Proceedings of the 11th World Congress on Mechanical, Chemical, and Material Engineering (MCM'25)
Paris, France - August, 2025
Paper No. ICMIE 164
DOI: 10.11159/icmie25.164

Anthropometric Table Consolidation for the Honduran Population Database

André Fabian Carrasco Rivera [1], Juan Diego Fiallos Ruiz[2], Paola Michelle Pascua Cantarero[3]
[1] Facultad de Ingeniería, Universidad Tecnológica Centroamericana
Distrito Central, Tegucigalpa, Honduras
andref@unitec.edu; juanfiallos@unitec.edu; paola.pascua@unitec.edu.hn
[2] Facultad de Ingeniería, Universidad Tecnológica Centroamericana
Distrito Central, Tegucigalpa, Honduras

Abstract **-** In Honduras, the availability of anthropometric tables is limited, leading Honduran companies to resort to international anthropometric tables that do not represent the body dimensions and needs of Honduran workers. We will carry out a consolidation of previous anthropometric studies developed in the following departments of Honduras: Francisco Morazán, Cortes, Yoro, Choluteca, El Paraíso, Olancho, Comayagua, Intibucá and La Paz. The research used a quantitative approach and analytical scope, since a relationship was sought between anthropometric measurements and their impact in the workplace in Honduras. To determine whether the segmentation of the Consolidation should be by region or a single representative table of the Honduran population could be made, a statistical pilot was applied taking 3 of the 9 departments measured, concluding that 66% of the Anthropometric measurements for men and 72% for women respectively in the departments of Francisco Morazán, Cortés and Yoro statistically present different means in their data. Therefore, a consolidation by region was carried out. To verify the validity of this consolidated database, a comparison was made with US tables to verify whether the population data differed as proposed at the beginning of the research. This comparison also confirmed the differences raised. This research was successfully validated through statistical piloting in Minitab and expert triangulation with three engineering advisors. The research concluded that this database was not completely representative of the Honduran population, leading to the continuation of measurements in the remaining nine departments to resume this consolidation using this research as a proposal and guide.

Keywords**:** Database, Consolidated data, Anthropometric Tables, Measures of Central Tendency, Honduran Population.

1. Introduction

Ergonomics plays a fundamental role in the design of workspaces, furniture, and tools, as it directly influences the safety, comfort, and efficiency of workers. One of the essential factors in ensuring optimal ergonomic conditions is the use of anthropometric data specific to the target population. However, in Honduras, the availability of anthropometric tables is limited, forcing companies to resort to international references that do not accurately reflect the body dimensions and needs of Honduran workers [1]. This lack of adequate information can generate space and product designs that do not adapt to the physical characteristics of the population, affecting health and job performance, as demonstrated by Baca with his research consisting of the diagnosis and analysis of the current situation in ergonomics, hygiene, and occupational safety at the National Commission of Banks and Insurance of Honduras with the application of the risk analysis matrix based on ISO 45001. [2] In response to this problem, the present study seeks to consolidate previous studies on anthropometric tables carried out at the Central American Technological University (UNITEC). These studies cover the following departments of Honduras: Francisco Morazán, Cortes, Yoro, Choluteca, El Paraíso, Olancho, Comayagua, Intibucá and La Paz. This with the objective of generating a representative database of the Honduran population. This information will be useful for the national industry, allowing more appropriate ergonomic designs and contributing to the reduction of occupational risks associated with inadequate postures or non-adapted furniture [3].

2. Methodology

2.1. Focus

In the research, we used a quantitative approach where the consolidation and analysis of the tables of anthropometric measurements compiled from previous research in the years 2023 and 2024 in Honduras was carried out, descriptive statistics were used, as mentioned in the Qualtrics blog, that this approach requires the collection and analysis of numerical data to implement statistical and mathematical tools to explain phenomena within the data. [4] The data were integrated into a database and analysed using non-probabilistic sampling, obtaining the variances of measurements between the different departments and with international standards.

2.2. Scope

The present study used an analytical scope having carried out the consolidation and analysis of anthropometric data of the Honduran population with the purpose of generating a representative database for its application in the ergonomic design of workspaces, furniture and clothing. Previous studies from the Central American Technological University (UNITEC) will be analysed using statistical tools and international regulations such as ISO 7250, covering the working population of Honduras and considering the diversity of their anthropometric characteristics at the regional level. The validation of the results will be carried out through a quantitative approach based on descriptive statistics and expert triangulation, ensuring their reliability and applicability in future research and ergonomic projects [5].

2.3. Variables Analysed

The 29 measures shown in Table 1 were considered with the mean and variance for each of the measures.

