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Research Article

Serum Vitamin D Level and Nutritional Status Associated with Musculoskeletal Disorders among the Workers in a Garment Industry in Narayanganj

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Abstract

In Bangladesh, musculoskeletal disorders are a common complaint among garment workers, and work-related factors have been associated with musculoskeletal disorders. So far, vitamin D deficiency has not been linked to musculoskeletal disorders among garment workers in Bangladesh. This study attempted to identify the serum vitamin D level and nutritional status associated with musculoskeletal disorders in garment workers.

This was a cross-sectional study conducted among garment workers in Narayangonj. Respondents in the study were workers who had worked for at least one year in the selected garment industry. The total respondents of the study were 168 workers. Face-to-face interviews were conducted with respondents to collect the information. To assess musculoskeletal disorders (MSDs), the Nordic Musculoskeletal Questionnaire was used. To determine the serum vitamin D level, 3 mL of venous blood was collected from each respondent.

MSDs were found in 37.5% of the total respondents. Workers who worked > 9 hours per day and had no or little work experience suffered significantly more (47.9% and 43.5%, respectively) from MSDs. Those who did not or infrequently consume vitamin D-rich foods had a significantly ($p < .05$) higher proportion of MSDs. Workers with a deficiency or insufficiency in serum vitamin D, however, had more MSDs (62.5% and 35.5% respectively). The mean serum vitamin D level was found to be significantly lower (61.06 ng/mL) in workers with MSDs. According to a logistic regression analysis, every unit decrease in serum vitamin D level increased the risk of developing MSDs by 1.6 %. This study came to the conclusion that, in addition to work-related factors, vitamin D deficiency was responsible for the occurrence of MSDs.

Keywords: Musculoskeletal Disorders; Vitamin D; Nutrition; Garment worker; Bangladesh

Introduction

Vitamin D has an immunomodulatory effect and helps humans in developing immunity against infections, including viral infections [1-3]. Insufficiency or deficiency of vitamin D has been reported to be associated with diabetes as well as other immune dysregulation diseases. Deficiency of vitamin D is manifested by excessive sleepiness, fatigue, tiredness, musculoskeletal pain and other symptoms [3-7]. Vitamin D is an important factor for calcium and phosphorus absorption which are required for bone metabolism. As a result, vitamin D deficiency causes a variety of bone diseases. Many studies have found that people with vitamin D deficiency or insufficiency experience non-specific musculoskeletal weakness and pain [8-11].

The sources of vitamin D in human body are mostly natural. It is produced in the skin as a result of the sun's ultraviolet rays. About 90% of the vitamin D in the human body is derived from sunlight, with the remainder derived from vitamin D-rich foods. It has been reported that 15 to 30 minutes of peak-time sunlight exposure twice a week is enough to produce vitamin D in the human body. However, vitamin D deficiency is now a common problem in urban areas due to a variety of environmental factors. People are exposed to very little or no sunlight as a result of prolonged indoor work, moving in vehicles, and few or no outdoor activities [10,12,13].

Musculoskeletal disorders (MSDs) are diseases of the locomotor system - such as, muscles, bones, joints and associated tissues such as tendons and ligaments. The common manifestations of MSDs are pain, stiffness, joint crepitus, weakness, and restricted joint motion. Musculoskeletal disorders are one of the leading contributors to disability in both industrialized and developing countries, which leads to restriction of work, absenteeism, or change in work [13-16]. According to the recent WHO fact sheet, about 1.71 billion people worldwide have MSDs. Among the MSDs, low-back pain has been found in 568 million people, which is the highest prevalence. MSDs have been identified in 160 countries as a leading cause of disability [16]. In Bangladesh, MSDS is an important public health problem. Several studies have shown that MSDs are common among people in different jobs, especially among garment workers [17-23].

