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ORIGINAL ARTICLE

Risk Factors for Work-related Musculoskeletal Disorders among Sugar Factory Workers in Jinja, Eastern Uganda: A Cross-Sectional Study

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ABSTRACT

Introduction: The disease outcome of musculoskeletal disorders includes; serious occupational disorders and disabilities that are associated with the loss of useful working days and socioeconomic burden to the individual, the organization, and society at large. The aim of this study is to determine the work-related musculoskeletal disorders and associated risk factors among sugar factory workers. **Methods:** The cross-sectional study design was employed in this study in the workplace among 402 workers between two sugar factories. The self-structured Standardized Nordic Musculoskeletal Disorders questionnaire was administered. Data were analysed into descriptive statistics, binary logistic, and multiple logistic regression using SPSS vs. 26. **Results:** The results indicate that the prevalence of work-related musculoskeletal disorders in the previous 12 months among sugar factory workers was 53%. The Lower back region has the highest prevalence of 52.2% and the lowest prevalence of 12.7% on Neck region. The following highlighted factors were significantly associated with the reporting of WRMSD among sugar factory workers during the last 12-months, such as; age of the respondents, educational status, work designation, monotonous task, standing for long periods, and time taken to carry out the task. **Conclusions:** Workers in sugar factories are constantly exposed to ergonomic hazards which predisposed them to WRMSD. If these situations are not prevented it might worsen the burden of WRMSDs among workers, result in cases of more absenteeism and low productivity.

Keywords: musculoskeletal disorders, prevalence, related to work, sugar factory workers

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INTRODUCTION

Musculoskeletal disorders (MSDs) are one of the most salient health problems that affect not only workers within the private sectors but also those within the government sectors. Such avoidable ailments often cause serious occupational disorders and disabilities that are associated with the loss of useful working days, which also have a negative impact, such as the socio-economic burden on the individual, the organization and society at large (Dehghan *et al*., 2016). Similarly, Jay *et al*. (2018) highlighted that MSDs in North America and Europe has constituted a very significant socioeconomic burden on public health.

In the reviewed literature, a very high rate of incidence of MSD was reported among postal workers, sewing machinists, farmers, and office workers, to mention a few (Chandrasekara, Warnakulasuriya and Kisokanth, 2020). Similarly, two researchers Moodley and Naidoo 2015, arising from their findings, classified possible risk factors that are associated with the development of MSD as ergonomic, work factors (psychosocial risk factors due to work stress) and biomechanical (repetition, awkward postures) (Moodley and Naidoo, 2015). A recent statistics report of the occupational health and safety executive of Great Britain, 2015, revealed a prevalence of 44% of work-related musculoskeletal Disorders (WRMSD) diseases and the incidence of

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WRMSD was 169,00. The incidence rate of 530 cases was also reported per 100,000 people. A total estimate of 9.5 million working days was lost as a consequence of work-related musculoskeletal disorders (WRMSDs Great Britain, 2021). Moreover, most agricultural work activities were performed while workers assumed some awkward body postures, this should however be assessed throughout ergonomic evaluation (Jain *et al*., 2018). Conventionally, majority of farm activities were carried out manually, most especially in developing countries, including Uganda. In developing countries, MSD conditions appear to be on the increase because of many aging populations and the increase of sedentary lifestyle which results in obesity (Dianat *et al*., 2020). Internationally, all quarterly visitations to a primary care physician or accident and emergency department are due to symptoms of WRMSD (Brown *et al*., 2020).

This also includes years of life lost due to premature mortality with the year that individuals lived with disability (Husky *et al*., 2018). Musculoskeletal disorders have resulted in the loss of more than 45 000 disabled-adjusted life years in South Africa (Brown *et al*., 2020).

The sugar factory is one of the fastest growing agro-allied/ agro-processed agricultural products in Uganda and the entire East Africa. Non-availability of information on WRMSDs may hinder policymakers in making an accurate estimation that will assist in concluding on well-informed decisions related to resource allocations and subsequent management of those people living with WRMSDs.

