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Original Article

Assessment of nutritional status and cardiometabolic risk using anthropometric health variables in Chilean schoolchildren with diverse disabilities

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Abstract:
To describe and relate anthropometric evaluations used in the Health Science and physical education disciplines to detect relative risk of waist, cardiometabolic risk and prevalence of obesity or overweight, in schools in Temuco, Chile. These school house children with special educational needs. The study compares Gender and; a) Intellectual disability (ID), b) Motor disability (DM), c) Generalized Developmental Disorder (PDD), d) Cerebral palsy (PC). The participants correspond to schoolchildren n = 156 total, Women n = 50 (age 13,78 + 5,41) and Men n = 106 (13,09 + 5,57). The cardiometabolic risk was estimated by waist-hip index (ICC) and conicity index (CI), waist circumference (CCI) and hip (CCa). Nutritional status was estimated by body mass index (BMI). Student's t test was used for the parametric variables between two groups, and the Mann-Whitney U test were used for nonparametric variables. For the comparison of the parametric variables between more than two groups Anova was used. In the case of nonparametric variables, the Kruskal Wallis test was used.
Schoolchildren with intellectual disabilities had statistically higher values in weight, BMI, waist and hip ($p < 0.05$). The women showed high values of BMI, waist and relative waist risk ($p < 0.05$). 44, 23% of schoolchildren had excessive malnutrition, 53, 8% had a relative risk of abdominal obesity.
Conclusion associating anthropometric variables is an economic and effective health predicting tool in any type of study population. It can be used to make decisions in future food prescription or exercise therapy programs in order to avoid childhood obesity and improve the quality of life in individuals with disabilities.
Key words: schoolchildren, disability, nutritional assessment

Introduction

During the last century, a positive secular tendency in physical growth in most populations of the world has been identified (Fleta &et al,2000; Zhen-Wang & Cheng-Ye,2005; Simsek & et al,2005; Chrzanowska & Ulijaszek,2007; Boddy & et al, 2009). This growth tendency has also influenced the increase of health risk factors, which in some populations has tripled the prevalence of overweight and obesity (Kautiainen & et al, 2009). The situation described corresponds to a endocrinical-metabolic disease, which is characterized by excessive accumulation of fat and adipose tissue (Valdelamar & et al,2007). The multiplicity of factors involved in the genesis of obesity and the presence of metabolic disorders associated difficult their prevention and treatment (Burrows, 2001).

This situation constitutes a risk factor for other diseases such as cardiovascular, cancer, orthopedic disorders and surgical risks, among others, due to the multifaceted character (Benjumea & et al,2008; Soriano & et al,2007). Besides, it fosters a series of cellular processes that promotes leptin resistance, broadening weight gain induced by genetic and environmental factors (Del Corral & et al 2009) predisposing cardiovascular diseases and conducting towards mobility and mortality states (Myers & et al, 2010).

The situation in Latin-America and Chile is not different from the rest of the world. Socio-economical change and globalization have created serious changes in the physical and dietary habits, that are similar to those

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of developed countries, which leads to malnutrition by excess and an increase in sedentary life style (Lizana & et al, 2011).

The scenario described previously leads to the conclusion that in Chile, where the sedentary index according to the National Health Survey is equivalent to 89,2% and the obesity prevalence reaches 67% (Karamouzis & et al,2011). If the obesity situation in general population is worrying, the situation among disabled people is alarming (De Winter & et al, 2011; Ojeda & Cresp, 2011).

In the World Report about Disabilities (WHO, 2011), was informed that over one billion people live with some sort of disability, and almost 200 million of them experience considerable difficulties in their functioning. This was also reported in the First National Study of Disability in Chile. In this study, a disabled person is defined as "those who present deficiencies in their body structure and/or functions, limitations in the activities and restrictions in participation, as a result of a negative interaction of their health condition with contextual factors (environmental and personal) in which he/she develops" (Ministry of Health Chile,2011).

It is extremely relevant to develop research that contribute to knowledge concerning anthropometric indicators in diverse population, including those with some disabilities (Cresp & et al,2014; San Jose,2007). Obesity an important health issue for people with intellectual disabilities (ID) (De Winter & et al, 2009; González & et al,2011), causing a greater incidence in morbidity while they grow up. This is associated with a significant increase in the cost of sanitary assistance(Tenenbaum & et al,2012).