Studies revealed the occupational risk factors such as work in prolonged sitting or standing condition, awkward posture, manual handling of heavy loads, vibration and forceful exertions, and physical and psychological stress at work as responsible for the occurrence of MSDs among the garment workers in Bangladesh [18-23] However, the occurrence of MSDs among garment workers is due to other factors, specifically vitamin D deficiency or insufficiency, so far, not observed in the study. The duration of the job and the performance of the garment workers require them to work in an indoor environment for the majority of the time, keeping them out of the sun exposure. As a result of this, as well as nutritional factors, garment workers may be deficient in vitamin D, which may contribute to the development of MSDs [2-5]. Vitamin D and nutritional factors were investigated in this study among garment workers to investigate if there was any association with the occurrence of MSDs.

Materials and Methods

This cross-sectional study was conducted to find out the relationship between serum vitamin D and nutritional status with MSDs among garment workers. The study was carried out in a garment industry of Narayanganj from June 2019 to May 2020. The respondents of this study were the workers of a selected garment industry who had at least one year of experience of working and gave consent to participate in the study. A total of 168 workers were available during the data collection period and they allowed to take blood samples from them for vitamin D estimation. A pre-tested questionnaire was used to collect data during face-to-face interviews with respondents. The respondents' self-reported pain or discomfort on different sites was identified in the Nordic Musculoskeletal Questionnaire (NMQ) body map as yes or no. The workers were asked to recall any pain or discomfort they had experienced in the previous six months. Following the interview, the respondents were asked to provide a blood sample. As per requirement, 3 ml of venous blood samples were collected with every precaution and transported to the laboratory. In the laboratory, sample blood was tested for vitamin D by the Enzyme-Linked Immunosorbent Assay (ELISA). Serum vitamin D levels were classified as deficient (10 ng/mL), insufficient (11-29ng/mL), sufficient (30-100 ng/mL), or toxic (> 100 ng/mL). To assess the consumption of vitamin D rich foods, on the basis of a 7-day recall, the common vitamin D rich food items consumed by the respondents were recorded. Depending upon the frequency and quantity of food items consumed during the previous 7 days, the consumption of vitamin D-rich foods is categorized as: no, infrequent, and regular.

The collected data was analyzed with Windows SPSS. The analysis was carried out in accordance with the study's objectives and pre-determined variables. For descriptive analysis, the frequency was calculated as a percentage, mean, and standard deviation. The student's t-test was used to compare means, and the chi-square test was used to investigate the relationship between MSDs and vitamin D status, nutritional factors, and socio-demographic characteristics. A binary logistic regression was performed to find out the effect of vitamin D and nutritional status on MSDs.

Ethical considerations: Ethical approval of the study was given by the Ethical Review Committee of the Bangladesh University of Health Sciences (BUHS). Prior to the data collection procedure, the

respondents were informed of the study's objective, that their participation was voluntary, and that they could withdraw from the research at any time without penalty. Respondents were also assured that the information gathered would be kept confidential and their identities would not be revealed.

Result

Among the total of 168 respondents, MSDs found in 37.5% (63) of the respondents. Almost half of them (49.2%) suffered from 2 to 3 sites in the body. Workers reported MSDs in six different sites of their body. The lower back (60.0%), shoulder (47.7%) and knee joint (36.8%) were common sites for MSDs (Table 1). Of the respondents who suffered from MSDs, 35.9% were male and 38.5% were female. MSDs were found in a high proportion of respondents aged 25-34 years (47.4%), with primary education (42.1%), more than 6 family members (47.6 %), and a monthly income of Taka 10000 to Taka 14000 (43.2%) However, socio-economic factors did not differ significantly with the occurrence of MSDs (Table 2).

Musculoskeletal Disorders (MSDs)		Frequency	Percent
Suffered	Yes	63	37.5
	No	105	62.5
Number of Sites	Single site	21	33.3%
	2-3 sites	31	49.2%
	> 3 sites	11	17.5%
Body Sites*	Lower Back	39	60.0%
	Shoulder	31	47.7%
	Knee joint	24	36.9%
	Hip Joint	17	26.2%
	Neck	16	24.6%
	Elbow Joint	16	24.6%

Table 1: Respondents by Musculoskeletal Disorders.

