energy drinks, to-bacco, or medications that could affect the ANS response. Finally, after application of those criteria the sample was 74 children (n= 34 girls, n= 40=boys) who complete the requirements.

To enroll a child in the study, parents or legal guardians' permission was requested. All subjects, parents or legal guardians were informed of the study and the procedures involved and gave written consent. The study was approved by the Ethics and Bioethics Committee of the Autonomous University of Ciudad Juárez (ID CIEB-2020-1-11). It was conducted following the Declaration of Helsinki, respect the human rights of the participants.

2.2. Procedures

2.2.1. Anthropometric Measurements and Body Composition

Anthropometric evaluations were developed by certificated professionals on ISAK and in controlled conditions in the morning. The requirements for the study subjects were to present to the evaluation in fast and with an empty bladder, also without corporal lotions that could affect the measurement. To obtain the corporal weight a weighing machine with a 0.1 kg precision [TANITA® UM-081, Tokyo, Japan], the measurement was made with the subject in a standing position, wearing a short and the girls a light top who were proportionated by the investigation group. The height was sized by a stadiometer in the wall with a 1mm precision [Seca® 206] in the standing position without no footwear nor socks, using the head traction in the Frankfort. Posteriorly the marking of the anatomic points of reference using a dermo-graphic pencil to measure the tricipital skinfold thickness, subscapularis, front thigh, medial calf, as the same as the relaxed arm circumferences, relaxed waist circumference, gluteus maximus, medial thigh and maximum calf for those who were used Lufkin® [Executive Thinline W606ME] metallic inextensible tapes and a skinfold caliper Slim Guide® with a 0.5mm. The body mass index (BMI) was obtained dividing the corporal weight (kg) with the height (m)2, at-tending the *NORMA Official Mexicana* NOM-008-SSA3-2017 that stablish points of measurement of the anthropometric indicators for the Mexican population. In other hand the waist–hip ratio (WHR) was obtained by the division of the circumference of the waist (cm) with the height (cm).

Further, the muscular composition (kg) was quantified by the equation Poortmans *et al.* (2005) through the next equation:

$$\text{Muscular Mass (kg; MM)} = \text{Height} * ([0.0064 * \text{corrected arm perimeter}^2] + [0.0032 * \text{corrected thigh perimeter}^2] + [0.0015 * \text{corrected calf perimeter}^2] + [2.56 * \text{sex}] + [0.136 * \text{age}]) \quad (1)$$

In the equation height it is expressed in (m); the corrected arm perimeter= arm relaxed perimeter (cm) – (triceps fold [mm] /10); the corrected thigh perimeter= medial thigh perimeter [cm] – (anterior thigh fold [mm] / 10); the corrected calf perimeter= calf perimeter [cm] – (fold calf [mm] / 10); in respect with the sex= the 0 value for the women and the 1 for men, age is expressed in years.

The body fat percentage was quantified by using the Slaughter *et al*. (1998) equations for children respectably as shown in the next equation:

$$\text{In boys: \% Fat Mass (\% FM)} = 0.735 * (\text{tricipital fold} + \text{medial leg fold} + 1.0) \quad (2)$$

In girls: % Fat Mass (% FM)= 0.610 * (tricipital fold + medial leg fold + 5.1) (3)

For both equations of Slaughter *et al*. (1998) the tricipital fold is expressed in (mm) and the medial leg fold also in (mm).

2.2.2. Heart Rate Variability Measurements

In accordance with international recommendations for HRV measurement (Malik *et al*., 1996), students were asked to refrain from intense physical activity for 24 hours prior to the measurements, as well as from ingesting caffeinated beverages or any stimulant beverage for 12 hours before the recording. Parents or legal guardians were instructed to bring the children fasting and with an empty bladder at 8:00 a.m. to perform the evaluation. The measurement was developed in a controlled environment, maintaining control of lighting, temperature 24 - 26oC and in the absence of devices that could generate noise in the recording (Sharma *et al*., 2015). A recording of the R-R intervals between heartbeats (N-N) was performed, which were recorded at a sampling rate of 1000 Hz with the Polar® elastic electrode belt, using Wearlink bands, employing a Windlink infrared computer transmitter as it has been employed in subjects with similar characteristics to the sample (Michels *et al*., 2013) the duration of the recording was of 10 minutes duration (Michels *et al*., 2013; Sharma *et al*., 2015) in the same position as in previous studies (Naranjo *et al*., 2019).

