

DESIGN ANTHROPOMETRIC REFERENCED LETTERS TO THE LABOR POPULATION OF CABORCA CITY IN SONORA MEXICO.

M.C. Joaquín Vásquez Quiroga¹, M.C. Jesús Rodolfo Guzmán Hernández², Dr. Enrique Javier de la Vega Bustillos³.

¹ Program Coordinator and Professor, Department of Physics, Mathematics and Engineering, Universidad de Sonora, Caborca Sonora, México.
jovaqui@caborca.uson.mx

² Professor and Researcher at the Instituto Tecnológico de Hermosillo, Mexico
e_delavega_mx@yahoo.com

³ Professor, Department of Physics, Mathematics and Engineering
Universidad de Sonora, Caborca, Sonora, México.
rguz@caborca.uson.mx

RESUMEN

Esta investigación es el resultado de las mediciones de 50 variables antropométricas de 200 personas en edad laboral de la Ciudad de Caborca Sonora México, con el objetivo de poder hacer una aportación importante a la creación de cartas antropométricas para la población mexicana. En la actualidad son pocos los datos que se tienen de las medidas antropométricas de la población mexicana, haciéndose necesario utilizar las medidas de otros países en donde las condiciones y complejidad física son diferentes.

Las cartas antropométricas que aquí se obtuvieron están distribuidas por grupos de edad, sexo y lugar de origen. Este trabajo puede ser el inicio de investigaciones similares en otras poblaciones de México y llegar a tener un registro antropométrico del total de la población mexicana, para poder desarrollar estaciones o espacios de trabajo que se adapten a la población, herramientas, ropa, equipo de protección personal como cascos y guantes, calzado, lo mismo que lugares de descanso.

Palabras claves: Cartas Antropométricas, Antropometría y Ergonomía.

ABSTRACT

This research is the result of 50 anthropometric measurements of 200 people of working age of Caborca Sonora Mexico City, in order to be able to make a significant contribution to creating cards for the Mexican population anthropometric. At present there are few data have anthropometric measurements of the Mexican population, making it necessary to use measures other countries where conditions and physique are different.

The anthropometric letters were obtained here are divided by age, sex and place of origin. This work may be the beginning of similar investigations in other populations of Mexico and get to have a record of all anthropometric Mexican population, to develop stations or workspaces that are tailored to the people, tools, clothing, protective equipment personal as helmets and gloves, footwear, as well as resting places.

Keywords: Anthropometric Letters, Anthropometry and Ergonomics.

1. INTRODUCTION

It is now of vital importance to take into account the design and the anatomic structure of individuals to understand and develop all those areas in which performance involves human beings, this is not new and has been studied before in different countries and not with measures aimed at the Mexicans. The purpose of a study of this type is able to physically help the worker in all areas where it is involved, such as designing work spaces suitable for each person, the design of tools, safety equipment and personal protection clothing, and have references dimensional population.

With all the technological advances that have occurred, you can have a better life, as studies have been developed in several areas, one of them is the anthropometry, with which they determine the dimensions of the human body, in this area there are some studies in developed countries, but very few of the Mexican population. Hence the interest start recording anthropometric data, thinking about making a contribution to the creation of anthropometric cards to this population. The creation of these cards is essential to have a population register, in order to make designs of stations, the design of tools and equipment, etc., Always trying the user is comfortable and without risk of injury by position not normal. This is important to understand their measurement and to determine the field of development or dimensional capabilities that people have. For this reason the study will focus to working anthropometric cards of population of H. Caborca, Sonora, and this is an important input to record anthropometric measurements of the Mexican population.

Throughout history, many investigations that have been developed in the area of anthropometry. In more current times these investigations have risen to be an important support for ergonomics, this is the case:

Annis (1996) did an analysis of anthropometric changes the size and body shapes as they get older people, to see the implications of these changes in the dimensions of workspaces.

Gosseens (1998) studied the dimensions of the seats of five different types of civil aircraft. The results were compared with existing standards and biomechanical criteria. It was evident that these seats failed to meet requirements of depth, slope, height of lumbar support and armrests. Therefore, none of these seats allow the pilot was in a comfortable sitting posture. In comparison with aviation standards, the anthropometric dimensions were not satisfactory.

Panagiotopoulou (2003) developed a study for the purpose of comparing the size of primary school students, with the dimensions of the desks, to determine if the dimensions of the furniture is well designed and see if they promote good posture sitting considering the dimensions of children.

Jung (2005) developed a prototype of an adjustable chair for educational institutions, where they assess their suitability according to international standards. His research began with simple mechanisms for adjusting the height of chair legs and backrest height and seat depth.

In Mexico, these investigations have increased due to the recommendations made in the Federal Regulation on Safety, Hygiene and Environment Working in Article 102 and as SEMAC associations (Society of ergonomic Mexicana AC), which organizes conferences in presented research papers such as:

Ergonomic design for computer work stations, presented by Martinez (2000).