*Multiple Responses

In terms of occupation, it was found that workers with less experience (43.5%) and those who worked for (47.9%) prolonged hours (> 9 hours) every day had MSDs significantly ($p < .05$) more commonly than those who did not. Work in either a sitting (38.6%) or a standing (35.6%) posture did not show any significant difference with the suffering from MSDs (Table 3).

Characteristics		Musculoskeletal Disorders (MSDs)		Total	Significance Test
		No - n (%)	Yes- n (%)		
Age in Years	Up to 24	49 (68.1)	23 (31.9)	72 (42.9)	χ^2 = 3.605; p =.165
	25-34	30 (52.6)	27 (47.4)	57 (33.9)	
	35 and above	26 (66.7)	13 (33.3)	39 (23.2)	
Sex	Male	41(64.1)	23 (35.9)	64 (38.1)	χ^2 = 0.108; p =.743
	Female	64 (61.5)	40 (38.5)	104 (61.9)	
Education	Illiterate	15 (71.4)	06 (28.6)	21 (12.5)	χ^2 = 1.561; p =.458
	Primary	44 (57.9)	32 (42.1)	76 (45.2)	
	Secondary	46 (64.8)	25 (35.2)	71 (42.3)	
Marital Status	Married	45 (65.2)	24 (34.9)	69 (41.1)	χ^2 = 0.369; p =.544
	Unmarried	60 (60.1)	39 (39.9)	99 (68.9)	
Family Members	Up to 3	74 (65.5)	39 (34.5)	113 (67.7)	χ^2 = 1.394; p =.498
	4-6	20 (60.1)	13 (39.1)	33 (19.8)	
	Above 6	11 (52.4)	10 (47.6)	21 (12.6)	
Monthly Income (Taka)	Below 10000	46 (68.7)	21 (31.3)	67 (39.9)	χ^2 = 2.127; p =.345
	10000-14000	42 (56.8)	32 (43.2)	74 (44.0)	
	15000 and above	17 (62.9)	10 (37.1)	27 (16.1)	
	Mean ± Sd	10720 ± 3738	11428 ± 4521	10986 ± 4051	t = -1.097; p =.274

Table 2: Socio-economic characteristics and Musculoskeletal Disorders among the Respondents.

Of the respondents who were overweight, a higher proportion (41.7%) were found to suffer from MSDs than underweight (36.9%) and normal weight (35.2%) respondents. In terms of eating habits, it was found that people who did not eat or ate vitamin D-rich foods infrequently in the previous week had significantly ($p < .05$) more MSDs (50.0% and 40.5 %, respectively) than workers who ate vitamin D-rich foods on a regular basis. (Table 4).

The serum vitamin D level of the respondents was categorized into three groups: deficiency (14.3%), insufficiency (63.7%), and sufficiency (22.0%). MSDs was found significantly ($p < .05$) more common among the respondents who had insufficiency (35.5%) or deficiency (62.5%) of vitamin D. The mean serum level of vitamin D was also found to be significantly (p=.016) lower among those who had MSDs (61.06 ± 35.467ng/mL) compared to those who did not have MSDs (Table 5).

Work Related factors		Musculoskeletal Disorders (MSDs)		Total	Significance Test
		No - n (%)	Yes - n (%)		
Present work experience (Years)	Up to 3	82 (62.5)	49 (37.5)	131 (77.8)	χ^2 = 0.002; p =.962
	> 3	23 (62.1)	14 (37.9)	37 (22.2)	
	Mean ± Sd	3.20 ± 2.026	3.00 ± 1.685)	3.12 ± 1.902	t = -.659; p =.511
Previous Work Experience (Years)	Up to 3	61 (56.5)	47 (43.5)	108 (64.3)	χ^2 = 4.674; p =.031
	> 3	44 (73.3)	16 (26.7)	60 (35.7)	
	Mean ± Sd	4.64 2.062	4.25 1.840	4.49 1.985	t = 1.216; p =.266
Working Hours	Up to 9	68 (70.1)	29 (29.9)	97 (57.7)	χ^2 = 5.661; p =.017
	> 9	37 (52.1)	34 (47.9)	71 (42.3)	
Working Posture	Standing	38 (64.4)	21 (35.6)	59 (35.1)	χ^2 =.141; p =.707
	Sitting	67 (61.4)	42 (38.6)	109 (64.9)	

