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ERGONOMIC REQUIREMENTS FOR DESIGNING A LAPTOP COMPUTER -ANTHROPOMETRIC STUDY ON ALGERIANS STUDENTS IN TEACHING HALLS AT THE FACULTY OF HUMANITIES AND SOCIAL SCIENCES AT MOHAMED BOUDIAF UNIVERSITY IN M'SILA, AGED BETWEEN 18 AND 26 YEARS-

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Abstract:
This study aimed to identify the appropriate ergonomic standard by indicating the necessary anthropometric criteria in designing a workstation for laptop computer usage. To uncover the current standard, the researcher conducted a study on a sample consisting of twenty (**20**) university students, both male and female, in teaching halls from the Faculty of Humanities and Social Sciences at Mohamed Boudiaf University - M'sila, aged between 18 and 26 years. To achieve this, the researcher utilized an Anthropometric Measurements Registration Form to measure the level of body dimensions, which included the following physical variables:
This research investigates the ergonomic design of physical dimensions essential for furniture design, focusing on anthropometric measurements. Utilizing the Rosscraft Anthropometer, various body dimensions including sitting height, eye height, hand height, shoulder height, thigh length, leg width, elbow height, arm reach, arm length, trunk height from sitting, elbow length, forearm length, hand grip length, hand grip width, posterior height of the 7th vertebra, shoulder width, and chest depth were measured.
A Rosecraft anthropometer was used to measure physical variables.
The study reveals that the physical dimensions should be designed based on a greater percentage of the 95th percentile and a smaller percentage of the 5th percentile. Furthermore, it emphasizes the principle of symmetry between physical and bodily dimensions. This research contributes to enhancing ergonomic design practices in furniture design.

Keywords: Design, Ergonomics, Ergonomic Design, Anthropometry, Anthropometry in Design.

INTRODUCTION:

The laptop computer is considered one of the specialized electronic industrial products designed specifically to serve as a portable and processing system for a vast amount of information required by users, particularly researchers and university students, in various research tasks. Furthermore, it has witnessed a fundamental growth in usage following the advent of the internet around the mid-1990s. (Markey, 2007, p 1071).

This led to a significant increase in the number of laptops per individual, resulting in a global trend towards multiple computers per household. According to a report by Canalys Research, in the last quarter of 2021, the percentage of sales of computers, including desktop, laptop, and workstations, increased by 1% to 92 million units in the last quarter for the second year in a row, compared to 91 million units in 2020.
(https://www.canalys.com/newsroom/global-pc-market-Q4-2021)
This trend reflects a paradigm shift towards each family having one or more computers worldwide.

Currently, the nature of academic research tasks performed by university students using laptop computers has imposed prolonged periods of use. This is considered a manifestation of both static and dynamic motor performance aspects. The dynamic nature of this movement is evident in the interaction with the physical dimensions of the laptop computer. Regardless of the nature of these movements in their various interactions, they are also influenced by the nature of the physical dimension design. The assumed sitting position may limit the (student's) mobility capabilities, thereby affecting their natural and healthy posture due to the complexity of its design or usage. Considering that adapting the nature of laptops according to ergonomic considerations in their design is essential to ensure user health and safety, anthropometric data is considered one of the most important determinants in redesigning them. They should be designed to align with the structural and motor characteristics of students, allowing them to adopt comfortable and natural postures for interacting with them easily. This ensures that users do not suffer long-term negative effects that may even impact overall performance and health of anatomical body parts. Given the importance of the subject, this research focuses on highlighting the suitable anthropometric ergonomic standard. This includes designing the physical dimensions of the computer workstation screen or finding specific supportive means, as well as future design standards that enable students to optimally use laptop computers.

Problem Statement (problematic): Despite the entry of human engineering (ergonomics) into the field of industrial product design over (61) years ago, and its international recognition in building products and electronic computer systems, each with its own nature, the usage of various engineering standards in evaluating the design performance of electronic display interfaces, such as laptops and information display devices, has increased. The relationship of all these standards with the health variables of laptop users, their comfort, safety, and improvement of performance quality is deemed necessary and imperative to be embodied. However, within the limits of the review, it appears that the situation with laptop users is completely different from the actual component of laptop usage and also different from the physical attributes data relevant to its design. At the local level, particularly among university students, a large aspect of the reasons for failure associated with both its use and design is attributed to the lack of substitution of physical attribute data for the relevant students and their body dimensions, both in stability and movement.

This relates to the challenges faced by university students in every moment of interaction in their daily lives during the execution of their research work, either at the university or outside, with laptops designed for general use that may not be suitable for direct use by research students, either because they need to adopt suitable positions or because their design inherently requires a substitution of physical and mechanical attribute data in an enhanced manner. Another aspect of the reasons for failure in the design for university students is attributed to the lack today of an entity responsible for design with engineering standards supporting muscular changes when using laptops, such as a decrease in body muscle content. This caused by different postures and weak muscular coordination and back bends with the disappearance of lumbar vertebrae and all that falls under anthropometric and mechanical data of body parts during usage and its associated pains, excessive energy consumption, and impairment in the user's physical activity, which also has implications such as poor time management for completing assigned research tasks, making this group vulnerable to cumulative trauma disorders (Cumulative Trauma Disorders) such as shoulder, wrist, neck pains, etc. Additionally, there are a variety of health problems affecting students during their research tasks on laptops, with a large number of them suffering from back injuries at some stage of their academic life due to their need to adopt difficult and unhealthy positions. Based on this glaring deficiency in the standards investigating the design, it is primarily incumbent to recognize the needs of user students while providing appropriate supports to reduce the burden of their movements and activities during their laptop usage. This has encouraged research into the appropriate anthropometric ergonomic standard for designing laptop workstations according to a User-Centered design methodology that focuses on modern design theories aimed at improving the design of ergonomic computers. Among the observations of some problems associated with the complexity of laptop usage in the university campus space, we provide the following clarifications:

- Localized muscle stress in the arm due to prolonged grip periods by the user, in the absence of a design indicating the appropriate posture that considers comfortable angles for arm movement and the optimal shape and size for usage placement during handling.
- The user's frequent need to adopt unstable head and neck positions to avoid other complications caused by prolonged stable postures.
- The user's non-acceptance of the current design both morally and emotionally due to its weight, in the absence of a design reflecting user emotion (the user-emotion design). This is accompanied by the almost complete absence of supportive aids to adopt a healthy and proper sitting posture and movements that take a long time to perform.
- As well as the fine observations made by the researcher that there are no appropriate supports to adopt the proper posture in a way that ensures placing the laptop in its correct position through its physical dimensions compatible with the user's sitting position. Therefore, in this research, we aim to find the appropriate ergonomic (anthropometric) standard in designing a healthy posture plan and suitable supports in designing a healthy posture plan that allows direct use by students. This falls under ergonomic studies and applications characterized by comprehensive coverage in finding solutions to problems related to the complexity of designing some electronic devices such as computers, to achieve the

highest levels of usability compatibility and facilitate tasks for university students. From this perspective, the following main question can be posed:
What is the level of selected static anthropometric measurements related to the design of a laptop computer, and the supplementary aids for the research sample of the study?

1. Study Framework:

1. The research topic to be examined and scrutinized is primarily linked to establishing the anthropometric ergonomic standard. In this research, there is a strong desire to contribute by providing a study on the importance of having ergonomic design for the workstation on the laptop computer screen for university students, carrying health-related goals, and improving the quality of their performance during their research tasks. The research will delve into the necessary ergonomic considerations in the ergonomic design for the category of university students, aiming to achieve usability compatibility of the laptop computer and the auxiliary supports for motor compatibility needed by the student throughout their research tasks as specified in this study.

2. Study Objectives and Significance:

There are a number of objective reasons that prompted the researcher to conduct this study, reflecting familiarity and keenness in achieving the following cognitive performance objectives:
- It is expected that through the results of this study, some anthropometric human data related to the design of the laptop computer device and supports for university students aged between 18 and 26 will be provided.
- It is expected that conducting this study will lead to the design of the correct plan for usage positioning, both statically and dynamically necessary in designing the workstation on the laptop computer screen.
- It is expected that this study will provide banks of data on body data related to the design of the workstation on the laptop computer screen from both static and motion perspectives.
- Through the results of this study, it is expected to guide the optimal design of laptop computers aimed at university students, the age group of the current study sample.

4. Procedural definitions of study terms

4-1. Ergonomic Design: It is the process of gathering information related to the ergonomic design of devices, equipment, and tools within the scope of use, selecting the best ergonomic evaluation methods that suit these devices, and ultimately providing continuous feedback to address design problems discovered through the ergonomic evaluation process of design performance. (Najm Abboud, 2012, p 302). The procedural definition involves gathering information about the design of the workstation on the laptop computer screen aimed at university students, the research sample, in line with physiological measurements (both static and dynamic) obtained through anthropometric survey procedures.

4-2. Anthropometry: The term anthropometry originates from Greek, consisting of two parts: anthropos meaning human, and metrien meaning measurement, i.e., measuring the human body. (Quetlet, 1870, p 22). Anthropometry is usually defined as the application of scientific physical methods to humans to evaluate geometric designs and products made to ensure their suitability for users. (Mohamed Sayed, 2004,p 808). The procedural definition involves a set of physical data obtained through bodily measurements using anthropometric dimensions such as height, width, girths, height, depth, span, or reach.

4-3. Anthropometry in Design: Every designer continuously faces the problem of establishing a connection between the dimensions of products and tools they design and the humans who use them. Before the industrial revolution, such problems did not arise as measurements of products were obtained from traditional patterns. The attempts made to adapt them to humans over the centuries through trial and error experiments are numerous. However, contemporary designers do not have such patterns and should not rely on trial and error. Today's designers are required to produce accurate designs from the first attempt. The methods proposed here is the first step towards creating a system that gradually enables us to achieve skill and eliminate traditional methods in the dimensions of a new product we design, whether traditional or non-traditional. In this regard, designers face two main difficulties: firstly, when the product is designed for a single person, the problem lies in determining the best dimensions for the product that suit the user. This cannot be done until there is an agreement on considerations and rules that can determine what is most suitable for the user. (Yasser, 2003, p. 42). The second difficulty arises when the product is designed for a large number of people, making the problem more complex as it involves creating a connection between the dimensions of the product and the different sizes of users' bodies. Here, designers either resort to traditional methods recognized in ergonomics or to more contemporary methods, what we call modern methods.