Implementation of an ergonomic process for the industry for control musculoskeletal injuries, presented by Sánchez (2002).

Research and Ergonomics in Mexico, presented by de la Vega (2004).

In developing this work is clearly important that represents the human resources within an organization, since this depends on the effectiveness of the production process. Therefore, the objective of the development of this research is the creation of letters of the anthropometric measurements of the working population of the City of Caborca, by age group, sex and place of origin.

Obtaining anthropometric cards may be made designs for the population, helping businesses and people in general. Currently there are very few reliable records of the anthropometric dimensions of these people, so it is taken as the measures of other countries where physique is different and the conditions too.

When designing industrial products is important to provide who are the users to succeed in the product, taking into account different body sizes, safety and human comfort, it is here that involves anthropometry (Reeder 2003).

Hence the great importance of anthropometric data to researchers from the human factor, for practical use with these, such as would be the design of clothing, tools, to provide statistical guidelines for product design and build models biomechanical. (Park, Kim 1997).

According Cavassa (2004) there are two types of anthropometrics: anthropometry static or structural, which refers to the dimensions in which the body is in static state, for example, height, weight, etc.

The other type is the dynamic anthropometry: it refers to taking action where the body is operating, for example stretching one arm to reach something.

At the time of wanting to design, there are some factors that influence the anatomical structure of the human body are: age (until maturity), sex (male, female), race, occupation, clothing (especially in cold weather) and even the time of day (in the morning the people are measuring 6 mm more, because the spinal discs are not compressed (Konz 1999).

When will develop designs for a group of people is important to take into account some principles such as:

1. Design principle to extremes: this design takes the maximum and minimum value of the characteristics of user populations.
2. Adjustable design principle: it is used for facilities and equipment that can be adapted to various individuals.
3. Design principle for the average: this approach is less expensive but less used, since it is difficult to get the design that fits 50% of the population (Niebel 2001)

The anthropometric cards is to develop a record of human body stockings for people to have a higher confidence level to develop a design such as a workstation, machinery, equipment, clothing, etc. such is the case study by Mohammad (2005) which record some measures of hand. There are an infinite number of steps you can take the human body as recommended by the manual of procedures (Secretariat 2002). For the case study of this work, selected 50 of them, according to the definitions used in similar anthropometric examinations conducted by the National Aeronautics and Space Administration (NASA 1978).

2. MATERIALS AND METHODS

For the development of the research team used the following:

- three anthropometer model 01140, 01290 and 01291 marks Lafayette.
- One stadimeter marks Seca.
- One analog scale marks Seca.

- Two measuring tape marks Powerlock Stanley.
- Two flexible tapes.
- Two calibrators marks Chicago Brand.
- Two chairs designed with a height adjustment system.
- One calibrated cone diameter grip.
- One computer for recording information.

The methodology for taking the measures was as follows:

It had a special area for training and standardization process of the four assistants in order to achieve uniformity in the way of measuring.

The measurements were conducted in a private room and quiet, being present only the individual, the analyst and an assistant.

People who were measured were treated with respect and care, trying to earn their trust.

Before the measurement was given a brief explanation of the steps, procedures and requirements for measurement.

Was prepared and calibrated all equipment necessary to make anthropometric measurements, ensuring that all necessary materials are available.

To begin with the taking of measures, the person must wear few clothes, nothing in the head or feet, the surface of the floor, seat or platform must be flat, horizontal and non-compressible, measure the right side of the person. At the time of the measures breathing should be light.

The 50 measures that were recorded for each person are:

Code	Name of the measure
N920	Weight
N805	Stature
N328	Standing eye height to
N23	Standing shoulder height
N309	The standing elbow height
N949	Standing waist height
N398	Height standing gluteus
N973	Standing tall on the wrist
N265	Standing height to the middle finger
N797	Width arms outstretched
N798	Width at center chest elbows
N80	Arm length from the wall
N752	Distance from wall to the center of the fist
N122	Standing shoulder width
N223	Standing chest width
N457	Standing Hip Width
N639	Standing neck circumference
N230	Standing chest circumference
N931	Waist circumference stands
N178	Standing hip circumference
N430	Head circumference
N144	Distance from ear to ear on the head
N165	Face width to the height of the pins
N427	Head width
N595	Height of the chin to the top of head
N441	Head length
N420	Length of hand

N656	Length of the palm
N411	Width of palm
N402	Grip diameter
N758	Seat height sitting at the head
N330	Seat height sitting in the eye
N25	Seat height sitting shoulder
N312	Seat height to seated elbow to 90
N856	Sitting thigh-high
N914	Seat height to the middle finger sitting
N912	Height to the center of the cuff arms up
N2FGM	Height of sitting down
N4FGM	Seat height from floor to sit
N200	Back of the knee to the back of chair
N194	Length from knee to back of chair
N678	Height from floor to knee back
N529	Height from floor to knee
N381	Length from elbow to middle finger
N507	Back Width arms outstretched in front
N459	Seated hip width
N859	Width thighs with knees together
N775	Leg length
N777	Foot width
N776	High instep

Was measured at 200 and will be an analysis of data from the 200 people using the spreadsheet Excel, the result will reflect the percentiles 5%, 50% and 95%, the maximum and minimum of each measurements.