Subsequently, the data was extracted from the Polar® program using a notepad and processed in the Kubios HRV software (Tarvainen *et al*., 2014) to develop the HRV analysis using the time-domain method, through the mean of the N-N intervals (mRR), rMSSD, the logarithm of the square root of the sum of the mean of the differences of the squares of consecutive N-N intervals LnRMSSD, considered variables reflecting parasympathetic nervous system (PNS) activity (Michels *et al.,* 2013; Sharma *et al*., 2015). Likewise, the variables of the very low frequency band (MBF; 0.0033 - 0.04 Hz), the low frequency band (BF; 0.04 - 0.15 Hz), the high frequency band (AF; 0.15 - 0.4 Hz) and the total spectral power (TP= VLF + LF + HF) were analyzed using the frequency domain method.

In addition, the data was analyzed using the nonlinear Poincaré dispersion plot method, through which parameters that quantify the standard deviation (SD) of the short- and long-term N-N interval variability (SD1 and SD2, respectively) can be characterized (Rahman *et al*., 2018). Where SD1 reflects short-term HRV, which is believed to reflect a measure of parasympathetic nervous system (PNS) activity (Rahman *et al*., 2018; Tayel, & AlSaba, 2015) and SD2 represents the standard deviation of the continuous N - N interval variability, of which is believed to reflect long-term HRV (Tayel, & AlSaba, 2015).

Finally, the two new indexes were applied: the first one is the stress score (SS), which is obtained from the following equation:

$$SS = 1000 * 1 / SD2 \quad (4)$$

Because SD2 is an inverse function of parasympathetic activity, the inverse of SD2 is expressed to obtain a value that is directly proportional to sympathetic activity, it is multiplied by 1000 so that the value obtained is a number that can be handled more easily, this index can be considered as an index of physiological stress (Naranjo *et al*., 2015).

The second is the sympathetic parasympathetic ratio (R S:PS):

$$R\ S{:}PS = \text{The rational of } (SS : SD1) \quad (5)$$

Where SS is the stress score and SD1 is the diameter or transverse axis of the ellipse of the Poincaré diagram. This index allows expressing a relation between sympathetic and parasympathetic activity (Naranjo *et al*., 2015).

1000 × 1 / SD2. Since SD2 is an inverse function of sympathetic activity, we expressed the inverse of SD2 to obtain a value that is directly proportional to sympathetic activity (multiplied as physiological stress index and parasympathetic sympathetic ratio (R S:PS) (Naranjo *et al*., 2015).

2.2.3. Statistical Analysis

The analysis was performed using Statistical Package for the Social Sciences (SPSS) version 24.0 (SPSS Inc., Chicago, IL, USA). Descriptive statistics were calculated to obtain the mean ($\bar{x}$) and standard deviation (SD) for each variable. The Kolmogorov-Smirnov goodness-of-fit test ($n \geq 50$) was applied to determine the normality of the data and, since the results obtained were nonparametric, the Mann-Whitney U test was performed for nonparametric data, where boys were compared with girls, and percentile tables were generated for the variables analyzed.

3. Results

3.1. Results of Body Composition

Firstly, the next socio-demographical characteristics are presented in the total of the sample, the data expressed in the mean and SD respectively. The weight was of 35.37 ± 9.39 kg, the size of 138.56 ± 7.99 (cm), the BMI of 18.38 ± 3.463 (kg / m2), the FM was of 14.35 ± 3.7 (kg), the % of the BFP of 29.04 ± 10.3 %, WHR was of .85 ± .05 arbitrary units (ua) finally the WSR was of 0.45 ± .05.

By comparing the corporal position by gender there were only significant differences in two variables: Muscular mass and waist-hip ratio, allowing to asseverate that in the present sample of the children in the north of Mexico, the boys of 11 years old have a bigger muscle mass compared with girls, also in this group exists a bigger propension to develop an accumulation on adipose tissue in the abdominal region according to the waist-hip ratio ≥ 0.88 ± 0.44 compared with other girls of the same age p= 0. In the table 1 is shown the complete breakdown of the descriptive data in corporal composition by gender.

