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ASSESSING SEVERITY OF POSTURAL LOADING IN FOUR *GARI* -FRYING METHODS

T. M. SAMUEL[1]*, J. C. IGBEKA[2] AND O. P. KOLAWOLE[3]

[1]Dept. of Agricultural Engineering, Olabisi Onabanjo University, Ogun State, Nigeria
[2]Dept. of Agricultural and Environmental Engineering, University of Ibadan, Nigeria
[3]PPS, International Institute for Tropical Agriculture (IITA), Ibadan, Nigeria
***Corresponding author:** Samuel_taiwo1966@yahoo.com

ABSTRACT

Posture at work is a source of musculoskeletal load. This is in addition to the external task-induced load depending on the task, which must be minimized to ease the work. Four working postures common to *gari*-frying workers in the southwestern Nigeria namely, sitting beside (SB), sitting in front (SF), alternating sitting and standing (ASS) and standing (S) were investigated to assess severity of loading in each posture. Activities of 16 fryers were videotaped and played back for assessment using Rapid Upper Limb Assessment (RULA) technique. RULA grand score recorded were SB 7.00, S 6.50, SF 6.00 and ASS 5.75. Postural angles were also measured giving SB 36, S 50, SF 79, and ASS 50^0. RULA result has been confirmed by postural angle measurement, indicating that ASS has the least severity due to postural loading with the least bending/twisting and flexion of the back during *gari*-frying task. ASS posture, therefore, is recommended for *gari* frying in southwestern Nigeria.

KEYWORDS: RULA, *gari*-frying workers, severity, posture, musculoskeletal disorder

INTRODUCTION

The importance of cassava (*Manihot esculenta*) in the lives of many Nigerians cannot be over-emphasized. As food, it comes first among the root and tuber crops despite the respect yam commands as a ceremonial crop. Cassava products include *gari*, fufu, flour and starch. The leaves are also edible. Cassava is a crop for hunger alleviation and it has great potential for sustainable food security and export promotion. Depending on the processing procedure used, the percentage of cyanide reduction varies from 70 to 100% (IITA, 1990). The tubers, according to IITA (opp. cit), are detoxified by hydrolysis of linamarin and lotuaustarin into hydrogen cyanide (HCN), which is volatile and evaporates rapidly at temperatures above 20^0C. Some measure of detoxification can also be achieved by mechanical disintegration (pounding, grating or chipping the tubers).

In cassava processing, about 65-70% of the rural women are actively engaged in physical cultivation of land, planting, harvesting, etc, while women are exclusively responsible for the remaining steps in the food chain, particularly food processing, preparation and distribution (UN, 1994; Ali, 1996). Studies have shown that food processing is a major commercial focus for women in many settlements in Nigeria (Asota & Kaul, 1991). Akpabio & Ekpe (2001) analyzed gender role

in cassava production in Akwa Ibom state of Nigeria and revealed that female farmers are fully involved in five-task activities and also make greater contribution than male farmers in three of the jointly performed task activities. Igbeka (1993) performed ergonomic studies on some Nigerian women involved in agricultural processing of cassava roots into *gari*, a common staple food in Nigeria. He faulted the unnatural postures of the operators as well as the unconducive working environment, which generates excessive heat. He then proposed an improved method for reducing fatigue and increasing productivity of the operators.

Gari frying (*garification*) is about the last operation in *gari* production and, to a large extent, the determinant of the final product. This involves simultaneous cooking and dehydration, that is, heat treatment of dewatered cassava mash, which has been pulverized into grains, to produce gelatinized and dried grains known as *gari* (Igbeka, 2003).

