Original Article

Musculoskeletal Pain and its Ergonomics risk factors among school teachers from Tamil Nadu, India: A cross-sectional study

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ABSTRACT

Introduction: Teachers are often exposed to occupational hazards like musculoskeletal pain which may force them to early retirement from their jobs, affecting their quality of life. This study aimed to estimate the prevalence of musculoskeletal pain among government school teachers and to assess its ergonomic risk factors.

Methods: A cross-sectional study was conducted among government school teachers in Kundrathur Block, Kancheepuram District, Tamil Nadu, India. The Nordic Musculoskeletal Questionnaire was used to estimate the prevalence of musculoskeletal pain. The study was conducted from June to November 2019 for 6 months. In total, 400 participants were included in the study. Descriptive statistics like frequency and percentage were used for different variables and the various risk factors as well as inferential statistics like prevalence, confidence interval, odds ratio, and chi-square test were used for finding the association between the dependent and independent variables.

Results: The prevalence of musculoskeletal pain among school teachers was 69.8%. Binary logistic regression analysis showed that the factors such as sex (adjusted odds ratio [aOR] = 2.47; 95% confidence interval [CI]: 1.47-4.15) with p-value = <0.01* and number of students in each class (aOR= 1.86; 95% CI: 1.12-3.08) with p-value = <0.01* were identified to be significant risk factors associated with musculoskeletal pain.

Conclusion: The prevalence of musculoskeletal pain among school teachers was found to be high. This clearly shows the significant burden of this occupational hazard on the teacher's community, which should be addressed to focus on its prevention.

Keywords: Ergonomic risk factors, Musculoskeletal pain, Prevalence, School teachers

Introduction

Occupational health problem is common among the working population due to ergonomics risk factors. Musculoskeletal pain is one of the most common health issues that arise in this population. According to the World Health Organization (WHO), musculoskeletal disorders are the highest contributor to the global need for rehabilitation and it is the condition that often co-exist with non-communicable diseases and mental health issues.[1] National Institute for Occupational Safety and Health (NIOSH) states that musculoskeletal disorders are soft-tissue injuries caused by sudden or sustained exposure to repetitive motion, force, vibration, and awkward positions. These disorders can affect the muscles, nerves, tendons, joints, and cartilage in your

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upper and lower limbs, neck, and lower back.[2] Musculoskeletal pain causes disability by lessening the ability to do work, thereby affecting the overall quality of life. World Health Organization (WHO) and the International Labour Organization (ILO) report that the risk factors for Musculoskeletal pain are activities and environments involved with rapid or repetitive motion, forceful exertion, the concentration of excessive mechanical force, awkward or non-neutral posture, and vibrations.[3] Some working populations are experiencing more work-related musculoskeletal pain. The teaching profession stands out among them. Musculoskeletal Pain is one of the most common physical health complaints of teachers during their careers. Teachers always play an important role in the transformation of society. The teaching profession is not only limited to teaching. Teachers are doing extra activities other than the teaching and these activities normally exceed their traditional allocation. These extra activities include paper correction work, supervision duties, election duties, and conducting the school's annual program competition. These may affect their organizational aspect resulting in various health problems compromising the quality of their life. Musculoskeletal pain among teachers may force them to early retirement from their jobs. Compared to private school teachers, government school teachers face increasing occupational demands like a greater number of classes per day, excess student strength, continuous teaching with no adequate breaks in between, handling more than one subject, and lack of teaching aids. Other factors to be considered are age, gender, and duration of the teaching experience.

The teaching job forces the working individual to maintain a certain awkward or non-neutral posture for a long time. These awkward postures include writing on a blackboard with arms extended, bending or stooping, and standing for a sustained period. These may act as an influencing factor for developing musculoskeletal pain. Because of the constant pain, sick leave is increasing which impairs the curriculum and affects productivity in the teaching profession. Among school teachers, the most commonly reported sites for musculoskeletal pain were the neck, shoulder, lower back, and upper limbs.[4,5,6,7] In recent years, the research on the teaching profession is steadily increasing but most studies focus only on the prevalence of common health problems, not on their risk factors. By concentrating on this area, we can improve the personalized prevention programs for teachers. This study aims to estimate the prevalence of musculoskeletal pain and to assess the ergonomic risk factors associated with it.