5. Types of dimensions and anthropometric measurements

5-1. Static Anthropometric Measurements:

Body dimension measurements vary depending on the researcher's interest. Anthropologists aim to describe specific dimensions or aspects of the body structure to study human evolutionary variations. Ergonomists, on the other hand, are concerned with describing the body as a movable framework consisting of a set of organs and partial structures. The former examines the body in fixed and regulated positions where the effects of posture, muscle tone, stimulation, comfort, and clothing influence are minimized. Despite recognizing the importance of standardizing measurements, as acknowledged by anthropologists and their reservations about it, ergonomists attempt to measure and consider the aforementioned variables in designing human and machine frameworks. Methods used to measure static dimensions include those that can be measured using an anthropometer or the traditional self-designed method by (Moran). Techniques involve using iron walls forming intersecting vertical and horizontal planes graded using the small square method, through which the desired dimension is determined. (Mbarki, 2000, p 158).

5-2. Dynamic Kinematic Measurements: These are measurements that describe the body in its moving state. Those interested in dynamic measurements approach this kinetic description of body position from two different perspectives. The first primarily focuses on what is known as the final effect, describing the endpoint of movement or its resulting envelope, such as reach envelope. The second perspective focuses on the basic capabilities of each joint constituting movement and the role of each joint or its contribution to the final movement or its consequences. (Mbarki, 2004, p 82). Common methods for determining and measuring various body parts involve techniques primarily based on measuring different body angles or parts with extreme precision, specifying the joints' centers and the connecting axes between them. Then, the position of each angle in its range of motion is measured, and the relationship of each angle to the other is determined. For example, if we want to analyze the workspace, we can predict the range or reach of the arm if we know the arm's length, the shoulder joint's position, and the range of shoulder joint movements.

5-3. Dynamic Measurement of Body Position in Space:

Both Yob (1972) and Dorliss (1959) summarized the practical problems of recording and dynamically measuring human movement due to the nature of human body movement that cannot be standardized in practical life. Any precise scientific research requires standardizing any situation, clearly distinguishing between imposed judgments and self-judgments. The most important element of objective judgment is standardization, which includes method, measurement, and measurement tools. Researchers in the field of motion recording and measurement have attempted to use various systems and methods to control body movement, including mechanical, pneumatic, optical, electrical, and auditory systems. (Mbarki, 2000, p 161).

6. Previous Studies:

6-1. Studies on Anthropometry:

Some analytical presentations of body dimensions indicate that attention to the relationship between the science of body dimension measurement and worker productivity was not emphasized until World War II, when interest began to focus on the role of physical requirements in designing control tools and sitting positions. After World War II, interest in the concept of machine adaptation to humans developed, with both commercial and military interests continuing to study body dimensions and work requirements. For example, "Houten" (1945) conducted an anthropometric survey involving 3867 men and women at train stations in Boston and Chicago to obtain body dimensions during sitting positions for use in designing workstations on desktop computers. Similar studies continued on desktop and laptop computers at the Harvard School of Public Health in the late 1940s to improve the use of various modern computer devices. For example, evaluations were conducted from an ergonomic perspective involving about 300 students to find the relationship between different measurements and the internal dimensions of the seating station, focusing on posture while sitting, eye level, arm reach, and leg length during sitting. These measurements were conducted by "Daman, Stodt, and McFarland" (1966) as well as by Daman and McFarland (1955). (Mbarki,1987, p 24)

6-2. Ergonomic Studies on Laptops:

Regarding ergonomic studies on laptops, the researcher found some studies that focused on studying the health effects of using laptops, and the following is a brief overview of the most important of these studies.

The first study: A study conducted by the Institute of Occupational Safety and Health Research in Osaka, Japan, in the mid-1980s included 3418 workers, 66 of who were involved in various projects. Among them, 54% worked more than 4 hours a day on the computer. The study found that these workers suffered more from eye strain and myopia than their colleagues. The study concluded the need for attention to monitor, screen-worker distance, regular examination of workers' eyes, hands, and arms.

The second study: A study conducted by a team at the Swiss Credit Bank included 800 computer workers. The study showed both positive and negative aspects of computer use. The positive aspects included introducing modern work methods, stimulating interest, and increasing skills. The negative aspects included boredom, headache, sleep disturbances (28%), musculoskeletal problems (22%), eye strain (31%), back, shoulder, and neck pain (20%).

The third study: A study conducted by the Optometry College at New York University included 7757 computer workers. The study aimed to identify the visual problems and effects of computer use. The study found a correlation between working on the computer and visual problems. Ninety-one percent of workers reported eye strain, 79% had visual inflammation, 61% experienced headaches, and 59% complained of back pain. The study also found that these symptoms were strongly and inversely correlated with the time spent working on the computer, stronger than their correlation with the type of tasks performed.