3. ANALYSIS OF RESULTS

The results of research carried out in each of the measurements are shown in the tables or charts anthropometric working population of Caborca, Sonora, as follows:

Table 1 shows the total data by age group and sex in years, in tables 2, 3, 4, 5, 6, 7 and 8 shows the results of the analysis of the 50 measures anthropometric research by age, sex and place of origin.

The tables show the calculation of the percentiles 5, 50 and 95%, and the maximum and minimum measurements. The calculations were analyzed in the Excel spreadsheet. The weight calculation is given in kilograms, the other measures are in centimeters.

Table 1 Distribution of data by age group and sex.

AGE	SEX		TOTALS
	MEN	WOMEN	
18-20	69	24	93
21-23	49	26	75
24-27	24	8	32
TOTALS	142	58	200

Table 2 Results of analysis of measures for the age ranges of 18-20 years.

Code	Name of the measure	Percentile			MIN	MAX
		5%	50%	95%		
N920	Weight	48.6	68	93.4	40	105
N805	Stature	156.8	170.5	183.4	151.1	194
N328	Standing eye height to	145.3	160.2	173.6	140.5	182.4
N23	Standing shoulder height	130.6	142.8	153.3	126	167.5
N309	The standing elbow height	98.8	108.2	117.3	95.6	129.2
N949	Standing waist height	93.6	102.5	110.4	92	121.7
N398	Height standing gluteus	68.1	74	86.1	62	96.4
N973	Standing tall on the wrist	75.4	83.6	90.3	71	105
N265	Standing height to the middle finger	59.1	64.9	71.1	56	78.1
N797	Width arms outstretched	156.6	175.1	187.2	150.7	200.7
N798	Width at center chest elbows	79.3	91.5	97.2	68.3	99.4
N80	Arm length from the wall	76.9	89.3	115	68.5	118
N752	Distance from wall to the center of the fist	66.5	75.7	106.5	64.8	111
N122	Standing shoulder width	37	43.3	48.1	34.5	54
N223	Standing chest width	26.4	30.4	35	24.3	38.4
N457	Standing Hip Width	31	35.4	39.8	30.3	46.7
N639	Standing neck circumference	31.3	37	41.6	29.7	44
N230	Standing chest circumference	81	94.5	110.2	77	117
N931	Waist circumference stands	67.1	85	105.2	64.5	115.2
N178	Standing hip circumference	90.3	102	117.9	84.7	127
N430	Head circumference	54	57	60.5	52.5	98.4
N144	Distance from ear to ear on the head	34.5	37	39.8	32.3	55
N165	Face width to the height of the pins	12.9	14.4	15.7	11.7	15.9
N427	Head width	14.5	15.5	16.9	12	17.9
N595	Height of the chin to the top of head	20	23	25.2	18.5	25.7
N441	Head length	17.5	19	20.3	16.4	20.9
N420	Length of hand	16.4	18.5	19.8	16.1	21.2
N656	Length of the palm	9.4	10.6	11.4	9.2	12.3
N411	Width of palm	7.3	8.4	9.3	6.9	9.8
N402	Grip diameter	4.2	4.8	5.6	3.5	6.5
N758	Seat height sitting at the head	82	88.8	95.5	79	100.5
N330	Seat height sitting in the eye	71.5	78	84.2	64.6	90.2
N25	Seat height sitting shoulder	57	61.5	66.6	54.3	68.5
N312	Seat height to seated elbow to 90	22	26	29	19.4	38
N856	Sitting thigh-high	13.5	16	18.8	12	21
N914	Seat height to the middle finger sitting	119.5	132.3	145.7	114	148.5
N912	Height to the center of the cuff arms up	110.2	121.3	133.7	104.2	136.3
N2FGM	Height of sitting down	121.9	130	139.2	115.5	143.4
N4FGM	Seat height from floor to sit	37.8	42	45.6	36	47.2
N200	Back of the knee to the back of chair	41	45.4	51	39.1	56.7
N194	Length from knee to back of chair	53.2	59.2	66.5	48.4	72.3
N678	Height from floor to knee back	37	42.3	45.4	33.5	49
N529	Height from floor to knee	48.4	54.3	58.9	30.4	64.2
N381	Length from elbow to middle finger	42.3	48	51.5	41.1	53
N507	Back Width arms outstretched in front	37.2	42	46.9	32.7	49.9
N459	Seated hip width	35.5	39.1	46.2	32	49.3
N859	Width thighs with knees together	29.8	33.3	40	26.1	49.8

N775	Leg length	22.8	26	28.5	21.6	30.4
N777	Foot width	8.6	9.7	10.7	8	11.2
N776	High instep	6.2	8.3	10	5	12.3

Table 3 Results of analysis of measures for the age ranges of 21-23 years.

