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ORIGINAL RESEARCH ARTICLE

ASSESSMENT OF WORKERS' LEVEL OF EXPOSURE TO WORK-RELATED MUSCULOSKELETAL DISCOMFORT IN DEWATERED CASSAVA MASH SIEVING PROCESS

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ABSTRACT

This study was undertaken to assess the level of exposure of processors to work-related musculoskeletal disorder when using the locally developed traditional sieve in the sieving process. Quick ergonomic checklist (QEC) involving the researcher's and the processors' assessment using the risk assessment checklist, was used in this assessment and data was obtained from a sample of one hundred and eight (108) processors randomly selected from three senatorial districts of Rivers State. Thirty-six processors from each zone comprising of 14 males and 22 females, were selected., and assessed on the bases of their back, shoulder/arm, wrist/hand and neck posture and frequency of movement during traditional sieving process. The result of the assessment showed that the highest risk of discomfort occurred at the region of the wrist/hand, followed by back, shoulder/arm, and neck. The posture used in the sieving process exposed the processors, not only to the discomfort of pain but also put them at high risk of musculoskeletal disorder at indicated by a high level of percentage exposure of 66% QEC rating. The result indicated a need for immediate attention and change to an improved method that will reduce the discomfort on the body parts assessed. identified parts.

1.0 Introduction

Dewatered cassava mash (DCM) sieving process carried out to separate fine particles from the coarse using traditional method, whereby a processor sits in an awkward posture besides a traditional sieve made of raffia, load a lump of cassava mash, shatters it and then bends back and forth to shear the mash against the sieve with shearing and compressive force is considered to be labour intensive and hence consumes time and energy (Agbetoye and Oyedele, 2007; Adetunji et al., 2013, Abubakar et al., 2014, Ahiakwo et al., 2015, Abiodun et al., 2016). It takes two hours thirty minutes to sieve 60kg of dewatered cassava mash on a traditional sieve of dimension 600 x 700mm with 2.87mm average sieve aperture. On the average commercial cassava processors using traditional sieve spends 5 hours daily in the sieving operation (Ahiakwo, 2018).

Also, the cardiovascular response of the processors to the rigours of the sieving process is not static. , as research has shown that processors utilizing the traditional sieving process spend energy at the rate of 3.17 to 3.52kJ/min (Asiru et al., 2010; Ahiakwo, 2018). This energy depletion over time together with the awkward posture incidental to this sieving process gives rise to work-related discomfort that may cause disorder in the processor's musculoskeletal system.

There is limited literature on the level to which processors are exposed to when using the traditional sieving process. However, there are methods that are designed to assess the exposure of workers to occupational discomfort. These methods include use of ergonomic questionnaire and postural evaluation method using: Quick Ergonomic Checklist (QEC), Rapid Upper Limb Assessment (RULA), Rapid Entire Body Assessment (REBA), Ovako Working Posture Assessment System (OWPAS), (Alan 2005, Joanne, 2007; Sandiq et al., 2014, and Mohsen et al., 2015). Among these methods of exposure assessments, the quick ergonomic checklist (QEC) offers an advantage of quickly assessing and evaluating the exposure of workers to the risks of work-related musculoskeletal discomfort (WMSDs) (Anas et al., 2012). QEC is centred on the practitioners' requirement and investigation on major WMSD risk factors. QEC has great level of usability and highly recommended observer reliability. Field survey proves that QEC is relevant for a wide variety of tasks. QEC provides an appraisal of a workplace and design of equipment, which enhances redesign. QEC helps to prevent many kinds of WMSDs from developing and educates users about WMSD risks in their workplaces (Samuel et al., 2016). QEC uses Observer's and worker's Assessment Checklist to investigate exposure to MSD. The QEC user (the observer) uses the "Observer's Assessment" checklist, to carry out a risk evaluation for a particular task. At least one whole work process is observed before making the evaluation. The assessment can be carried out by direct observation or by using video footage. The worker being observed will have to complete the "worker's Assessment Checklist," (Neville, et al., 2005).