In a recent report by WHO on analysis of Global Burden of Disease (GBD) 2019, data revealed that approximately 1.71 billion people globally live with musculoskeletal disorders, which include low back pain, neck pain, amputation(Cieza *et al*., 2020; Babantunde *et al*., 2022)

Furthermore, this burden of disability as provided and estimated by the above summary on measures of health has an impact on the individual's quality of life, during and outside of their job, and the economic independence, as well as the costs to society because of the health and social care at work inform of absenteeism. However, despite this growing burden, there is a lack of priority on policies focusing in the area of musculoskeletal health. This needs to change if we are to meet the demands of an aging population that requires us to remain economically independent (Woolf, 2015). Due to the enormous and significant physical, psychological, and economic costs that are directly associated with the development of WRMSD injuries, it is therefore essential to determine the full scope of the risk factors related to WRMSD to develop prevention and control measures of injury risk. In Uganda, studies on WRMSD have been conducted among schoolchildren (Munabi *et al*., 2014) and healthcare workers (Babatunde and Olaniyan, 2017), but an extensive review of the literature did not reveal studies on the prevalence and risk factors of WRMSD among farmers, especially workers of sugar factories in the country. Sugar factory workers perform detailed tasks that always require them to assume prolonged and static working postures, perform fine muscular work in unnatural postures, and use high-frequency vibration tools, which has been reported to result in the development of WRMSDs (Baxi, Sant and Hande, 2016). Therefore, this study sought to address challenges related to WRMSDs, especially among sugar factory workers, by highlighting the associated risk factors that predict the development of WRMSDs among sugar factory workers in Uganda.

METHOD

This was a cross-sectional study; a cluster random sampling technique was conducted among sugar factory workers in two sugar factories/ companies. A cross-sectional survey was either used to study a phenomenon at a given time or to collect data from multiple groups at the same time (Grove and Gray, 2018). This study design was selected because it has been used in previous studies on musculoskeletal disorders (MSDs) among dentists, steelworkers, nurses and office workers (Woolf, 2015; López-Aragón *et al*., 2017).

Study Location

The study was conducted in Jinja and Buikwe, municipal Uganda; Jinja Municipal consists of Agro-allied industries where most of the sugar factories are located. The study was carried out in two different factories located in Jinja, Uganda.

Sample Population and Sample Size

Since the target population in the sugar factory was the sugar factory, all workers in all units were considered. Sample size determinations make the following assumptions in calculating the minimum

sample size for the two study sites. The two sugar factories comprise approximately 10,000 workers, the sample was calculated as follows using the formula by Schulz and Grimes (Elfil and Negida, 2019).

$$n = \frac{\left[Z_{\alpha}\sqrt{(1+1/m)\bar{p}(1-\bar{p})} + Z_{\beta}\sqrt{p_0(1-p_0)/m + p_1(1-p_1)}\right]^2}{(p_0 - p_1)^2}$$

The formula above clearly shows the minimum number of subject cases that are required in identifying a true relative risk or an experimental event rate that has the power and two-sided type I error probability α (alpha). 5% is mostly the usual choice for α. Typical values for the power (the probability of detecting a real effect of a sample) are 80%, 85%, and 90%, respectively.

β = 1 – power; nc is the sample size corrected for continuity; m is the number of control subjects per experimental subject; p0 is the probability (probability) of the event in controls occurring; p1 is the chances (probability) that the event in an experimental subject will occur; Zpi is designated as the normal standard deviation for the probability p. (Sarma, 2019)

Using the formula above n =366; Having 10% of no response as an assumption, the final sample was 366 + 36.6 = 402.

Study Tools

This study adopted the Nordic Musculoskeletal Questionnaire (NMQ) because it is known to be suitable for its applicability in workplaces and a large number of workers Also, it is very quick and inexpensive (López-Aragón *et al*., 2017), This Nordic Musculoskeletal Questionnaire (NMQ) includes the nine anatomical body areas: the neck, the shoulders, the back, the elbows, the wrist / hands, the thighs, the knees, and the ankles. The most useful measuring instrument that is always used to evaluate work-related musculoskeletal disorders among workers in different sectors worldwide is the Nordic Musculoskeletal Questionnaire (NMQ). The NMQ has several advantages over other measuring instruments. Some of them are standardized questions, worldwide recognition, and are free. They also provide a basis for self-evaluation among workers and it is fast in the rapid identification of primary symptoms of musculoskeletal disorders among workers (Iti, Nigudgi and Reddy, 2016).

This modified NMQ has components that can assess the risk factors for MSDs such as sociodemographic characteristics of the respondents, the biomechanical factors.