The fourth study: A study conducted by Najm Aboud Najm on the effects and symptoms resulting from computer use. This study revealed many negative symptoms experienced by computer workers, distributed among the eyes, back, legs, headache, mood swings, and muscle pain.
The conclusions of this study are as follows:
1- He laptop is considered an additional means of directing and controlling production and administrative work processes.
2- The computer, as one of the applications of modern technology, has contributed to improving work quality, speed, efficiency, and productivity, but on the other hand, it has had its problems and negative effects on its users. This is due to the inappropriate design of work systems and human characteristics and anthropometric dimensions.
3- The basic components of a computer workstation include computer components such as the monitor, keyboard, document holder, and mouse, as well as work furniture such as the work chair and desk, and physical work conditions such as lighting, temperature, and ventilation. These factors had negative effects when not suitable for users.
4- The study showed that working on the computer for a long period is associated with negative health symptoms, including back pain, eye strain, redness and tearing of the eyes, muscle pain, and sleep disturbances.
5- There is a need to consider standards related to human engineering requirements (in addition to other standards) when purchasing computers to ensure a greater degree of adaptation and suitability of these devices, their furniture, and the conditions of use according to the characteristics of the users and the environment.
6- Workers and their workplaces need to be subject to occupational safety instructions specific to working on computers. It is appropriate for these instructions to cover areas that have been introduced into legislation and collective agreements in many countries, including:
- Determining the maximum computer use in the workday and using rest breaks for workers.
- Some guidelines for working conditions such as lighting, temperature, and ventilation.
-Providing consultations for computer workers for health and technical tests, which should be made available to workers who can benefit from them when needed.
7- Computer workers should undergo regular health tests, including visual tests, back and muscle pain, headaches, which are the most common symptoms.
8- Authorities responsible for these units should work on promoting research and studies to increase awareness of their effects and provide resources on them. (Najm Aboud, 2000, pp. 374-380).

7. Methodology and Field Procedures of the Study:
7-1. Spatial and Temporal Scope of the Study: The study was conducted in teaching halls at the Faculty of Social and Human Sciences at Mohamed Boudiaf University, M'sila.
The study was carried out during the period from 11 Mai to Mai 20th of the academic year 2024
7-2. Study Population: The study population consisted of university students aged between 18 and 26 years old.
7-3. Sample of the Study: The study was conducted on a random sample consisting of 20 individuals, distributed evenly between males and females. There were 6 male students and 14 female students, distributed across three departments: Social Sciences, Humanities, and Sports, spanning all study levels from the first year to the third year.
The following Table (02) illustrates the specifications of the study sample:

Table 02: Specifications of the Study Sample

Department	Males	Females	Undergraduate	Master's	Doctorate
Social Sciences	2	6	1	5	2
Humanities	2	4	2	4	0
Sports	2	4	1	5	0
Total	6	14	4	14	2

8- STUDY METHODOLOGY:

Given that the nature of the current study requires describing the body dimensions and kinematic mechanism of the participants as they are in reality, along with the necessity of inferring two standards based on the selected biometric measurements, the researcher employed the descriptive-analytical and inferential methodologies. This choice was made due to its suitability and the nature of the current study.

9- Mean and its Formula:
The mean (M) is calculated by dividing the sum of all scores (ΣX) by the number of samples (n), where M represents the mean.

Standard Deviation and its Formula:

The standard deviation (σ) is calculated as the square root of the variance (σ^2), where σ represents the standard deviation and σ^2 represents the variance.

Variance and its Formula:

The variance (σ^2) is calculated as the difference between the mean of the squared values (ΣX^2) and the squared mean (M^2), divided by the number of data points (n - 1), where σ^2 represents the variance, ΣX represents the data points, and n represents the number of data points.

Percentiles:

- 05th percentile ($M05$) = Mean - (Standard Deviation × 1.64). It signifies the logical basis for comfort.
- 50th percentile ($M50$) = Mean. It signifies the logical basis for plotting motion profiles and completing arithmetic operations.
- 95th percentile ($M95$) = Mean + (Standard Deviation × 1.64). It signifies the logical basis for safety and security.

10- Identification of Anthropometric Measurements:

Before identifying the bodily variables for the measurements used, a thorough review of scientific sources and previous studies addressing anthropometric measurements and specifications was conducted. These include works by Khattaroubek (1980), El-Ishi (1976), Morad (1976), Kamal (1984), Mbarki Bouhafs, and Davis (1990) on "Anthropometric Measurements of Algerian Women", Ferreira and Hboubi (1991) on "Anthropometric Measurements of Brazilian Men", Shakir Bhatti (1997) on "Anthropometric Measurements of Women and Men in India", Kagimoto (1990) on "Anthropometric Measurements of Men in Japan", Maras and Kim (1993) on "Anthropometric Measurements of Short Stature Men in the United States", Wael Mohammed Jalil on "Design Standards of Metal Supplements for the Elderly", and a study from the Center for Ergonomics at the University of Michigan (2003) titled "Anthropometric Measurements", among others.

Following this, the researcher selected bodily measurements relevant to the design of a workstation for laptop computers. Additionally, the researcher examined the current design and usage method of the laptop device on campus to determine the relationship between physical dimensions and bodily dimensions. Considering the complexity of usage positions and the research objectives, the researcher was able to select bodily measurement variables relevant to ergonomic design.

These measurements were finalized into seventeen (17) variables distributed across sitting posture measurement methods. Below are the most important bodily measurements identified according to their names, measurement methods, purposes of use, and measurement tools, following anthropometric survey methodology:

11-Anthropometric Measurements in Sitting Position:

1- **Setting Height:** Measurement of the vertical distance between the top of the head and the level of the chair seat, with the individual positioned upright and facing forward, hands resting on the thighs, and legs maintained at a right angle.

- The purpose of the 95th percentile value for the setting height variable in our current study is to determine the level of the laptop screen center for achieving a healthy sitting posture.

2- **Eye Height:** Measurement of the vertical distance between the level of the chair seat and the inner corner of the eye, with the individual seated upright and facing forward.

- The purpose of the 95th percentile value for the eye height variable in our current study is to establish a position that provides the best internal visual field for the seating location, neck, and overall neck position, in addition to determining the minimum and horizontal heights for healthy horizontal vision.

