Anthropometric dimensions of sickle handle among Algerian farmers

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RASS. Pensées Genre. Penser Autrement. VOL 4, No 5 (Novembre 2024)

Abstract

This study aims to identify the extent to which the anthropometric measurements of agricultural workers are compatible with the handle of the sickle, We used a descriptive exploratory approach and relied on Vernier calipers to measure the dimensions of hand grip and the dimensions of the sickle handle, The study concluded that the anthropometric measurements of agricultural workers do not align with the sickle handle, The following modifications were proposed: a sickle diameter of (3,95 cm) and a handle length of (9,47 cm),

Key words: Anthropometric, farm workers, Sickle.

Dimensions anthropométriques du manche de faucille chez les agriculteurs algériens

Résumé

Cette étude vise à identifier dans quelle mesure les mesures anthropométriques des travailleurs agricoles sont compatibles avec le manche de la faucille, Nous avons utilisé une approche descriptive exploratoire et avons utilisé des pieds à coulisse pour mesurer les dimensions de la prise de main et les dimensions du manche de la faucille, L'étude a conclu que les mesures anthropométriques des travailleurs agricoles ne s'alignent pas avec le manche de la faucille, Les modifications suivantes ont été proposées : un diamètre de faucille de (3,95 cm) et une longueur de manche de (9,47 cm),

Mots-clés: Anthropométrique, travailleurs agricoles, faucille**.**

Introduction

Agricultural labor is a crucial part of the agricultural sector, and Algeria heavily relies on it, though it is influenced by general policies. The highest percentage of agricultural labor is concentrated in the coastal and steppe regions at 32.24%, followed by the highland areas at 29.16%. The mountainous regions account for 21.38%, while the southern areas have a rate of 17.21%. This concentration of agricultural labor in the northern regions aligns with the significant agricultural activity there, despite the establishment of large-scale agricultural projects in the south through various development programs.

In 2005, the number of workers in the agricultural sector was estimated at 2,234,915. This figure fluctuated over the years and reached approximately 2,244,148 workers in 2009. The upward trend continued, with the number rising to 2,528,972 by 2013, a growth attributed to the resources and support provided by development programs (H. Jaber, 2018). However, the agricultural sector faces growing competitive challenges in the coming decades, largely driven by advancements in science and technology (R. William, 1995). Additionally, agriculture is recognized as one of the most hazardous sectors globally, ranking second in terms of injuries, fatalities, and occupational diseases (L. Benos & D. Tsaopoulos &D. Bochtis, 2020).

Agricultural work often involves long hours of standing, bending, and frequent movements in awkward positions, which significantly increase the risk of accidents due to fatigue and improper handling of tools (H. Peter, 2007). Alarmingly, incidents in agriculture are often underreported (P. Lundqvist, 2001). To mitigate these risks, it is crucial to design tools that are tailored to users' needs, as poorly designed workplaces and tools can lead to both psychological discomfort and physical exhaustion (M. Mokdad, 2002). The field of anthropometry, which measures and describes the physical dimensions of the human body (M. M. R. Khadem, Khan & D. Al Farsi & M.A. Islam, 2014), plays a vital role in improving the design of hand tools and equipment to enhance overall efficiency (K. N. Dewangan & C. Owary & R. K. Datta, 2010).

Research has shown that agricultural tools often suffer from poor design, primarily because manufacturing units are typically located in remote areas (K. N. Dewangan & C. Owary & R. K. Datta, 2008). Poorly designed tools can lead to numerous health issues and pose significant risks to human well-being (D.N. Kumbhare & S. Vishal & W. Prashik & A. Altaf & T. Vikas & R. D. Gorle, 2016). Additionally, they contribute to a high rate of injuries among

farmers (M. S. Parvez & M. M. Shahriar, 2018). One commonly used tool, the machete, often forces farmers into awkward working positions, resulting in back pain and joint problems, highlighting the tool's unsuitability for agricultural tasks (P.K. Nag & A. Goswami & S.P. Ashtekar & C.K. Pradhan, 1988).