Methods

This cross-sectional study was carried out among government school teachers in Kundrathur block, Kancheepuram District, Tamil Nadu, India. The study period was 6 months from June to November 2019. Based on the intense review of the literature, the prevalence of musculoskeletal pain was found to be 74.47%.[8] Taking it as prevalence, with a limit of accuracy of 5% and with a Z value of 1.96, the sample size calculated was 296. About 10% of the sample size of 30 was added to take care of any refusal to participate in the study and the total minimum sample size arrived for the study was 326. Using a multi-stage random sampling technique, Kanchipuram district was chosen for the study. Under the Kanchipuram district, Kundrathur block was selected using the lottery method. All Government schools under the Kundrathur block were enlisted and selected for the study. A list of all teachers employed by selected government schools was compiled, and only those teaching at high and higher secondary levels were included in this study. Even though the desired sample size is 326, we have recruited all 488 teachers who have met the inclusion criteria for the study. Out of 488 participants, 88 did not give informed consent due to time constrain and other concerns about the study. Hence 400 were included in the study which was more than the sample size required.

Ethical clearance was obtained from the Institutional Ethics Committee of Sri Ramachandra Medical College and Research Institute (SRIHER) [CSP-MED/19/JUN/53/63]. Permission to do the study was also obtained from the Chief Education Officer, Kancheepuram District, and Tamil Nadu for conducting Interviews in Government Schools. Participants

were government school teachers (both male and female) handling high and higher secondary level, and also including music, art, and physical teachers in the age group of above 20 years and who gave informed consent. Primary and middle school teachers were excluded from the study due to the lack of permission from the concerned authority. The pilot study was conducted among School teachers using the validated Instrument before the actual study to know the difficulty of participants in understanding the terms and time required to fill out each questionnaire. Pre-testing of the questionnaire was done to obtain information on socio-demographic details and teaching-related characteristics. Government high school, Mathur, Sriperumbudur Block (outside the study area) was chosen and participants who gave informed consent were included in the pilot testing. A total of 25 participants were studied. The data from the pilot study was not included in the final analysis of the results. Based on the pre-testing, there was no need to make changes to the final format of the questionnaire.

Before data collection, the headmasters of the selected school were contacted by phone about the visit and briefed about the importance and usefulness of the study. On the day of data collection, each teacher was contacted in person and a written consent form was given. After informing the details of the study, the teachers were requested to sign the consent form, only if they were willing voluntarily to participate in the study. A standardized Nordic Questionnaire is a self-administered tool, created by Kourinka et al for screening musculoskeletal pain in an ergonomic context.[9] The Nordic Musculoskeletal Questionnaire consists of a human body diagram showing nine anatomical areas (neck, shoulders, elbows, wrist/hands, upper back, lower back, hips, knees, and ankles). All the subjects were asked to answer yes or no if they had problems such as pain, discomfort, ache, or numbness in the specified areas mentioned in the diagram in the last 12 months and 7 days and whether it affected their normal activity. This questionnaire is proven to be a valid and reliable screening tool for assessing musculoskeletal symptoms for various working groups including teachers. Permission

for using the study tool was duly obtained.

Data compilation and analysis were done using the Statistical Package for Social Sciences (SPSS) version 21 software. Descriptive statistics were calculated for background variables and the various risk factors. Prevalence and 95% confidence intervals were calculated. The odds ratio was calculated to find the association. The chi-square test was done for the test of statistical significance.

Results

A total number of 400 teachers from high and higher secondary schools in the Kundrathur block participated in this cross-sectional study. Out of 400 school teachers, the mean age of the teachers was 45.7 years (SD ± 7.5 years). The minimum age of teachers was 24 years and the maximum age was 58 years. The majority 184(46%) of the teachers belong to the age group of 41 to 50 years. The percentage of male teachers was 85(21.3%) and females were 315(79.7%).

Among the study participants, 11(2.8%) teachers were currently smoking and the number of teachers consuming alcohol was 19(4.8%). Most of the teachers, 297(74.2%) chose the private mode of transport followed by the public mode of transport which was 103(25.8%). The mean duration of traveling was 40.35 minutes (SD ± 31.84 minutes) and most of them 228(57%) travelled less than 30 minutes to reach the school. Out of 400 teachers, 200(50%) travel less than 10 kilometers (km) to reach the school, 137(34.2%) travel 11 to 20 km, 36(9%) travel 20 to 30km, and 27(6.8%) travel more than 30km to reach the school. The majority 162(40.5%) of teachers had 10 to 19 years of teaching experience with an overall mean of 17.88 years (SD ± 8.08 years). The majority of them, 266(66.5%) reported the average number of students per class was more than 40, and a few teachers 96(24%) are handling more than 1 subject. Most of the teachers 361(90.2%) reported 21 to 30 hours of teaching per week. Of the school teachers 204(51%) reported being involved in continuous teaching for less than 45 minutes. The Background, personal details, and teaching-related characteristics of the participants are given in (Table 1).