The Chilean national research, focused on sedentary life style, overweight and obesity of this special population are limited, specially in children and adolescents. The information obtained in this study will be relevant for decision making processes related to health, nutritional, physical activity or educational public policies. The objective of this study is to analyze the prevalence of overweight and obesity in children-adolescents from Temuco schools which take care of students with special educational needs, compared by: a) Intellectual disabilities (ID), b) motor disabilities (MD), c) Generalized Development Disorder (GDD), d) Brain Paralysis (BP), by means of anthropometric values such as BMI, HHI and the conicity index to characterize the sample according to their age, weight, size, type of disability, including in the variable description the mean, standard deviation and P* value.

Material and method

The waist circumference, Body Mass Index and the conicity index were evaluated in 156 children and adolescents (106 men and 50 women). Inclusion criteria corresponds to: regular students with Intellectual Disabilities (ID), Motor Disabilities (MD), Brain Paralysis (IP), General Development Disorders (GDD) who are between 6 and 21 years old from special education urban schools in Temuco, IX region, Chile. The sample was selected through a non-probabilistic sampling, chosen non-randomly, of the transversal quantitative type.

This study was carried out considering the Helsinki Statement for Bio-Medic research with human beings. The individuals or their parents granted their written consent, stating identity confidentiality of the participants, as well as the researcher commitment not to publish data without official publication. Also, this study was sanctioned by the ethical Committee of Universidad Católica de Temuco, Chile.

Statistical procedures

The Komolgorov-Smirnov (KS) test was used to evaluate the normality of the analyzed data set. Considering the values delivered by the statistical test, it was possible to conclude that all the variables present a normal distribution. A descriptive statistics procedure to analyze the variables which included the mean and standard deviation. For the comparison of parametric variables between 2 groups the t student was used, and in the case of the non-parametric variables among more than 2 groups, Anova was used, the test of Tukey and Scheffe - PostHoc was used.Values of $p < 0.05$ were considered statistically significant.

Instruments for data collection

The individuals were evaluated within their school community and the data was registered in an excel spreadsheet. The measurement instruments used corresponded to a Detecto (brand) floor scale model 339 with height rod and a metric tape.

According to the WHO (2010), the Body Mass Index (BMI), which is obtained by the division of the body weight (in kilos), by the height (in square meters), corresponds to an anthropometric measure used to identify overweight in children, adolescents and adults. However, this measurement little contributes to the determination of adipose tissue, because it cannot distinguish the lean mass from fat mass, so it does not represent distribution of body fat (Benjumea & et al,2008) . The standards proposed by the WHO (2010) were used as a diagnostic criterion of the nutritional state.

Similarly, the Waist Circumference (WC) (defined by measuring the lowest circumference between the iliac crest and the costal edge) and the Hip Circumference (HC) (defined by means of the measurement at the level of the greater trochanter, that in general coincides with the symphysis pubis) are particularly better

predictors of visceral obesity, a disease that represent a high risk of developing chronic non-transmissible diseases such as diabetes mellitus and cardiovascular diseases(Benjumea & et al,2008) .

The waist-to-hip ratio was analyzed based on the standards propped by the World's Health Organization. Women with values over 80cm and men with values over 94cm were classified as accumulating abdominal fat, which is considered a risk associated with the development of obesity related diseases.

The conicity index (CI) was calculated by using the formula which the constant 0,109 results of the conversion of volume and mass units into length units. The range of this index varies between 1 and 1,73, representing the body based on a perfect cylinder towards a double cone with joint basis (Valdez,1992).