Wrist pain is a common issue among workers, especially when using poorly designed sickles. These tools can lead to wrist strain, inflammation, and chronic discomfort, as workers often have to exert excessive pressure on their joints to perform their tasks, increasing the risk of injury. Moreover, tools with improper dimensions can cause pain in the shoulders and back. When a tool is uncomfortable or poorly fitted, farmers are forced to exert more effort, which puts extra strain on their shoulders and spine, eventually leading to long-term health issues and reducing their ability to work for extended periods.

Improvements in tool design have shown positive results. For example, after enhancements in machete design that improved usability, the area covered in one hour increased from 99 m²/h to 112 m²/h, reflecting a 13.1% improvement in efficiency (V. V. Aware & P. U. Shahare & N. A. Shirsat, 2016). In the El Oued region, which is known for its abundant palm trees, workers use sickles for harvesting fruit. These sickles are distinct from traditional machetes and better suited to the task at hand.

Based on this, the study aims to examine how well the anthropometric measurements of farm workers match the handle of the sickle used by farmers in the El Oued region of northeastern Algeria .The hypothesis was that the anthropometric measurements of farm workers do not match the handle of the sickle used by farmers in the El Oued region of northeastern Algeria.

1. Methods and materials

1.1. Study group

The study was conducted in the years 2021-2022, It included 241 men, women are not employed in agriculture in this region, due to the nature of traditions and customs, between the ages of 21 and 51 years, and the quota was determined according to age (groups 21-25, 26-35, 36-45, 46-51 years) for workers who spend at least 6 hours in farming, They work on different farms in El Oued, in the northeastern Algerian desert,

Table I, Structure of the respondents by age group (N=241)

Age group (years)	Number of subjects	%
21-25	73	30,30
26-35	88	36,51
36-45	49	20,33
46-51	31	12,86

Source : Prepared by the researchers, (2021)

1.2. Process selection

Farmers in the El Oued area still practice the old methods of harvesting, namely using sickles made by a local blacksmith, Therefore, a traditional machete was selected from the local market for a study,

Table II: Specifications of Sickle

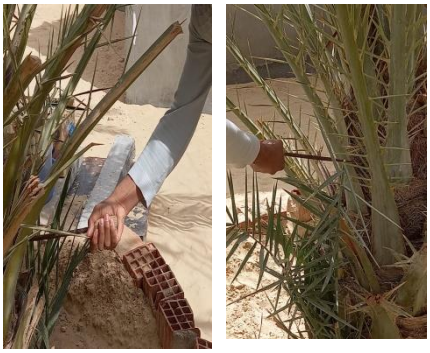
Notation	Definition
A	Handle length
B	Handle diameter

Source : Prepared by the researchers, (2021)

Figure 1 : Dimensions of sickle handle

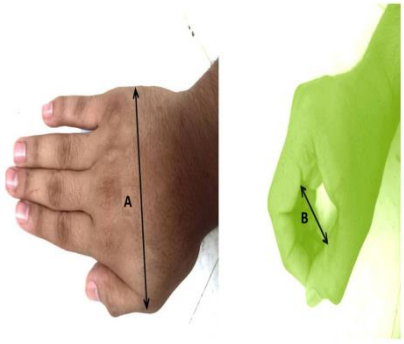
Source : Prepared by the researchers (2021)

Figure 2: Scythe positions



Source : Prepared by the researchers, (2021)

Figure 3 : Dimensions of show and hand Diameter



Source : Prepared by the researchers, (2021)

Table III: Specifications of Hand

Notation	Definition
A	Hand show
B	Hand diameter

Source : Prepared by the researchers, (2021)

1.3. Equipment

In this study, Vernier calipers were used to measure hand grip dimensions and machete handle dimensions, The Statistical Package for the Social Sciences (SPSS v22) was also used, a program designed for statistical data analysis, It allows researchers and scientists to analyze quantitative data and extract results that help them understand the studied phenomena and make data-driven decisions,

2. Results

For the anthropological measurements of the total sample 241 workers in agriculture, as the measurements were taken for all workers who are occupied, considering that this tool is used by everyone, and the results were as:

Table IV: The average arithmetic, standard deviation, and anthropometric dimensions of workers

Dimension (cm)	Mean(cm)	SD	Percentile	
			5^{th}	95^{th}
Hand show	9,47	0,20	9,14	9,80
Hand Diameter	3,95	0,19	3,64	4,29