Data Analyses

Data analysis was performed using IBM Social Science Statistic Packages (SPSS) version 26 (George and Mallery, 2019). For each anatomical region, the prevalence of MSDs that arose during the last 12 months was calculated. Data were further analysed into descriptive statistics, binary logistic and multiple logistic regression, to reveal if there was any association between work-related musculoskeletal disorders and the risk factors among sugar factory workers.

Ethical Considerations

This study was carried out according to the research guidelines of the institution's MKU/ERC/1644 and approved by the ethical review board of Uganda CIUREC/0234. The following guidelines were used to address ethical issues in the field during the investigation: The purpose of the study was explained to participants using an information sheet; The participant was assured of strict confidentiality of any information they provided; Each participant was required to sign an informed and written consent letter; Anonymity was ensured for the participant using codes for identification instead their names.

RESULTS

Sociodemographic Factors of the Study Participants.

Table 1 below shows the sociodemographic characteristics of the respondents in the two sugar factories with a total sample size of 402. 87.8% of the respondents (n=353) were majorly male, while 12.2% of the respondents (n=49) were female. Not more than half of the respondents (n=213) were over 30 years old 53.0%, while 47.0% of the respondents (n=189) were under 30 years old. Out of 402 respondents, 253 of the respondents (62.9%) were married and most of the respondents (n=357) had their educational level at diploma or below (88.8%).

Taking into account the departments or units where the respondents work, not more than half of the study respondents (n=202) were from manufacturing departments (50.2), administrative and engineering units had a similar number of

respondents 6.2% (n=25). Of the total of respondents; 402, majority were field/junior staff 76.4% (307), while 23.6% of the respondents were at the middle / senior level of work (n=95). Taking into account the lifestyle characteristics of the respondents, almost all of the respondents 95.3% (n=383) in this study do not smoke and consume alcohol 83.6% (n=336). More than half of the respondents 58.7% (n=236) have worked in factories for more than 5 years, while the majority of the respondents 68.7% (n=276) work more than 40 hours per week.

Prevalence of Work-Related Musculoskeletal Disorders

This study showed a slightly higher prevalence of 53% among sugar factor workers working in both factories, as shown in Figure 1.

Table 2 above shows the prevalence of WRMSDs in the nine anatomical areas from the respondents using Nordic Musculoskeletal disorders questionnaire. Lower back region has the highest prevalence of 52.2% which accounts for more than half of the respondents affected with lower back

Table 1. Sociodemographic Characteristics of the respondents (n = 402)

Variables	Frequency	Percentage	MSDs	
			Yes	No
			n (%)	n (%)
Sex of Respondents				
Male	353	87.8	188(53.3)	165(46.7)
Female	49	12.2	25(51.0)	24(49.0)
Age of Respondents				
<30	189	47.0	121(64.0)	68(36.0)
>30	213	53.0	91(42.7)	122(57.3)
Marital Status				
Single	149	37.1	91(61.1)	58(38.9)
Married	253	62.9	121(47.8)	132(52.2)
Educational Status				
Diploma and below	357	88.8	197(55.2)	160(44.8)
Above diploma	45	11.2	15(66.7)	30(33.3)
Department/Unit of the Respondent				
Administration Department	25	6.2	14(56.0)	11(44.0)
Engineering Department	25	6.2	14(56.0)	11(44.0)
Manufacturing Department	202	50.2	101(50.0)	101(50.0)
Cane Department	150	37.3	83(555.3)	67(44.7)
Work Designation of the Respondents				
Field/Junior staff	307	76.4	157(51.1)	150(48.9)
Middle/Senior staff	95	23.6	55(57.9)	40(42.1)
Smoking Habit				
Yes	19	4.7	10(52.6)	9(47.4)
No	383	95.3	202(52.7)	181(47.3)
Drinking Habit				
Yes	66	16.4	29(43.9)	37(56.1)
No	336	83.6	183(54.5)	153(45.5)
Experience in Years				
< 5 years	236	58.7	143(60.6)	93(39.4)
>5 years	166	41.3	69(41.6)	97(58.4)
Work Duration per week (Hrs.)				
< 40 hours	126	31.3	69(54.8)	57(45.2)
> 40 hours	276	68.7	143(51.8)	133(48.2)

pain. The lowest prevalence of 12.7% was reported from this study, which accounts for relatively one-tenth of the respondents having Neck pain.

Table 3 above shows the respondents work activities during their work schedule in the sugar factory and the time spent in each of the activities.