Table 1. Comparison of the corporal composition by gender

Variable	Girls M SD	Boys M SD	*p* value
Weight (kg)	36.25 ± 9.59	34.34 ± 9.19	0.28
Size (cm)	140.18 ± 8.11	136.66 ± 7.54	0.58
BMI (kg/m$^{2)}$	18.44 ± 3.46	18.31 ± 3.52	0.69
MM (kg)	13.13 ± 3.57	15.79 ± 3.50	0.001*
FM (%)	30.31 ± 8.69	27.54 ± 11.94	0.09
WHR (ua)	0.83 ± 0.05	0.88 ± 0.04	0.00*
WSR (ua)	0.44 ± 0.05	0.46 ± 0.05	080

Note: x̄: mean; SD: standard deviation; the BMI: body mass index (kg / m2); MM: muscular mass (kg); FM: percentage off fat mass; WHR: waist-hip ratio; WSR: waist to stature ratio; ua: arbitrary units; *statistically significative differences comparing by gender.

In the Table 2 values of percentiles are shown for the variables of the corporal composition, stated by gender.

Table 2. Percentiles 5, 10, 25, 50, 75, 90, 95 for corporal composition parameters

Variable	Gender	Percentiles						
		5th	10th	25th	50th	75th	90th	95th
Weight (kg)	Feminine	22.80	25.43	28.65	35.65	41.80	52.72	57.23
	Masculine	22.88	23.80	27.68	32.00	39.20	51.45	52.50
Size (cm)	Feminine	125.38	127.76	135.03	140.75	145.90	150.90	154.54
	Masculine	125.73	129.50	130.58	134.20	142.23	148.45	153.40
BMI (kg/m^2)	Feminine	13.46	14.84	15.80	18.05	20.38	22.76	26.96
	Masculine	14.10	14.75	16.05	16.90	19.65	24.15	26.10
MM (kg)	Feminine	7.22	9.71	10.55	12.82	15.60	18.46	20.47
	Masculine	10.82	12.16	13.26	14.67	17.97	21.69	22.84
FM (%)	Feminine	19.20	19.91	23.02	28.54	36.02	43.93	45.05
	Masculine	12.05	15.98	18.41	25.44	31.74	44.77	55.40

WHR (ua)	Feminine	0.75	0.76	0.79	0.83	0.88	0.90	0.90
	Masculine	0.79	0.82	0.85	0.87	0.91	0.93	0.95
WSR (ua)	Feminine	0.37	0.38	0.40	0.43	0.46	0.51	0.54
	Masculine	0.40	0.41	0.43	0.45	0.48	0.54	0.59

Note: the percentiles are shown stratified by gender of a *n*= 74 (34 girls and 40 boys); the BMI: its expressed as (kg / m^2); MM: muscular mass (kg) obtained through the equation of Poortmans *et al*. (2005); FM: fat mass percentage determinated by the equation of Slaughter *et al*. (1998); WHR: waist-hip ratio, WSR: waist-to-stature ratio; ua: arbitrary units.

3.2. Results of Autonomic Profile

The results of the autonomic profile are evaluated by the HRV, applying the time-domain method, reflexing that there is a behavior in the parasympathetic nervous system like an autonomic modulation, comparing the boys with the girls of the same age (11 years old), without presenting differences statistically significative, the descriptive data are shown in the Table 3.

Table 3. HRV analyzed by the time-domain method

time-domain method	Girls M SD	Boys M SD	*P* value
mRR (ms)	616.16 ± 81.52	611.89 ± 72.27	0.80
rMSSD (ms)	28.92 ± 17.29	26.45 ± 14.42	0.55
LnRMSSD (ua)	3.19 ± 0.614	3.15 ± 0.49	0.55

Note: M: mean; SD: standard deviation; MRR: mean of N-N intervals; rMSSD: square root of the sum of the mean value of the sum of square of the differences between RR intervals; LnRMSSD: natural logarithm transformed the square root of the mean value of the sum of the squares of the differences between N – N; ms: units measured in milliseconds; ua; arbitrary units.

