Assessing Musculoskeletal Risks in Gari-Frying Workers

Taiwo Moses SAMUEL* and Babatunde Olusola ADETIFA

Agricultural and Mechanical Engineering Department, College of Engineering and Environmental Studies, Olabisi Onabanjo University, Ibogun, Ifo, Ogun State, Nigeria.

E-mails: taiwo_samuel@mail.com; st.tunnie@yahoo.com

[*] Corresponding author: Phone: +2348055825158 1

Abstract

Cassava processing into various staple foods, including gari, has been identified by various researchers as very stressful with diverse risk factors. In this paper, the gari-frying task was broken into its work elements (as required for Job Hazard Analysis (JHA)) comprising loading, stirring and the unloading task. Data were collected using questionnaire and oral interview to elicit the level of stress attached to the work and the body areas where pains were experienced. Musculoskeletal stress was assessed with Quick Ergonomic Check (QEC) while awkward posture was assessed using the arm reach ratio. 97.5% of respondents complained of pain in the shoulder region, while QEC puts pains into region above shoulder/arm, back and the wrist. Results showed that stirring task was more strenuous than loading and unloading and the sitting sideways posture as the most stressful posture. Also, overstretching was an identified risk factor for the population under study since the workers deviate from the neutral back position in an angle of $\theta=77.22^{\circ}$ to the vertical. It was established that the gari-frying process is very tedious and has some ergonomic risks like repetitive stress, awkward posture and other a risk of musculoskeletal disorders making the workers work in discomfort.

Keywords

Cassava; Job Hazard Analysis; Arm reach; Overstretching; Quick Ergonomic Check.

Introduction

Gari is a free-flowing product, consisting of cassava particles, which have been gelatinized and dried. Gari is creamy white or yellow, depending on the type of cassava used or whether palm oil has been added. Gari frying is highly labour-intensive in this part of the world due to the crudeness of the methods used, as it is carried out at an artisan level [1, 2].

The gari frying process is as follows: placing the frying pan over firewood, pressing the sieved mash against hot surface of frying pan and turning vigorously to avoid caking while the fryer sits sideways to observe the frying process. The inherent problems of this process has to do with reduced level of performance due to non-conducive atmosphere and its attendant low productivity; also, the discomfort, due to heat and the sitting posture of the operator [3].

So many problems have been identified with this gari-frying method. These problems not only affect efficiency in terms of the output and the overall returns, but have its root in the workers, workplace setting and the environmental factors that affect the work. The manual operations besides being uncomfortable are characterized by low output and unhygienic products [4]. The discomfort due to heat and the sitting posture of the operator have been of concern to researchers [3].

Work-related musculoskeletal injuries and repetitive stress injuries are often associated with overexertion of the body at work [5]. The manual materials handling activity of lifting is a major source of work-related musculoskeletal disorders. Musculoskeletal and low back disorders are often attributed to overexertion of the body when the operator works to meet the demand of MMH tasks. A very basic concept in ergonomics is that the task demand should be within the limit of a person's capacity. As the demand approaches a person's capacity, the risk associated with the task will increase.

Ergonomic study of the gari-frying process is meant to identify the inherent risk factors and mitigate them, with a view to increasing productivity as well as ensuring the health of the processor. Ergonomics is the area of knowledge dealing with the capabilities and limitations of human performance in relation to the design of machines, job and other modifications of the environment [6, 7].

Immediately the presence of risk factors has been established, the degree of risk associated with those factors is evaluated. This evaluation is done through the application of analytical ergonomic tools. There is a great variety of analytical ergonomic tools. The tools are frequently orientated to a specific type of work or a particular body part. An analytical tool can, at best, provide an approximation of the degree of risk. Variation in individual physiology, history of injury, work methods, and numerous other factors influence whether a person will sustain an injury.

A Quick Ergonomic Check is one of the analytical ergonomic tools used by several researchers [8-12].

Quick Exposure Check (QEC) is designed to assess the changes in exposure to musculoskeletal risk factors of the back, shoulders and arms, hands and wrists, and neck before and after an ergonomic intervention. It involves a practitioner (i.e. the observer) who conducts the assessment, and the worker who has direct experience of the task. It indicates change in exposure scores following an intervention [13].