Code	Name of the measure	Percentile			MIN	MAX
		5%	50%	95%		
N920	Weight	51.7	68	106.3	47	132
N805	Stature	153.5	168	181.3	148	184
N328	Standing eye height to	142.2	157.5	169.8	138	174.2
N23	Standing shoulder height	128	140.6	152	126	185.5
N309	The standing elbow height	97	106.3	116.2	90.8	123.8
N949	Standing waist height	93	100	111.3	91	116
N398	Height standing gluteus	64.4	74	82.7	59	106.8
N973	Standing tall on the wrist	73.6	82	92.2	69	95.3
N265	Standing height to the middle finger	56.9	65	72.4	55	75.8
N797	Width arms outstretched	153.7	172	186.3	152	189.6
N798	Width at center chest elbows	77.9	89.2	95.6	64	98.2
N80	Arm length from the wall	77.5	98	115.7	73.3	128.7
N752	Distance from wall to the center of the fist	68	92	105.4	61.7	112
N122	Standing shoulder width	37.4	42.8	48.3	35.5	51.1
N223	Standing chest width	27.1	30.2	35.9	25.5	40
N457	Standing Hip Width	32.4	35.7	43.2	30.5	45.2
N639	Standing neck circumference	31	36.9	41.7	29.5	46
N230	Standing chest circumference	85.9	96	118.2	83	124.5
N931	Waist circumference stands	70	85	115.3	56	125.4
N178	Standing hip circumference	93.9	104	125.7	91	135.5
N430	Head circumference	54	56.8	59.2	53.5	61
N144	Distance from ear to ear on the head	34	37	39.6	33.5	41
N165	Face width to the height of the pins	12.9	14	15.8	12	16.7
N427	Head width	14.1	15.5	16.5	12	16.8
N595	Height of the chin to the top of head	19.5	22.2	24.8	19	25.8
N441	Head length	17.4	18.9	20.5	17	24.6
N420	Length of hand	16.4	18.1	19.7	15.6	20.5
N656	Length of the palm	9.1	10.4	11.4	7.8	19.2
N411	Width of palm	7.2	8.4	9.3	6.5	9.5
N402	Grip diameter	4	4.7	5.4	3.4	5.6
N758	Seat height sitting at the head	80.6	88	93.8	79	95
N330	Seat height sitting in the eye	70.9	77.2	82.4	66.7	84
N25	Seat height sitting shoulder	56	60.9	70.3	53.5	83
N312	Seat height to seated elbow to 90	22	26	30.7	19.2	39
N856	Sitting thigh-high	13.1	16	19.9	12	21.5
N914	Seat height to the middle finger sitting	118.3	132.2	141	113.4	145
N912	Height to the center of the cuff arms up	110	122.4	129.8	103.3	140.5
N2FGM	Height of sitting down	119	130	137	115.4	140
N4FGM	Seat height from floor to sit	37.3	41	45	36	46.5
N200	Back of the knee to the back of chair	40.1	46	50.1	39.7	55
N194	Length from knee to back of chair	52.7	59	64.4	51	70.5
N678	Height from floor to knee back	36.6	42	46	35.5	50.9

N529	Height from floor to knee	47.3	54	58.6	43.4	65.5
N381	Length from elbow to middle finger	40.9	46.6	51	40	54
N507	Back Width arms outstretched in front	36.7	41.6	46.1	34	47.7
N459	Seated hip width	35.5	39	46	29	54.7
N859	Width thighs with knees together	30	33.5	40.2	28.4	46.8
N775	Leg length	22.7	25.5	27.8	22	28.6
N777	Foot width	8.4	9.8	11	8	12
N776	High instep	5.9	8	9.2	5	10.5

Table 4 Results of analysis of measures for the age ranges of 24-27 years.