Also, assessment of workers exposed to work-related musculoskeletal disorder (WMSD) has been done in other fields where energy, time consumption and awkward posture are involved, as it is in the traditional sieving process. Simonson and Rwamamara (2009), examined ergonomic exposures from the use of conventional and self-compacting concrete; Oladele (2012) carried out study on discomfort levels in four working postures used during Gari frying, Anas et al. (2012) carried out ergonomic study of WMSD among the workers in typical Indian saw mills, Ismail and Darshak, (2016) carried out anthropometric measurement for design of students' furniture in India, Samuel et al. (2016) carried out anthropometric studies for designing to fit gari-frying workers. These studies revealed the need to give attention to the levels to which workers are exposed to WMSD and make early adjustment where necessary for safety. A lot of musculoskeletal damages begin when worker starts feeling discomfort and if ignored, the risk factors responsible for the discomfort eventually leads to an upsurge in the severity of symptoms, and what began as mild discomfort would gradually become severe and will be experienced as aches and pains. More so, the pains and aches that signal some growing discomfort may eventually give rise to actual musculoskeletal damage, such as tenosynovitis, tendonitis, or serious nerve-compression injury like carpal tunnel syndrome (Neville, 2005).

Considering that the traditional sieving process is labour intensive and consumes energy, it implies that processors using this method of sieving are exposed to work–related discomfort (Asiru et al., 2010; Ahiakwo et al., 2015, Ahiakwo, 2018). It is important to determine this level of exposure to the risk factor, to enable a quick action to be taken on redesigning and educating

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processors to change to a safer method of accomplishing this sieving task. Redesigning besides reducing and where possible eliminating the risk factors will enhance high productivity in this unit operation. It is therefore the objective of this study to assess the level of exposure of processors to work-related musculoskeletal disorder when using the locally developed traditional sieve in the sieving process using Quick ergonomic checklist (QEC).

2. Materials and Method

2.1 Material

A quick ergonomic checklist was carried out to assess if processors using a locally developed traditional sieve constructed by the local craftsmen were exposed to WMSD as a result of the posture adopted during sieving process and the level of exposure. To do this, a sample of one hundred and eight subjects (108) randomly selected from the three senatorial districts of Rivers state, 36 from each zone 14 males and 22 females were used. Also used were the following materials:

dewatered cassava mash (DCM),
locally made traditional sieve
receptacle
wooden stool
weighing scale and
a mobile android phone

The traditional sieve is usually square or rectangular in shape. It is made of cane, raffia palm or palm frond material. This is cut out into several pieces of flat rectangular flexible strip measuring about 0.5 x 60 cm, with thickness of about 1 mm. whereas 0.5 cm represent the width of a single sieve strip, 60 cm, which represent the length of the sieve can vary depending on the length of the sieve. These are weaved by the native specialist craftsmen in such a way that an aperture (square holes) of about 2 to 3 mm^2 is revealed at alternate position throughout the sieve. The woven strip is secured over framework of thick material as shown Figure 1 (Ahiakwo et al., 2015)

Figure 1: A traditional sieve ready for sieving process

2.2 Method

Before the assessment, the procedure was explained to each of the subjects involved. They got the following materials ready: the dewatered cassava mash (DCM), locally made traditional sieve, receptacle and wooden stool which were to be used for the sieving processing. Three observers were trained to cover the three respective senatorial zones and were provided with a weighing scale and a mobile android phone. The weighing scale was for taking the weight of DCM sieved in a single task while the mobile android phone video/camera was used to capture processors posture and activities .- sieving process - (Sandiq et al., 2014). The observers, observed processors in their traditional accustomed manner of carrying out the sieving task through one complete cycle with the traditional sieve. The processors were assessed on the basis of their back posture, head/neck posture and wrist/hand deviation from neutral position during the sieving process, as shown in Figure 2. The assessment was done by observation of the sieving process, measurement and noting how the back, head/neck and wrist/hand were bent away from the normal position and assigning values based on Quick Exposure Checklist.They were also assessed on the basis of their back movement which was obtained by noting the number of times the processor moves back and forth during the sieving process, their shoulder/arm task position which was obtained by taking measurement of the sieving height and the seating height (Figure 3) of the processor and their hand motion pattern which was obtained by noting the degree of frequency of hand motion during the sieving process and the number of times the hand swings forth and back as the DCM is moved across the traditional sieve (Neville, 2005).