The method is based on epidemiological evidence and investigations of Occupational safety and health practitioners' aptitudes for undertaking assessments. It has been tested, modified and validated using simulated and workplace tasks, in two phases of development, with participation of 206 practitioners. The QEC allows the four main body areas to be assessed and involves practitioners and workers in the assessment. Trials have determined its usability, intra- and inter-observer reliability, and validity which show it is applicable to a wide range of working activities [14, 15].

The tool focuses primarily on physical workplace factors, but also includes the evaluation of psychosocial factors. Tasks can normally be assessed within 10 min. It has a scoring system, and exposure levels have been proposed to guide priorities for intervention. Subsequently it should be used to evaluate the effectiveness of any interventions made. The QEC can contribute to a holistic assessment of all the elements of a work system. [16, 17]

QEC has been used alongside other analytical tool. Nordic Musculoskeletal Disorders Questionnaire (NMQ) and QEC were used in evaluating the exposure of musculoskeletal disorders risk factors among male workers from a metal structure manufacturing factory [8]. Also, QEC was used in assessing the ergonomic risk in an engine oil company and the result was compared with that of Rapid Entire Body Assessment (REBA) which gave a similar result. [9]

Some of the factors used in assessment by QEC are:

1. Back posture: Whether it is normal, flexed, bent or static while performing the task
2. Wrist posture: Whether it is straight, bent or deviated while performing the task

3. Neck posture: How often the neck is bent or twisted performing the task
4. Shoulder/arm: The height to which the hand is elevated and the frequency of movement of the hand while performing the task
5. Weight: The maximum load (in kilogram) carried while performing the task
6. Frequency: The rate of wrist movement while performing the task.
7. Duration: The time spent (hours) to complete a task
8. Repeated Motion: The number of similar motion performed per minute while performing the task
9. Visual Demand: Whether there is need to view fine details while performing the task

After QEC was developed at the Robens Centre for Health Ergonomics, it was further developed, evaluated and modified through several research works [14-16] due to the need to improve: the scope of guidance; the layout of the forms; the terminology for the workers questions and responses and the transparency of the scoring system. Action levels were developed for QEC comparing it to Rapid Upper Limb Assessment RULA. These action levels are as stated in Table 1.

Table 1. QEC Action Levels [17]

QEC Score (Percentage Total)	*Action*	*Equivalent RULA Scores*
<40%	Acceptable	1-2
40-49%	Investigate further	3-4
50-69%	Investigate further and change soon	5-6
≥70%	Investigate further and change immediately	≥7

Other analytical tools include; Rapid Upper Limb Assessment (RULA) [18], Ovako Working Posture Analysis System (OWAS), Repetitive Motion Evaluation, Observation Analysis of the Hand and Wrist, Utah Back Compressive Force Model, Utah Shoulder Moment Model, AAMA Metabolic Model, Anthropometry Analysis, etc.

The use of ergonomic principles in the design and evaluation of human work especially in Agriculture has been advocated and promoted in the workplace to minimize the occurrence of work-related musculoskeletal injuries.

The seven common post-harvest agricultural production systems in Ghana (cashew nut processing, gari processing, groundnut oil processing, palm kernel oil processing, pito brewing and soap processing milling) were investigated using a variety of Participatory Rural Appraisal (PRA) techniques and a modified hazardous ergonomics risks checklist. It was observed that 70% of all tasks undertaken in these processes involved repetitive motions which were considered amongst the most common causative factors of cumulative trauma disorders. A detailed survey of occupational and musculoskeletal disorders at a gari processing co-operative revealed that every respondent complained of having suffered from musculoskeletal pain or discomfort from work [19].

The four common working postures of gari-frying workers observed in Southwestern Nigeria are sitting beside (SB), sitting in front (SF), alternating sitting and standing (ASS) and standing (S). The discomfort levels in these identified postures were measured in 120 workers using Cornell Musculoskeletal Discomfort Questionnaire. It was discovered that there was higher work-related musculoskeletal disorders (WMSDs) in the low back and upper back, placing musculoskeletal discomfort in the trunk. Specifically, WMSDs occurred in the hip-buttock, knee and neck for SB, hip-buttock for SF, low leg and shoulder for S and right forearm for ASS [20].