3- **Hand Height:** Measurement of the vertical distance from the level of the chair seat to the midpoint of the hand grip, with the individual seated in a natural position and the hand extended forward.

- The purpose of the 95th percentile for hand height in our research is to design and determine the physical dimension of intermediary supports to adjust the height level of the computer screen surface while using it on a specific desktop surface.

4- **Shoulder Height:** Measurement of the vertical distance between the chair seat surface and the highest point on the side edge of the shoulder, with the individual seated upright and looking directly forward.

- The purpose of the 95th percentile for shoulder height in our research is to design the minimum height level for the monitor screen from the desktop surface to the beginning of the monitor screen height.

5- **Thigh Length:** Measurement of the horizontal distance from the furthest protrusion on the buttocks to the edge of the tibial tuberosity (knee cap), with the individual seated on the chair seat.

- The purpose of the 95th percentile for thigh length in our research is to design the 6- length level of the seating material on the chair to maintain a right-angle knee flexion.

6- **Knee Breadth:** Measurement of the horizontal distance between the outermost point of each knee joint.

- The purpose of the 95th percentile for knee breadth in our research is to design the physical dimension of the seating material width on the chair.

7- **Thigh Height:** Measurement of the vertical distance between the chair seat surface and the highest point on the upper side of the thighs, with the individual seated without forming a right angle or any bend at the knee level.

- The purpose of the 5th percentile value for thigh height in our research is to design and determine the vertical distance between the desk surface and the chair (the gap between the chair seat and the desk) corresponding to the body height of the thighs and to design the physical dimension for the height gap between the chair and the computer desk surface.

8- **Arm Reach:** Measurement of the final impact of both horizontal and vertical distances from the shoulder axis to the farthest point in the hand, with a firm grip closure, with the individual seated in a natural sitting position on the chair.

- The purpose of the 5th percentile for arm reach in our research is to designate the positions of control tools on the desktop in a sitting position and to determine the maximum range that the hand can reach for the laptop. Also, it aims to determine the maximum reaches for closing the laptop.

9- **Hand Length:** Measurement of the horizontal distance from the shoulder axis to the midpoint of the hand grip, with the individual seated on the chair while keeping the thighs together.

- The educational purpose of the 95th percentile value for hand length in our research is to design a place for object handling, to reach all keyboard buttons and control tools like the mouse, and for future design standards of computer screens characterized by pressure use without mouse clicks.

10- **Trunk (Suprasternale) Height Sitting**: Measurement of the vertical distance from the chair seat surface to the prominence of the costal margin with the elbows placed beside the trunk, forming a right angle with the forearm, with the individual seated on the chair.

- The educational purpose of the 95th percentile value for trunk height in our research is to design the maximum height for the desk surface and to determine and limit the maximum height level of the backrest lining position corresponding to the edge of the spinal column region.

11- Elbow Height: Measurement of the vertical distance from the chair seat surface to the lower humeral prominence of the olecranon process. The individual is positioned with elbows forming a right angle without stiffness or excessive tension, and with the elbows touching the side of the trunk. The measurement is taken in a natural sitting position on the chair.

- The educational purpose of the 5th percentile value for elbow height in our research is to determine the level of the chair armrest height.

12- Right Forearm Length: Measurement of the vertical distance between the lower humeral prominences of the olecranon process to the ulnar styloid process. The individual's arm is extended inward in a natural sitting position on the chair.

- The educational purpose of the 95th percentile value for right forearm length in the current study is related to securing the chair position inward and outward to obtain a right angle for elbow flexion.

13- Hand Length: Measurement of the vertical distance from the styloid process of the thumb to the end of the metacarpal bones. The individual's hand is placed flat on a surface.

- The educational purpose of the 95th percentile value for hand length in the current study is associated with designing the physical dimension for the length of the concerned mouse for use and for future design standards of such control tools.

14- Hand Breadth: Measurement of the horizontal distance from the midpoint of the fold line of the palm base at the prominence of the styloid process of the thumb to the end point of the prominence of the styloid process of the pinky.

- The purpose of the 5th percentile value for hand breadth in our research is to design the physical dimension for the width of the mouse or control device located on the keyboard of the laptop.

15- Cervical Height (C7 Level Height): Measurement of the vertical distance from the prominence point of the cervical vertebra to the seventh vertebra (C7) of the spine.

- The educational purpose of the 95th percentile value for cervical height is primarily related to designing the level of the physical dimension for the height of the backrest lining position.

16- Shoulders Breadth: Measurement of the horizontal distance from the lateral side of the outer muscle bulk of the clavicle bone to the same area on the opposite side of the other arm. The individual is positioned in a natural sitting position on the chair.

- The educational purpose of the 95th percentile value for shoulder breadth is related to limiting the physical dimension value for the width of the work layout horizontally on the laptop screen.

17- Chest Depth: Measurement of the internal horizontal distance from the level of the nipple to the uppermost area on the back for males, and from the level of the nipple for females to the uppermost area on the back. The measurement is taken in a natural sitting position on the chair without inhaling.

- The purpose of the 95th percentile value for chest depth is to determine the internal space between the seating position and the display screen.