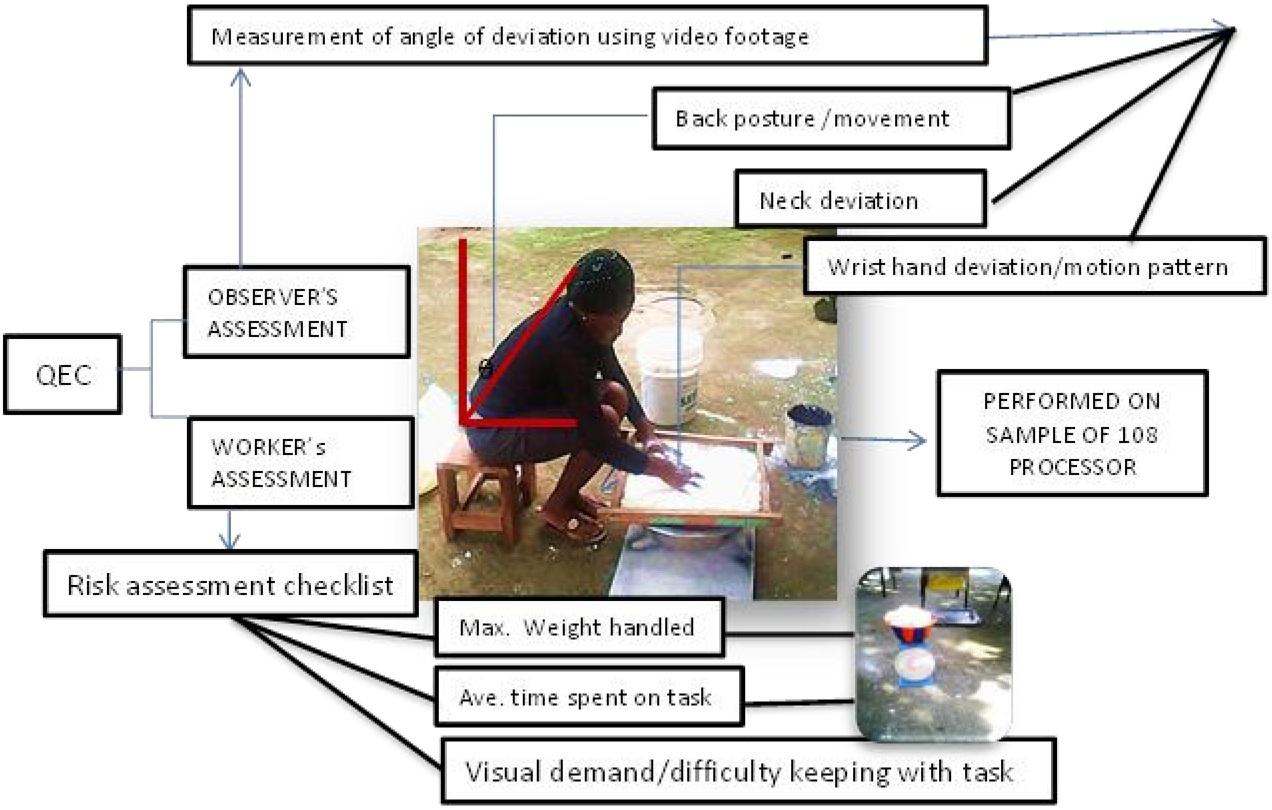

Figure 2: Method of observer and processors' assessment

Figure 3: A processor performing sieving task below waist height in the traditional posture

