



## PREVALENCE OF MUSCULOSKELETAL DISCOMFORTS AMONG RURAL FARMERS IN NORTH-WESTERN NIGERIA

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### ABSTRACT

Agricultural tasks can be considered some of the most demanding and hazardous, especially in developing countries where crop production relies heavily on manual implements. Weeding, one of the common agricultural activities performed by farmers, requires a significant amount of physical effort and often involves awkward wrist and trunk postures, subjecting farmers to multiple risk factors that can result in musculoskeletal discomfort. In this study, a combination of qualitative and quantitative approaches is used to examine the prevalence of musculoskeletal conditions among rural peasant farmers in Jigawa, a state in northwestern Nigeria. The results of this study indicate that lower back pain, upper back pain, and wrist/hand pain are the most prevalent musculoskeletal conditions experienced by peasant farmers who are exposed to intensive manual farming operations.

**Keywords:** hazards, musculoskeletal conditions, rural farmers, northwestern Nigeria

### INTRODUCTION

With a population of about 150 million people, Nigeria seems as the most populous black nation on earth. The country is agrarian in nature with about 80% of its food crops being produced by peasant farmers who mostly cultivate less than two hectares of land (Olowogbon *et al.* 2021; Ismail *et al.*, 2013). Generally, the agricultural sector is among the major employer and contributors to the Nigerian economy, in 1971 it employs about 60% of the entire population (Odefadehan, 2017; Adewole, 2018). This trend declined steadily employing only about 37% of the population in 1997 (Adewole, 2018). In the period from 2011 to 2012 which is regarded as the oil boom era, the oil and gas sector contributed a greater percentage of GDP to the Nigerian economy. However, with the dwelling decline of global oil prices, the country bends its policy on diversifying the economy to agriculture.

Jigawa State is located in the north-western region of Nigeria between latitudes 11.00oN to 13.00oN, and longitudes 8.00oE to 10.15oE. The state shares a border with Kano and Katsina states to the west, Bauchi state to the east, and Yobe state to the northeast. To the north, the state shares an international border with the Niger Republic (Jigawa State, 2023). Jigawa State is reported as the eighth largest state by population in Nigeria with a projected population of 6,346,156 people as of 2018, Jigawa State has over 2 million hectares of dry, and fadama lands suitable for all-year-round cultivation. It has a huge reservoir of water bodies and able-bodied youths, making it one of the major producers of staple foods in the country.

One of the detriments of the agriculture potential to the Nigerian economy is the lack of mechanized farming. Most agricultural activities are carried out using manual implements for crop production, with humans as the main sources of power for crop production, human power constitutes about 90% of the energy sources (Das and Gangopadhyayb, 2010). Manual farms are mostly developed using indigenous knowledge. Although indigenous knowledge has contributed significantly in many areas of rural life, particularly in food production (Ominikari & Wasini, 2022), local inventors often ignore or have little knowledge of body mechanics. They lack an understanding of

the implications of their designs on the efficiency, performance, and well-being of the users. The vast majority of local farm tools are hazardous, they involve working in awkward body positions of wrists and trunk, these awkward positions mostly stay for a long duration, making muscles in a body part such as the waist, neck, back, and legs get static loads leading to static contraction, and shortage of blood flow, which causes energy shortage resulting to a gradual increase in body pain, and decrease in productivity (Mulyati *et al.* 2019). The use of manual implements for farming activities can be highly stressful, manning these implements may exceed the physical capabilities of the users (Helander 2006). Among the common manual farming activity frequently performed by farmers is weeding: the use of manual implements (hoes) for the removal of weeds. The design features of farming implements such as hoes have significant effects on the performance efficiency and the health of users. A strong positive relationship exists between the design features of the hoes and the user's efficiency, productivity, and discomfort. And inefficient design of hand farm implements leads to discomfort and injuries to users (Das and Gangopadhyayb, 2010). Scholars have reported the prevalence of work-related musculoskeletal conditions due to intensity factors such as force, repetition, and the angle of wrist deviations. Also, angle of inclination of the blade to the handle of a hoe, and the handle length of its handle negatively affect use's well-being, especially when it is extended for a long period. This results in compressive forces in the lower back, a region where the common prevalence of discomfort and injuries is reported by farmers (Sanders and McCormick 1992; Das & Gangopadhyayb, 2010). Generally, there are reported occurrences of ergonomics-related injuries among rural farmers in Nigerian agricultural workplaces, however, relevant agencies are still indifferent (Olowogbon *et al.* 2021).