In addition, by analyzing the autonomic profile through the HRV, using the frequency domain method, it was found that exists a similar behavior in boys and girls of 11 years and there were no statistically significative differences in the TP, in the MBF, Bf and the AF as it´s shown in the Table 4.

Table 4. HRV analyzed by the frequency domain method

Frequency variables.	Girls M SD	Boys M SD	*p* value
TP (ms^2)	3407.20 ± 2820.63	3416.94 ± 3043.99	0.75
VLF (ms^2)	1338.65 ± 1316.48	1540.68 ± 1569.73	0.62
LF (ms^2)	896.33 ± 601.97	889.62 ± 819.05	0.39
HF (ms^2)	1164.88 ± 1509.77	980.50 ± 1231.65	0.42

Note: M: mean; SD: standard deviation; TP: total spectral power; VLF: very low frequency band; LF: low frequency band; HF: high-frequency band; ms^2: units measured in milliseconds at square.

In other hand, as a part of the analysis of autonomic modulation non-lineal methods were applied as the dispersion graphics of Poincaré and the SS indexes and the R S:PS to determine if there are differences in the sympathetic pre-domain or parasympathetic in respect to gender, nevertheless, there were no differences founded in the SNS activity nor in the vagal tone evaluated by the parasympathetic activity indexes, the data are shown in the Table 5.

Table 5. The HRV analyzed by non-lineal methods

Poincaré Plots	Girls M SD	Boys M SD	*p* value
SD1 (ms)	19.97 ± 11.31	18.72 ± 10.21	0.58
SD2 (ms)	73.74 ± 26.40	74.23 ± 32.89	0.66
SS (ua)	15.55 ± 6.30	15.61 ± 5.54	0.66
R S:PS (ua)	1.32 ± 1.67	1.19 ± 0.96	0.54

Note: M: mean; SD; standard deviation; SD1: transversal axis of the dispersion diagram ellipse of Poincaré that reflect the parasympathetic activity; SD2: Longitudinal axis of the dispersion diagram ellipse of Poincaré, representing the inverse function of the sympathetic activity; SS: score stress or physiological is obtained by developing the equation of 1000·1/SD2; R S:PS: relation through SS:SD1; ms: units measured in milliseconds; ua; arbitrary units.

Finally in the Tables 6-8 are shown in the 5th, 10th, 25th, 50th, 75th, 90th, 95th percentiles for the time domain parameters and frequency, of the graphical dispersion of Poincaré and the indexes SS y R S:PS, stratified by gender in Mexican kids of 11 years old in the northwest of Mexico.

Table 6. Percentiles 5, 10, 25, 50, 75, 90, 95 for time domain parameters of gender

Variable	Gender	Percentiles						
		5th	**10th**	**25th**	**50th**	**75th**	**90th**	**95th**
MRR (ms)	Feminine	460.28	528.2	584.18	610.95	660.43	711.82	789.37
	Masculine	478.63	509.15	570.98	610.5	659.4	697.7	754.33
rMSSD (ms)	Feminine	7.44	10.14	16.15	25.45	34.5	59.13	72.58
	Masculine	10.77	14.3	16.43	20.75	35.95	48.55	56
LnRMSSD (ua)	Feminine	2.01	2.32	2.78	3.24	3.54	4.08	4.28
	Masculine	2.36	2.66	2.8	3.03	3.58	3.88	4.01

Note: The percentiles are shown stratified by gender of n= 74 (34 girls y 40 boys); MRR: media of the intervals N – N; rMSSD: square roots of the medium value of the sum of the squares in difference between intervals RR; LnRMSSD: natural logarithm transformed the square root of the medium value of the sum of the squares of the differences between intervals N – N; ms: units measured by milliseconds; ua: arbitrary units.

