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Musculoskeletal Symptoms among Plantation Workers in Kerala, India

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ABSTRACT

Introduction: Musculoskeletal disorder (MSD) is one of the major occupational health problems worldwide. Musculoskeletal symptoms (MSS) can indicate an underlying MSD. This paper assesses the prevalence of MSS among different plantation workers in Kerala, India.

Methods: A cross-sectional survey was conducted from January to February 2021 among 83 rubber tappers, 90 cardamom plantation workers, and 87 tea pluckers (N=260). The Standardized Nordic Questionnaire (SNQ) was used to capture the MSS. MSS was compared across the three types of plantation workers, and the Chi-square test was used to test the significance. The Odds Ratios (OR) and 95% Confidence Intervals (CI) were estimated using binary logistic regression analysis.

Results: The prevalence of MSS (any regions) in the last 12 months among all participants was 87.7% and did not significantly vary between the three groups of workers. In general, the most affected regions were the low back (61%), one or both knees (47%) and shoulders (44%), respectively. Compared to rubber tappers, the odds of MSS in hips/ thighs (adjusted OR=2.38: 95% CI: 1.17-4.84) and wrists (adjusted OR=3.77: 95% CI:1.85-7.69) were significantly high among cardamom plantation workers. But the odds of MSS in elbows (adjusted OR=0.58: 95% CI: 0.31-1.07) and knees (adjusted OR=0.26:95% CI: 0.10-0.63) were low in the tea plantation workers as compared to rubber tappers.

Conclusion: Though there was no variation in the overall prevalence of MSS between the three groups, there was a significant variation between the groups regarding the MSS in different body regions. Using supportive aids according to the nature of work and doing simple stretching exercises during breaks may help to improve the musculoskeletal health of plantation workers.

Key words: Agricultural Workers Diseases, India, Musculoskeletal Disease, Musculoskeletal Pains, Occupational Illnesses.

INTRODUCTION

Good musculoskeletal health is a crucial factor for every individual to actively participate in all aspects of life and maintain social, economic, and financial independence.[1] Globally about 1.71 billion people are affected with musculoskeletal conditions or disorders (MSD), and low back pain is the major contributor to the overall burden of MSD.[2] MSD is a major cause of habitual absence from work (work-absenteeism), which impacts workers, employers, and society.[3] In addition to MSD affecting the functional ability, work itself can act as a cause for the development of MSD.[4]

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In the eighteenth century, the Italian physician Bernardino Ramazzini was the first to recognize the relationship between work and certain musculoskeletal disorders.[5] As per the Occupational Health Safety Associations (OSHA), work-related musculoskeletal disorders (WRMSD) is defined as the disorders of muscles, skeleton, and related tissue, which have been empirically shown or suspected to have been caused by workplace activity.[6] Though WRMSD is not life-threatening, it constitutes a significant proportion of occupational morbidity and associated impacts, thus potentially impairing the quality of life of workers.[7]

Musculoskeletal symptoms (MSS) such as ache, pain or discomfort are subjective feelings of a functional disturbance in the musculoskeletal system.[8] MSS can indicate an underlying disease or condition where the affected individuals with the symptoms experience a change in the normal function, appearance, or sensation of the locomotor apparatus.[9]

Plantation agriculture is a form of commercial farming characterized by single crop specialization, large labour workforce and large crop area.[10] People in the agriculture sector, including plantations, usually have to do physically demanding work such as repetitive and sustained stooping, intensive handwork, fast and repetitive cutting, excessive reaching, carrying heavy loads, and twisting movements.[11,12] Due to the labour intensiveness, people working in the plantation are exposed to many health issues, among which MSD is a major one.[13]

Rubber, tea and cardamom are the major plantation crops grown in Kerala, and it provides livelihood for thousands of people in Kerala.[14,15] Despite plantation agriculture being one of the key sectors that constitutes a large workforce in Kerala, not many studies have explored the musculoskeletal health issues of workers in different types of plantations into one frame.

Hence, the present study was aimed to assess the prevalence of musculoskeletal symptoms and explore the anatomical regions where the symptoms are mainly localized among workers in the Rubber, Cardamon, and Tea plantations in Kerala.

METHODS

Kottayam and Idukki districts are the leading producers of rubber, cardamom and tea in Kerala state.[16–18] We conducted a cross-sectional survey from January to February 2021 among rubber, cardamom and tea plantation workers in Kottayam and Idukki districts of Kerala state.