Measurement Tool: The tool used for data collection in the study is as follows: Rosscraft Centurion Kit Anthropometer: This tool is used for collecting body measurements in the study sample. It consists of:
Eight (08) main metal-plastic pieces, which are:
-A metric tape measure (1060 millimeters long) in the shape of the letter "F" for measuring longitudinal dimensions.
-Three flexible metric tapes for measuring circumferences.
-A ruler with two iron rods fixed on it by screws. These rods are used to measure the width and depth of the larger body parts.
-Another similar ruler in a smaller size for measuring smaller body parts.
-Another plastic piece for measuring leg thickness and fat in fatty areas of the body such as the abdomen and leg.
-Another iron piece specifically for measuring head dimensions.
-Below is the image illustrating the tool used in the study:

Image (01) illustrates the Rosscraft Centurion Kit Anthropometer.

The choice of this type over:
The purpose of choosing this type over other measurement devices such as (Harpenden.Anthropomet) lies in its distinctive features, which include the following characteristics
This type of anthropometric measurement device is specialized in measuring body dimensions. It stands out from other measurement devices such as the tape measure due to its ease of use in terms of readability and the ability to note changes. Moreover, it offers extreme precision in determining the outcome of measuring body dimensions, in addition to allowing the user to monitor the correct measuring position.

12. Presentation and Interpretation of Results:
In this study, anthropometric measurements were conducted to discover suitable body dimensions, considering the relative importance of key anthropometric landmarks in designing and outlining the workstation on a computer screen, with the aim of determining and delineating the physical dimensions of specific media for the ergonomic compatibility of the laptop computer. This was done based on the question posed, which is: What is the level of static anthropometric measurements selected related to the design of the laptop computer and the supplementary metal accessories for the study sample?
Below is a detailed explanation of achieving anthropometric standards for designing the workstation on the laptop computer screen and its various purposes.

1. Seated Height (n=20 individuals):

Gender	Mean	Standard Deviation	5th Percentile	50th Percentile	95th Percentile
Male	871	56.63	1335.56	871	1521.31
Female	827	27.28	1311.54	827	1401.01

To design the physical dimension of the computer screen height, we use the relative importance of the 95th percentile value. Therefore, the level of the physical dimension for the computer screen height should be determined according to the value equivalent to 1521.31 millimeters for males and the 95th percentile value equivalent to 1401.01 millimeters for females. For the design that accommodates both genders, we take the common denominator, which in this case is M(95)

= 1461.16 millimeters. This value allows maintaining a natural sitting position and thus avoiding complications such as neck pain. Therefore, the first standard indicator is: (Seated height corresponding to screen height = 1461.16 millimeters).

2. Eye Height (in seated position):

Gender	Mean	Standard Deviation	5th Percentile	50th Percentile	95th Percentile
Male	749.2	36.54	1168.76	749.2	Type your text 1288.61
Female	714	41.85	1102.32	714	1239.59

To achieve a healthy horizontal vision, we use the relative importance of the 95th percentile value for eye height, equivalent to 1288.61 millimeters for males and the 95th percentile value equivalent to 1239.59 millimeters for females. For a design that accommodates both genders, we take the common denominator, which in this case is M(95) = 1264.1 millimeters. This value provides the best range for internal vision of the seating area and the positioning of the neck and neck as a whole. Therefore, the second standard indicator is: (Eye height corresponding to internal vision range = 1264.1 millimeters).

3. Hand height:

Gender	Mean	Standard Deviation	5th Percentile	50th Percentile	95th Percentile
Male	329.2	25.71	497.72	329.2	582.05
Female	321.92	35.68	469.43	321.92	586.46

To design the auxiliary support for computer screen height, we rely on the relative importance of the 95th percentile value, which is equivalent to 582.05 millimeters for males and 586.46 millimeters for females. Therefore, to adjust the level of the computer screen height on a specific desktop surface, we take the common denominator between both genders for the 95th percentile, which is equal to 584.25 millimeters. Hence, the third standard indicator is: (Arm height corresponding to auxiliary support height ≥ M(95) 584.25 millimeters).

4. Shoulder Height (n=20 individuals):

Gender	Mean	Standard Deviation	5th Percentile	50th Percentile	95th Percentile
Male	547.2	31.01	846.55	547.2	948.26
Female	549.46	31.27	849.83	549.46	952.39

To design the minimum level of display screen height from the desk surface to the starting point of the display screen height, we rely on the relative importance of the 95th percentile value, which is equivalent to 948.26 millimeters for males and 952.39 millimeters for females. For a design that accommodates both genders, we take the 95th percentile value common to both, which is equal to 950.32 millimeters. Therefore, determining the minimum level of the physical dimension for the display screen height is associated with the common 95th percentile value between them.
Hence, the fourth standard indicator is: (Shoulder height corresponding to minimum display screen height ≥ M(95)(950.32 millimeters).

5. Thigh Length :

Gender	Mean	Standard Deviation	5th Percentile	50th Percentile	95th Percentile
Male	573	46.55	863.37	573	1016.06
Female	520.69	34.81	796.84	520.69	911.02

To design the level of the seat cushion length on the chair corresponding to thigh length and to maintain a right angle knee bend in the seated position, we rely on the relative importance of the 95th percentile value, which is equivalent to 1016.06 millimeters for males and 911.02 millimeters for females. For a design that accommodates both genders, we take the 95th percentile value common to both, which is equal to 963.54 millimeters.
Hence, the fifth standard indicator is: (Thigh length corresponding to seat cushion length ≥ M(95)(963.54 millimeters).