Source : Prepared by the researchers based on the outputs of SPSS v22

The results from Table IV, derived from the measurements of the workers' dimensions as shown in Figure 3, indicate that the average hand width is estimated at (9.47 cm), while the standard deviation (SD) is (0.20 cm). The average hand diameter is estimated at (3.95 cm), with a standard deviation (SD) of (0.19 cm). Where the sample size is (N=241)

Table V: Measure the dimensions of the sickle handle,

Dimension	The size (cm)
Handle length	9,30
Handle Diameter	3,73

Source : Prepared by the researchers based on the outputs of SPSS v22

The results shown in the table V, derived from the measurements of the sickle handle used in agricultural practices as depicted in Figure 1, indicate that the handle length is (9.30 cm) and the handle diameter is (3.73 cm).

3. Discussion

The purpose of this study is to determine the extent to which the anthropometric indicators of the hand grip, which were defined here as the length and diameter of the hand, are compatible with the diameter and length of the sickle handle, were measured using the Vernier calipers, and the results were analyzed and compared with previous research**.**

Table VI: Comparing the anthropometrics of the worker's Hand and The dimensions of the sickle handle

The dimensions of the sickle handle	The anthropometrics of the worker's Hand	The difference
Handle length	Hand show	17 mm
Handle Diameter	Hand Diameter	22 mm

Source : Prepared by the researchers based on the outputs of SPSS v22

Evaluating the physical dimensions of the human body and applying them in the design of tools, workstations, equipment, and tasks to match human dimensions and capabilities is one of the oldest arts and sciences (K. H. Kroemer, 1984). Designing equipment and tools without considering the user's body dimensions can lead to musculoskeletal disorders, discomfort, and reduced efficiency.

This study aimed to assess the compatibility of the anthropometric measurements of agricultural workers with the handle of sickles in the El oued region of northeastern Algeria. The anthropometric data presented in Table IV assists designers in creating new agricultural equipment or improving existing tools to better suit the user population (R.T. Vyavahare & S. P. Kallurkar, 2016).

The handle is a crucial part of hand tools, making appropriate grip dimensions essential for effective tool operation. A mismatch between the dimensions of workers' hands and the dimensions of the tool handle can cause injuries, such as cuts and blisters on the skin (M. S. Parvez & M. M. Shahriar, 2018).

In the El oued region, residents use sickles to harvest the widely grown palm trees, which are the only type that meets their performance needs due to their availability, low cost, and simplicity in design and operation (P.K. Nag & A. Goswami & S.P. Ashtekar & C.K. Pradhan, 1988). These sickles are made from a piece of wood and a metal rod, with one hand holding the handle and the other supporting the palm tree .

This study concluded that the anthropometric dimensions of agricultural workers' hands do not match the dimensions of the sickle handle (see Table VI). The difference between the diameter of the hand and the diameter of the sickle is 22 mm, while the difference between the width of the hand and the length of the sickle handle is 17 mm. These discrepancies are attributed to poor design, particularly since they are manufactured by local blacksmiths who

lack precise scientific measurements in their production process and rely on simple tools for manufacturing. Additionally, there are no private companies producing these tools, and no prior studies have focused on the anthropometric measurements of farmers' hands in the region. This study is the first to address this topic in this area, specifically focusing on this group of workers.

Conclusion

A carefully designed handle can significantly reduce the physical strain experienced by farmers when using the sickle. This means that farmers can work for longer periods with less effort, which ultimately contributes to increased productivity. When users feel comfortable during work, they are better able to focus on agricultural tasks, leading to improved outcomes.

This study found that the dimensions of the sickle handle used on farms in the Wilaya of El Oued, Algeria, do not match the anthropometric measurements of hand grips. The results indicate that the optimal handle design should include a length of 9.47 cm and a diameter of 3.95 cm. These dimensions are not just numbers but reflect the importance of agricultural tool design for achieving greater work efficiency.

