ERGONOMÍA OCUPACIONAL

INVESTIGACIONES Y APLICACIONES

VOL. 12

ERGONOMÍA OCUPACIONAL

INVESTIGACIONES Y SOLUCIONES

VOL. 12

EDITADO POR:

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Presidente SEMAC 2017-2020

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ISBN: 978-0-578-48915-5

CONTENT

ANTHROPOMETRY

COGNITIVE ERGONOMICS

COMPARATIVE STUDY OF ANTHROPOMETRIC MEASUREMENTS FOR CHILDREN OF 5 YEARS OF AGE OF TWO REGIONS OF MÉXICO

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Resumen: Uno de los objetivos principales de la ergonomía es el diseño y/o adaptación de las estaciones de trabajo al usuario, utilizando las cartas antropométricas adecuadas a la edad del trabajador.

Al buscar aplicar el precepto anterior en un salón de clases de niños en edad preescolar encontramos solamente dos cartas antropométricas cubriendo la edad necesaria (5 años), una correspondiente a una población del área metropolitana de Guadalajara, Jalisco, Mx. y otra del Departamento de Salud de Estados Unidos que incluye solamente el peso y la estatura de niños americanos de cinco años.

Teorizando que la población de la parte norte de México es más similar a la carta de Guadalajara, este estudio valida el uso de esas tablas tomando ocho medidas antropométricas de una pequeña muestra compuesta por doce niñas y nueve niños de la población de Cuauhtemoc, Chih., comparando los resultados con la carta anteriormente mencionada.

Los datos obtenidos proveen suficiente evidencia para afirmar que no hay diferencia significativa entre las dimensiones antropométricas de los niños de Guadalajara y las obtenidas en Cuauhtemoc, por lo cual se puede utilizar todas las dimensiones de las tablas para la adaptación de las estaciones de trabajo involucradas.

Palabras clave: Ergonomía, Cartas Antropométricas, Diseño de Estaciones de trabajo, Niños en edad preescolar.

Relevancia para la ergonomía: La validación de información antropométrica de otra población de la misma edad, usando una limitada cantidad de mediciones, reafirma la confianza para usar todos los datos de las cartas antropométricas para el diseño/rediseño de estaciones de trabajo.

Abstract (Spanish/English, this order): One of the main objectives of human factors is the design and/or adaptation of workstations to the user, using anthropometric tables appropriate to the age of the worker.

In seeking to apply the previous precept in a classroom of preschool-age children we find only two anthropometric tables covering the necessary age (5 years), one corresponding to a population of the metropolitan area of Guadalajara, Jalisco, Mx. and another one from the U.S. Department of Health and Human Services that includes the weight and stature of five years old American children.

Theorizing that the population from the northern part of Mexico is more similar to the sample from Guadalajara, this study validates the use of these tables taking eight anthropometric measures of a small sample that includes twelve girls and nine children of the population of Cuauhtemoc, Chih., comparing the results obtained with the ones presented in the anthropometric tables mentioned before.

The data obtained provide enough evidence to affirm that there is no significant difference between the anthropometric dimensions of the children of Guadalajara and those obtained in Cuauhtemoc, so you can use all the dimensions of the tables for the adaptation of the work stations involved.

Keywords: Human Factors, Anthropometric tables, Workstations design, Kindergarten age children.

Relevance to Ergonomics: The validation of anthropometric information from other population of the same age, using a small quantity of measurements, endorse the use of all the data to design or redesign work spaces with an ergonomics approach.

1. INTRODUCTION

Ergonomics have as a fundamental objective to study interfaces between people, tools, products they use, the activities they perform, and the environments in which they work, study or play to mention the main activities of any human. In this manner, at early ages, infants' environments, such as school furniture must be adapted to the anthropometry and biomechanical characteristics of users, influencing the reduction of future musculoskeletal injuries and the person's performance (Fasuloa, et.al, 2019; Tunay & Melemez, 2008).

If we speak of teaching-learning spaces, ergonomics has been devoted mainly to the adaptation of furniture, especially benches based on the anthropometry of the students, and there are numerous studies and norms (INIFED SEP, 2014; INEE, 2016) that endorse and/or give us guidelines for the ergonomic optimization of these factors.

However, research of this topic addressing furniture standards have been focused on elementary students (Agha, 2010; Altaboli, et.al., 2015; Carneiro, et al., 2017; Castellucci, et al., 2015 and Chung & Wong, 2007) or degree level students (Fasuloa, et.al., 2019; Tunay & Melemez, 2008 and Wilson Taifa & Desai, 2017). Therefore, there is an important gap in studies focused on kindergarten children in

a range of age of 3 to 5 years. For Arana et al. (2018), child growth is very important and poor postures due to an inadequate design of areas and furniture can affect performance and comfort. These authors present an approach to adapt teaching-learning area to the anthropometric dimensions of children under this range of age (Arana et al., 2018).