6. Leg width:

Gender	Mean	Standard Deviation	5th Percentile	50th Percentile	95th Percentile
Male	381	52.61	538.55	381	711.12
Female	273.38	24.49	408.17	273.38	488.50

To design the physical dimension for the width of the seat cushion on the chair corresponding to the width of the thighs, we use the 95th percentile value, which is equivalent to 711.12 millimeters for males and 488.50 millimeters for females. For a design that accommodates both genders, we take the 95th percentile value common to both, which is equal to 599.81 millimeters.
Therefore, the sixth standard indicator is: (Leg width corresponding to seat cushion width ≥ M(95) (599.81 millimeters).

7. Thigh Height :

Gender	Mean	Standard Deviation	5th Percentile	50th Percentile	95th Percentile
Male	142.8	9.36	218.84	142.8	249.54
Female	132.76	14.86	193.35	132.76	242.09

To design the clearance between the desk surface and the body dimension for thigh height, we rely on the relative importance of the 5th percentile value, which is equivalent to 218.84 millimeters for males and 193.35 millimeters for females. For a design that accommodates both genders, we take the 5th percentile value common to both, which is equal to 206.09 millimeters.
Hence, the seventh standard indicator is: (Thigh height corresponding to desk surface clearance ≥ P(05) (206.09 millimeters).

8. Arm Reach:

Gender	Mean	Standard Deviation	5th Percentile	50th Percentile	95th Percentile
Male	754.6	37.19	1176.55	754.6	1298.3
Female	687.15	37.89	1064.78	687.15	1189.06

To determine the positions of the control tools above the desk surface relative to the arm reach, we rely on the relative importance of the 5th percentile value, which is equivalent to 1176.55 mm for males. For females, the 5th percentile value, equivalent to 1064.78 mm, is considered. For joint design between them, we take the 5th percentile value equivalent to 1120.66 mm. Therefore, the eighth standard indicator (Arm Reach versus Control Tool Positions ≤ 5th percentile (1120.66 mm) .

9. Hand Length:

Gender	Mean	Standard Deviation	5th Percentile	50th Percentile	95th Percentile
Male	644.2	38.54	993.28	644.2	1119.69
Female	592.92	30.96	921.61	592.92	1023.16

To design a place for object handling and to determine future design standards such as hand touch, for example, relative to hand length, we rely on the relative importance of the 95th percentile value, which is equivalent to 1119.69 mm for males. For females, the 95th percentile value, equivalent to 1023.16 mm, is considered. For joint design between them, we take the 95th percentile value equivalent to 1071.42 mm. Therefore, the ninth standard indicator (Future design standards versus hand length ≥ 95th percentile (1071.42 mm).

10. Elbow Height :

Gender	Mean	Standard Deviation	5th Percentile	50th Percentile	95th Percentile
Male	207.4	17.70	311.10	207.4	369.16
Female	218.46	23.76	319.30	218.46	397.24

To design the level of chair armrest height relative to elbow height, we rely on the relative importance of the 5th percentile value, which is equivalent to 311.10 mm for males. For females, the 5th percentile value, equivalent to 319.30 mm, is considered. For joint design between them, we take the 5th percentile value equivalent to 315.2 mm. Therefore, the 10th standard indicator (Elbow height versus chair armrest height ≥ 5th percentile (315.2 mm) .

11. Trunk Height from Seated Position:

Gender	Mean	Standard Deviation	5th Percentile	50th Percentile	95th Percentile
Male	188.6	12.13	289.41	188.6	329.19
Female	201.92	25.64	289.09	201.92	373.19

To design the maximum position for the rear liner corresponding to the edge of the spinal area, relative to trunk height, we rely on the relative importance of the 95th percentile value, which is equivalent to 329.19 mm for males. For females, the 95th percentile value, equivalent to 373.19 mm, is considered. For joint design between them, we take the 95th percentile value equivalent to 351.19 mm. Therefore, the 11th standard indicator (Trunk height versus rear liner position ≥ 95th percentile (351.19 mm).

12. Arm Length:

Gender	Mean	Standard Deviation	5th Percentile	50th Percentile	95th Percentile
Male	283.2	14.51	440.65	283.2	488.24
Female	254.69	12.15	397.76	254.69	437.61

To secure the positioning of the chair inwards and outwards and to obtain a perpendicular angle for elbow flexion relative to arm length, we rely on the relative importance of the 95th percentile value, which is equivalent to 488.24 mm for males. For females, the 95th percentile value, equivalent to 437.61 mm, is considered. For joint design between the sexes, we take the 95th percentile value equivalent to 462.92 mm. Therefore, the 12th standard indicator (Arm length versus positioning of the chair inwards and outwards ≥ 95th percentile (462.92 mm) .

13. Height of the Backrest for Vertebra C 07:

Gender	Mean	Standard Deviation	5th Percentile	50th Percentile	95th Percentile
Male	609.4	28.005	953.48	609.4	1045.34
Female	632.92	73.52	917.41	632.92	1158.56

To design the height of the backrest for the head position relative to the height of the back for vertebra 07, we rely on the relative importance of the 95th percentile value, which is equivalent to 1045.34 mm for males. For females, the 95th percentile value, equivalent to 1158.56 mm, is considered. For joint design between them, we take the 95th percentile value equivalent to 1101.95 mm. Therefore, the 13th standard indicator (Height of the back for vertebra 07 versus height of the backrest for head position ≥ 95th percentile (1101.95 mm) .