Code	Name of the measure	Percentile			MIN	MAX
		5%	50%	95%		
N920	Weight	57.6	74.5	108.4	50	138
N805	Stature	158.9	171	183.3	156	187
N328	Standing eye height to	147.3	161	169.7	132	177.6
N23	Standing shoulder height	132	142.5	153.8	131	159.3
N309	The standing elbow height	102.3	107.5	117.5	100.5	119
N949	Standing waist height	91.3	101	109	85	113
N398	Height standing gluteus	65	73	80.7	62	89
N973	Standing tall on the wrist	76.1	81	92.2	68.5	92.8
N265	Standing height to the middle finger	59.8	65.1	72.9	58.5	74
N797	Width arms outstretched	160	174	188.2	155	193
N798	Width at center chest elbows	85	91	96.3	83	99
N80	Arm length from the wall	81.3	95.2	116.3	77	122.5
N752	Distance from wall to the center of the fist	62.8	87.2	106.7	60	107
N122	Standing shoulder width	38	44.7	49.5	36.2	52.9
N223	Standing chest width	27.6	32	37.3	26.2	41.4
N457	Standing Hip Width	31.6	36	44.2	31.5	76.5
N639	Standing neck circumference	32.6	38	44	31	44.8
N230	Standing chest circumference	86.6	98.4	117.5	85.5	150
N931	Waist circumference stands	74.8	90	120	70	151.8
N178	Standing hip circumference	94.6	107.2	122.9	93	149.5
N430	Head circumference	54.8	57.5	60	54	60
N144	Distance from ear to ear on the head	34.6	36.8	40	34	40
N165	Face width to the height of the pins	12.5	14.1	16.1	11.4	16.2
N427	Head width	14.4	15.3	16.7	12.4	17
N595	Height of the chin to the top of head	20.9	23	27.1	20	29
N441	Head length	17	19	20.2	16	20.6
N420	Length of hand	17	18.6	20	17	20.1
N656	Length of the palm	9.6	10.7	11.3	9.5	22
N411	Width of palm	7.3	8.7	9.1	7	9.3
N402	Grip diameter	4	4.9	5.6	3.8	5.8
N758	Seat height sitting at the head	84.3	88.2	93.2	83	98
N330	Seat height sitting in the eye	72.9	77.1	83	70	84.5
N25	Seat height sitting shoulder	58	61	68.1	57	83
N312	Seat height to seated elbow to 90	21.8	27.2	29.8	21	32
N856	Sitting thigh-high	13.7	16.3	18.9	13	20
N914	Seat height to the middle finger sitting	122.4	131.8	140.8	117.4	150
N912	Height to the center of the cuff arms up	111.7	122	129.7	109.4	138

N2FGM	Height of sitting down	123.6	130	137.8	121.5	139
N4FGM	Seat height from floor to sit	37.6	41.8	46.2	37	47
N200	Back of the knee to the back of chair	41.4	45.3	49.1	40	53.5
N194	Length from knee to back of chair	55.4	58.2	65	53	67.2
N678	Height from floor to knee back	37.8	42.7	46.3	36	48.5
N529	Height from floor to knee	50.4	55.3	61	49.5	63.2
N381	Length from elbow to middle finger	43.6	47	49.5	41	50.3
N507	Back Width arms outstretched in front	37.2	43	47.8	35	49.7
N459	Seated hip width	36.3	39.5	48.4	36	56.4
N859	Width thighs with knees together	29.3	34.6	43.8	27.5	52.6
N775	Leg length	23.1	26	28.3	23	30
N777	Foot width	9	9.7	11	8.7	11
N776	High instep	6.1	8	10	6	10

Table 5 Results of analysis of measures for female.

Code	Name of the measure	Percentile			MIN	MAX
		5%	50%	95%		
N920	Weight	46.9	57.5	95	40	138
N805	Stature	151	160	172	148	172.8
N328	Standing eye height to	140.9	149.4	159.7	138	161.6
N23	Standing shoulder height	126.9	133	142.4	126	147
N309	The standing elbow height	96.8	102.9	109.9	94	114
N949	Standing waist height	92.6	98.5	106.5	85	109
N398	Height standing gluteus	66.3	72.4	80.1	61.5	82.7
N973	Standing tall on the wrist	73	79.4	85.8	71	87
N265	Standing height to the middle finger	56.4	62.1	68.1	56	69.9
N797	Width arms outstretched	152.4	160.4	176.5	150.7	177
N798	Width at center chest elbows	73.9	83.5	89.6	64	93.7
N80	Arm length from the wall	75.5	81.8	106.5	73.3	114
N752	Distance from wall to the center of the fist	64.7	71.7	98.9	61.7	104.5
N122	Standing shoulder width	35.5	39.6	46.6	34.5	52.9
N223	Standing chest width	26	29	35.4	24.3	41.4
N457	Standing Hip Width	32.6	35.6	45	30.3	46.7
N639	Standing neck circumference	30	33	38.2	29.5	44.8
N230	Standing chest circumference	82.8	92.5	118.5	79.8	150
N931	Waist circumference stands	66	77.5	112.2	64.5	151.8
N178	Standing hip circumference	92.7	99.2	127.2	84.7	149.5
N430	Head circumference	53.5	56	58.2	53	98.4
N144	Distance from ear to ear on the head	33.9	36	38.7	33	39
N165	Face width to the height of the pins	12.3	13.5	15.1	11.4	15.8
N427	Head width	14.2	15.1	16.2	12	17.9
N595	Height of the chin to the top of head	19	22	24.2	18.5	29
N441	Head length	17.1	18.5	20	16.4	20.3
N420	Length of hand	16.1	17.5	18.9	15.6	19.4
N656	Length of the palm	9	9.7	11.2	7.8	19.2
N411	Width of palm	7	7.5	8.5	6.5	9.3
N402	Grip diameter	3.9	4.5	5	3.5	5.6
N758	Seat height sitting at the head	79.5	85	89.4	79	93
N330	Seat height sitting in the eye	69.8	74.1	78.3	66.3	81.7