Another important aspect of the problem is the lack of anthropometric data for children of this age. As reference there is one study concerning five years old Mexican children, this work of Avila Chaurand et al. (2007) includes a sample of kindergarten individuals from the metropolitan area of Guadalajara, Mexico; another one found is from the U.S. Department of Health and Human Services that includes only weight and stature data from five years old American children (U.S. Department of Health and Human Services, 2012)

The objective of this work is to determine the adequacy of the available anthropometric data with a small sample of measurements obtained from population from Cuauhtemoc, Chih. Mx.

2. OBJETIVES

In general, to validate that the anthropometric information of another population is not significantly different compared with the infantile residents of the municipality of Cuauhtémoc, Chih., using a small sample of anthropometric measurements.

Particularly to approve the use of a larger quantity of anthropometric data for design or redesign of learning-teaching areas of kindergarten age population included furniture, spaces and learning tools among others.

2.1 Delimitation

Anthropometric measurements including weight, height, arm length, leg length, knee height while seated, elbow to hand, hand length and trunk length were taken, from preschool-age population (5 years), of the Cuauhtémoc, Chih. area; specifically, twelve girls and nine boys and the mean of each measurement was calculated.

The data obtained was compared with the same measurements of an anthropometric table of the same age of Guadalajara, Jal. population, which includes the arithmetic mean from measurements of 48 girls and 54 boys exposed in the book from Avila et al. (2007) “Anthropometric dimensions from Latin-American population: Mexico, Cuba, Colombia, Chile”. (Avila Chaurand, et al., 2007)

3. METHODOLOGY

Eight anthropometric measurements: (weight, stature, arm length, leg length, knee height, elbow to hand, hand length and trunk length) were obtained from twenty-one children. Twelve of them were female and nine were male. The data obtained was statistically compared to more broad anthropometric data (Avila Chaurand, et.al., 2007) of children of the same age, looking for validation of the use of this data for the population appraised.

First the weight was obtained following the technique presented in Ávila et al. (2018) “Weight and Height national registry in scholars 2015-2016” a study where several Mexican governmental entities where involve for example the Department of health, the Department of Public Education (SEP), the National Council of Educational foment (CONAFE), to mention some. The procedure begins putting the scale in a flat surface verifying that is calibrated, if not it must be calibrated. Next the children must take off their shoes and stand in the scale with their arms parallel to the body axis without moving, is important to verify that the subject had the minimal clothes and no extra weight in their pockets. (Ávila et al, 2018).

Height was obtained with a stadiometer, all the other measurements were taken with a portable anthropometer from the right side of the subjets while they were sitting in an erect position on a height-adjustable chair with a horizontal suface, with their legs flexed at a 90° angles, and their feet flat on the floor.

When the data antrhropometric data was obtained, a observational type study based in the statistical contrast methodology according to Devore et al. (2017) and McClave et.al. (2016) among others, which includes a t-student test for difference between means with a significance level of 0.05 was done. The procedure of this methodology includes the following segments:

1. HYPOTHESIS (Ho, Ha)
    a. Null Hypothesis (Ho): Theory written in terms of the values of population parameters. It is the theory you want to challenge.
    b. Alternative Hypothesis (Ha): Theory that opposes the null hypothesis and that it is generally desired to prove that it is true.
2. TEST STATISTIC: Sample Statistical used to decide whether the null hypothesis is rejected, in this case t-student.
3. REJECTION REGION: Set of test statistic values for which the null hypothesis is going to be rejected. The probability that the test statistician falls into the rejection region, when the null hypothesis is true, is equal to ALPHA. It Must Be accompanied by a decision rule.
4. EXPERIMENTATION, SAMPLING AND CALCULATIONS: The sampling experiment is carried out and the values of the statistic test are determined.
5. DECISION. (base point 3). It is made based on Ho.
    a. If the numerical value of the test statistic falls within the region of rejection, then it is decided to reject the null hypothesis and conclude in terms of the alternative hypothesis, which is supported by the experimental evidence.
    b. If the numerical value of the test statistic does not fall within the rejection region, then the judgment on the null hypothesis is not decided and the decision is not accepted, because the probability of committing type II error is not known.
6. CONCLUSIONS. (based on Ha). It Is concluded in accordance with the decision and in the context of the problem on which the hypothesis was extracted.
7. ASSUMPTIONS. Tests of normalcy, independence, form, etc., using non-parametric statistics.