On the other hand, the processors were assessed after filling the workers' risk assessment checklist shown in Tables 1 on the basis of maximum weight handled, average time on task, maximum force level exerted by one hand, visual demand, difficulty in keeping with the work and level of stress.The maximum weight (kg) handled was obtained by measurement with the weighing scale, the highest quantity of DCM lump a processor loads onto the sieve to carry out one complete sieving cycle. The average time on task was obtained by summing up the hours all the processors individually spent carrying out sieving task per day and dividing by the number of

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processors (hr./day) while the maximum force exerted by one hand is the force required to overcome the resistance of the maximum weight of the DCM on the sieve in moving it across the sieve by one hand (kg). Also the opinions of the processors were sought with respect to their visual demand, difficulty keeping with the work and level of stress during the sieving process.

Table 1: Quick Exposure Checklist (QEC) for Work-Related Musculoskeletal Risks Assessment

Observer's Assessment	Worker's Assessment
Back	• What is the maximum weight handled in this task?
A. When performing the task, is the back	H1: Light (5 kg or less)
A1. Almost neutral?	H2: Moderate (6 to 10 kg)
A2. Moderately flexed or twisted or side bent?	H3: Heavy (11 to 20 kg)
A3. Excessively flexed or twisted or side bent?	H4: Very heavy (more than 20kg)
B Select Only One of the two following task option:	• How much time on average do you spend per day doing this task?
For sealed or standing stationary tasks.	J1: Less than 2 hours
Does the back remain in a static position most of	J2: 2 to 4 hours
the time? B1: No B2: Yes	J3: More than 4 hours
For manual handling tasks only: Is the movement of the back-	• When performing this task (single or double handed), what is the maximum force level exerted by one hand?
B3: Infrequent? (Around 3 times per minute or less)	K1: Low (e.g., Less than 1 kg)
B4: Frequent? (Around 8 times per minute)	K2: Medium (e.g., 1 to 4 kg)
B5: Very frequent? (Around 12 times per minute or more)	K3: High (e.g., More than 4 kg)
Shoulder/arm	.Is the visual demand of this task
• Is the task performed	L1 Low (almost no need to view fine details)?
C1: At or below waist height?	L2 High (need to view some fine details
C2: At about chest height?	• Do you have difficulty keeping up with this work?
C3: At or above shoulder height?	P1: Never
• Is the shoulder/arm movement repeated	P2: Sometimes
D1: Infrequently? (Some intermittent arm movement)	P3: Often
D2: Frequently? (Regular arm movement with some	• How stressful do you find this work?

pauses)	
D3: Very frequently? (almost continuous arm movement	Q1: Not at all stressful?
Wrist/Hand	Q2: Mildly stressful?
• Is the task performed	Q3: Moderately stressful?
E1: With almost a straight wrist?	Q4: Very stressful?
E2: With a deviated or bent wrist position?	
• Is the task performed with similar repeated motion patterns	
F1: 10 times per minute or less?	
F2: 11 to 20 times per minute?	
F3: More than 20 times per minute?	
Neck	
G. When performing the task, is head/neck bent	
G1: No	
G2: Yes, occasionally	
G3: Yes, continuously	

Source: Winery Ergonomic Risk Assessment (2012)

In each of the cases, data and responses were obtained from the observers' assessment and the processors' assessment for analysis. From data obtained inferences were drawn and rated based on QEC and scores assigned based on Winery ergonomic risk assessment score sheet. Data obtained by the observer, include data on back angle deviation (o) from normal and rated A1, A2 or A3 depending on degree of deviation, head/neck and data on hand/wrist angle deviation which was obtained by measuring degree of deviation from the processing picture (Figure 3) was rated E1 or E2 depending on degree of deviation and inferences were drawn and rated based on QEC and scores assigned based on Winery ergonomic risk assessment score sheet (2012).