In a review work of the University of California Agricultural Ergonomics Research Centre for the past decade, three general risk factors were cited as both endemic and of highest priority throughout the agriculture industry. They include: lifting and carrying heavy loads; sustained or repeated full-body bending (stoop); and very highly repetitive hand work (clipping, cutting). Each type of production agriculture has its own unique ergonomic hazards and musculoskeletal injury problems, although some hazards are similar throughout production agriculture in general. [21]

In farm power and machineries, postural discomforts during power tiller operation were assessed by some researchers [22, 23] This assessment was carried out using the Overall Discomfort Rating (ODR) and Body Part Discomfort Score (BPDS) using rating scales. Majority of discomfort was experienced in the arm, leg, and shoulder region for all the subjects for the walking type power tiller during rotor-tilling and majority of the discomforts was in the lower back, buttocks, thigh and the thigh region for the power tiller. [22]

This paper assesses work-related musculoskeletal risk in the gari-frying task to provide information for necessary redesign of the work system to reduce or eliminates musculoskeletal disorders the worker may be susceptible to, with the benefit of enhancing the health of the operator as well as increasing efficiency and productivity of the small-scale processor.

Material and Method

Forty *gari*-frying workstations (a worker per station) were selected in Ifo Local Government and its environs in Ogun State, southwestern part of Nigeria using purposive sampling technique. *Gari*-frying task was divided into three main work elements namely, loading, stirring and unloading of the grated cassava mash. This excludes the setting up of the facility and other menial activities that took place after the main processing task. The risk factors investigated include musculoskeletal stress and awkward posture. Musculoskeletal stress was assessed by carrying out an elementary survey and a Job Hazard Analysis (JHA) of the workers, work posture, work environment and the work tasks. Awkward posture was analysed using the arm reach ratio.

Elementary survey for the assessment of musculoskeletal stress was based mainly on the workers filling questionnaire to elicit information relating to the problems, difficulties, discomforts and side-effects experienced while performing the task. The questionnaire contained a ‘body map’ as an aid to the workers to pinpoint the particular area where they experience body discomfort and the duration and frequency of such to determine the severity, in addition to interview and visual inspection.

To further analyse the prevalence of musculoskeletal stress, JHA was performed which has the following steps

1. involving workers
2. selecting the job to be analysed
3. breaking the job down into a sequence of steps
4. identifying hazards
5. determining preventive measures to overcome the hazards. [24]

Step 1 was carried out during the elementary survey which made the workers to access the level of stress they experienced while performing the task. From the questionnaires, the workers rated the level of discomfort experienced on a scale of very stressful, moderately stressful, mildly stressful and not stressful as defined below:

- Very stressful: The discomfort experienced due to the task is highly unbearable.
- Moderately stressful: The discomfort experienced due to the task is unbearable.
- Mildly stressful: The discomfort experienced due to the task is bearable.
- Not stressful: No form of discomfort was experienced while performing the task.

The frequency at which they experience discomforts during gari frying was also elicited using on a scale of never, seldom and always defined as follows:

- Never: Discomforts had never being experienced while performing the task
- Seldom: The discomforts were experienced once in a while
- Always: Discomforts were experienced regularly any time the task is performed.

For the step 2 of the JHA, the job to be analysed is clearly the gari frying process while in the third step, the process of frying gari was broken down into three which are;

a. Loading Task
b. Stirring Task
c. Unloading Task

In carrying out the fourth step of the JHA, 'Quick Ergonomic Check' (QEC) was carried out for each tasks. The QEC assesses exposure to musculoskeletal risk factors for the back, shoulders/arms, hands/wrists, and neck regions; the level of stress in the work and the work pace all in different sections. It contains likely effects of working situations, working pace, duration of work, repetitive activities, etc. on the various parts of the processor's body with each effect having a corresponding score. The summation of the scores for each section determines the extent of the exposure to such risk given a safe limit. Also, based on the scores, the stress level and the work pace were determined.