3.1 Hypothesis

Ho: The means tabulated in anthropometric tables from kindergarten age children of Guadalajara are equal to that of the same age of Cd. Cuauhtémoc, Chih.

Ha: The means tabulated in anthropometric tables of the kindergarten age children of Guadalajara are not the same as that of the same age of Cd. Cuauhtémoc, Chih.

n=21 kids (12 girls and 9 boys, 5 years of age)

alfa= 0.05

t-student test for means difference: For (n-1) degrees of freedom (1)

$$t = \left[\frac{(\bar{x} - \mu)}{\frac{\sigma^2}{\sqrt{n}}} \right] \quad (1)$$

Data normality tests were also carried out finding that all the points are within the confidence limits, so it is concluded that they are distributed normal.

4. RESULTS

The following tables shows the calculated mean of the eight anthropometric dimensions involve in the study, from both populations, the data includes their corresponding standard deviation. The weight was measured in kilograms and all the other were in centimeters.

Also, the t-value obtained from the tables, and the one calculated, the last column mentions the result from the Comparison test (Significant or Non-Significant).

Table 1. Results for girls

	C = Cuauhtemoc G = Guadalajara					Ho: C=G Ha: C≠G, ALFA=0.05			
		ẋ	Std. Dev.	N	t-Table value	t-Calculated	P-Value	PH	Test
Weight in kilograms	C	19.37	2.96	12	1.796	0.44	0.669	C=G	NON-SIGNIFICANT
	G	17.3	2.3	48					
Stature in centimeters	C	111.18	3.88	12	1.796	0.38	0.739	C=G	NON-SIGNIFICANT
	G	110.8	7.6	48					

Arm length in centimeters	C	45.29	2.927	12	1.796	5.67	0	C=G	SIGNIFICANT
	G	40.5	2.9	48					
Leg Length in centimeters	C	58.7	4.53	12	1.796	-5.82	0	C=G	SIGNIFICANT
	G	66.3	5.6	48					
Knee Height in centimeters	C	31.55	2.83	12	1.796	-1.41	0.187	C=G	NON-SIGNIFICANT
	G	32.7	2.3	48					
Elbow to Hand in centimeters	C	28.47	2.04	12	1.796				
	G			48					
Hand length in centimeters	C	12.7	0.897	12	1.796	1.93	0.08	C=G	NON-SIGNIFICANT
	G	12.2	6	48					
Trunk length in centimeters	C	38.7	3.42	12	1.796	2.73	0.02	C=G	NON-SIGNIFICANT
	G	36	2.5	48					

Table 2. Results for boys

	C = Cuauhtemoc G = Guadalajara		Ho: C=G Ha: C≠G, ALFA=0.05

		ẋ	Std. Desv.	N	t-Table value	t-Calculated	P-Value	PH	Test
Weight in kilograms	C	19.95	1.66	9	2.306	1.00	0.345	C=G	NON-SIGNIFICANT
	G	17.3	2.3	54					
Height in centimeters	C	125.31	17.67	9	2.306	2.6	0.032	C=G	NON-SIGNIFICANT

	G	110.8	7.6	54					
Arm length in centimeters	C	46.94	2.22	9	2.306	8.3	0.000	C=G	NON-SIGNIFICANT
	G	40.5	2.9	54					
Leg Length in centimeters	C	61.28	5.0	9	2.306	-3.001	0.017	C=G	NON-SIGNIFICANT
	G	66.3	5.6	54					
Knee Height in centimeters	C	32.89	2.07	9	2.306	-0.16	0.876	C=G	NON-SIGNIFICANT
	G	32.7	2.3	54					
Elbow to Hand in centimeters	C	30.51	1.87	9	2.306				
	G			54					
Hand length in centimeters	C	12.91	1.05	9	2.306	2.32	0.049	C=G	NON-SIGNIFICANT
	G	12.2	6.0	54					
Trunk length in centimeters	C	40.7	2.25	9	2.306	6.23	0.00	C=G	NON-SIGNIFICANT
	G	36.0	2.5	54					

Do not reject Ho in most anthropometric measurements, since the calculated test statistic, t-student, is less than the one in the tables.

4. CONCLUSIONS

The data obtained randomly for anthropometric measurements of children of preschool age in Cd. Cuauhtémoc, Chih., provide sufficient evidence to affirm that there is no significant difference between mean values of anthropometric dimensions obtained in Guadalajara, Jal. from Children of the same age, given a random sample of 21 children, with a significance level of 0.05.

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