Table 1: Variables Analysed

Anthropometric Measurements (cm,kg)	
Weight	Thigh clearance
Body height	Gluteus to knee distance
Eye height	The throat depth
Shoulder height	Waist circumference
Elbow height	Hand length
Hip width	Hand width
Seated height	Foot length
Eye height, seated	Foot width
Shoulder height, seated	Head length
Elbow height, seated	Head width
Shoulder width	Head circumference
Elbow to elbow distance	Front grip
Hip width, seated	Elbow grip
Popitlia height, seated	knuckle height
Height to knee	

Source: Own Elaboration

2.4. Instruments and Techniques Applied

A. *Instruments:*

-Minitab: Tool used for data analysis.

-Excel: Tool used for data storage.

-ISO 7250-1 (2017): Used for comparison with international standard anthropometric measurements.

B. Techniques

- Measures of central tendency: Measures of central tendency (mean, median, mode) and dispersion (standard deviation, variance) were used to evaluate the distribution of the data.

- Non-probabilistic distribution for convenience: the anthropometric measurements were compared with the ISO 7250-1 (2017) and ISO 15535 (2018) regulations, allowing the representativeness of the data to be evaluated in the international context.

- Analysis of variability and percentiles: the differences between the data from different departments of Honduras were analysed, using percentile distributions to evaluate their variation and relationship with reference values.

2.5. Population and Sample

2.5.1 Population

The population in this study was made up of measurements from 540 Honduran workers, collected in 9 of the 18 departments of Honduras.

2.5.2 Sample

The research, sampling was not carried out since we are going to analyse the entire population for the database by consolidating all the measurements of Honduran workers collected in the studies in the years 2023 and 2024, thus creating a census. For this reason, we do not apply probabilistic or non-probabilistic sampling, as mentioned in the book Research Methodology, also known as Sampieri, for cases where a census is carried out and the entire population is considered, the taking of a sample is omitted [6].

2.5. Validation Methodology

Triangulation by experts: The results will be validated by a panel of experts in ergonomics, anthropometry and industrial engineering. According to Denzin, expert triangulation improves the precision of studies by obtaining multiple perspectives and reducing bias [7].

Piloting: A pilot study will be applied with a small group of participants to evaluate the effectiveness of the data consolidation process. According to Creswell, piloting is a key strategy in quantitative research to detect possible errors in instruments and adjust methodologies before large-scale implementation [8].

3. Results and Analysis

3.1. Data segmentation for anthropometric consolidation using analysis of variance.

To determine the segmentation of the Consolidation, a statistical pilot was first applied, as Marqués mentions, for correct piloting the same steps must be carried out that are desired to be applied in a real study, with the intention of identifying errors and misinterpretations. [9] The research was carried out by taking 3 of the 9 departments measured as summarized in Table 2, to see the complete table referring to the report. The pilot consisted of an analysis of variance as carried out in Panama by Alfaro Ureña analyzing the grades for 3 different teaching methodologies taking as a sample 21 students in the Inferential Statistics class, concluding that there was no significant difference between the means of the students' grades. [10] The results in Table 2 show that 10 of the 29 measures for men and 8 of the 29 measures for women are true of the null hypothesis that all means are equal. Like the Díaz study, we had valuable conclusions for our study, such as the significant difference between the anthropometric measurements of the Honduran population by department. [11]

Table 2: Data Segmentation Pilotage

Statistically equal means:	**YES**	**Statistically equal means:**	**YES**
The null hypothesis is fulfilled	**NO**	**The null hypothesis is fulfilled**	**NO**
Anthropometric measurements for men		**Anthropometric measurements of women**	
Weight in kg	YES	Weight in kg	YES
Body height	NO	Body height	NO
Eye height	NO	Eye height	NO
Hip width	NO	Hip width	NO
Height, sitting	NO	Height, sitting	NO
Eye height, sitting	NO	Eye height, sitting	NO
Hip width, sitting	YES	Hip width, sitting	YES
Waist circumference	YES	Waist circumference	YES
Head circumference	NO	Head circumference	YES

Source: Own Elaboration

Continuing with the determination of the correct segmentation, an analysis of variance was carried out in the Minitab tool for the 9 departments measured in the past investigations in 2023 and 2024, the results of these analysis showed that 100% of the measurements for men and 90% of the measurements for women do not meet the null hypothesis that all the measurements are equal, validating the initial conclusion of the pilot to carry out the consolidation by regions by having different measurements by Department.

3.2. Percentiles for anthropometric measurements of the 540 Honduran workers divided by region

To determine the percentiles by region, the anthropometric measurements were unified by region, that is, the databases of the northwest region were unified by the departments that make up this region and the same procedure was applied to the other regions, to obtain general measures that can be used in said region. These were created using Excel, where it was decided that it was optimal to segment the percentiles between 5%, 50% and 95%.