The principal means of eliminating or reducing hazard exposure used include:

1. Engineering measures (i.e. redesigning the process or equipment)
2. Substitution measures (e.g. changing equipment or tools).
3. Administrative measures, such as revising work procedures, i.e., changing the sequence of steps or adding steps [25]

This was used in carrying out the fifth step of the JHA.

For awkward posture analysis, a comparison was made of the worker's arm reach to the longest length to the end of the frying pan over which the processor may have to stretch during the work as follows:

$$R = \left(\frac{F + X}{L}\right) \tag{1}$$

where: L = worker's arm length; F = the longest length (diagonal) of the frying pan; X= distance between the worker and the frying pan; R = arm reach.

For a safe operation, R≤1, signifying that the ratio of the length of the worker's arm length to the longest length to the end of the frying pan must be less than or equal to one. Equality condition holds, when the workers' arm reach is just sufficient to reach the work piece without stretching or twisting the body. At any point when the ratio is greater than 1, the implication is that the worker's arm reach is not sufficient to reach the work piece, but must stretch or twist his/her body in an attempt to perform the task. Such a condition would confirm the presence of awkward posture while performing the task.

Statistical Analysis

ANOVA was performed on the result of the QEC scores for each task using Excel 2003 (Analysis Tool Pack) to test the hypothesis based on the following criteria:

Null hypothesis, H_o: no significant difference between the results gathered from all the workers for the different parts of their body.

Alternative hypothesis, H_i: = there is a significant difference between the results gathered from all the workers for the different parts of their body.

Decision: Accept $H_{0,}$ if $F_{tab} < F_{cal}$, that is, the treatment has no effect on the parameter of interest. Hence H_1 is rejected;

Accept H_1 if $F_{tab} > F_{cal,}$ that is, there is significant difference in the treatment with respect to the parameter of interest. Hence H_0 is rejected.

where: F_{tab} is the variance ratio from the table at 1% while F_{cal} is the variance ratio calculated by the software.

Results and Discussion

The workers identified for the workstation are as shown in Table 2 below which shows that 97.5% of the workers assessed were female.

Table 2. Distribution of Gari Frying Workers with Age

SEX	*15-25yrs*	*26-40yrs*	*>40yrs*
Male	3	2	0
Female	1	14	20

From Table 3, most of the workers (82.5%) complained of body pain especially while working. The reduction in the number of those experiencing pain always after work was due

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to the fact that the workers took some medication. Also, the workers complained about pain in some specific parts of their body.

Table 3. Discomforts Experienced during *Gari*-frying Task

	Never	*Seldom*	Always
Discomforts during work	1	6	33
Discomforts after work	6	7	27

From the body map it was discovered that about 97.5% of the workers complained of pain in the shoulder/arm region and the back region (about 35.0%). In addition, some specific working postures were identified which contributed to the stress level of gari frying. 23.08% of the complaints got from those using the frontal *gari*-frying posture are for back pain while 26.2% of the complaints from those frying with sideways experienced back pain. These results are presented in Figure 1.