We calculated the sample size to estimate MSS prevalence in any one of the regions among plantation workers. The anticipated prevalence of MSS was considered 30% as the global prevalence of MSD, assuming that workers with musculoskeletal conditions would present with the symptom.[1]

Using the formula,

$$Z^2 * \frac{p(1-p)}{d^2}$$

Where, Z=1.96 for two-sided alpha at 5% level (for the 95% confidence interval), p=0.30, 1-p =0.70, and d=0.10 (absolute precision of 10%), the sample size was estimated to be 81. Further, we assumed a non-response rate of 10%. Hence the sample size was increased to 90. However, to explore the study objectives separately for each category of plantation workers, we decided to include 90 from each of them.

The initial plan was to identify all three types of plantations from the two districts, randomly select three plantations from each group, and select an equal number of respondents from the three chosen plantations of each type using simple random sampling. However, the lockdown and travel restrictions in the state during the COVID-19 pandemic made us redefine the sampling plan to complete the data collection within the time frame of the academic calendar. Eight rubber plantations, four cardamom and six tea plantations were identified from the available resources, and the authorities were approached to survey the plantation workers. After receiving the authorities' approval, the number of plantations included in the study was two, three, and three from rubber, cardamom, and tea plantations, respectively.

Rubber tappers were identified from randomly selected collection centres located within the plantation premises, where the workers came to measure their collected latex after rubber tapping. The investigator explained the details of the survey and requested their consent to participate in the study. Data collection for cardamom plantation workers was done at their workplace using a similar approach as mentioned above. In tea plantations, the respondents were selected from their dwellings located within each plantation, where each line or block had an average of 10 houses. One block was randomly chosen, and

the investigator consecutively visited all households to identify eligible individuals and collected data if the worker consented to participate. The process was completed when the target number was achieved from each plantation. At the end of each interview, the interviewer verified the schedule for any missing information and concluded the interview.

Before data collection, clearance was obtained from the Institutional Ethical Committee (IEC), and information was collected only after receiving the written consent of respondents without any compulsion. Privacy and confidentiality were ensured during and after the survey by assigning a unique respondent ID to each participant.

The structured questionnaire included socio-demographic and work-related details of the respondents. The Standardized Nordic Questionnaire (SNQ) was used to detect symptoms in nine body regions: neck, shoulders, elbows, wrists/hands, upper back, lower back, hips/thighs, knees, and ankles.[19] A body map further supported the SNQ to understand the regions better. The interviewer showed each region in the body map to obtain information from the respondent (Appendix A).

Data were entered into Microsoft Excel and then exported to IBM SPSS Statistics, version 25, for further analysis. The background details of the respondents and musculoskeletal symptoms reported by them were tabulated and analysed. A dichotomous variable “any symptoms present” was defined as “0” if no symptoms were reported by the participant and “1” if the participant reported symptoms in any one of the nine regions during the last 12 months. The overall and site-wise prevalence of musculoskeletal symptoms were compared across the three types of plantations workers. The Chi-square test was used to assess the significance of the associations. The Odds Ratios (OR) and 95% Confidence Intervals (CI) were adjusted for age (<50 years, >=50 years) in the Binary logistic regression analysis.

RESULTS

A total of 260 workers, 83 from rubber plantations, 90 from cardamom plantations and 87 from tea plantations, participated in the study. Nearly two-thirds of tea plantation workers were below 50 years old versus half of the participants in the other two groups. The majority were females in tea and cardamom plantations, whereas the male-female ratio was almost equal in rubber plantations. The educational attainment of tea plantation workers was the lowest. The majority of cardamom plantation workers were temporary employees. Compared to the other two groups, rubber tappers generally had to carry more than 10 kilograms of weight at a stretch (92%). All workers in rubber and tea plantations proclaimed using specific equipment or tools at the workplace (Table 1).

Daily, a rubber tapper had to tap an average of 404 rubber trees (SD: 13.7, range: 380-450), and a cardamom plantation worker had to collect an average of 19 kilograms of cardamom pods (SD: 7.2, range: 0-24). The tea pluckers collect an average of 23 kilograms (SD: 3.75, range: 18-27) of tea leaves per day. Minor falls and small wounds were the commonly reported workplace injuries.