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Table 2: Ergonomic Risk Assessment Score Sheet

BACK — Back posture (A) & weight (H)

	A1	A2	A3
H1	2	4	6
H2	4	6	8
H3	6	8	10
H4	8	10	12

SHOULDER/ARM — Height (C) & Weight(H)

	C1	C2	C3
H1	2	4	6
H2	4	6	8
H3	6	8	10
H4	8	10	12

WRIST/HAND — Repeated Motion (F) & Force(k)

	F1	F2	F3
K1	2	4	6
K2	4	6	8
K3	6	8	10

NECK — Neck Posture (G) & Duration(J)

	G1	G2	G3
J1	2	4	6
J2	4	6	8
J3	6	8	10

Back posture (A) & Duration (J)

	A1	A2	A3
J1	2	4	6
J2	4	6	8
J3	6	8	10

Height (C) & Duration(J)

	C1	C2	C3
J1	2	4	6
J2	4	6	8
J3	6	8	10

Repeated Motion (F) & duration(J)

	F1	F2	F3
J1	2	4	6
J2	4	6	8
J3	6	8	10

Visual demand (L) & duration (J)

	L1	L2
J1	2	4
J2	4	6
J3	6	8

Duration (J) & weight (H)

	J1	J2	J3
H1	2	4	6
H2	4	6	8
H3	6	8	10
H4	8	10	12

Duration (J) & weight (H)

	J1	J2	J3
H1	2	4	6
H2	4	6	8
H3	6	8	10
H4	8	10	12

Duration (J) & Force(k)

	J1	J2	J3
K1	2	4	6
K2	4	6	8
K3	6	8	10

Work pace

P1	P2	P3
1	4	9

Frequency (B) & weight (H)

	B3	B4	B5
H1	2	4	6
H2	4	6	8
H3	6	8	10
H4	8	10	12

Frequency(D) & weight (H)

	D1	D2	D3
H1	2	4	6
H2	4	6	8
H3	6	8	10
H4	8	10	12

Wrist Posture (E) & Force(k)

	E1	E2
K1	2	4
K2	4	6
K3	6	8

Stress

Q1	Q2	Q3	Q
1	4	9	16

Frequency (B) & Duration(J)

	B3	B4	B5
J1	2	4	6
J2	4	6	8
J3	6	8	10

Score 5:________

Frequency(D) & Duration (J)

	D1	D2	D3
J1	2	4	6
J2	4	6	8
J3	6	8	10

Score 5:________

Wrist Posture (E) & Duration(J)

	E1	E2
J1	2	4
J2	4	6
J3	6	8

Score 5:________

Total score for back:_____

Total score for Shoulder/arm:_____

Total score for wrist/hand:_____

Source: Winery Ergonomic Risk Assessment (2012

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Scores were assigned by associating observer assessment and processors assessment. The back was assessed as A2 because on average, it was bent more that 20o but less than 60o whereas the maximum weight handled in this task was rated H1 because it fell in the range of light (Table 1). This association attracted a score under A2H1 (Table 2). The total association scores for back assessment was the summation of scores under A2H1, A2J3, J3H1, B3H1 and B3J3; the total association scores for shoulder/arm assessment was the summation of the scores under C1H1, C1J3, J3H1, D2H1 and D2J3 also the total association score for hand/wrist assessment was the summation of the scores under F3K2, F3J3, J3K2, E2K2 and E2J3 whereas the total association score for neck assessment was the summation of the scores under G3J3 and L1J3. The total actual exposure (χ) was the summation of the total scores under back, shoulder/arm, hand/wrist and head/neck with workplace and stress level assessment

The resulting scores were presented in table of exposure score and analyzed based on ergonomic exposure equation expressed by Neville (2005):

$$E_i = \frac{x}{x_{max}} \times 100\% \qquad (1)$$

where:

E = Overall exposure

x = actual total exposure score

Xmax = maximum possible total exposure (XmaxMH = 176%for manual handling Neville, 2005)

3. Results and Discussion

3.1 Observers' assessment

Table 3 shows the measured back posture deviation from the normal position of 108 males and females processors who were observed performing sieving task using the locally developed traditional sieve. The average back posture deviation for the three senatorial zones is 37o.