Table 7. *Percentiles 5, 10, 25, 50, 75, 90, 95 for parameters of frequency domain by gender*

Variable	Gender	Percentiles						
		5th	10th	25th	50th	75th	**90th**	**95th**
TP (ms^2)	Feminine	506.15	753.5	1592.75	2904.5	3832.25	7358.1	7713.9
	Masculine	659	981	1298.75	2251.5	4184	8806	11422.25
VLF (ms^2)	Feminine	188.3	267.6	637	1011.5	1522.25	2875	4854.05
	Masculine	325.5	355	654.25	996	1893.5	4357	6076.75
LF (ms^2)	Feminine	117.9	179.1	398.75	838	1232.25	1847.1	2395.5
	Masculine	218.5	258	367.75	649.5	1111	2154	2766.5
HF (ms^2)	Feminine	31.95	140.3	301	767.5	1192.5	2781	4353.75
	Masculine	85	117.5	282.5	514	1290	2657.5	4152.75

Note: the percentiles are shown stratified by gender of a n= 74 (34 girls and 40 boys); TP: total spectral power; VLF: very low frequency band, LF: low frequency band; HF: high frequency band; ms^2: milliseconds at square.

Table 8. Percentiles 5, 10, 25, 50, 75, 90, 95 for parameters of the Poincaré diagram, the SS and R S:PS by gender

Variable	Gender	Percentiles						
		5th	10th	25th	50th	**75th**	**90th**	**95th**
SD1 (ms)	Feminine	5.23	7.19	11.4	18.05	24.43	33.63	44.31
	Masculine	7.63	10.15	11.58	14.7	25.42	34.35	39.65
SD2 (ms)	Feminine	31.97	37.51	57.05	71.65	82.9	113.19	123.52
	Masculine	39.18	43.1	51.28	62.6	86.45	129.55	155.8
SS (ua)	Feminine	8.1	8.83	12.06	13.96	17.53	26.72	31.29
	Masculine	6.47	7.74	11.57	15.98	19.5	23.21	25.62
R S:PS (ua)	Feminine	0.22	0.3	0.49	0.78	1.54	3.78	4.39
	Masculine	0.15	0.23	0.52	1.04	1.52	2.2	3.5

Note: the percentiles are shown stratified by gender of a n= 74 (34 girls and 40 boys); SD1: the transversal axis of the dispersion diagram ellipse of Poincaré, it represents the inverse function of the parasympathetic activity; SS: score stress or physiological stress that is obtained by developing the equation of 1000·1/SD2; R S:PS: relation through the SS:SD1; ms: units measured by milliseconds; ua: arbitrary units.

4. Discussion

The purpose of this study was mainly to explore the values of the corporal position and the autonomic profile through the HRV and determine the possible differences by gender in students. In second instance, to generate percentile tables of the corporal position and autonomic profile of the children in the north of Mexico as part of the public schools.

The comparison of the results was defiant, because of the related differences in the sample size, the age, and the analysis of the corporal composition. Although it was possible to find info to compare the values of the corporal position with studies made in the South American and Latin-American context (Da Silva *et al.*, 2014; Mederico *et al.*, 2013; Rodríguez *et al.*, 2015). The results of the present study shown the anthropometric characteristics of size, corporal weight, and the BMI of the girls in the northwest of Mexico, it's under the mean of their congeners of Venezuelan origin with the same age, nor as the waist-hips index that was bigger in the Mexican girls (Mederico *et al.*, 2013). By other side, by comparing the data of the children it has been found that Mexicans represent anthropometric characteristics of size, corporal weight, and BMI, under the mean excepting the waist-hip ratio in respect of the reported values of the study developed in Venezuela (Mederico *et al.*, 2013). In addition, by comparing the anthropometric characteristics of the present sample with the reported values in a Colombian study it has been shown that the Mexican girls reflect values under the mean of Colombian girls for weight variables, weight, but the waist-hip ratio is bigger than the Mexicans compared with the Colombians (Rodríguez *et al.*, 2015), also, the Mexican kids of the present study that reflects the inferior mean values in comparison with the central tendency measurement presented in the Colombian children in the anthropometric variables of height and weight, because in the waist-hip ratio the value of the mean is bigger for the Mexicans that for Colombians 0.88 ± 0.04 vs 0.82 ± 0.13, respectively (Rodríguez *et al.*, 2015). In fact, as result of this comparisons we can appreciate the corporal composition by ethnicity or populational group, because of previous studies had shown that ethnic group, and the racial differences have influences on the corporal composition (Fernández *et al.*, 2004).