The prevalence of musculoskeletal symptoms in any body region during the last 12 months was 87.7%. It did not vary much between the three groups of workers. The most affected body region was low back in all three groups with an overall prevalence of 61%, followed by one or both knees in rubber and cardamom workers. In contrast, the shoulders were the second affected region among tea pluckers, followed by knees. The prevalence of MSS in the wrist region and hips/thighs were significantly high among cardamom plantation workers, but the MSS in Knees and elbows were found low among rubber tappers (Table 2).

Among sociodemographic and work-related factors, no factors showed a significant association with MSS at 5% significance level. However, age was showing some evidence of association with a p-value of 0.086 (84.5 in <50 years Vs 91.5 in >=50 years) (Table.3).

The odds ratios for MSS among different groups of workers were analysed using Binary logistic regression where rubber tappers were considered the reference group. The variables showing p<0.10 in the bivariate analysis were included in the multiple regression model. Hence the Odds ratios were adjusted for the variable age (Table.4).

Table 1: Sociodemographic and work-related details of study participants

Characteristics	Plantation workers							
	All		Rubber		Cardamom		Tea	
	(N=260)		(N=83)		(N=90)		(N=87)	
	n	%	n	%	n	%	n	%
Age								
< 50 years	142	54.6	41	49.4	47	52.22	54	62.07
>= 50 years	118	45.4	42	50.6	43	47.78	33	37.93
Sex								
Male	52	20.0	40	48.19	10	11.11	2	2.3
Female	208	80.0	43	51.81	80	88.89	85	97.7
Education								
Up to secondary	122	46.0	21	25.3	40	44.44	61	70.11
Highschool or above	138	53.0	62	74.7	50	55.56	26	29.89
Type of employment								
Temporary	92	35.4	16	19.28	76	84.44	0	0
Permanent	168	64.6	67	80.72	14	15.56	87	100
Working for								
<= 10 years	79	30.4	21	25.3	39	43.33	19	21.84
> 10 years	181	69.6	62	74.7	51	56.67	68	78.16
Duration of standing								
0-4 hours	82	31.5	39	46.99	42	46.67	1	1.15
5-6 hours	178	68.5	44	53.1	48	53.33	86	98.85
Carrying weight at a time								
5-10Kg	154	59.2	7	8.43	75	83.33	72	82.76
> 10 Kg	106	40.8	76	91.57	15	16.67	15	17.24
Using any specific tools								
Yes	79	69.6	83	100	79	87.78	87	100
No	181	30.4			11	12.22	0	

Table 2: Prevalence of Musculoskeletal symptoms among study participants

MSS	Among all	Rubber	Cardamom	Tea	P-value*
Any regions	87.7	86.7	90	86.2	0.708
Low back	61.2	63.9	63.3	56.3	0.525
Knees	46.9	53	50	37.9	0.111
Shoulders	44.2	43.4	40	49.4	0.443
Neck	29.6	31.3	30	27.6	0.863
Hips/Thighs	28.1	18.1	34.4	31	0.043
Upper back	26.5	22.9	25.6	31	0.469
Wrists	23.9	16.9	43.33	10.3	<0.001
Elbows	18.1	26.5	18.9	9.2	0.013
Ankles	16.2	15.7	23.3	9.2	0.038

*prevalence of MSS in any region, and different regions were compared across the three groups of plantation workers using Chi-squared test for associations.

Table 3: Musculoskeletal symptoms versus characteristics of plantation workers

Characteristics	Any symptoms		P-value
	n	%	
Age			
< 50 years	120	84.5	
>= 50 years	108	91.5	0.086
Sex			
Male	46	88.5	
Female	182	87.5	0.85
Education			
Up to secondary level	107	87.7	
Highschool or above	121	87.7	0.995
Type of employment			
Temporary	84	91.3	
Permanent	144	85.7	0.19
Working in plantation sector for			
<= 10 years	70	88.6	
> 10 years	158	87.3	0.767
Duration of standing in plantation			
0-4 hours	73	89	
5-6 hours	155	87	0.657
Carrying weight at a time			
5-10Kg	137	88.9	
> 10 Kg	91	85.8	0.453
Using any specific tools			
Yes	70	88.6	
No	158	87.3	0.767

Table 4: Risk of MSS in plantation workers- Results from binary logistic regression analysis