N25	Seat height sitting shoulder	55.8	59	63.5	53.5	69
N312	Seat height to seated elbow to 90	22	26.6	29.6	20.5	39
N856	Sitting thigh-high	12.6	15.2	18.7	12	21.5
N914	Seat height to the middle finger sitting	114.9	123.7	133.1	113.4	135
N912	Height to the center of the cuff arms up	108	115	122.5	103.3	127.7
N2FGM	Height of sitting down	117	124.8	131.1	115.4	134.1
N4FGM	Seat height from floor to sit	37	39.2	44	36	45.1
N200	Back of the knee to the back of chair	40	44	49	39.1	49.2
N194	Length from knee to back of chair	51	56.9	61.4	48.4	65.4
N678	Height from floor to knee back	36	38.9	43.1	35.5	44
N529	Height from floor to knee	46.6	51.1	55.3	30.4	56
N381	Length from elbow to middle finger	40.7	44	47	40	49.1
N507	Back Width arms outstretched in front	35.5	39.9	43.6	33	48.6
N459	Seated hip width	35.1	39	49.2	32.7	56.4
N859	Width thighs with knees together	30	33.7	42.8	28.5	52.6
N775	Leg length	22	23.8	25.1	21.6	27.2
N777	Foot width	8.1	9	10	8	10.3
N776	High instep	6	7.7	9	5	9.7

Table 6 Results of analysis of measures for male.

Code	Name of the measure	Percentile			MIN	MAX
		5%	50%	95%		
N920	Weight	57.1	73	100.9	49	132
N805	Stature	163	172	183.8	156.7	194
N328	Standing eye height to	151	161.5	174	132	182.4
N23	Standing shoulder height	135.2	144.2	153.5	132	185.5
N309	The standing elbow height	102	109.7	118	90.8	129.2
N949	Standing waist height	94.1	103	111.4	91	121.7
N398	Height standing gluteus	65	74.7	88.6	59	106.8
N973	Standing tall on the wrist	76	84	92.5	68.5	105
N265	Standing height to the middle finger	59	66	73.4	55	78.1
N797	Width arms outstretched	166	177.4	189.2	160.5	200.7
N798	Width at center chest elbows	86.3	92.1	97.5	68.3	99.4
N80	Arm length from the wall	84.2	93	116.6	68.5	128.7
N752	Distance from wall to the center of the fist	72	79.8	107	60	112
N122	Standing shoulder width	41	44.6	49.3	36.6	54
N223	Standing chest width	28	31	36.4	25.7	40
N457	Standing Hip Width	31.5	35.6	39.2	30.3	76.5
N639	Standing neck circumference	34	37.9	42.5	32.8	46
N230	Standing chest circumference	85.1	96.5	116.3	77	124.4
N931	Waist circumference stands	73.1	87	111.4	56	126
N178	Standing hip circumference	94	104	117.8	87	135.5
N430	Head circumference	54	57	60	52.5	86.5
N144	Distance from ear to ear on the head	34.5	37	40	32.3	55
N165	Face width to the height of the pins	13	14.5	16	12.5	16.7
N427	Head width	14.5	15.6	16.6	12.4	17.7
N595	Height of the chin to the top of head	20.5	23	25.4	18.9	28.8
N441	Head length	17.5	19	20.6	16	24.6
N420	Length of hand	17.4	18.8	20	17	21.2
N656	Length of the palm	10	10.7	11.4	9.5	22

N411	Width of palm	7.9	8.7	9.3	7.5	9.8
N402	Grip diameter	4.1	4.9	5.6	3.4	6.5
N758	Seat height sitting at the head	84	89.6	95.1	81	100.5
N330	Seat height sitting in the eye	73	79	84	64.6	90.2
N25	Seat height sitting shoulder	58	62	67.5	56	83
N312	Seat height to seated elbow to 90	22	26	29.5	19.2	32
N856	Sitting thigh-high	14	16.4	19.4	12.4	21
N914	Seat height to the middle finger sitting	127.2	134.3	145	119	150
N912	Height to the center of the cuff arms up	117	124	134	111.5	140.5
N2FGM	Height of sitting down	123.6	131.5	139	120.4	143.4
N4FGM	Seat height from floor to sit	38.5	42.3	46	36.5	47.2
N200	Back of the knee to the back of chair	42	46	51.2	40	56.7
N194	Length from knee to back of chair	55.7	60	66	52	72.3
N678	Height from floor to knee back	39.2	43	46.7	33.5	50.9
N529	Height from floor to knee	52.4	55.5	60.2	50.4	65.5
N381	Length from elbow to middle finger	45	48	51.5	41.6	54
N507	Back Width arms outstretched in front	38.4	43	47.2	32.7	49.9
N459	Seated hip width	35.7	39.2	46	29	54.7
N859	Width thighs with knees together	29.7	33.6	41.5	26.1	49.8
N775	Leg length	24.7	26.4	28.6	24	30.4
N777	Foot width	9	10	11	8.5	12
N776	High instep	6	8.3	10	5	12.3