Table 3: Work Related Factors of the Respondents.

Nutritional factors		Musculoskeletal Disorders (MSDs)		Total	Significance Test
		No - n (%)	Yes - n (%)		
Height	Mean ± Sd	152.7 ± 9.127	153.8 ± 8.673	153.1 8.948	t = -.747; P =.456
Weight	Mean ± Sd	53.59 ± 9.257	52.70 ± 8.820	53.20 ± 9.079	t =.615; P =.539
BMI	Mean ± Sd	22.7 ± 3.561	22.21 ± 3.273	22.60 ± 3.462	t = 1.241; p =.217
	Under Weight	12 (63.1)	07 (36.9)	19 (11.3)	χ^2 =.3424 p =.843
	Normal	72 (63.8)	41 (36.2)	113 (67.3)	
	Overweight	21 (58.3)	15 (41.7)	36 (21.4)	
Eating Vitamin D rich foods	No	12 (50.0)	12 (50.0)	24 (14.3)	χ^2 = 6.411 p =.041
	Infrequently	63 (59.4)	43 (40.5)	106 (63.1)	
	Regularly	30 (78.9)	08 (21.1)	38 (22.6)	

Table 4: Nutritional status and Musculoskeletal Disorders of the Respondents.

Serum Vitamin D Level		Musculoskeletal Disorders (MSDs)		Total	Significance Test
		No = n (%)	Yes = n (%)		
Vitamin D	Deficiency	9 (37.5)	15 (62.5)	24 (14.3)	χ^2 = 8.312 p =.016
	Insufficiency	69 (64.5)	38 (35.5)	107 (63.7)	
	Sufficiency	27 (73.0)	10 (27.0)	37 (22.0)	
	Mean ± Sd	75.07 ± 28.218	61.06 ± 35.467	69.82 ± 31.767	t = 2.825; p =.005

Table 5: Serum D level and Musculoskeletal Disorders.

Independent Factors	B	Sig	Exp(B)	CI (95%)	
				Lower	Upper
Working Hour > 9	.959	.011	2.608	1.247	5.456
Previous Experience	-.874	.024	.417	.196	.889
Vit D Foods	.	.298			
Vit D Foods- Infrequent	.694	.277	2.001	.573	6.990
Vit D Foods- No	.722	.122	2.059	.824	5.146
Under Weight		.989			
Normal	.059	.928	1.060	.298	3.773
Overweight	.064	.881	1.066	.460	2.471
Serum Vitamin D	-.016	.006	.984	.973	.996

Table 6: Logistic regression analysis of MSDs and independent factors.

A binary logistic regression analysis (Table 6) was performed to assess the influence of serum vitamin D level, consuming vitamin D rich foods, and BMI on the likelihood of developing MSDs. The respondents' work experience and daily working hours were also included in the analysis to determine their impact on the likelihood of developing MSDs. The analysis revealed that increasing serum vitamin-D levels decrease the likelihood of developing MSDs as well as the odds of developing MSDs. The analysis indicates that every unit decrease in the serum vitamin D was associated with a 1.6% increase in the odds of developing MSDs. In relation to the jobs of the respondents, it was found that those who worked more than 9 hours a day had a significant ability to predict the development of MSDs, which was 2.6 times higher than those who worked up to 9 hours. Furthermore, those who had previous work experience (more than 3 years) in the garment industry had significantly less ability (42%) to develop MSDs. BMI and consumption of vitamin D-containing foods, on the other hand, were found to be non-significant predictors of the development of MSDs.