MSS	OR and 95% CI (adjusted for age)		
	Rubber	Cardamom	Tea
Any regions	Ref	1.40(0.54-3.60)	1.03(0.42-2.52)
Low back	Ref	0.98(0.52-1.82)	0.74(0.39-1.37)
Knees	Ref	0.89(0.49-1.64)	0.58(0.31-1.07)
Shoulders	Ref	0.88(0.47-1.62)	1.37(0.74-2.53)
Neck	Ref	0.94(0.49-1.80)	0.85(0.44-1.65)
Hips/Thighs	Ref	2.38(1.17-4.84)	2.05(0.99-4.22)
Upper back	Ref	1.16(0.58-2.35)	1.58(0.79-3.16)
Wrists	Ref	3.77(1.85-7.69)	0.57(0.23-1.41)
Elbows	Ref	0.63(0.30-1.30)	0.26(0.10-0.63)
Ankles	Ref	1.65(0.76-3.56)	0.56(0.21-1.44)

DISCUSSION

The main observation from the present study is that the prevalence of MSS during the last 12 months was high among plantation workers, and the most prevailing regions of MSS in plantation workers were low back, knees and shoulders, respectively. Awkward occupational postures, physically strenuous tasks, prolonged standing, and lifting heavy loads have been reported to be associated with the development of musculoskeletal symptoms, especially in the regions of the lower back, knees, and shoulders.[20–22]

In the present study, two-thirds of respondents had been working in the plantation sector for more than ten years. Irrespective of the type of plantation, all respondents reported carrying heavy loads, standing for a long duration, and working in awkward body postures. Rubber tappers had to either bend their low back completely or moderately or keep it straight depending upon the site of incision performed on the tree. Cardamom plantation workers had to assume a bent posture to collect pods, while tea leaf pluckers had to lean forward with outstretched arms for plucking tea leaves. Repetitive hand movements had to be done by the tea leaf pluckers for performing the task. These elements in the work pattern might have contributed to the high prevalence of MSS in the low back, knee and shoulders in three groups of workers.

However, some differences in the patterns were also observed. Wrists were the third most affected body region in cardamom plantation workers, while it was one of the least affected sites in the other two groups. This difference may be because of adopting repetitive wrist movements involving continuous flexion and extension of wrist joint for plucking out the pods compared to the other workers.

Another difference we observed in the pattern of symptoms was that one-fourth of rubber tappers reported MSS in the elbows. In contrast, it was one of the least affected parts among other plantation workers. For rubber tappers, elbows should assume a sustained flexed or extended posture to perform an incision on the tree depending upon the site where the cut is performed. The worker executes the tapping process with the knife using both hands, wherein the left hand applies the most demanding force. Thus, a great deal of force has to be exerted during the entire process, which has to be repeated an average of 400 times in a working day. The awkward posture coupled with the repetitiveness of the task can be a reason for reporting pain in elbows among rubber tappers.

Also, we observed that shoulders were the second most affected site in tea leaf pluckers compared to other groups. Arms have to be stretched forward for collecting tea leaves, thus causing flexion of the shoulder joint, leading to the high prevalence of MSS reported in shoulders among tea workers.

The present study findings were in line with a study among rubber tappers in Sri Lanka, where 65% of participants reported MSS in the last 12 months, and the low back (43%) was the most affected region.[23] Another study conducted among rubber tappers in Thailand reported that 53% of the respondents had low back pain during the previous three months.[24] A study conducted among tea leaf pluckers in Tamil Nadu, India, reported that MSS in the last 12 months were 83.6%, and the most affected body region was the shoulders (59%).[6] Another study among 210 women working in tea gardens of West Bengal, India, showed 92.4% of women had musculoskeletal disorders in the past 12 months.[25] A recent study using a five-point scale measure of pain among 40 women tea leaf pluckers in Meghalaya, India, reported severe discomfort (score >=4) in different body parts such as the head, neck, fingers, upper and lower back and feet, among participated women.[26]

All these previous studies offer a novel perspective on the impaired musculoskeletal health of plantation workers, which is consistent with the present study findings. To the best of our knowledge, there was no study focusing on the musculoskeletal health of cardamom plantation workers in India. Also, no studies explored the musculoskeletal health of different plantation workers in a single frame. Hence, the impaired musculoskeletal health status of the plantation workers in a state that is a leading producer of rubber, cardamom, and tea in India seek importance from a public health perspective.