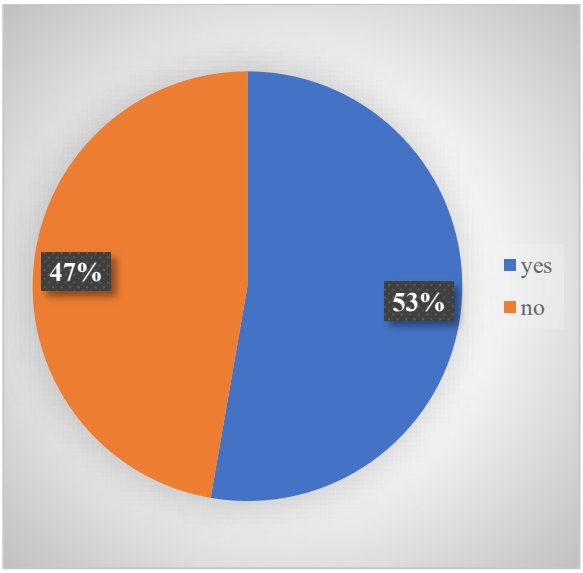

Figure 1. 12-month Prevalence of Work-Related Musculoskeletal Disorders

Table 2. Prevalence of WRMSD on the Nine Anatomical Body Areas of the Study Participants (n=402)

Anatomical Body Areas	Categories	Frequency	Percentages
Neck	No	351	87.3
	yes	51	12.7
Shoulder	No	333	82.8
	yes	69	17.2
Elbow (s)	No	349	86.8
	yes	53	13.2
Wrist (s)/ Hands (s)	No	325	80.8
	yes	77	19.2
Upper Back	No	256	63.7
	yes	146	36.3
Lower Back	No	192	47.8
	yes	210	52.2
Hip(s)/Thigh (s)	No	339	84.3
	yes	63	15.7
Knee (s)	No	335	83.3
	yes	67	16.7
Ankle (s) Foot or Feet	No	358	83.3
	Yes	67	16.7

More than half of the respondents spent more than Five hours in some of this work activities such as overstretching of the body parts during their tasks 50.4% (n=136/270) and sitting for long during their tasks 53.1% (n=77/145). More than half of the respondents spent less than Five hours in some of this work activities such as Bending, twisting and awkward posture during the task 52.5% (n=147/280), Monotonous task during their task 52.8% (n=163/309), Carrying Heavy load during their task 55.8% (n=110/197) and standing for long periods during their tasks 51.2% (n=124/242).

Risk Factors for Work-Related Musculoskeletal Disorders

As shown in Table 3 bivariate analysis of sociodemographic and biomechanical characteristics, predictor variables including age of the respondents (COR: 2.386; 95% CI (1.595,3.567); p=0.000), marital status (COR: 1.712; 95% CI (1.134,2.583); p=0.010), educational status (COR: 2.462; 95% CI (1.280,4.736); p=0.007), experience in years

Table 3. Respondents work activities and time spent on the job activities

Work Activities		Time spent on job activities				Total
		< 5hrs		≥5hrs		
		n	%	n	%	
Bending, twisting and Awkward posture during the task	Yes	147	52.5	133	47.5	280
	No	55	45.1	67	54.9	122
Overstretching during the task	Yes	134	49.6	136	50.4	270
	No	68	51.5	64	48.5	132
Monotonous Task during the task	Yes	163	52.8	146	47.2	309
	No	39	41.9	36.3	58.1	93
Carrying Heavy load during the task	Yes	110	55.8	87	44.2	197
	No	92	44.9	113	55.1	205
Standing for long during the task	Yes	124	51.2	118	48.8	242
	No	78	48.8	82	51.2	160
Sitting for long during the task	Yes	68	46.9	77	53.1	145
	No	134	52.1	123	47.9	257
Repetitive hand movement during the task	Yes	174	51.0	167	49.0	341
	No	28	45.9	33	54.1	61
Same postures for long periods during the task	Yes	143	50.9	138	49.1	281
	No	59	48.8	62	51.2	121

(COR: 2.162; 95% CI (1.443,3.239); p=0.000), overstretching during task (COR: 1.694; 95% CI (1.113,2.577); p=0.014), monotonous task (COR: 2.503; 95% CI (1.547,4.050); p=0.000), carrying heavy load during the task (COR: 2.166; 95% CI (1.453,3.230); p=0.000), standing for long periods during the task (COR: 2.693; 95% CI (1.784,4.064); p=0.000), sitting for long periods during the task (COR: 0.488; 95% CI (0.322,0.737); p=0.001), repetitive hand movements during the task (COR: 2.231; 95% CI (1.268,3.923); p=0.005), same postures for long periods during the task (COR: 1.889; 95% CI (1.244,2.870); p=0.003), task-time (COR: 1.942; 95% CI (1.306,2.888); p=0.001) were shown to have significantly influenced work-related musculoskeletal disorders.