The Rapid Upper Limb Assessment (RULA) system is designed for assessing the severity of postural loading and is particularly applicable to sedentary jobs (McAtamney and Corlett, 1993). The method adopts the concept of OWAS as reported by Guanyan & Peter (1999), using numbers to represent postures with an associated coding system. The range of movement for each upper body part (head, trunk, upper and lower arm, wrist) is divided into sections that are numbered. Number 1 is given to the range of movement or working posture where risk factors causing load on the structures of the body segment are minimal, and higher numbers are given to parts of the movement range with more extreme postures. If an abduction or rotation is involved, the scoring is described beside the diagram (Cornell University, 2000). In addition to posture recordings, RULA also considers the load on the musculoskeletal system caused by static or repetitive muscle work and force exertion, so that an action list can be produced. This indicates the level of intervention required to reduce the risks of injury due to physical loading on the operator. The method has been tested in a laboratory situation relative to VDU operation (McAtamney and Corlett, 1993). However, further validation may still be needed for the system relative to other occupations. Of all reasons why postures have interested researchers and practitioners, postures as a source of musculoskeletal illnesses, such as low back diseases, have attracted the most attention. Musculoskeletal problems related to repetitive work are also connected to postures (Stellma, 1998). Awkward working postures, repetitive use of body segments, forceful movements, vibration and long periods of standing are also sources of the physical workload. The physical workload has been recognized as the cause of musculoskeletal injuries in construction workers. Working postures of *gari* fryers has not been researched in Nigeria, especially in the processing industry, hence the objective of the paper is to assess postural loading of *garification* workers in Southwestern Nigeria.

MATERIALS AND METHODS

Four improved traditional *garification* working postures (ITGWPs) have been identified in the Southwestern Nigeria (Samuel, 2008). They are described as follows:

ITGWP I – sitting beside (SB): A seated fryer (separate from the fireplace) – beside the fireplace, and adopting conventional sitting posture.

ITGWP II – sitting in front (SIF): A seated

fryer – directly facing the fireplace, with either or both legs fully stretched out.

ITGWP III– stand (S): A standing fryer – beside the fireplace, with some movement around the work piece.

ITGWP IV – alternating sitting and standing (ASS): A sit-stand fryer – beside the fireplace and alternating sitting and standing postures, with some movements round the work piece.

Methods for measuring postures have been categorized into three namely, self-reports from workers on workplace exposure to both physical and psychosocial factors, observational methods and direct methods (Guangyan & Peter, 1999). One of such observational methods Rapid Upper Limb Assessment (RULA) is being used in this paper.

Sixteen subjects (four for each posture) were videotaped to capture all movements during work. The workers participating in this research were assigned randomly. For each worker, a 1.5-hour videotape was recorded. The videotapes were recorded either in the morning (between 8:00 and 11:00 a.m.) or in the afternoon (between 12:00 and 4:00 p.m.) depending upon the availability of both the jobs being performed and the researchers. The two recording periods were believed to be representative since the workers performed the tasks almost all the time. The videotape was not used when the worker was idle due to any unexpected event during the recording period. The weight of the load handled was determined after the completion of the videotaping so that the worker's task was not disturbed. The videotapes were then played back and the working postures (involving arms, wrist, neck, trunk and leg) were coded. The posture adopted had been observed whilst undertaking the task prior to selecting the posture(s) for assessment. Therefore, selection was made of the longest held posture and the assessment was made at 30-second interval over the working period. Prof Alan's worksheet was replicated in excel worksheet to calculate RULA's grandscore using excel software. However, data were captured from recorded videotape for this analysis. The guideline in Cornell University (2000) was used to determine the RULA grand score. The grand score was then compared to the Action Level list in Table 1, which provides a guide for further action. This provides a guide for the control of any risks identified and the action to be taken.

Angle of bending of each subject was determined using the same videotape earlier used for RULA. In each case, the extreme bending situation at work was captured and postural angles were determined by using still photographs and the reference point was lumbosacral (L5) (Kumar et al, 2005).

RESULTS AND DISCUSSION

Table 2 shows the results of the analysis of the RULA assessment. From Table 2, the RULA mean scores of all the ITGWPs were between 5 and 7, implying action levels 3 and 4, which respectively implies investigation and changes are required soon and investigation and changes are required immediately according to Table 1. SIF and S postures have RULA mean scores of 6.5 and 6.75 (approximately 7), giving the same action level 4. It does mean that the discomfort level in these working postures in the upper limb was not significantly different from SB with the mean RULA score of 7. However, ASS have score of 6, implying investigation and changes are required soon. Hence ASS

had the least risk of musculoskeletal disorders.