Furthermore, as this is the first study in this field in the Wilaya of El Oued, the findings underscore the need for attention to detail in the design of agricultural tools. If the dimensions are unsuitable, tools may be challenging to use, negatively impacting the effectiveness of agricultural operations. Therefore, it is essential to conduct further research to understand how these dimensions affect user comfort and performance. Such studies are vital for developing agricultural tools that better meet farmers' needs.

Although the sample size in this study was limited, the findings provide valuable insights for designers and agricultural engineers. This information can aid in developing tools that are more efficient and better suited to farmers' requirements, contributing to improved agricultural performance overall.

Finally, this study reinforces the idea that well-thought-out tool design can lead to increased productivity and enhanced comfort during work. These findings should therefore serve as motivation for further studies and research in this field, promoting innovation and the development of effective and user-friendly agricultural tools that benefit both farmers and the broader agricultural community.

Bibliographic references

Aware, V, V, Shahare, P, U, Shirsat, N, A,& Aware, S, V, 2016,« Modifications in serrated sickle for increasing field capacity and reducing drudgery », Agriculture Update, 11(3), p313-317,DOI : 10,15740/HAS/AU/11,3/313-317.

Benos, Lefteris& Tsaopoulos, Dimitrios& Bochtis, Dionysis, 2020, «A Review on Ergonomics in Agriculture, Part I: Manual Operations », Applied Sciences, 10(6), p05-19,https://doi,org/10,3390/app10061905

Dewangan, K,N & Owary, C & Datta, R,K, 2008, «Anthropometric data of female farm workers from north eastern Indiaand design of hand tools of the hilly region», International Journal of Industrial Ergonomics 38 , p90–100.

Dewangan K, N & Owary, C & Datta, R,K, 2010, «Anthropometry of male agricultural workers of northeastern India and its use in design of agricultural tools and equipment», International Journal of Industrial Ergonomics, 40, p560-573,https://doi,org/10,1016/j,ergon,2007,09,004

Jaber, H, 2018, «The evaluation of the agrecultur sector », Journal of Administration and Development for Research and Studies, 14, p57-68.

Khadem, Khan Mohammad Miftaur Rahman, Al Farsi, Dawud, & Islam, Md, Anisul, 2014, «Anthropometric data of Omani male population of age group 18–60», International Journal of Industrial and Systems Engineering, 16(4), kp523-536, doi: 10,1504/IJISE, 2014,060657

Kroemer, K, H, 1984, «Engineering anthropometry, Ergonomic Data for Equipment Design», p101-114.

Kumbhare Dhiraj N & Vishal, Singh& Prashik, Waghmare& Altaf, Ansari & Vikas, Tiwari& Gorle, R D, 2016, «Fabrication of Automatic Pesticides Spraying Machine», International Research Journal of Engineering and Technology, 03(04), pp912-916.

Lundqvist, PETER, 2001, «Occupational Health and Safety of Workers in Agriculture and Horticulture», NEW SOLUTIONS: A Journal of Environmental and Occupational Health Policy, 10(4), p351–365.

Mokdad Mohamed, 2002, «Anthropometric study of Algerian farmers», International Journal of Industrial Ergonomics 29, p331–341, DOI: 10,1016/S0169-8141(01)00073-7

Nag, P, K & Goswami, A & Ashtekar S, P &Pradhan, C,K, 1988, «Ergonomics in sickle operation», Applied Ergonomics, 19 (3), p233-239, doi: 10,1016/0003-6870(88)90142-1

Parvez, M, S,, & Shahriar, M, M, 2018,«Agricultural farm-related injuries in Bangladesh and convenient design of working hand tools», Journal of healthcare engineering, 2018.

Peter Hurst, 2007, «Agricultural Workers and their Contribution to Sustainable Agriculture and Rural Development», International Labour Organization (ILO), Food and Agriculture Organization of the United Nations (FAO), International Union of Food, Agricultural, Hotel, Restaurant, Catering, Tobacco and Allied Workers' Associations (IUF).

Vyavahare, R, T,, & Kallurkar, S, P, 2016, «Anthropometry of male agricultural workers of western India for the design of tools and equipments», International Journal of Industrial Ergonomics, 53, p 80–85.

William, Rivera, M, 1995, «Human resource development in the agriculture sector: Three levels of need», International Journal of Lifelong Education, 14(1), p 65-73.

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