As shown in Table 4, after controlling all confounding variables in a multivariate logistic regression model, only variables such as age of respondents, occupation of work (COR: 1.942; 95% CI (1.306,2.888); p=0.001), educational status, monotonous task, standing for long periods during the task, time taken to carry the task (AOR: 1.991; 95% CI (1.241,2.914); p=0.003) remained the main contributors to work-related musculoskeletal disorders among sugar factory workers.

This study revealed that respondents whose ages were > 30 years were 1.88 times more likely to develop MSD compared to respondents whose ages were <30 years (AOR: 1.882; 95% CI (1.113,3.182); p=0.018). Respondents whose educational level fell below diploma and below were 2.87 times at

Table 4. Multivariate Logistic Regression of Sociodemographic Factors Associated with WRMSD among Sugar Factories Workers

Variables	COR	CI 95%	p-value	AOR	CI 95%	p-value
Sex of Respondent	1.187	0.653-2.158	0.574	1.199	1.286-3.082	0.584
Marital status	1.712	1.134-2.583	0.010*	1.160	0.697-1.930	0.568
Age of Respondents	2.386	1.595-3.567	0.000**	1.882	1.113-3.182	0.018*
Work Designation	0.871	0.693-1.094	0.234	0.686	0.528-0.892	0.005*
Department/Units of the Respondents	0.978	0.767-1.247	0.858	0.978	0.745-1.284	0.872
Smoking Habit	0.996	0.396-2.505	0.993	1.262	0.476-3.347	0.640
Drinking Habit	1.526	0.897-2.596	0.119	1.293	0.725-2.306	0.384
Educational Status	2.462	1.280-4.736	0.007*	2.867	1.401-5.871	0.004*
Experience in Years	2.162	1.443-3.239	0.000**	1.1419	0.879-2.292	0.152
Work Duration Per Week (Hrs.)	1.126	0.738-1.718	0.583	0.895	0.563-1.422	0.639

*Significant association at * p <0.005, ** p <0.01, and *** p <0.001, COR (Crude odd ratios), AOR (Adjusted odd ratios)

Table 5. Multivariate Logistic Regression of Biomechanical Factors Associated with WRMSDs among Sugar Factories Workers

Variables	COR	CI 95%	p-value	AOR	CI 95%	p-value
Bending, twisting and awkward posture during the task	0.741	0.484-1.136	0.169	1.315	0.74-2.206	0.300
Overstretching during the task	1.694	1.113-2.577	0.014*	1.235	0.724-2.105	0.439
Monotonous task during the task	2.503	1.547-4.050	0.000**	1.802	1.071-3.034	0.027*
Carrying heavy load during the task	2.166	1.453-3.230	0.000**	1.506	0.929-2.443	0.097
Standing for long periods during the task	2.693	1.784-4.064	0.000**	1.867	1.156-3.016	0.011*
Sitting for long periods during the task	0.488	0.322-0.737	0.001*	0.667	0.416-1.078	0.099
Repetitive hand movement during the task	2.231	1.268-3.923	0.005*	1.494	0.781-2.857	0.225
Same postures for long periods during the task	1.889	1.244-2.870	0.003*	-	-	-
Task-time	1.942	1.306-2.888	0.001*	1.991	1.241-2.914	0.003*

*Significant association at * p <0.005, ** p <0.01, and *** p <0.001, COR (Crude odd ratios), AOR (Adjusted odd ratios)

higher risk of developing WRMSD compared to respondents whose educational level fell above diploma (AOR: 2.867; 95% CI (1.401,5.871); p=0.004). Having monotonous tasks among the respondents makes them 1.80 times more likely to develop WRMSD than the respondents whose work activities were not monotonous (AOR: 1.802; 95% CI (1.071,3.034); p=0.027. The odds of developing WRMSD increased 1.867 more likely among respondents who maintained standing posture for long periods during their task than among respondents who did not stand for long periods during their work activities (AOR: 1.867; 95% CI (1.156,3.016); p=0.011). During some of these work activities, respondents spent some hours while maintaining the same posture for long period, the respondents who spent more than 5 hours doing the work activities are 1.99 times more likely to develop WRMSDs as compared to the respondents whose time spent were less than 5 hours during work activities.