Though the closeness of the scores does not give distinct classification, especially between S and SIF postures, SB and ASS were clearly indicated respectively as worst and best postures among others with their scores, corroborated by their standard deviations.

In this analysis, RULA had been used as part of wider analyses to determine risks of musculoskeletal disorders in the subjects. This result requires further analysis, because as its name implies, it is for rapid assessment. Hence, further analyses with determination of the bending angles of the subjects stands to give a clearer picture of the analysis.

Plates 1 through 4 shows the postural angles measured in each of the postures under study. The angles were recorded at the extreme bending posture of the workers during *garification* operation, that is, at the time the worker attempted to stir *gari* mash in the fry pan at the far edges of the pan. The angles recorded were 36, 50,50 and 79^0, respectively, for SB, S, ASS and SIF. The relatively small angle recorded for SB came as a result of smaller fry pan in use in most locations where SB postures thrive.

The largest angle recorded for SIF was not surprising because the posture really did not fit the worker because the work surface was somehow low and that was the reason the processor had to bend over. The situation was compounded by the large fry pan which was not within the arm reach of the worker, the worker was forced to take this hard posture as seen in Plate 3. In this case, the work surface could have been close to the chest level with the fry pan within arm reach, since only stirring was required with low force involved.

Table 1: RULA Grand Score and Action Level

RULA Score	Action Level	Description
1-2	1	Posture is acceptable if it is not maintained or repeated for long periods
3-4	2	Further investigation is needed and changes may be required
5-6	3	Investigation and changes are required soon
7	4	Investigation and changes are required immediately

Source: Prof Alan Hedge, Cornell University

Table 2: RULA Assessment Results for Four Improved Traditional *Garification* Working Postures (ITGWP)

ITGWP	Range	STDEV	Mean RULA Score
SB	7	0	7
SIF	6-7	1	6.5
S	6-7	1	6.75
ABSS	5-7	0.817	6