Strength and limitations of the study

The choice of the three types of plantations was due to its dominance in the Indian sector in terms of both production and crop area. The study setting was limited to two districts because these two districts had a significant share of the selected plantations in Kerala. One major limitation of the study is that we couldn't strictly follow random selection of participants from the three groups. However, each type of plantation in

the two districts keeps a similar pattern of work and characteristics of workers. Thus, the sampling strategy may not have much affected the assessment and the generalizability to a larger extent since our focus was on assessing MSS in workers. As the plantation industry is a female-oriented sector, exploring MSS for sex differences was also limited.

CONCLUSION

The study showed a high prevalence of MSS in plantation workers, with the low back being the most affected body region in the three groups. Though there was no variation in the overall prevalence of MSS between the three groups, there was a significant variation between the groups regarding the MSS in different body regions. There was a high risk for MSS in the wrists and hips/thighs among cardamom plantation workers and a low risk for MSS in elbows and knees among Tea plantation workers compared to rubber tappers.

Practicing simple stretching exercises to ease the muscles, taking small breaks, and occasional postural changes during work can help to reduce MSS in general. Adopting newer technologies and ergonomically designed hand tools, using musculoskeletal aids such as braces, wrist supports, bands, and lumbar belts according to the nature of work in different plantations can help reduce MSS risk. Workers should also be made aware of the importance of seeking proper healthcare at the start of the feeling of discomfort or pain. Such small interventions and improvements in the workplace can provide a great deal of difference, as goes by the proverb, "Small changes eventually add up to huge results."

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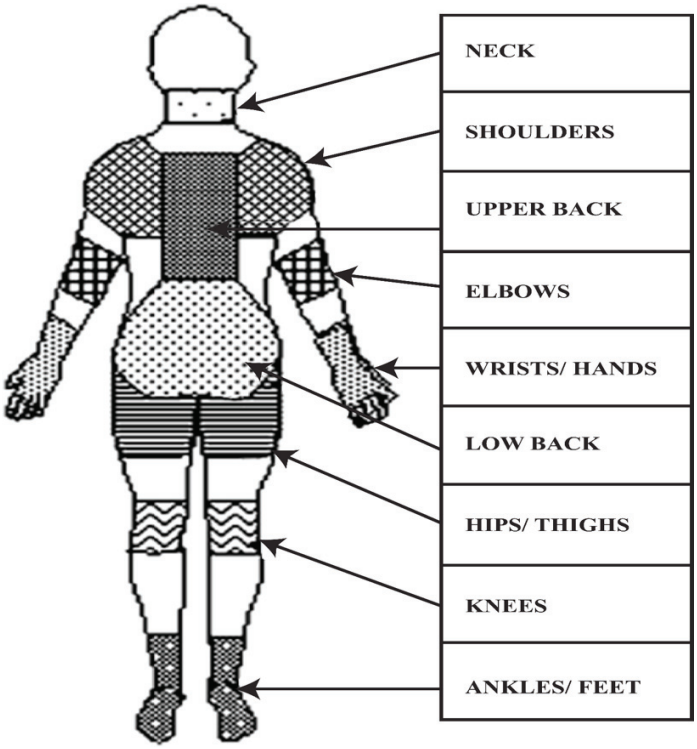
Musculoskeletal Symptoms assessment form

Based on the Standard Nordic Questionnaire [19] Participant id: ----------

Picture: In this picture you can see the approximate position of the parts of the body referred to in the questionnaire. Limits are not sharply defined, and certain parts overlap. You should decide for yourself in which part you have or have had your trouble (if any).



Have you at any time during the last 12 months had trouble (ache, pain, discomfort) in:		Have you at any given time during the last 12 months been prevented from doing your normal work (at home or away from home) because of the trouble:	Have you had trouble at any time during last 7 days?
 NECK	NO YES	NO YES	NO YES
 SHOULDER	NO YES, IN RIGHTHOULDER YES, IN LEFT SHOULDER YES, IN BOTH SHOULDERS	NO YES	NO YES
 ELBOW	NO YES, IN RIGHT ELBOWS YES, IN LEFT ELBOWS YES, IN BOTH ELBOWS	NO YES	NO YES
 WRIST/HANDS	NO YES IN RIGHT WRISTS YES, IN LEFT WRISTS YES IN BOTH WRISTS	NO YES	NO YES

 UPPER BACK	NO YES	NO YES	NO YES
 LOWER BACK	NO YES	NO YES	NO YES
 ONE OR BOTH HIPS/THIGHS	NO YES	NO YES	NO YES
 ONE OR BOTH KNEES	NO YES	NO YES	NO YES
 ONE OR BOTH ANKLES	NO YES	NO YES	NO YES