### Relevant Literature

Depending on the nature of any activity the human body is naturally to be stable, however, prolong static, or dynamic position can lead to the accumulation of fatigue. Physiological fatigue results in the weakening of the energy supply and identifiable changes in the physiological processes. Mental fatigue occurs due to a reduction in the reticular activation

system weakening mental alertness and concentration. The effects are reduced productivity, increase discomfort, over-exertion, and injury (Mital, Desai, & Mital, 2017). Human factors/ergonomics involves identifying the physical and psychological needs of the work, fitting the people to the task(s) rather than fitting the task(s) to the people, it examines the interactions between humans and tools, equipment, or machines and how the design of products influences human performance (Helander 2006). The term refers to a scientific discipline that aims at improving efficiency, productivity, comfort, and safety, and reducing fatigue, stress, and human errors (Garg 1991). According to a definition provided by International Ergonomics Association (IEA) The term human factors/ergonomics has been applied to situations that apply theory, principles, data, and methods in understanding the interactions among humans, and other elements of a system (Zink 2006). The overall objective is to apply relevant data relating to human capabilities, limitations, characteristics, behavior, and motivation to the design for people's use and the environment in which people use them (Sanders & McCormick 1992). In 2006, Helander popularized the term ergonomics to describe how information about human behavior, abilities, limitations, and other characteristics are studied and used in the design of tools, machines, systems, tasks, jobs, and environments for productive, safe, comfortable, and effective human use. Human factors/ergonomics have been an active research topic in different scientific domains.

In production economics, evidence suggests strong relations between ergonomic work conditions, human performance, and product quality (Govindaraju et al. 2001). The significance of human factors/ergonomics consideration in all areas of agricultural processes is highlighted by Adewole, (2018). Das and Gangopadhyayb, (2010) evaluate posture-related discomfort and occupational health conditions among rice farmers in West Bengal, India, discomfort and body pains among rice farmers due to prolong awkward body posture is observed. In a study that set out to determine the prevalence and exposure ergonomics risk factors among cassava farmers in Nigeria, Olowogbon *et al.* (2021) concluded that shoulder, lower back pain, and upper back pain are the most prevalent ergonomic injury experienced during cassava farming operations. However, Olowogbon's results were based on data from self-reported evidence. According to Benos, Dimitrios, and Bochtis (2020) lower back injuries are of epidemic proportion among rural agricultural workers because most rural agricultural activities are performed near ground level with prolonged trunk flexion. The risk factors associated with musculoskeletal conditions during different agricultural activities have been extensively studied. However, most of these studies have only been carried out in a small number of areas. In an investigation of energy expenditure required by farmers using manual hoes, Ismail *et al.* (2013) observed postural load in mold-making farming activities, and suggests mechanized approaches. A major criticism of Ismail's work is that only a small number of participants took part in the study. The effects of manual farming activities on the well-being of rural farmers were studied by Odefadehan (2017) who reported waist pain as the most predominant health injury suffered by rural farmers. However, Odefadehan fails to fully acknowledge the significance of other risk factors.

## MATERIALS AND METHODS

This study used a convenience sample technique, 147 participants were drawn among peasant farmers across Jigawa state. By the end of the survey period, data had been collected from the participants, all the respondents are male with a mean age of 40.8 (SD 14.3) years. Questionnaires were used to ask the respondents to indicate the most frequently hand implements they used for regular farming activities, other questions includes their farming experience which entails the cumulative number of years they used the hand implement; the frequency (number of months in a year) the respondent used the hand implement, and days per month the respondent used the hand implement. In the final part of the survey, respondents were asked if they have been experiencing any discomfort in Chest, shoulder, lower back, upper back, and hand/wrist: A two-point discomfort level scale is used, where 1 represented noticeable pain, and 2 represented no pain. Fuzzy sets methodology represent sharp numerical values using overlapping boundaries of fuzzy numbers; it takes into cognisance human thinking pattern and their inherent imprecision in the decision-making process. These which may not be easily evaluated using conventional numbers (Abubakar and Wang 2019). Different fuzzy models can be found in the literature (Mikhailov, 2003; Fan et al., 2004; Chen, 2001; Chou et al., 2008; Laarhoven and Pedrycz 1983). Triangular fuzzy numbers are the most widely used. Triangular fuzzy number (TFN) is a widely used methodology, TFN may be described as  $\tilde{R}(r_1, r_2, r_3)$  denoting that  $\tilde{R}$  is a fuzzy set with membership  $r_1, r_2, \text{ and } r_3$  as shown in Fig. 1. Thus,  $\mu_{\tilde{R}}(K)$  define the degree of membership of element K. A triangular fuzzy set R consisting of a set  $r_1, r_2, r_3$  is expressed as:

$$\mu_{\tilde{R}}(K) \left\{ \begin{array}{l} 0, \quad K \\ \frac{K-r_1}{r_2-r_1}, \quad r_1 \leq K \leq r_2 \\ \frac{r_3-K}{r_3-r_2}, \quad r_2 \leq K \leq r_3 \\ 0, \quad K \quad r_3 \end{array} \right\} \quad (1)$$