Table 3: Observer's average assessment processors for the three zones

	Male Processors in zones					Female Processors in zones				
Parts Assessed	A	B	C	Mean	SD	A	B	C	Mean	SD
Back posture (°)	35	37.9	27.9	34	5.14	45	38	28	37	8.54
Back movement (no. of times)	3.2	4	3.4	3.5	0.42	3.95	4.18	3.5	3.88	0.35
Shoulder arm task position (mm)	42	46	41	43	2.65	37	41.2	41.5	40	2.52
Seating height (mm)	44	46	40.4	43	2.83	41	41.3	40.4	41	0.46
Wrist hand deviation (°)	21.6	26	17.4	21	4.30	22	23	21	220	1
Motion pattern per minute	62	57	61.8	60	2.83	62	57	61.8	60	2.83

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The back movement of the processors as they carry out the sieving task was 4 times times per sieving cycle and rated B4.. The positions of the arm and the seating height while performing the sieving task were 40 mm and 41mm measured from the floor respectively indicating that the task was performed below waist height and rated C1. The average wrist hand deviation from normal was 22o and rated whereas the average movement of arm back and forth in a minute was 61 times. Table 3 show also the measured back deviation from the normal position of men processors who were observed performing the sieving task using the locally developed sieve. The average deviation considering the three zones was 34o. The back movement of the processors' as they carry out the sieving task was 3 to 4 times. The positions of the arm and the seating height while performing the sieving task were 43 and 43 measured from the floor respectively indicating that the task was performed below waist height. The wrist hand deviation from normal is 21o and the number of times the arm was moved back and forth in a minute was 60 times respectively (Ahiakwo, 2018).

3.2 Processors' assessment

Table 4 shows the result of assessment of male and female processors carrying out sieving task with the locally developed traditional sieve. The average maximum weight handled was 2.1 ± 0.23kg , the average time spent per day on this task was 5 ± 0.40h and the maximum force exerted was 1.5 ± 0.10N

Table 4 : Processors' average assessment

	Male Processors in zones					Female Processors in zones				
Parts Assessed	A	B	C	Mean	SD	A	B	C	Mean	SD
Max. weight handled (kg)	2.3	2.3	2.2	2.2	0.10	1.8	2.2	2.2	2.1	0.23
Average time spent per day (hr.)	4.5	5.1	5.1	4.9	0.35	4.6	5.0	5.4	5.0	0.40
Max force exerted (N)	1.9	1.3	1.6	1.6	0.30	1.5	1.4	1.6	1.5	0.10

Table 4 also shows the result of assessment of 42 male processors carrying out sieving task with the locally developed traditional sieve. The average maximum weight handled, the average time spent per day on this task and the maximum force exerted were 2.2 ± 0.10kg, 4.9 ± 0.35h, and 1.6N ± 0.30, respectively. In the traditional sieving process, the maximum quantity of 2.2kg for a sieving cycle cannot easily be increased since it was limited by the sieve size. Also the force exerted by the hand cannot be reduced in its reciprocation motion across the sieve. The fact that this quantity and the exerted force have to be repeated in each cycle of operation until the total quantity was exhausted in the awkward posture by the processor contributes to exposing the processor to an increase level of discomfort. It was also noted that the total time required to completely sieve a given quantity of DCM depended on the quantity of the DCM (maximum) that can be handled per unit cycle of sieving operation, the size of the sieve and its aperture as well as the frequency of the hand motion. If the quantity for a sieving cycle of operation, the sieve size and the aperture as well as the frequency of hand motion on the sieve were increased, sieving time per day on average would decrease below 4.9hours. Obviously, these factors cannot be increased without increasing discomfort level of the processor. An alternative option to decreasing discomfort level of the processor would therefore be in the direction of developing an improved sieve that consider increasing the sieve aperture, sieve capacity and eliminating or reducing the use of the hand. These provisions, while increasing the quantity considerably above 2.2kg and the throughput capacity, would reduce sieving time spent by farmers on average below the 4.9 h per day.