Honduras is divided between 6 regions, these being: The Western region is composed of the departments of Copán, Ocotepeque and Lempira, the Northwestern region is composed of Cortés, Santa Barbara and Yoro, the Northeastern region composed of Gracias a Dios, Atlántida, Colon and Islas de la Bahía, the Western Central region composed of Intibucá, Comayagua and La Paz, the Eastern Central region composed of Francisco Morazán, El Paraíso and Olancho, finally, the southern region is composed of Choluteca and Valle. [12] Tables 3 and 4 below show only the percentiles of the Central-West region for space purposes, to see the complete tables of all regions read the report.

Table 3. Percentiles of the Central Western Region, Men and Women

Western Central Region Men				**Western Central Region Women**		
Percentiles	**5%**	**50%**	**95%**	**5%**	**50%**	**95%**
Weight	52.34	67.04	95.25	48.55	60.42	98.25
Body height	160	172	180	150	159	166
Eye height	148	158	168	137.6	148	157
Hip width	28	34	39	29	34	42.1
Height sitting	77	86	91	74.5	81	85
Eye height, sitting	66	75	80	66	71	75.1
Hip width, sitting	29	36	44	31	37	44.2
Waist circumference	68.4	87	110	64.6	82	105.9
Head circumference	53	56	58.1	50	54	56.71

Source: Own elaboration

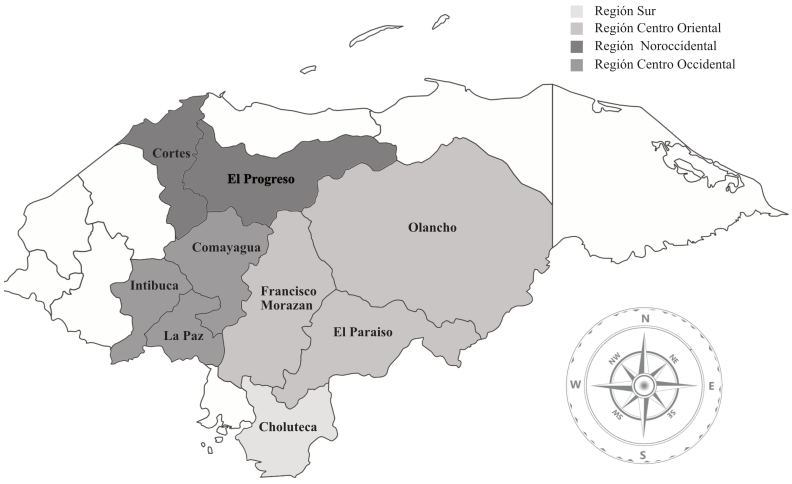

Fig. 1: Map of the segmentation by regions of Honduras.

Percentiles are a way to group or divide data. That is, percentiles allow a pattern to be made of a group of data by dividing them as the research or study requires, to represent the most common data or the data furthest from the mean. [13] With these tables, useful comparisons could begin to be made to determine if the international tables are not representative of the Honduran population, as López Cortéz did in Honduras with an anthropometric percentile table for student children and another obtained from the United States to verify that its study population was not in good health. [14]

3.3. Comparison of anthropometric tables made in the 4 Honduran regions and the American table

Data were compared by analysing the differences between the measurements from the United States anthropometric tables and the anthropometric tables from the four regions of Honduras used in the consolidation. Table 5 shows the measurements of the US population divided by percentiles, using the 5%, 50%, and 95% confidence intervals, divided between men and women. Table 5 contains fewer anthropometric measurements, as it considers the 16 used in the table to be more relevant. The comparison will be made using the method suggested in the book "Methods, Standards and Work

Design", which consists of finding the differences between the 50th percentile of each table and analysing if the differences are significant, focusing on what is being analysed. [15]

Table 5. Table of U.S. Anthropometric Measurements

	E.E.U.U Men			E.E.U.U Women		
Percentiles	**5%**	**50%**	**95%**	**5%**	**50%**	**95%**
Weight	56.2	74	97.1	46.2	61.1	89.1
Body height	161.8	173.6	184.4	149.5	160.5	171.3
Eye height	151.1	162.4	172.7	138.3	148.9	159.3
Shoulder height	132.3	142.8	152.4	121.1	131.1	141.9
Elbow height	100	109.9	119	93.6	101.2	108.8
Seated height	84.2	90.6	96.7	78.6	85	90.7
Eye height, seated	72.6	78.6	84.4	67.5	73.3	78.5
Elbow height, seated	19	24.3	29.4	18.1	23.3	28.1
Elbow to elbow distance	35	41.7	50.6	31.5	38.4	49.1
Hip width, seated	30.8	35.4	40.6	31.2	36.4	43.7
Popitlia height, seated	39.2	44.2	48.8	35.5	39.8	44.3
Height to knee	49.3	54.3	59.3	45.2	49.8	54.5
Thigh clearance	11.4	14.4	17.7	10.6	13.7	17.5
Gluteus to knee distance	54	59.4	64.2	51.8	56.9	62.5
Throat depth	21.4	24.2	27.6	21.4	24.2	29.7
Knuckle height	69.8	75.4	80.4	64.3	70.2	75.9