In the other hand, in the Mexican context there is a study considered as referent for the pediatric Mexican population in which is presented by tables of percentiles by age (Del Rio *et al.*, 2007), and by developing a comparison with the obtained values of the present study with the values of the reference proposed by the Mexican population of 11 years of age, the present sample evidence measures of central tendency under the referential values of the weight, size and BMI for both sexes variables, so: the mean values obtained for the variables of weight in girls, are in the 40th percentage classification, the height in 30th. In the kids of this study the values of corporal weight appear in the 40th, meanwhile the height is classified in the 20th. In a try to explain the differences between normative data for the pediatric Mexican population and the founded values in the present study, it is remitted to our own aspects of the gradual development model in which there is a manifestation of a big grade of individuality in the development processes related to the pre-disposition of the environment who has a lot of influence over the develop (Martin *et al.*, 2004), because of this motive although the sample of the normative data (Del Rio *et al.*, 2007) belong to the same ethnic group and have the same age present different values.

In continuation, by analyzing the info of the studies developed in Mexico in pediatric populations that analyze the fat mass percentage (FM%) applying the method proposed by Slaughter et al. (1998) it was founded a protocol (Orta *et al.*, 2014)that analyzes a sample of the same size and with similar characteristics to the present investigation and the data reveals that the FM% for the total of the sample is minor in this study, compared with the previous (Orta *et al*., 2014). In addition, another previous study developed in Morelos, México (Alpizar *et al*., 2017), a sample of 2,026 boys and 1,488 girls was analyzed, of those, 434 had age as the same as our sample, as the same as belonging to the public education system, of those were tables developed of percentiles by their age and gender, for distinct variables of corporal composition and by comparing the results it is found that in the present study the measurements of the weight variables, height, BMI for both sexes are under the media of the study of Morelos, Mexico, but the media of FM% of the children in the north of Mexico and the children of Morelos (Alpizar *et al*., 2017), the difference in this variable evidence that the women in the north of Mexico in ages of 11 years old present an increase of FM% probably related to the "reaction norm" (Martin *et al*., 2004, p. 31), in which is represented by the potential of genotype because of the genetic charge that the individuals possess and the phenotypical factors of the environment that determines how much could a charge of genetic potential could be developed, that reflects the status of the predisposition-environment.

It must be added that another variable of importance about corporal composition is the muscular mass (MM) because in children and adults represents an important component of the nutritional evaluation also being one independent marker of the metabolic health (McCarthy *et al*., 2013). In that sense the results of the study were compared with the study that originated the anthropometric equation of the MM prediction (Poortmans *et al*., 2005), were it says that Mexican girls 13.13 ± 3.57 vs 11.6 ± 0.4 and boys 15.79 ± 3.50 vs 12.5 ± 0.5 possesses superior values of MM in respect to Belgium children, this difference could be directly related by the biological development because of the sample used to stablish the pre-diction equation used subjects in years from seven to nine years old, classified in the first stage of growth in mass and corporal size (Martin *et al*., 2004), were the growth in both sexes is parallel with minimal differences but the Mexican sample in this category of the second growth phase, characterized by the somatic differentiation by sexes (Martin *et al*., 2004).

Also, by comparing normative data of the corporal composition of the Czech (Zborilová *et al*., 2021) of the same age of those in this present study it is appreciated that the physical development is bigger in Czech kids, presenting a bigger physical development in the weight, size and particularly in the variable of MM in girls 16.2 ± 2.9 vs 13.3 ± 3.57 and boys 17.5 ± 2.7 vs 15.79± 3.50, also a less FM% in the Czech boys. A possible explanation to these differences in the physical development could be attributed to the ethnical, alimentary, socials and even of weather because the physical characteristics are modified creating populational profiles (Brito *et al*., 2014).

In respect to the anthropometric variables, we still could mark intentionally that at the closure of the corporal composition topic that exists an analogical variable but the commented before and its being applied as indicator of the health because it could be an early predictor of the central obesity, associated by the cardiovascular risks related with the corporal fat distribution, the WSR (Padrón *et al*., 2016) proposes a limit with a value of 0.50 for the kids, young and adults, making the analyzed sample as the mean for the girls and boys groups, and put them below the value proposed as limit.