The exposure level of risk factors that may lead to musculoskeletal disorders is computed using the formula:

$$\varepsilon = \frac{(((\delta \times \delta') \times \alpha) \times \varphi) \times \beta}{\alpha'} \quad (2)$$

Where  $\beta$  is duration of farming activities since birth (years),  $\delta$  denote the utilisation of hand farm implement by farmer per day (hours),  $\delta'$  is the utilisation of hand farm implement by farmer in a week (days),  $\varphi$  year of farming practice (months),  $\alpha$  represent number of weeks in a month,  $\alpha'$  signify total number of hours in a year, and  $\varepsilon$  indicate exposure level of risk factors that may lead to musculoskeletal disorders. To simplify the study, the following assumptions are made: 1) number of weeks in a month: the number of weeks in a month is taken as 4 weeks, 2) total number of hours in a year: the total number of hours in a year is considered as 8640 hours.

The fuzzy membership concept was adopted in this study to evaluate the exposer level; linguistic terms were assigned depicting the amplitude of the exposer. The exposure level is categorized into three classes: a value from 0 to 2.0 indicates exposure to multiple risk factors that may lead to musculoskeletal disorders; a value of 2.1 to 4 signifies high exposure, and a value of 4.1 to 6 implies extreme exposure. Figure 1 shows the linguistic scale defining the level of an individual's exposure corresponding to the triangular fuzzy numbers.

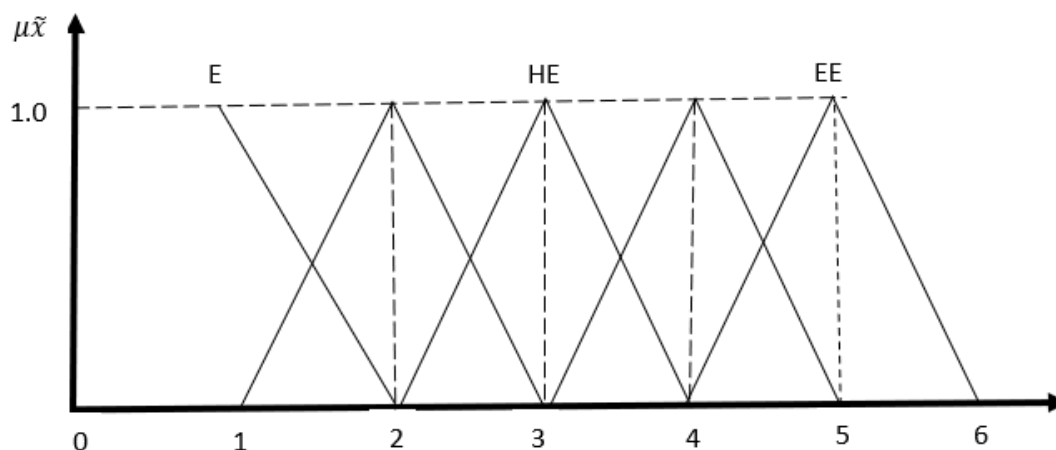


Figure 1: Degree of membership of triangular fuzzy numbers

**RESULTS AND DISCUSSION**

The significance of human aging on the human physiological decline is being studied by scholars: Human physiological abilities increase until the age of about 40 years old (Abubakar

and Wang 2019). Table 1 presents the demographic profile of the respondents, about 50% (50.9) are within the age band of 10 to 40 years old. This indicates that about half of the respondents are at their optimum production age

**Table 1: Demographic profile of the respondents**

Age of respondents (years)	Frequency	Percentage	Mean age of the respondents	Std dev.
10 – 20	13	8.8		
21 – 30	33	22.5		
31 – 40	30	20.4	40.8	14.3
41 – 50	36	24.5		
Above 50	35	23.8		

The Table 2 below illustrates some traits of the respondents, it indicates that a considerable number (30.7%) of respondents had between 1 to 5 years of farming experience, 29.2% had between 16 to 25 years of farming experience, 29.2

% between 26 to 40 years, and 10.2% between 41 to 55 years. While 0.7% had farming experiences above 55 years. The mean farming experience of the respondents was 33.7.

**Table 2: Farming experiences of the respondents**

Farming Experience (years)	Frequency	Percentage
1 – 15	45	30.7
16 – 25	43	29.2
26 – 40	43	29.2
41 – 55	15	10.2
Above 55	1	0.7

The majority of farmers (95.8) make use of hand implements throughout the week. As can be seen from Table 3 below, very few farmers (11%) used hand implements for 1 to 2 month a

year, while a significant number of farmers (27.2%) used hand farm implement for 7 to 8 month in a year.