Results

Table 1. Classification of Nutritional State (CNS) according to Disability and Gender

	UNDERWEIGHT				NORMAL				OVERWEIGHT				OBESITY			
Diagnostics / Gender	M	%	F	%	M	%	F	%	M	%	F	%	M	%	F	%
Intellectual Disability	9	47,37	1	20	31	70,45	12	63,16	16	66,70	7	77,78	13	68,40	10	58,82
Motor Disability	6	31,58	2	40	8	18,18	4	21,05	4	16,70	2	22,22	5	26,30	3	17,64
Brain Paralysis	4	21,05	2	40	2	4,55	3	15,79	2	8,33	0	0	1	5,26	3	17,64
General Development Disorders	0	0,00	0	0	3	6,82	0	0	2	8,33	0	0	0	0	1	5,88
TOTAL	19	00,00	5	100	44	100,00	19	100,00	24	100,00	9	100,00	19	100,00	17	100,00

The results related to the nutritional state calculated by the BMI, the type of disability and gender show that the majority of the individuals are classified as "normal". This represent a total of 44 men and 19 women, who mostly present Intellectual Disabilities (70,45% men and 63,16% women). The individuals that present Intellectual Disabilities are the only sub-group that in its majority can be classified as "under-weight", concentrating 44,4% of men and 25% of women with such pathology. This group also represents the 21,05% of men and 40% of women that are classified in this category in the whole population of this study.

Table 2: Relative Risk by waist-to-hip ratio according to Disability and Gender.

Diagnostics	NORMAL				ELEVATED			
Disability / Gender %	M	%	F	%	M	%	F	%
Intellectual disability	37	63,79	4	28,57	32	66,67	26	72,22
Motor Disability	12	20,69	5	35,71	11	22,92	6	16,67
Brain Paralysis	6	10,34	5	35,71	3	6,25	3	8,33
General Development Disorders	3	5,17	0	0,00	2	4,17	1	2,78
TOTAL	58	100	14	100	48	100	36	100

Based on the waist-to-hip ratio, it is possible to see that 72,22% of women with elevated risk are those with Intellectual Disabilities, amount that reaches 66,77% in men of the same group. At the same time, 22,92% of men and 16,67% of women that show elevated risk belong to the Motor Disabilities sub-group .

Variables	Women (n=50) 32,05%	Man (n=106) 67,95%	P value
Age (years)	13,78±5,41	13,09±5,57	0,648
Weight (kg)	45,91±18,71	46,35±22,37	0,835
Size (m)	1,38±0,19	1,45±0,21	0,060
BMI (kg/mt²)	22,84±4,52	20,67±5,82	0,011 *
Waist (cm)	76,79±12,78	72,74±15,57	0,035 *

Table 3. The comparison in children-adolescents with disabilities according to gender

HIP (cm)	85,07±13,46	81,78±15,26	0,195
WHR (cm)	0,90±0,06	0,88±0,06	0,169
Conicity Index	1,26±0,11	1,22±0,12	0,051
Waist Relative Risk	1,72±0,45	1,45±0,50	0,002 *

Data presented as a median ± Standard Deviation. BMI: Body mass index. WHR: waist-to-hip ratio. *The is statistical significance $p < 0,05$.In the comparison of variables regarding gender, considering an statistical significance $p < 0,05$, in table 5 it is possible to observe significant differences in the BMI (p. 0,011), waist circumference (p.0,035) and relative risk (p. 0,002). There are no statistical differences in hip circumference, waist-to-hip-ratio
and conicity index ($p > 0,05$) .

Table 4: Variable comparison in children-adolescents according to the disability they present.

Variables	Intellectual disability (n=99) 63,46%	Motor Disability (n=34) 21,79 %	Brain Paralysis (n=17) 10,89%	GDD (n=6) 3,85%	P value
Age (years)	14,66±5,21	10,97±5,72	12,88±5,32	10,83±4,53	0,003*
Weigth(Kg)	51,63+20,30	38,35+22,24	31,41+9,75	43,13±23,11	0,000*
Size (m)	1,49±0,17	1,33±0,22	1,28±0,19	1,41±0,21	0,000*
BMI (kg/mt²)	22,35±5,73	19,74±5,80	19,28±5,49	20,14±4,43	0,029*
Wais (cm)	76,94±14,10	69,50±16,11	66,14±10,46	74,25±17,94	0,010*
HIP (cm)	86,30±13,68	76,89±16,48	73,91±8,61	84,50±17,04	0,000*
WHR (cm)	0,89±0,06	0,90±0,06	0,89±0,08	0,87±0,04	0,536
Conicity Index	1,22±0,09	1,25±0,17	1,24±0,16	1,26±0,12	0,668
Wais Relative Risk	1,59±0,49	1,50±0,50	1,35±0,49	1,50±0,54	0,386