DISCUSSION

This study was aimed at determining the work-related musculoskeletal disorders and associated risk factors among sugar factory workers. The following risk factors such as sociodemographic characteristics of the respondents, which include age, gender, level of education were test statistically show their association with the development of MSDs among the sugar factory workers. The biomechanical factors include working postures assumed by the respondents during their daily task, such as bending, sitting for long and standing for long periods etc.

Prevalence of Musculoskeletal Disorders among Sugar Factory Workers

This study was a cross-sectional study in the workplace to evaluate risk factors for work-related musculoskeletal disorders among sugar factory workers in Jinja, Uganda. The 12-month prevalence of work-related musculoskeletal disorders among sugar factory workers was 53%. This finding was higher than the prevalence in Indonesia (22.4%) (Skillgate *et al*., 2009), Nigeria (31.5%) (Ayanniyi, Nudamajo and Mbada, 2016), and Malaysia (40.7%) (Amin *et al*., 2016).

Sociodemographic Characteristics of the Respondents

This current study was dominated by male sex. This was due to the nature of work in sugar factories that requires physical strength and more manual work. The age of the respondents was a predictor of the development of WRMSDs among the respondents in both bivariate and multiple logistic regression, which was in agreement with the findings of other studies (Biswas, Bhattacharya and Bhattacharya, 2017). This implies that older people are 1.88 times at higher risk of MSDS than respondents below 30 years of age. Taking into account the tasks in the sugar factory, people were exposed to the same work activities in the same departments regardless of age category. This could be one of the reasons why older respondents tend to develop MSD due to reduced physical strength during longer tasks (Sites *et al*., 2018). They disclosed that an increase in age among workers will lead to a decrease in tissue elasticity; joints may become less flexible, less mobile, and inflamed; the structural changes will occur in the spine and load bearing joints, which are due to the decrease in the fluids of the joints and the wear and tear on the cartilage. The improvement of some modern, mechanized facilities would reduce this high prevalence among workers, especially the older ones. There is an association between the prevalence of the musculoskeletal disorders that increases with the age of an individual. Also, younger people are affected, often during their income-earning years (World Health Organization, 2017).

This study comprises of more filed workers and junior staff as compared to middle-level workers or senior staff. The level of work was also a predictor of WRMSDs among the respondents at multivariate level. This could also translate into low level of awareness and compliance to safety procedures at work. Furthermore, the field workers or junior staff were constantly exposed to manual tasks, and this predisposed them to WRMSDs. A study also reported that most jobs in a sugar factory are done manually such as separating sugarcane leaves before it is crushed on crush rollers, checking the texture of the extracted juice, crystallized sugar, comparing the colour of crystallized sugar from raw sugar, adjusting packages in the machine for packing,

loading the packed sugar into trucks to store them into the warehouse (Karkousha and Elhafeza, 2017). The findings of the above report suggest why most workers are predominantly field workers.

Majority of the respondents' educational level were either at diploma or below. This was significant at bivariate and multivariate levels. Most of the respondents were from the suburbs of the factories and their economic status was not that good. This could also be reasons for not having proper education. This implies that education plays a major role in the development of MSDs, due to the fact that educated respondents were better informed than people with lower level of education. Educated people are more likely to follow the safety procedure and precautions than the uneducated or lower level of education. Biswas, Bhattacharya and Bhattacharya (2017) also confirmed from his study among male (sugar factory) molasses workers in India on work-related musculoskeletal Disorders. They reported that workers above the primary level of education do not have risks of WWRMSDs. Although, this is a slight deviation from this study, as education is not a predictor of WRMSD development among workers. A similar study on the correlation power of related factors affected complaints of musculoskeletal disorders complaints in Indonesia among rice mill unit operators. The study showed a different result. Based on their findings, the educational level was not statistically significant to the development of WRMSD among workers (Ramdan, Wiranto and Candra, 2019).