Talking about the autonomic profile, the referential studies of the standardized methods for the analysis and classification (Malik *et al*., 1996; Sassi *et al*., 2015) provide referential data of the analysis of time and frequency domain in periods of short and long duration (Malik *et al*., 1996) and for the analysis of the diagram of Poincaré (Sassi *et al*., 2015) although are oriented to the adult population, so there are no solid reference data in respect to the evaluation of the parameters for these variables in children of the north of Mexico.

In respect with the autonomic profile, by not founding in the literature review referential values for Mexican children, the results were compared with normative data of the Indian population (Sharma *et al*., 2015) because it represented socio-demographic characteristics similar to children in north of Mexico, thus, it could be appreciated that in the time domain methods evaluated by the rMSSD, the sample of the non-athlete children of Pondicherry, India is above the obtained values of the Mexican children with a mean of 69.0 vs 28.92 ± 17.29 in girls and of 58.70 vs 26.45 ± 14.42 in boys, respectively, the behavior in the analyzed variables in the frequency domain, in the LF (ms^2), the high frequency band HF (ms^2), except in the TP(ms^2), putting in evidence that the parasympathetic activity is shown reduced in the Mexican children in comparison with the Indian sample. It must be added to discussion that a factor that probably is determinant in this discrepancy of the results es the wide margin of ages used in the Indian study, from 12 to 17 years, a previous study (Bobkowski *et al*., 2017) maintains that this argument in which they found the populational measurements of the HRV present age modifications, not by gender or at least in pediatric population.

Another study that generated normative data (Michels *et al*., 2013), analyzed a population sample of Belgium with children from 5 to 10 years and the result in the present study differs of the proposed, the Belgian girls presented a mean of mRR of 725 vs 616.16 ± 81.52ms and the boys 751 vs 611± 72.27ms, in the rMSSD the girls of Belgium 66 vs 28.92 ± 17.29 and boys 73 vs 26.45 ± 14.42. As the domain of frequency method the variables, VLF, LF and HF in Belgian children was under the Mexican children and is very interesting the mean values of the FM% of the Belgian children because it´s close to the half of valor of the Mexican kids, this could explain the difference on the sympathetic modulation, the argument has its base on the review (Liao *et al.,* 2014) in were they talk about the overweight and obesity altering the balance of the autonomous cardiac modulation with a tendency on parasympathetic reduced activity and an increase of sympathetic activity.

According to the Mexican context, the normative data found in the HRV are presented by stratification of sex and physical activity level, although had as goal population subjects from 18-24 years old (Medina *et al*., 2012), so it could not been compared with the referential data of the Mexican population.

It is important to mention that exists some studies in which they analyze variables trough non-lineal methods in Spanish children (Mendoza & Clemente, 2020), so there were no matches on the values of the total of the sample of Spanish children in Mexican girls, (SD1 46.46 ± 19.26 ms vs 19.97 ± 11.31) and for the Mexican kids (18.72 ± 10.21 ms), this behavior was appreciated also in the SD2 variable and the rMSSD, so its appreciated a reduction in the vagal tone. This same pattern of behavior of the variables in which it could not been saw any coincidences that repeated by comparing with a developed study in Swiss children for the SD1, SD2, in the band of VLF, LF, HG and in the mRR. This possible behavior could be because of ethnic aspects as mentioned by another authors (Gąsior *et al*., 2018).

By talking about the indexes of SS and R S:PS, until this moment of the exhaustive literature review, they were not found data to compare with the pediatric populations, probably because of the novelty in the new indexes or to the fact that they arise because of the analysis developed in football-players.

Finally, the limitations on the present study were the adequations to the methodologic design because of the pandemics that occurred for the SARS-Cov2 virus, obtaining the data though of baseline. In other hand and as result of the sensibility of the autonomic modulation variables it was necessary to apply some exclusion criteria on those subjects that could not accomplish the previous requirements excluding 48 students in total.

5. Conclusions

It is concluded that the corporal composition on children presents differences according to gender. Also, the study provides tables of percentiles for the variables of corporal composition, weight, size, BMI, MM, FM% and BMI, WHR and WSR as the tables of percentiles for the variability of cardiac frequency, analyzed through time-domain, frequency, and non-lineal methods as the Poincaré diagram and the SS and R S:PS indexes for children in the north of Mexico.

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