Table 7 Results of analysis of measures for Caborca people

Code	Name of the measure	Percentile			MIN	MAX
		5%	50%	95%		
N920	Weight	50	69	100.9	40	138
N805	Stature	155.1	169.1	183	148	194
N328	Standing eye height to	143.3	158.4	173.2	132	182.4
N23	Standing shoulder height	130.1	141.6	152.9	126	185.5
N309	The standing elbow height	98	107.1	117.4	90.8	129.2
N949	Standing waist height	93	101.5	110.5	85	121.7
N398	Height standing gluteus	65.1	74	85.5	59	106.8
N973	Standing tall on the wrist	75	82.5	92	68.5	105
N265	Standing height to the middle finger	58	64.9	72.6	55	78.1
N797	Width arms outstretched	155.1	174	187.6	150.7	200.7
N798	Width at center chest elbows	79	90.2	97.3	64	99.4
N80	Arm length from the wall	77.3	91.3	115.2	68.5	128.7
N752	Distance from wall to the center of the fist	66.2	78.9	106.7	60	112
N122	Standing shoulder width	37	43.2	48.5	34.5	54
N223	Standing chest width	26.8	30.7	36.8	24.3	41.4
N457	Standing Hip Width	31.6	35.6	42.5	30.3	76.5
N639	Standing neck circumference	31	37	42	29.5	46
N230	Standing chest circumference	84	95.9	117	77	150
N931	Waist circumference stands	68.1	85.2	112	56	151.8
N178	Standing hip circumference	93	103.3	121	84.7	149.5
N430	Head circumference	54	57	60	52.5	98.4
N144	Distance from ear to ear on the head	34	37	40	32.3	55
N165	Face width to the height of the pins	12.9	14.2	15.9	11.4	16.7
N427	Head width	14.5	15.4	16.6	12	17.9
N595	Height of the chin to the top of head	19.6	22.8	25.4	18.5	29

N441	Head length	17.3	19	20.4	16	24.6
N420	Length of hand	16.5	18.4	19.8	15.6	21.2
N656	Length of the palm	9.3	10.5	11.4	7.8	22
N411	Width of palm	7.2	8.5	9.3	6.5	9.8
N402	Grip diameter	4	4.7	5.5	3.4	6.5
N758	Seat height sitting at the head	82	88.3	95	79	100.5
N330	Seat height sitting in the eye	71	77.4	83.7	64.6	90.2
N25	Seat height sitting shoulder	56.8	61	67.3	54.3	83
N312	Seat height to seated elbow to 90	22	26.3	29.5	19.2	39
N856	Sitting thigh-high	13.1	16	19.4	12	21.5
N914	Seat height to the middle finger sitting	119	132	142.4	113.4	150
N912	Height to the center of the cuff arms up	110	121.8	131.9	103.3	140.5
N2FGM	Height of sitting down	121	130	138.9	115.4	143.4
N4FGM	Seat height from floor to sit	37.6	41.6	46	36	47.2
N200	Back of the knee to the back of chair	40.5	45.3	51	39.1	56.7
N194	Length from knee to back of chair	53	59	65.5	48.4	72.3
N678	Height from floor to knee back	36.7	42.1	46	33.5	50.9
N529	Height from floor to knee	48.5	54.5	59.9	30.4	65.5
N381	Length from elbow to middle finger	42	47	51.4	40	54
N507	Back Width arms outstretched in front	37	42	47.1	32.7	49.9
N459	Seated hip width	35.5	39.1	46.5	29	56.4
N859	Width thighs with knees together	29.8	33.6	42.1	26.1	52.6
N775	Leg length	22.9	25.9	28.4	21.6	30.4
N777	Foot width	8.5	9.8	11	8	12
N776	High instep	6	8	10	5	12.3

Table 8 Results of analysis of measures for Caborca not native people.

Code	Name of the measure	Percentile			MIN	MAX
		5%	50%	95%		
N920	Weight	50.3	68.0	89.7	46.0	105.0
N805	Stature	154.2	171.7	180.2	150.6	184.2
N328	Standing eye height to	144.3	161.0	170.8	143.0	175.0
N23	Standing shoulder height	128.6	144.2	152.5	128.1	155.0
N309	The standing elbow height	97.3	111.5	114.5	97.0	117.0
N949	Standing waist height	92.6	101.8	111.5	92.4	114.0
N398	Height standing gluteus	66.9	73.1	83.2	61.5	84.0
N973	Standing tall on the wrist	75.0	84.7	89.2	73.0	90.0
N265	Standing height to the middle finger	58.1	65.4	70.6	58.0	71.0
N797	Width arms outstretched	153.7	174.3	186.2	152.0	187.0
N798	Width at center chest elbows	77.0	91.3	94.7	74.3	95.0
N80	Arm length from the wall	76.0	92.7	116.2	73.3	117.0
N752	Distance from wall to the center of the fist	66.2	78.3	105.3	63.1	107.0
N122	Standing shoulder width	37.5	43.8	48.3	35.7	49.8
N223	Standing chest width	27.0	29.9	35.2	26.6	36.4
N457	Standing Hip Width	31.8	35.6	37.2	30.5	38.1
N639	Standing neck circumference	31.9	36.5	39.8	31.0	44.0
N230	Standing chest circumference	86.6	95.0	113.6	84.0	117.0
N931	Waist circumference stands	73.8	85.2	109.1	70.0	115.2
N178	Standing hip circumference	94.4	101.8	112.9	91.0	117.8