Discussion

Among the garment workers in Bangladesh, MSDs are a common disease. Many studies have reported the occurrence of MSDs among garment workers in Bangladesh and revealed the several work-related factors responsible for MSDs [18-22]. In recent studies, 51% to 59% of garment workers were found to suffer from MSDs [20-22]. In this study, a lower proportion (37.5%) of the garment workers was found to suffer from MSDs. In contrast to other studies, the participants of the current study were more experienced workers and male, which might be the reason for the lower proportion of MSDs. The occupational factors which were investigated in the current study, of which working more than 9 hours a day, having no previous working experience, or being new in the garment industry, were found to be significantly associated with MSDs (47.9% and 43.5%, respectively). These two factors were also found in other studies in Bangladesh, significantly associated with MSDs among garment workers [18,20-22]. Due to prolonged working hours, the workers had to remain indoors throughout the whole day, which might have prevented the workers from getting exposure to the sun for a sufficient time. Although not statistically significant, a higher proportion of workers who worked in prolonged sitting posture suffered more from MSDs than those who worked in standing posture. However, studies done in Bangladesh found a significant association between MSDs and the sitting and standing posture of the workers [19,21-23]. In terms of nutritional status, this study found that a higher proportion of overweight workers suffered from MSDs than normal or underweight workers. Although this was not a significant finding, a number of studies found a significant association between increased BMI (overweight and obese) and MSDs, particularly low back pain, neck pain, and shoulder pain [22,24]. The food consumption of the respondents, particularly vitamin D-rich foods like milk, eggs, fish, spinach, yoghurt, cheese, and so on, was also investigated. It was found that workers who did not consume vitamin D-rich foods or consumed them infrequently suffered significantly more from MSDs than those who did.

Deficiency or insufficiency of Vitamin D has been reported to cause a variety of diseases, including MSDs [2-5]. Studies conducted in Bangladesh have also found an association between a number of diseases, including musculoskeletal pain and discomfort [25-27]. The current study also revealed that the workers who had deficiency or insufficiency significantly ($p = .016$) suffered more from MSDs. The mean serum vitamin D was found to be significantly lower among the sufferers (61.06 ± 35.467 ng/mL) than that of respondents who did not suffer (75.07 ± 28.218 ng/mL) from MSDs. Several studies done elsewhere have found a link between musculoskeletal pain and low levels of serum vitamin D [27-29]. The occurrence of musculoskeletal pain caused by vitamin D deficiency is not yet clear. According to studies, decreased serum vitamin D increases the sensitivity of nerve fibers and alters the sensitivity of the vitamin D receptor, both of which are responsible for musculoskeletal pain. However, vitamin D deficiency has been found to affect bone mineralization, muscle mass and strength, and neuromuscular performance [29-31].

A binary logistic regression analysis was done to find out how much the factors that were associated in the univariate analysis could predict the likelihood of developing MSDs. The analysis revealed that workers who worked more than 9 hours had the strongest ability to predict the development of MSDs (2.6 times). On the other hand, workers who had less experience were 59% more likely to develop MSDs. In the univariate analysis, it was found that the workers who had vitamin D deficiencies or insufficiencies a higher proportion of them (62.5% and 35.5%, respectively) associated with the occurrence of MSDs. Furthermore, the logistic regression analysis showed that the risk of developing MSDs increased by 1.6% for every unit decrease in serum vitamin D level.

Conclusion

This study has found a significant relationship between the occurrence of MSDs and serum vitamin D deficiency among garment workers. Prolonged working hours and having no or little experience in the garment industry were also found to be risk factors for MSDs. Furthermore, workers who consumed no or infrequently consumed vitamin D-rich foods in a week were found to be significantly associated with an increased occurrence of MSDs.

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