3.2.1 Inferences on observers' assessment

The inferences drawn from observers' assessment and processors' assessment are expressed in Tables 5 and 6 . Table 5 shows the inferences from Table 3 with respect to QEC for observers' assessment.

Table 5 : Inferences on observers' assessment and QEC rating

Parts assessed	Observation	Inference	Rating
Back	1) Back at370> 200	Back is moderately bent	A2
	2) The back movements was around 3 times per minutes	Back movements is infrequent	B3
	3) Task height ≈ seating height (40mm ≈ 41mm)	Task is performed at or below waist height	C1
	4) Shoulder-arm moved about 61 times per minute	Shoulder arm movement is repeated frequently	D2
Wrist/hand	1) Wrist is at 22°> 150	Task is perform with bent wrist	E2
	2) Task is repeated 61 times per minute	Task is performed with similar repeated motion more than 20 times per minute	F3
Head/neck	200> head/neck < 600	Head and neck is bent Continuously	G3

From the Table 5 , processors' back deviation was > 20. The inference of this from Quick Exposure Checklist (QEC)was that the back was moderately bent and attracted a rating of A2. Back movement was around 3 times, showing that the back movement was infrequent and rated B3. From the table also, The task was performed at a height approximate to the seating heightindicating from QEC that the task was performed below waist height and rated C1. The shoulder arm movement was about 61 times per minute and the inference from QEC was that the shoulder arm movement was repeated frequently and the rated D2. Because the wrist deviation was > 15 the task was performed with a bent wrist. The sieving task was performed with similar repeated motion > 20 times per minutes, and rated F3. On the other hand head and neck were considered to be bent continuously at 200> head/neck < 600 rated G3. (Neville, 2005, Ahiakwo, 2018)

The observation of the body parts namely back, shoulder arm, wrist and head neck and the inferences drawn indicated that these body parts were not in the normal position during the sieving process. It also showed that these body parts during sieving operation were stressed beyond comfort levels. The QEC rating corresponding to the activity of these parts in the sieving process provided insight and means of interpreting the level to which the body parts were exposed to musculoskeletal discomfort.

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3.2.2 Inference on processors assessment

Table 4 shows the inference from Table 2 with respect to QEC for workers' assessment.

Table 4: Inference on workers' assessment and QEC rating

Assessment	Assessment result	Inference	QEC Rating
Maximum weight handled	2.1kg	Maximum weight handled is light (5kg or less)	H1
Average time spent on task per day	5hrs	Task is performed more than 4hrs	J3
Maximumforce level exerted by one hand	1.5N	Force exerted by one hand is medium (1 to 4kg)	K2
Visual demand	Low	Almost no need to view fine details	L1
Difficult keeping with task	workers response	sometimes	P2
How stressful task is	worker response	mildly stressful	G2

Weight handled during the sieving process by the processor was considered light because it fell at the range of ≤ 5kg and rated H1. The inference drawn from the average time spent in the task was that the task was performed more than 4 hours with a rating of J3. Force exerted by one hand was considered medium because it fell between 1 to 4kg and rated K2. The visual demand for the sieving task was low because there was almost no need to view fine details during the sieving process and was rated L1. The workers acknowledge sometimes having difficulty keeping up with the sieving task while using the locally made sieve and rated P2 from the QEC. Also, the workers acknowledge having mild stress while using the locally made sieve and attracted a rating of G2 (Neville, 2005)

3.3 Ergonomic exposure scores for traditional sieving method

Table 5 shows the interaction between the observer's rating and the rating of workers' assessment with resulting scores.