Data presented as a median ± Standard Deviation. BMI: Body mass index. WHR: waist-to-hip ratio. *The is statistical significance $p < 0,05$. Variable comparison related to the type of disability have also been carried out using the same significant difference as gender ($p < 0,05$). In Table 4 it is possible to observe significant differences when contrasting disabilities manifestation in each sub-group regarding the following variables: BMI (p. 0,029), waist circumference (p. 0,010) and hip circumference (p. 0,000). There are no differences in the waist-to-hip-ratio, conicity index and waist relative risk

Discussion

Diagnostics, vigilance and monitoring of the nutritional state must be done using specific references that allow the nutritional characterization, by means of anthropometric measurements, of special education school students. This will provide information concerning the general health status of this population who are an at-risk group and a frequent consumer of health services at a global scale. In this sense, other studies have reported a greater prevalence of overweight and obesity in individuals with Intellectual Disabilities in relation to the general population prevalence. Research done in disabled population in Mexico show that (not statistically significant) the tendency to overweight and obesity is higher in men than in women; 48% vs. 39% (Ramos & et al 2012). Similar studies in Spanish student populations that have used gender and age as variables, have highlighted that women present higher obesity numbers than men(Zurita & Fernandez, 2010). This results do not coincide with what has been reported in this study, even though individuals with Intellectual disabilities concentrate the highest number of people with relative health risk (58,59%).

Data regarding to children with Brain Paralysis and low incidence syndromes obtained BMI values below 19 (Ramos & et al 2012). In the present study, these numbers go from 19 to 28 in the Brain Paralysis sub-group. In the motor disabilities, sub-group this value reaches 19,78, in the GDD group 20,14 and in the intellectual disability subgroup 20,35 (BMI). The same as in other reports, the BMI is higher in Cognitive Disabled people (Bruffaerts & et al,2008).

The lowest values correspond to the Brain Paralysis sub-group, who due to their pathology, will always present lower numbers than the general population (Marcos et al, 1993), based on data contributed by other authors(Cowley & et al, 2011). Similar studies in the school system in Spain (Ramos & et al 2012) report similar numbers; normal weight 60%, 15,2% underweight, 20,3% obese and 7,9% overweight. It is important to highlight, that the majority of these studies use a mixed sample population (men and women) to boost the statistic potential and the generalization of results (Cowley & et al, 2011; Mendonca, Pereira & Fernhall, 2011). Obesity in diverse population and in the age of adolescence present a higher risk of developing diabetes (Li C & et al, 2006), which may lead to other health problems including high cholesterol levels, hypertension and metabolic syndrome (Brophy & et al, 2009). All these issues have visceral obesity and resistance to insulin as main characteristics that determine a negative cardiovascular profile (Faloia & et al, 2012).

Concerning the Classification of Nutritional State (CNS), and in relation to disabilities and gender, this study shows an obesity and overweight tendency in the female individuals. This needs to be considered in the understanding that adipose tissue possesses important endocrinal, autocrinal and paracrinal functions. The adipocytes from visceral fat would play a more important role than the subcutaneous fat in the production of proinflammatory cytokines in obese women with intellectual disabilities (Ordonez ,2012) and without any of these disabilities (Ackermann & et al,2011) . Relating these types of variables will allow the understanding of proinflammatory markers more efficiently, simply, faster and in a non-invasive way. We believe the origin of this increment is the early puberty development shown in women, and that this development includes a significant body enlargement. Recent meta-analyzes include the conicity index within the 6 indices associated with obesity and metabolic syndrome predictor (Motamed & et al, 2017).

The analysis of the average values of the conicity index, show the central predominance of fat in women 1,26, individuals with motor disabilities 1,25 and with General Developmental Disorders 1,26. It is also possible to observe an elevated risk in women and an increment in the obesity proportion when they get older.

The association of anthropometric variables as health predictors in any type of population of these study is an economical tool, its interpretation, interrelation or correlations deliver important tools for the decision-making process related to future programs of dietary prescription or exercise therapy. The nutritional aspect and general physical activity constitute two valuable elements that prevent child obesity, and at the same time increase the quality of life of individuals with special education needs.

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