**Table 3: Used of hand implements (month/year) by respondents**

Use of hand farm implement (months/year)	Frequency	Percentage
1 – 2	16	11
3 – 4	32	21.8
5 – 6	27	18.3
7 – 8	40	27.2
Above 8	32	21.7

The exposure level of risk factors associated with musculoskeletal Disorders is computed using equation 2 based on the following assumptions: 1) there are 4 weeks in a month 2) 8640 hours constitute a year. Respondents are classified according to their level of exposure. Figure 2 reveals the occurrence of musculoskeletal conditions in five

body regions as reported by respondents. What is interesting in this data is that 100% of those who were highly exposed to manual agricultural activities had upper and lower back pains whereas 86.2% had neck pains, and 93.1% had wrist/hand pains. On the other hand, 84.8% of respondents exposed to manual agricultural activities had lower back pains whereas

74.4% had wrist/hand pains, 73.9% had upper back pains, 63.1 had chest pains, and 50% had neck pains. While 58.3% of those exposed to the use of manual agricultural activities had wrist/hand pains, 48.6% had upper back pains, 33.3% had chest pains, and 25% had neck pains. It is somewhat surprising that almost the same proportion of lower back cases

was reported by farmers who are exposed, and highly exposed to manual agricultural activities. Taken together, these results suggest that the upper back and lower back are the regions with a common prevalence of discomfort and injuries reported by rural farmers.

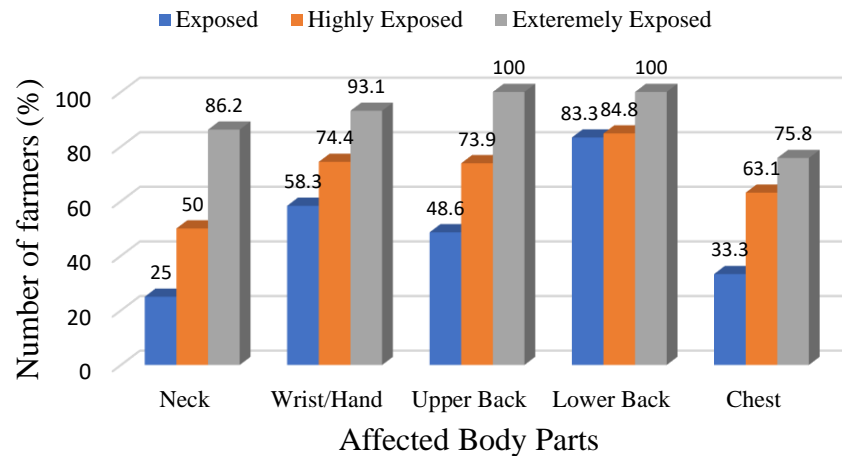


Figure 2: Prevalence of Musculoskeletal Disorders Based on Exposure Level.

### Discussion

Nigeria, with a population of over 150 million people, is considered the most populous black nation on Earth. Currently, the agricultural sector is one of the major employers and contributors to the nation's economy. Peasant farmers produce about 80% of food crops in Nigeria. The majority of implements used by farmers in developing countries are fabricated locally, and the fabricators often ignore or have little understanding of the implications of these tools on the efficiency, performance, and well-being of the users. According to the 2016 population census, Jigawa state is the eighth-largest state in terms of population and one of the major producers of staple foods in the country. Farmers in Jigawa state, in particular, can be vulnerable to musculoskeletal conditions, as they perform most of their agricultural activities using locally made implements with low awareness of body mechanics. Recently, investigators have reported the prevalence of work-related musculoskeletal conditions due to factors such as force, repetition, and the angle of wrist deviations.

The results of this investigation showed that farmers experienced work-related musculoskeletal discomfort in the neck, wrist/hand, upper back, and lower back. The present findings seem to be consistent with previous study by (Olowogbon, *et al.* 2021), which found that shoulder, lower back pain, and upper back pain are the most prevalent work-related ergonomic injuries experienced among crop farmers in Nigeria. Also, it is encouraging to compare the present findings with those found by Das and Gangopadhyay (2010) who evaluated posture-related discomfort and occupational health problems among rice farmers in India, and found that 99% of subjects experienced lower back injuries. Surprisingly, the present findings indicate that the intensity of the discomfort experienced by farmers depend on the exposure level of the manual activities.

### CONCLUSION

In this study, the prevalence of musculoskeletal conditions among farmers in rural communities is examined using a structured questionnaire. Interestingly, all respondents who

are extremely exposed to manual agricultural activities reported experiencing upper and lower back pain, whereas about 83% of those highly exposed and exposed had upper and lower back pain. The present results are significant, indicating that the severity of musculoskeletal conditions among rural farmers can be determined by frequent exposure to manual activities.

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