Source: (Methods, Standards and Work Design, 2009)

4. Discussions

The correct segmentation for consolidation was determined, with the creation of tables by region. This was achieved through an analysis of variance with a 95% confidence interval, showing that Honduran workers have varied builds and cannot be categorized as a single type. However, throughout the statistical analysis, it was concluded that an anthropometric database to be used officially in Honduras would require measurements from all 18 departments, leading to the need for three additional studies to measure Honduran workers using the same criteria and methods as the 2023 and 2024 studies.

It should be added that these investigations must have 30 men and 30 women measured by department, measuring exactly the 9 missing departments, these being: Lempira, Ocotepeque, Valle, Copán, Atlántida, Colón, Santa Bárbara, Islas de la Bahía and Gracias a Dios in order not to leave out the Western and Northeastern regions. Without these regions present in the research, it is difficult for us to establish that the consolidation carried out is representative of the entire Honduran population.

The percentiles for the anthropometric measurements of the sample studied during 2023 and 2024 in the nine departments of Honduras were determined by region. Similarly, for a percentile to be representative of the population, the same number of measurements must be taken by sex in each department. We therefore conclude that the consolidation carried

out is a proposal, given that more anthropometric measurements would need to be taken, covering all departments in Honduras, to create a reliable and representative database of Honduran workers.

The US population, on average, is taller, thinner, and narrower in the lower body than the four regions of Honduras analysed in the study. Regarding the anthropometric tables compiled during the consolidation, some similarities were observed in some anthropometric measurements, but not sufficient to conclude that the tables for the US population can be representative of Hondurans. It was concluded that the research has a significant impact on Honduran society, as the results show that the Honduran population is not the same as the US population. Furthermore, separate anthropometric tables should be created for each region of Honduras to create a reliable and representative database of Honduran workers, for use by industry and the community to provide ergonomic spaces for workers.

Expert triangulation as a validation method was found to be efficient and important for the project's implementation. In times of blockage, experts, with their greater knowledge and experience in the field, make highly helpful recommendations. In the research, the experts helped divide the regions of Honduras and carried out the pilot project. Thanks to the experts' help, the research has a high level of credibility.

General Conclusion

The results of the research showed that it is necessary to have an anthropometric database in Honduras, since continuing to use the tables from the United States may not be convenient. Given the impact the tables generate, it is considered essential to continue taking measurements in the remaining nine departments of Honduras to have a database for all regions of Honduras. Additionally, it is advisable to conduct fatigue comparisons in the booths of the Industrial Engineering laboratory to validate improvements using consolidation as a source of information.

5. Recommendations

1) In the application of the pilot to determine the segmentation of the Consolidation, we realized the importance of being clear about the statistical tests to use and what the best options are. Since in our case it took us a while to identify that the analysis of variance of means was the best option given the large number of variables, in our case being 29 Anthropometric measurements, a prior investigation of the statistical tools would considerably reduce the time and efforts.
2) When carrying out the percentiles of the Anthropometric measurements by region, we realized that the number of subjects measured per department was 60 but they were not equally distributed between men and women. Therefore, in some cases we have more measurements of men than women, creating a possible bias. Therefore, for this stage of data collection it would have been ideal to have had the same number of measurements between men and women per department. Another point to mention is that the number of departments should have been greater than the 9 of 18 departments in Honduras that we initially had for Consolidation.
3) For the comparison of anthropometric tables, we believe that having a greater number of measurements from the Honduran population would provide greater reliability to the analysis, since the study compared 5,000 Americans with 540 Hondurans. Taking CDC as a reference, which currently updates its anthropometric tables every three years and uses only five anthropometric measurements, the same guidelines could be followed for collecting anthropometric tables.
4) For triangulation by experts we consider that it is difficult to get experts in certain topics and even more so without knowing exactly what will be applied in the research. Using our research as an example, through progress in the research we were understanding which areas or topics would be applied, which is difficult to know having only the idea of the project. We understood that obtaining experts in the fields of Statistics as Thematic Advisors would have been of great help in solving doubts and inconveniences that, although we solved, but not efficiently, waste valuable time that we could invest in other areas of research.

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