The respondents' years of work experience was also significant at bivariate level; implying that respondents whose experiences were more than five years were 2.162 likely to have MSDs than respondents with less than five years' experience. The prevalence of WRMSDs was also found to be proportional to this work experience in years among workers, older workers with more experience have more exposure to the risk of WRMSDs than new workers with less work experience. This implies that the pain or discomfort in those anatomical regions was as a result of the duration of work among workers over the years. These findings are supported by studies by regions (Nilvarangkul *et al*., 2018), reported findings similar to this current study on risk assessment tools for work-related musculoskeletal disorders among sugarcane farmers in North East Thailand, that the majority of sugar factory workers work more than five hours a day and 30% of workers have fewer than 10 years of experience having discomfort in their anatomical. Another study on sugar factory workers also revealed that workers spend more than two hours in their various work schedules, which is similar to the findings of this study by (Pawar *et al*., 2019). They further established an association that was statistically significant on work experience among workers with the development of WRMSDs in their study to find the impact of work duration on health on sugarcane factory workers in India.

Biomechanical Factors of the Respondents

This study is similar to a cross-sectional study by Smita *et al*. (2016) which highlighted the relationship between risk factors such as biomechanical and musculoskeletal disorders among sugar factory workers, on their common repetitive actions during the cutting of sugar cane; extending or twisting the wrist, prolonged standing, stooping, over stretching (exerting or twisting the torso) lifting objects, assuming the same postures for long periods, and monotonous task among workers (Anap and Vasave, 2016). Work activities in sugar factories require the workers to overstretch while loading and offloading sugarcane into the truck. This posture makes the workers to assume unnatural posture while working and predisposes them to MSDs. Workers who overstretched in this study were 1.69 times at higher risk of developing MSD than workers who did not overstretched, although this was only significant at the bivariate level. The majority of workers are involved in monotonous tasks such as working on a particular task for a long period of time. It was significant at the bivariate and multivariate levels. This finding was supported by research by in North-East Thailand (Phajan *et al*., 2014) ; Biswas, Bhattacharya and Bhattacharya, 2017)]. Lifting of heavy load such as a bag of sugar from one place to another was common among the sugar factory workers. They had to bend to lift, which actually predisposed them to developing MSDs. In this study, heavy load / lifting was found to be significant at the bivariate level, which implies that respondents who carry/lift heavy load are 2.166 more likely to develop MSD compared to respondents who do not frequently

carry/lift heavy load at work. The findings show that sugar industry workers must lift heavy weight of sugarcane on their shoulder and back. This causes WRMSD pain and shows a strong association between bending and lifting as the most common causes of low back pain similar to the findings of this study (Jain *et al*., 2018). This could also explain the reasons why most workers who work lifting/ carrying loads are prone to developing MSDs compared to workers who have access to lifting equipment (Black *et al*., 2011; Phajan *et al*., 2014). However, another contrasting study by Amiri *et al*., (2020) concluded from their study that there was no significant relationship between the musculoskeletal disorders induced by farm work and the average daily load carried by farmers in Asadabad City in Afghanistan (Amiri *et al*., 2020). Standing for long periods during the daily tasks in the sugar factories was a predictor of MSD, and most of the workers carried out their activities while standing. Such activities include operating the machine and feeding the machine with sugar cane. It was evident from this study that the odds of developing WRMSD increased 1.867 more likely among respondents who maintain standing postures for long periods during their tasks than among respondents who do not stand for long periods during work activities. It is practically impossible for such workers to maintain sitting postures as long as they are unable to perform normal activities. Only a few activities involve sitting. Thus, this contributes to the reasons why most workers complain about WRMSD due to their work posture. The time required to perform while assuming this work posture was also a contributing factor to the development of MSD among respondents. Respondents whose spend 5 hours or more are 1.99 likely to develop MSDS compared to respondents who spent less than 5 hours during work activities daily. This was supported by findings from Bhattacharya *et al*. and Singh *et al*. (Singh *et al*., 2015; Biswas, Bhattacharya and Bhattacharya, 2017).

CONCLUSION

The sugar factories are dominated by young men, of whom the majority are not educated and are single. This study has explored various risk factors associated with the development of MSD among workers that have existed among workers. The following highlighted factors, such as age of the respondents, educational status, work designation, monotonous task, standing for long periods and the duration of carrying out tasks, were reported to be a predictor of WRMD among the workers. In order to meet up with a work force in the society free of disability, it is compulsory for the workers to take cognizance of their health. Also, the employers should take responsibility, where necessary, in preventing workers from ergonomic exposures. Employers should also be responsible for the provision of an enabling environment in order to discourage accidents that can predispose workers to the development of MSDs. Finally, findings arising from this current study show that workers have higher levels of exposure risk to developing musculoskeletal disorders.

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