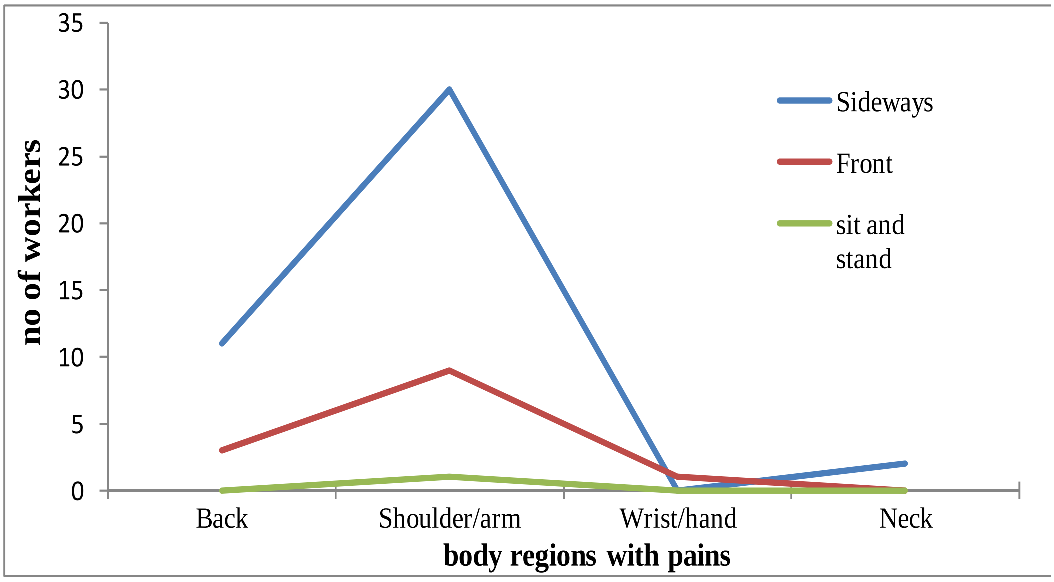

Figure 1. *Worker's Complain of Body Pains during Gari-Frying for Different Work Posture*

From Table 4, sit and stand posture was least stressful (mildly stressful) compared to sideways posture which was four times as stressful and, therefore, identified as the most stressful posture.

Table 4. Mean QEC Stress Scores of Workers' Performing *Gari* Frying

Posture	*Score*	*QEC Scale*
Front	10	Moderately stressful
Sideways	16	Very stressful
Sit and stand	4	Mildly stressful

The results from the QEC as revealed in table 5 and Figure 2, shows that stirring task is the most stressful compared to the other two. The stress recorded in the stirring task is at least double that of loading and unloading. Also, it was revealed that the loading and unloading tasks are not stressful except for the awkward postures taken. This is so because they are not repetitive, that is, the interval between each activity is far apart. Table 5 explicitly shows the stress level for various body regions compared to a permissible limit recommended in the QEC.

Table 5. Mean Stress Scores from QEC for Different Working Postures

Body parts	Loading	Stirring	Unloading
Back	12.35	23.80	8.55
Shoulder/arm	10.00	25.60	10.00
Wrist/hand	10.00	30.50	10.00
Neck	5.85	13.20	5.85

Figure 2. Mean QEC Scores in Different Body Region during Stirring Task

The results got from the QEC also shows that the working rate of the workers were affected, leading to reduced productivity (mean working pace score was 8; comparing it to a tolerable score of 4. This indicated that the workers were finding it difficult to keep up with the pace of the work).

From the result of the ANOVA in table 6, table 7 and table 8, since $F_{cal} < F_{tab}$ for the three tasks based on the QEC results, the null hypothesis was accepted while the alternative hypothesis was rejected. It implies that there was no significant difference between the results gathered from all the workers for the different parts of their body (i.e. shoulder/arm, wrist, back and neck) at 0.01 level for all the tasks (loading, stirring task and the unloading task).

Table 6. ANOVA for Loading Task

Source of Variation	Sum of Square	Degree of Freedom	Mean Square	F_{cal}	F_{tab}
Between Groups[1]	21.6	39	0.553846	0.071464	1.75995
Within Groups	930	120	7.75		
Total	951.6	159			

[1]Each of the body part considered were analysed as a group i.e. shoulder/arm, wrist, back and neck

Table 7. ANOVA for Stirring Task

Source of Variation	Sum of Square	Degree of Freedom	Mean Square	F_{cal}	F_{tab}
Between Groups	3340.775	39	85.6609	1.56611	1.75995
Within Groups	6847	120	54.05833		
Total	9827.775	159			

Table 8. ANOVA for Unloading Task

Source of Variation	Sum of Square	Degree of Freedom	Mean Square	F_{cal}	F_{tab}
Between Groups	12.4	39	0.31949	0.078243	1.75995
Within Groups	490	120	4.083333		
Total	502.4	159			

In the analysis of awkward posture, the result gathered showed that the entire workers under study have to stretch to reach the end of pan while frying. The mean arm reach ratio was 1.19 (F=64.30cm; X=16.54cm; L=67.73cm); this shows that overstretching is a risk factor under awkwardness in posture for the population under study. This overstretching makes the workers to deviate from the neutral back position in an angle of θ =77.22° to the vertical (given an average mid-shoulder height of B=59.20cm [26]) as shown in Figure 3 and 4.