N430	Head circumference	53.9	56.0	57.7	53.5	59.0
N144	Distance from ear to ear on the head	33.9	36.0	39.2	33.5	40.0
N165	Face width to the height of the pins	12.4	14.3	15.2	12.3	15.9
N427	Head width	14.2	15.7	16.6	14.0	17.3
N595	Height of the chin to the top of head	19.9	23.0	25.0	19.4	25.3
N441	Head length	17.3	18.2	19.1	17.0	19.2
N420	Length of hand	16.5	18.1	20.0	16.3	20.1
N656	Length of the palm	9.4	10.5	12.7	9.4	19.2
N411	Width of palm	7.4	8.5	9.3	7.3	9.3
N402	Grip diameter	4.1	4.9	5.6	3.9	6.4
N758	Seat height sitting at the head	82.0	89.0	92.7	79.0	95.2
N330	Seat height sitting in the eye	72.7	78.5	82.1	69.0	82.6
N25	Seat height sitting shoulder	57.3	61.7	68.6	53.5	83.0
N312	Seat height to seated elbow to 90	22.2	25.5	28.7	22.0	29.6
N856	Sitting thigh-high	14.2	16.2	18.3	13.7	19.8
N914	Seat height to the middle finger sitting	119.5	132.6	141.0	116.6	146.5
N912	Height to the center of the cuff arms up	112.9	122.8	130.1	107.8	136.3
N2FGM	Height of sitting down	120.5	130.0	137.7	117.5	141.4
N4FGM	Seat height from floor to sit	37.1	41.0	45.3	36.5	45.3
N200	Back of the knee to the back of chair	41.9	46.1	49.0	41.0	49.2
N194	Length from knee to back of chair	54.3	60.9	63.2	52.5	64.0
N678	Height from floor to knee back	36.9	41.9	45.0	36.6	45.0
N529	Height from floor to knee	47.3	54.2	58.2	47.0	58.5
N381	Length from elbow to middle finger	41.5	46.5	49.7	40.7	50.6
N507	Back Width arms outstretched in front	36.9	42.9	45.1	36.1	45.3
N459	Seated hip width	36.9	38.2	45.2	36.6	46.2
N859	Width thighs with knees together	30.9	33.6	37.9	30.0	42.8
N775	Leg length	22.5	25.7	28.0	21.8	28.3
N777	Foot width	8.4	9.8	10.7	8.3	11.0
N776	High instep	6.9	8.1	9.4	6.3	9.9

4. CONCLUSIONS AND RECOMMENDATIONS

Working conditions are an important issue, so it should be taken into account when designing a workspace, thereby, the worker will feel more comfortable and secure and will result in higher productivity, lower absenteeism, fewer accidents, lower turnover, etc. To achieve this it is necessary to design each station or place of work according to the needs of the population that will occupy this space, this implies knowing the dimensions of the population, if not known, it can hardly meet the target, however when known, can have an assurance that the highest percentage of people who use the work area, will have no problems in terms of size and awkward postures.

By creating a product would be recommended to be used without problem by the largest number of users. The reality is that many products do not have the ability to adapt to 100% of users. For this you can follow two paths, the first would make products of various sizes in such a way that takes the opportunity to choose the one that best suits the needs of the user, the other would be to create products that are adjustable over a range measures, making it necessary to know the cost-benefits so that decision making is correct. The selection of some of the alternatives mentioned above would be facilitated if known anthropometric dimensions of the population that is expected to address. From the above highlights the importance of the results of this research.

From this research were obtained anthropometric records or letters of the working population of the city of Caborca, Sonora, Mexico, in the age ranges from 18 to 20, 21 to 23 and 24 to 27 years, and the letter Anthropometric women and men, those from Caborca and not originating in Caborca. These letters reflect the measures of the population having an age range from 18 to 27 years, within which 71% are men and 29% are women, 91% are from Caborca and 9% do not originate in Caborca.

It is hoped that this research is another step towards the creation of anthropometric letters of the Mexican population, as currently there are very few records are.

At the end of the investigation we can see the importance of the study of ergonomics and especially one of its branches which is the anthropometry, which is responsible for examining each of the different measures that make up the human body. Knowing these measures can be designed with a higher degree of reliability workstations, tools and equipment, safety equipment, clothing, etc. so we can give each user a more convenient and comfortable life.

The recommendations can be made once this investigation is that it would be very interesting and important to continue to obtain anthropometric records of the total Mexican population, in order to develop equipment, workstations, tools and equipment as well as everything that needs dimensions of people, especially for the Mexican people and not have to take the actions of other countries and make adjustments later.

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