Table 5: Exposure score – traditional sieving method

Back	Shoulder/arm	Wrist/hand	Neck	Work pace	Stress
A2H1= 4	C1H1 = 2	F3K2 = 8	G3J3 =10	P2= 4	Q2= 4
A2J3 = 8	C1J3 = 6	F3J3 = 10	L1J3 = 6		
J3H1 = 6	J3H1 = 6	J3K2 = 8			
B3H1= 2	D2H1= 4	E2K = 6			
B3J3 = 6	D2J3 = 8	E2J3 = 8			
Total 26	26	40	16	4	4

From the ergonomic exposure score sheet and Table 5, the total back exposure of the processors using the traditional sieve in terms of QEC score was 26. The shoulder/arm exposure was 26, the wrist/hand exposure scorewas 40 whereas the neck exposure score was 16. The scores indicated the level of exposure for the individual body parts involved in the sieving process. From the scores, it was seen that the back and shoulder/arm were highly involved and hence under stress during the sieving process. The score of 26 showed that these body parts as well as the neck were in abnormal position. On the other hand the highest score of 40 recorded under wrist/hand was an indication of the body part that suffered highest discomfort as it was subjected to continuous reciprocation during the sieving process. However, it was the combination of the exposures of the individual body parts' discomfort that sumed up to the total exposure of the processors' to Work-related Musculoskeletal Discomfort (WMSD) while using the traditional sieve as shown in Figure .

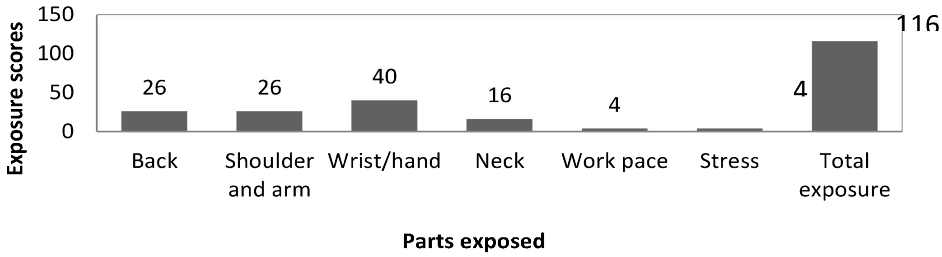

Figure 4 : Exposure of processor performing manual DCM sieving task to WMSD

From Figure 4 , it was observed that the total exposure was the sum of the individual exposures. This resulted to overall percent exposure or total exposure "E" of 66% (Neville, 2005).From table 6, the exposure of 66% indicated that the traditional sieving dewatered cassava mash sieving method requires to be changed soon to an improved method.

Table 6: Preliminary action levels for the QEC

QEC score (E) percentage total	Action Equivalent
≤ 40%	acceptable
41 – 50%	investigate further
51 -70%	investigate further and change soon
>70%	investigate and change immediately

4.0 Conclusion

Cassava processors involved in Dewatered Cassava Mash (DCM) sieving process using traditional method are exposed to Work-related Musculoskeletal Discomfort (WMSD). The observer and processors' assessment shown in the risk assessment exposure scores sheet revealed the level to which the processors' body parts actively involved in the sieving process were exposure to WMSD. The wrist/hand was the most stressed with the highest score of 40 followed by back and shoulder/arm with exposure score of 26 respectively and head/neck with exposure score of 16 given an Overall Exposure level of 66% based on Quick Exposure Checklist (QEC) rating. When compared to the preliminary action levels for the QEC, this method of processing DCM should be further investigated and change soon. Processors therefore should be educated, to be aware that the sieving posture they adopted and with the sieve aperture currently used in traditional sieving process, exposes them not only to the discomfort of pain but also put them at high risk of musculoskeletal discomfort over a period of time and therefore need to change to an

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improved manual method that will consider adjusting the seating and the sieving task height such that the posture of the processors' back and neck is close to normal and also adjusting the sieve aperture to a limit that will reduce the frequency of the processors' hand motion. An alternative will be a motorized method that will factor in mechanisms such that during the sieving process, the involvement of the body parts that suffers discomfort during the sieving process are reduce or eliminated in consideration to ergonomic factor as soon as possible.

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