These results are in line with the result of other researchers [20], [27-30] who identified musculoskeletal stress in Agriculture to occur mostly in upper back, low back, neck, upper extremities (hands, wrists, elbows, arms, and shoulders) regions.

Musculoskeletal stress could lead to numerous types of musculoskeletal disorders such as disorders of the back and neck, nerve entrapment syndromes, tenosynovitis, tendonitis, peri tendonitis, epicondylitis and non-specific muscle and forearm tenderness [27].

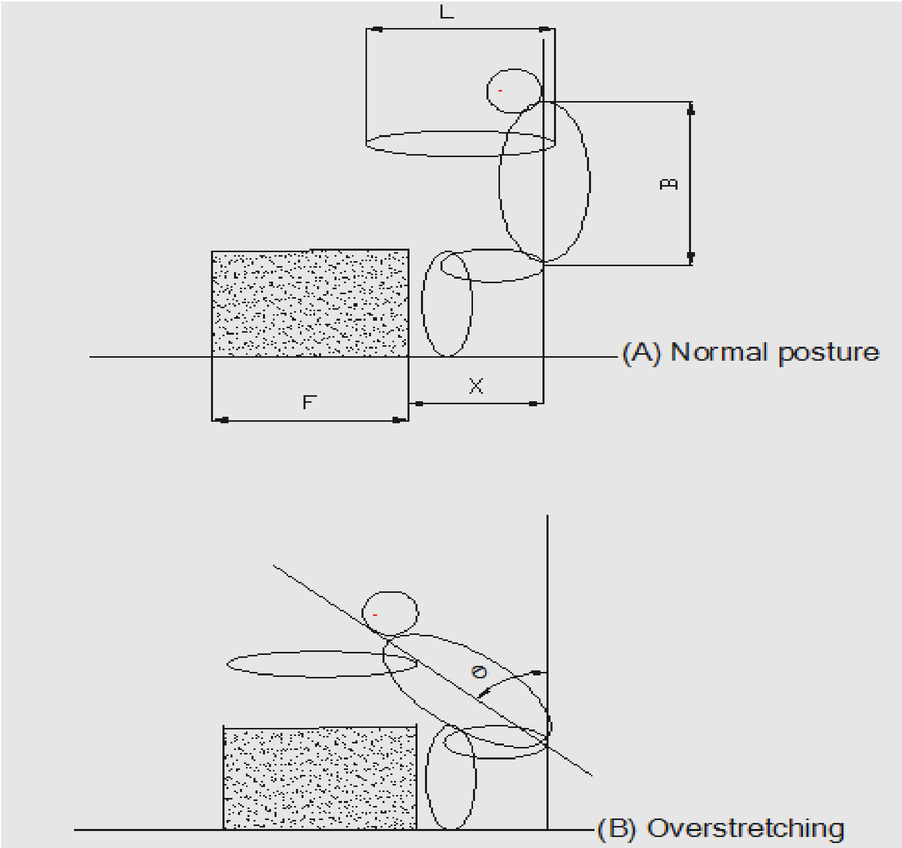

Figure 3. *Analysis of Overstretching In Gari Frying (*where: B= mid-shoulder height (length of the back) while sitting, θ= angle of deviation from the neutral back position)

Figure 4. *Overstretching while frying gari (photo by B.O Adetifa)*

With all these, it implies that in order to remove the stress involved in gari frying, the following areas should be worked upon;

a. Overstretching

- Adjustment of gari fryer dimension so that $L \geq (F + X)$ or
- Increase the number of workers making use of the present system so

that $nL \geq (F + X)$. Where n = an even number of workers who should be on opposite sides of the fryer.

b. Musculoskeletal stress (back and neck)
   - Design appropriate seats according to the anthropometrical data of the workers collected.
   - Observing rest breaks
   - Adjust the height of the frying surface so as to allow for alternation between seating and standing posture.

c. Musculoskeletal stress (Shoulder/arm and wrist)
   - Observing rest breaks
   - Stretching of arm after work
   - Reduced working hour

d. Repetitive stress (work pace)
   - Increase the number of workers making use of the present system
   - Observe rest breaks.