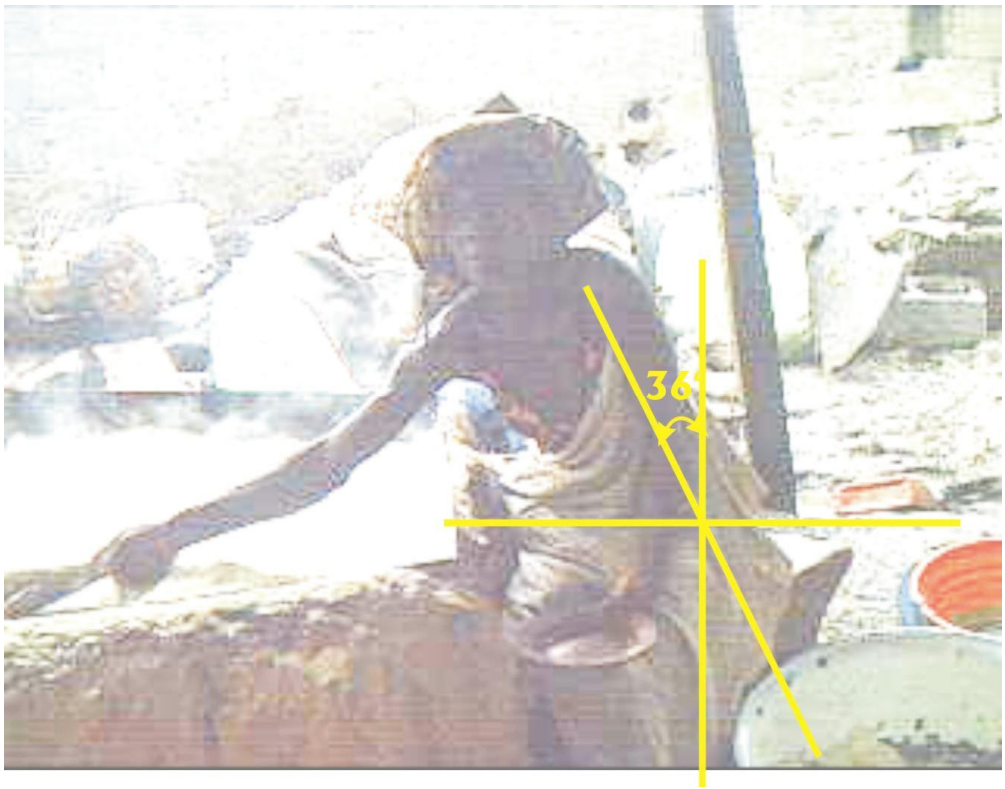

Plate 1: Still Picture Measuring Postural Angle for SB Posture

Plate 2: Still Picture Measuring Postural Angle for S Posture

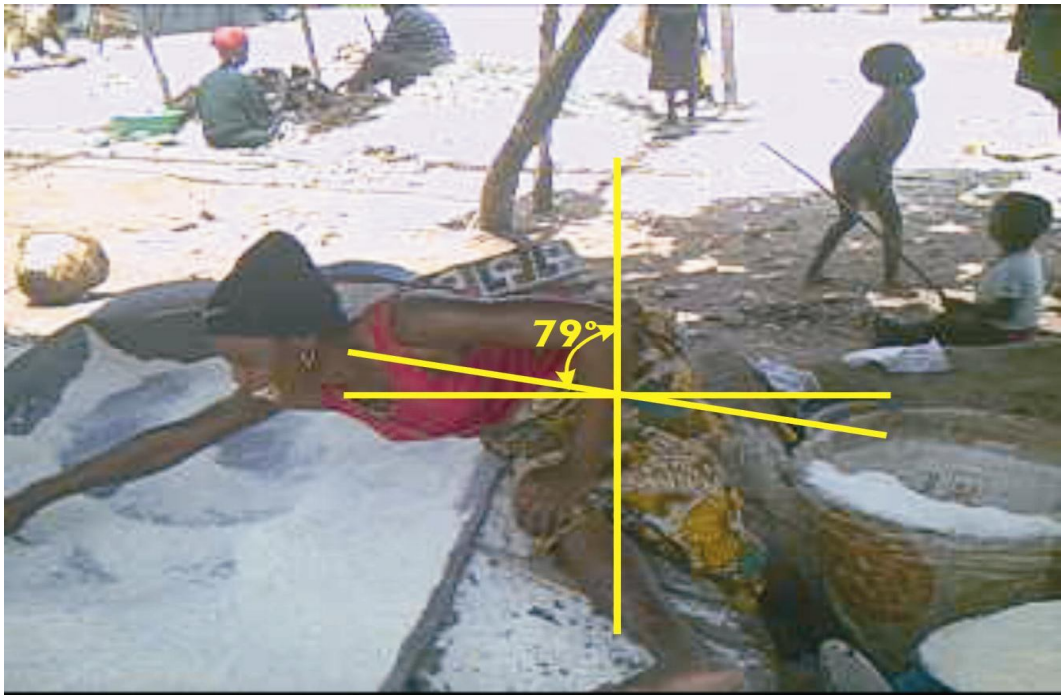

Plate 3: Still Picture Measuring Postural Angle for SIF Posture

Plate 4: Still Picture Measuring Postural Angle for ASS Posture

The same angle 50^0 recorded in ASS and S postures were as a result of measuring the angle at the extreme situation of bending of the worker at work. Since the same size of fry pan was in use in both postures and neither of them was within the arm reach as is supposed, the worker was forced to take this posture as seen in Plates 2 and 3. However, the situation was not as worse as in the case of SIF because the work surface of ASS was at the waist level in consonance with ergonomic guideline.

CONCLUSION

Both RULA analysis and the angle of bending depict that ASS posture has least severity of postural loading among the improved traditional *garification* working postures investigated in southwestern Nigeria. This is revealed by virtue of the low mean RULA grand score and comparatively low bending angle of the subjects who adopted ASS posture. ASS posture is, therefore, recommended for adoption in the southwestern Nigeria for *garification* task.

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