Table 1: Background characteristics, personal details and teaching related characteristics of the participants (n = 400)

Characteristics	n (%)
Age in years	
21-30	18(4.5%)
31-40	86(21.5%)
41-50	184(46%)
51-60	112(28%)
Sex	
Male	85(21.25%)
Female	315(78.75%)
Current smoker	
Yes	11(2.8%)
No	389(97.2%)
Alcohol consumption	
Yes	19(4.8%)
No	381(95.2%)
Duration of travel	
≤30 min	228(57.0%)
31 – 59 min	62(15.5%)
60 – 89 min	68(17.0%)
≥90 min	42(10.5%)
Mode of transport	
Public transport	103(25.8%)
Private transport	297(74.2%)
Distance	
≤10 km	200(50.0%)
11 – 20 km	137(34.2%)
21 – 30 km	36(9.0%)
>30 km	27(6.8%)
Teaching experience(years)	
1-9 years	66(16.5%)
10 – 19 years	162(40.5%)
20 – 29 years	129(32.2%)
≥30 years	43(10.8%)
Average students per class	
≤40 students	134(33.5%)
>40 students	266(66.5%)
No. of subjects teaching	
1 subject	304(76.0%)
>1 subject	96(24.0%)
Hours of teaching per week	
≤20 hours	36(9.0%)
21-30 hours	361(90.2%)
>30 hours	3(0.8%)
Hours of continuous teaching	
≤45min	204(51.0%)
More than 45min	196(49.0%)

The overall prevalence of musculoskeletal pain was found to be 69.8% with a 95% confidence interval from 64.9% to 74.2%. The prevalence of musculoskeletal pain was greater in females (84.2%) than compared in males (15.8%) and this difference was statistically significant (p-value<0.01*). The prevalence of musculoskeletal pain was greater among teachers between 41 to 50 years of age (45.9%) when compared to other age groups and the difference in prevalence is insignificant with p-value = 0.85. (Table 2).

Out of 400 participants, the prevalence of musculoskeletal pain in any part of the body was 279(69.8%), 267(66.8%), and 266(66.5%) for the last 12 months, 7 days, and 12 months of work-limiting pain respectively. The most affected part of the body was the neck, with 102(25.5%) having pain for the last 12 months and 91(22.8%) having pain for the last 7 days. Next to the neck, the most affected part was the hips/thigh where 97(24.3%) had 12 months of pain, and 87(21.8%) had 7 days of pain. The other most affected parts for the last 12 months were the knee 93(23.3%), shoulder 71(17.8%), ankle/feet 56(14%), and wrist/hands 44(11%). The least affected part in the last 12 months was the lower back 39(9.8%), elbows 24(6%), and the upper back 19(4.8%). (Table 3)

Table 2: Prevalence of Musculoskeletal pain as per sex and age group (n = 279)

Prevalence of Musculoskeletal pain based on age and sex	n (%)	95% CI	p-value
Sex			
Male	44(15.8%)	15.7-18.2	**<0.01***
Female	235(84.2%)	69.4-92.4	
Age group			
21 – 30 years	11(3.9%)	1.6 – 6.2	0.85
31 – 40 years	60(21.5%)	16.7 – 26.3	
41 – 50 years	128(45.9%)	40.1 – 51.7	
51 - 60 years	80(28.7%)	23.4 – 34.1	

**p value <0.05 is significant

Table 3: Prevalence of musculoskeletal pain according to Standardized Nordic Questionnaire - 12 months/ 7 days/ 12 months work limiting pain (n = 400)

Body parts	12-months prevalence n (%)	7-days prevalence n(%)	12 months of work-limiting pain n(%)
Neck	102(25.5%)	91(22.8%)	90(22.5%)
Shoulder	71(17.8%)	66(16.5%)	63(15.8%)
Elbows	24(6.0%)	19(4.8%)	19(4.8%)
Wrist/hands	44(11%)	38(9.5%)	38(9.5%)
Upper back	19(4.8%)	15(3.8%)	14(3.5%)
Lower back	39(9.8%)	32(8.0%)	32(8.0%)
Hips/thigh	97(24.3%)	87(21.8%)	90(22.5%)
Knee	93(23.3%)	83(20.8%)	83(20.8%)
Ankle/feet	56(14%)	48(12%)	51(12.8%)
Any musculoskeletal pain	279(69.8%)	267(66.8%)	266(66.5%)