Conclusions

It has been established that the *gari*-frying process is very tedious and has some ergonomic risks attached to it, causing a reduction in productivity, making the workers work in discomfort which affect their health. Musculoskeletal stress, repetitive stress and awkward posture have been identified as the ergonomic risk factors in the *gari*-frying process affecting processors, mainly aged women (above 40years) which can lead to musculoskeletal disorders. The body regions mostly affected are the shoulder arm region and the back. Stirring task has been identified as the most critical job element (task) of the frying process while sitting sideways was identified as the most stressful work posture.

For the prevention of injuries due to repetitive stress and exertion, rest breaks should be observed. Repetitive tasks should be combined with non-repetitive tasks. However, for a task like stirring of *gari*, rest breaks should be observed, since it requires a sustained period of repetitive turning of the *gari* in the pan.

In order to avoid any form of MSDs for the entire process it is recommended that:

1. A two-hour rotation between workers is suggested to reduce incidence of musculoskeletal

disorders, occasioned by repetitive, static work or a half-day-shift mode of operation. This might have been taken care of in the case of workstations where two workers are engaged in the task.

2. The worker should stretch their neck, shoulders, back, legs, arms and fingers at least twice during work duration.
3. Elevated frying surface with a corresponding seating should be designed to enable the worker use "sit and stand" posture.

References

1. Adeyemo F. S., Odediran O. F., Ogundeji R. K., *Cassava tubers and exiting cassava processing technologies in southern Nigeria*. NIJSS, 2006, 5(1), p. 37-42.
2. Oloko S. A., Falegan T., Agbetoye C. A. S., *Investigation into the Present Status of Gari Processing in Ondo State*, NJISS, 2006, 5(2), p. 65-71.
3. Igbeka J. C. *Recent developments in cassava frying operation and equipment used for gari production in Nigeria*, Transformation Alimentaire du Manioc, 1995. *ORSTOM*, p. 581-593.
4. Jekayinfa S. O., *Ergonomic evaluation and energy requirements of bread-bakingOperations in south western Nigeria*, Nutrition & Food Science 2008, 38, p. 239-248.
5. Pascarelli E. F. *Repetitive Stress Injury*. Microsoft® Encarta® 2009 [DVD]. Redmond, WA: Microsoft Corporation.
6. Abdul J. M., Olaboye Y. O.: *Ergonomics Appraisal of Passenger Seats of Locally-Built Buses*. NJEM, 2002, 3(3), p. 18-23
7. Waldemar K., *The Technology Management Handbook; Safety and Human Factors-Ergonomics and Human Factors*, CRC Press and IREE Press, 1999, p. 12-21.
8. Aabedini R., Choubineh A, Oltanzadeh S. A., Ghiasv R., Kazemhaghighi M., *Ergonomic evaluation of exposure to musculoskeletal disorders risk factors by Quick Exposure Check (QEC) technique in a metal structure manufacturing factory*. Jundishapur J Healt Sci, 2012, 4(2), p. 1-79.
9. Motamedzade M., Ashuri M. R, Golmohammadi R., Mahjub H., *Comparison of Ergonomic Risk Assessment Outputs from Rapid Entire Body Assessment and Quick Exposure Check in an Engine Oil Company*. Journal of Research in Health Sciences 2011,

11(1), p. 26-32.