14. Hand Grip Width:

Gender	Mean	Standard Deviation	5th Percentile	50th Percentile	95th Percentile
Male	88.6	6.73	134.26	88.6	156.34
Female	79.69	3.06	125.67	79.69	135.71

To design the physical dimension for the width of the mouse or control device on the keyboard relative to the hand grip width, we rely on the relative importance of the 5th percentile value, which is equivalent to 134.26 mm for males. For females, the 95th percentile value, equivalent to 125.67 mm, is considered. For joint design between them, we take the 95th percentile value equivalent to 129.96 mm. Therefore, the 14th standard indicator (Hand grip width versus mouse or control device width ≤ 5th percentile (129.96 mm) .

15. Hand Grip Length:

Gender	Mean	Standard Deviation	5th Percentile	50th Percentile	95th Percentile
Male	197.4	16.05	297.41	197.4	350.05
Female	183.38	8.51	286.78	183.38	314.69

To design the physical length dimension for the concerned mouse and for future design standards for this type of control device, relative to the hand grip length, we rely on the relative importance of the 95th percentile value, which is equivalent to 350.05 mm for males. For females, the 95th percentile value, equivalent to 314.69 mm, is considered. For joint design between them, we take the 95th percentile value equivalent to 332.37 mm. Therefore, the 15th standard indicator (Hand grip length versus mouse length = 95th percentile (332.37 mm).

16. Shoulder Width:

Gender	Mean	Standard Deviation	5th Percentile	50th Percentile	95th Percentile
Male	300	84.67	353.14	300	630.85
Female	373.07	9.07	569.96	344.53	626.70

To constrain the horizontal layout width on the computer screen relative to the shoulder width, we rely on the relative importance of the 95th percentile value, which is equivalent to 630.85 mm for males. For females, the 95th percentile value, equivalent to 626.70 mm, is considered. For joint design between them, we take the 95th percentile value equivalent to 628.77 mm. Therefore, the 16th standard indicator (Shoulder width versus horizontal layout ≥ 95th percentile (628.77 mm).

17. Chest Depth:

Gender	Mean	Standard Deviation	5th Percentile	50th Percentile	95th Percentile
Male	241	6.36	384.80	241	405.67
Female	234.71	11.80	365.57	234.71	404.27

To determine and confine the internal space between the seating position and the display screen relative to chest depth, we use the relative importance of the 95th percentile value, which is equivalent to 405.67 mm for males. For females, the 95th percentile value, equivalent to 404.27 mm, is considered. For joint design between them, we take the 95th percentile value equivalent to 404.97 mm. Therefore, the 17th standard indicator (Chest depth versus internal space ≥ 95th percentile (404.97 mm) .

RESULTS INTERPRETATION

It is evident from the fixed anthropometric data of the study sample that nthropometric measurements varied between the two genders. The researcher attributes the superiority of males over females in (sitting height, eye height, thigh length, shoulder width, thigh height, arm reach, hand length, forearm length, hand grip length, hand grip width, chest depth) to the anatomical growth rate, where skeletal ossification processes cease and full height is reached in females at the age of 16.5 and in males at the age of 18 and above.
Moreover, the reason can be attributed to the concentration of male hormone "testosterone" in males compared to females. An increase in testosterone is accompanied by an increase in muscle cross-sectional area. As a result of the increase in muscle cross-sectional area, circumferences increase in males compared to females. Previous studies that align with our current study include White et al. (1979) study, which revealed through anthropometric survey results that males outperform females in all body measurements except for the pelvic region. Similarly, the results of this study coincide with those of Don and Comila (1981), where they found in a study on Algerian rural populations that males outperform females in all body measurements except for forearm length, where females outperform males, attributing this to physical activity exerted by males more than females.

CONCLUSION

The ergonomic design of the computer workstation has received significant attention from many experts in the study of human factors due to its positive impact on performance efficiency. One of the areas that have advanced greatly in recent years in human factors engineering is the geometric measurement of body dimensions and the study of the biomechanics of human physiology to develop and design computers suitable for their users.

REFERENCES

1. Mbarki, Bouhafs. (2000). **Human Work,** 1st edition, Dar Al-Maghrib for Publishing and Distribution, University of Oran, Algeria.
2. Bouhafs Mbarki. (2004). **Human Work**, 2nd edition, Dar Al-Maghrib for Publishing and Distribution, University of Oran, Algeria.
3. Muhammad Abdullah ,Radwan. (1990). **The importance of anthropometric measurements in the design of metal furniture,** unpublished master's thesis, Faculty of Applied Sciences, Helwan University, Egypt.
4. Mohamed Sayed Abu Al-Nil. (2004). **Industrial and Organizational Psychology, Arab and International**, Dar Al-Fikr Al-Arabi, Egypt.
5. Najm Abboud Najm. (2000). **Study of Work and Human Engineering,** 1st edition, Dar Safaa for Printing, Publishing and Distribution, Jordan.
6. Yasser Muhammed Al-Sadiq. (2003). **Design standards for metal chairs for computer users,** unpublished master's thesis, Faculty of Applied Arts, Helwan University, Egypt.
7. Bouhafs Mbarki. (1987). **Anthropometric study of Algerian women with special reference to Domestic work,** department of engineering production. University of
8. Birmingham England.
9. Quetlet, Adolphe. (1870). **L'anthropometrie on mesure de différentes facultés de l'homme**, Bruxelles: C. Muquardt.

10. Markey, Karen. **Twenty- five years of end- user searching**, part: 2, future research directions. Jasis, 58 (8): 1123-1130 (2007).
11. https://www.canalys.com/newsroom/global-pc-market-Q4-2021.