Among the participants, female was found to have increased odds of developing musculoskeletal pain compared to male by 2.7 times (Odds Ratio [OR]=2.73; 95% confidence interval [CI]: 1.7-4.5) with p-value <0.05*. Those teachers who travel utilizing public transport had 1.8 times (OR=1.84; 95% CI: 1.08-3.12) with p-value <0.05* increased risk of developing musculoskeletal pain compared to those who travel using private transport. Teachers whose traveling distance of

more than 30 minutes had a high risk of developing musculoskeletal pain by 1.5 times (OR= 1.56; 95% CI: 1.02-2.42) with p-value <0.05*. Those, who had teaching hours more than 21 hours per week had 1.7 times (OR=1.77; 95% CI: 1.14 – 2.75) with p-value <0.05* increased risk of developing musculoskeletal pain compared to those with teaching hours less than 21. Those

teachers with an average number of students per class of less than 40 are at high risk of developing musculoskeletal pain by 1.8 times (OR=1.80; 95% CI: 1.16-2.78) with p-value <0.05*. Teachers, who are continuously teaching for more than 45 minutes had an increased risk of musculoskeletal pain by 1.8 times (OR= 1.80; at 95% CI: 1.16 – 2.78) with p-value<0.05*..

Table 4: Association between certain risk factors and musculoskeletal pain (n = 400)

Particulars	Musculoskeletal pain			Crude Odds ratio (95%CI)	p-value	aOR (95%CI)	p-value
	Present	Absent	Total				
Age							
>50 years	80	32	112	1.11(0.69-1.80)	0.64		
≤50 years	199	89	288	1			
Sex							
Female	235	80	315	2.73(1.66-4.49)	<0.01*	2.47(1.47-4.15)	<0.01*
Male	44	41	85	1			
Currently smoking							
Yes	7	4	11	0.75(0.21-2.62)	0.65		
No	272	117	389	1			
Consuming alcohol							
Yes	12	7	19	0.73(0.28-1.90)	0.52		
No	267	1142	381	1			
Mode of transport							
Public	81	22	103	1.84(1.08-3.12)	0.02*	1.28(0.70-2.34)	0.41
Private	198	99	297	1			
Travelling time							
> 30min	129	43	172	1.56(1.02-2.42)	0.04*	1.49(0.90-2.47)	0.12
≤30min	150	78	228	1			
Number of years of teaching							
>10years	2 18	91	309	1.18(0.71-1.94)	0.52		
≤10years	61	30	91	1			
Teaching hours per week							
>21hours	190	66	256	1.77(1.14-2.75)	<0.01*	1.31(0.74-2.31)	0.34
≤21hours	89	55	144	1			
Number of students in each class							
≤40 students	105	29	266	1	<0.01*	1.86(1.12-3.08)	<0.01*
>40 students	174	92	134	1.91(1.18-3.10)			
Continuous teaching							
>45min	149	47	196	1.80(1.16-2.78)	<0.01*	1.31(0.74-2.30)	0.34
≤45min	130	74	204	1			

^Chi-square test, #Multivariate logistic regression analysis, *p value <0.05 is significant

In the logistic regression model, the significant risk factors identified by univariate analysis such as sex, mode of transport, traveling time, teaching hours per week, the number of students in each class, and continued teaching were added as predictors. This established that sex (aOR=2.47; 95% CI: 1.47-4.15) with p-value = <0.01* and number of students in each class (aOR=1.86; 95%CI: 1.12-3.08) with p-value = <0.01* were found to be significant risk factors associated with musculoskeletal pain. (Table 4).

Discussion

This cross-sectional study was done to find out the prevalence of musculoskeletal pain among school teachers and to find out their association with certain related risk factors. This study was carried out among high and higher secondary school teachers working in Kundrathur block of Kancheepuram district, Tamil Nadu, India. In this study, it was found that the overall prevalence of musculoskeletal pain among teachers was 69.8% (95% CI: 64.9% to 74.2 %). In a study done by Vaghela et al among Gujarat school teachers, the prevalence of musculoskeletal pain was found to be 74.47%, which was close to our study.[8] In another study done by Thaseen et al among Chennai city school teachers to determine the impact of musculoskeletal pain, the prevalence was found to be 75.1% which was also similar to our study.[10]