10. Mesbah F., Choobineh A., Tozihian T., Jafari P., Naghib-Alhosseini F., Shidmosavi M., Pakshir K., Movahedi M., Sarvestani S., *Ergonomic intervention effect in reducing musculoskeletal disorders in staff of Shiraz Medical School* . Iran Occupational Health Journal 2012; 9 (1), p. 41-51.
11. Simonsson P., Rwamamara R.; *Ergonomic Exposures From the Usage of Conventional and Self Compacting Concrete*; in Proceedings for the 17th Annual Conference of the International Group for Lean Construction- Safety, Quality and the Environment, 2009, pp. 313-322.
12. David G. C., *Ergonomic methods for assessing exposure to risk factors for work related musculoskeletal disorders*. Occupational Medicine, 2005, 55, p. 190-199.
13. The Robens centre for health ergonomics: *Quick Exposure Checklist* www.surreyergonomics.org.uk (accessed 26/01/2009)
14. David G., Woods V., Buckle P. Research Report: *Further development of the usability and validity of the Quick Exposure Check (QEC).* Norwich: HSE Books. 2005.
15. David G., Woods V., Li G., Buckle P., *The development of the Quick Exposure Check (QEC) for assessing exposure to risk factors for work-related musculoskeletal disorders*. Applied Ergonomics, 2008, 39(1), p. 57-69.
16. Li G., Buckle P., *A practical method for the assessment of work-related musculoskeletal risk- Quick Exposure Check (QEC).* Proceeding of 42nd Annual Meeting the Human Factors and Ergonomics Society. 1998; US Santa Monica; p. 1351-5.
17. Brown R., Li G. *The development of action levels for the Quick Exposure Check (QEC) system*. In: McCape PT, Contemporary Ergonomics. London: Taylor & Francis. 2003, p. 41-6.
18. McAtamney L., Nigel Corlett E., *RULA: a survey method for the investigation of world-related upper limb disorders,* Applied Ergonomics 1993, 24(2), p. 91-99.
19. McNeill M., *Ergonomics in Post-Harvest Agro-Processing*; African Newsletter on Occupation Health and Safety, 2005, 15(1), p. 11-13.
20. Oladele Peter Kolawole, *Discomfort Levels in Four Working Postures in use during Gari Frying*. ICASTOR Journal of Engineering 2012, 5(2), p. 103-110.
21. Chapman L., Meyers J., *Ergonomics and musculoskeletal injuries in agriculture: recognizing and preventing the industry's most widespread health and safety problem.*

Agricultural Safety and Health Conference Proceedings. 2001

22. Sam B., Kathirvel K., *Assessment of Postural Discomfort during Power Tiller Operations*. Agricultural Mechanization in Asia, Africa and Latin America. 2008, 39(1), p. 14-17.
23. Nkakini S. O., Akor A. J., Zibokere D. S., *Ergonomics of Tractor Operation Controls of Comfort of Nigerian Operators*. Proceedings of the 7th international general meeting of the Nigerian institution of Agricultural Engineering, 2006, 28.
24. Occupational Safety and Health Administration (OSHA): *Job Hazard Analysis*, 3071, 2002 Revised edition.
25. Safety Regulations and Procedures: *Accident Prevention Program*, Job Hazard Analysis, S20.35, Revised August 2008.
26. Anonymous: *Cumulative Trauma Disorders/Anthropometry*; Available at: http://www.mech.utah.edu/ergo/pages/Educational/safety_modules/ctd-anthropometry/index.html#lecture (accessed 19/02/2012).
27. Surabhi S., Renu A. *Ergonomic Intervention for Preventing Musculoskeletal Disorders among Farm Women*. J Agri Sci, 2010, 1(2), p. 61-71.
28. Davis K. G., *Understanding the Ergonomic Risk for Musculoskeletal Disorders in the United States Agricultural Sector*, Am. J. Ind. Med, 2007, 50 (7), p. 501-511.
29. Meyers J., Miles, J. Faucett, J. Janowitz I. Tejeda D., Duraj V., Kabashima J., Smith R. W. E.: *High Risk Tasks for Musculoskeletal Disorders in Agricultural Field Work*. Paper Presented at the American Public Health Association, Washingnton, D. C. 1998
30. Samuel T. M., Igbeka J. C, Kolawole O. P., *A Survey of Improved Gari frying Methods*. International Journal of Food Engineering 2010, 6(2), 15.