In this study, we found, that 69.8% of teachers had musculoskeletal pain in any part of the body for the past 12 months, 66.8% of them had pain in the last 7 days and 66.5% of teachers had work-limiting pain. Solis–Soto et al conducted a study among Bolivian school teachers, and it was found that 86% of teachers had musculoskeletal pain in some parts of the body in the last 12 months, 63% had them in the last 7 days and 15% of teachers had work limiting pain. The high prevalence of work-limiting pain among school teachers in our study was due to the difference in the educational system, health-seeking practices, and availability of sick leave.[11] The present study also showed the most affected part of the body was the neck, with 25.5% having pain in the last 12 months and 22.8% having pain in the last 7 days. The next most affected part was the hip/thigh where 24.3% of

teachers had pain in the last 12 months and 21.8% had pain in the last 7 days. The study conducted by A.N. Alias among school teachers in the Terengganu region, Malaysia also reported that 22.6% of teachers had neck pain in the last 12 months and 22.2% of them had pain in the last 7 days, which was similar to our findings.[12] The prevalence of neck pain was found to be high in our study probably because most of the teachers maintained their heads in a forward bending posture for marking attendance and reading from the book and also in a backward bending posture for writing on the blackboard.

On assessing the association between musculoskeletal pain and sex, it was found females had a higher risk of developing musculoskeletal pain by 1.1 times more than male teachers and it was statistically significant (p-value <0.05). Chiu et al in their study also reported female teachers are at high risk of developing both neck pain and upper limb pain by 2.39 times and 1.89 times respectively.[13] This may be due to female teachers having less physical strength, after working hours they are eventually involved in domestic household work, increasing their susceptibility to musculoskeletal pain. On assessing the mode of transport and risk of musculoskeletal pain, teachers who were using a public mode of transport were at high risk of developing musculoskeletal pain by 1.8 times and it was statistically significant (p-value<0.05). Bogaert et al investigated the effects of various physical activities on teachers' health and the study did not show any significant association between the mode of transport and teachers' mental and physical health.[14] Teachers using public transport such as buses and trains are coming from a long distance and for a longer duration, which may prone them to adopt certain awkward postures while traveling which increases the risk for musculoskeletal pain. In our study, it was found, that teachers teaching more than 21 hours per week were at high risk of developing musculoskeletal pain by 1.7 times and it was statistically significant (p-value<0.05). Temesgan et al conducted the study among Ethiopian school teachers, and it was found teachers with teaching hours more than 30 hours per week were at high risk of developing shoulder

and neck pain by 1.57 times and the association was statistically significant.[15] Teachers with excessive teaching hours per week were exposed to cumulative effects of heavy workloads making them more prone to musculoskeletal pain. On assessing the association between musculoskeletal pain and duration of continuous teaching, it was found teachers who are being indulged in continuous teaching for more than 45 minutes were at high risk of developing musculoskeletal pain by 1.8 times and it was statistically significant (p-value<0.05). Teachers indulged in continuous teaching were involved in maintaining awkward postures like forwarding bending or backward bending and constant stretching of arms making them more prone to musculoskeletal pain. Studies shows that increased job stress also increases the odds of getting musculoskeletal pain.[16]

Our present study also showed teachers with an average class strength of fewer than 40 students were at high risk of developing musculoskeletal pain with the odds being 1.86 and which was statistically significant (p-value<0.05) which was contradicted to the study by Amit et al conducted among Philippines school teachers, which showed no significant association between musculoskeletal pain and the average number of students per class.[17] Our present study did not find any significant association between musculoskeletal pain and participant age, educational status, smoking habit, alcohol consumption, and teaching experience.

Conclusion

The present study concludes that the overall prevalence of musculoskeletal pain was high (69.8%) and the majority of them had neck pain which was followed by other body parts such as hips/thigh, knee, and shoulder pain. Demographic variables like sex and teaching-related characteristics such as hours of teaching, the average number of students per class, and continuous teaching were found to play an important role in inducing musculoskeletal pain among school teachers. This can be easily avoided by adopting proper working postures during their teaching hours.

The present study recommends that the school authorities and policymakers understand this occupational hazard faced by teachers in their working environment and also urge them to take the appropriate measures to prevent it. The teachers need to have proper health education or health promotion programs on ergonomic risk factors that they are going to encounter in day-to-day life as a part of their job and comprehensive prevention strategies for managing this hazard. Limitations of the present study are that results are based on a questionnaire, and clinical examination was not done hence there may be a chance of responder's bias in the study.

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