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# Ergonomics in the Teaching Profession: Musculoskeletal Disorders among Faculty Members of Colleges and Departments of Sardar Patel University

Dharti Variya<sup>1</sup>, Dr. Paulomi Dalal<sup>2</sup>

<sup>1</sup>M.Sc. Student, <sup>2</sup>Adhoc Assistant Professor, P.G. Department of Home Science, Sardar Patel University, Gujarat - India

**Abstract:** *Musculoskeletal Disorders (MSDs) are a common occupational health in the teaching profession which although long neglected has attracted increasing concern as recent years. The aim of this study is to assess work related musculoskeletal disorders among the faculty members and to assess the postures adopted by them. A self-structured questionnaire based study was conducted by a lottery randomly selected faculty members. Among the 114 completed questionnaires the prevalence of upper back, knee joint and shoulder was 57%, 37% and 30% respectively. Pain among teachers was associated with factors such as age, gender, job experience and teaching hours. Data was analyzed by SPSS – version 20 using appropriate statistical test. P-values less than 0.05 were considered among the subjects. Factors associated with MSDs were prolong standing, (52%, n=115), writing on a blackboard (26%, n=115). These findings highlighted specific actions, such as stretching (50%, n=115) and bending (49%, n=115) while sitting and side bending (37%, n=115), stretching (35%, n=115) and neck bending (35%, n=115) while standing in a class room. The findings draws an attention the ergonomic intervention programs to be implemented to prevent reduce the development of MSDs amongst teachers.*

**Keywords:** *Musculoskeletal-disorders, postures, faculty-members, colleges/departments, Sardar Patel University*

## I. INTRODUCTION

Musculoskeletal disorders (MSDs) affect the body's muscles, joints, tendons, ligaments and nerves. Most work-related musculoskeletal disorders (WRMSDs) develop over time and are caused, either by the work itself or by the employees' working environment. According to the National Institute for Occupational Safety and Health in United States, MSDs are among the most important and common work-related diseases, and the main cause of absenteeism. The work of teachers has a fundamental social value because education can ensure economic growth, and technical and scientific development in any society (Vedovato T. G, Monteiro I. 2014). Musculoskeletal disorders (MSD) represent a common occupational problem in the teaching profession and teachers represent an occupational group among which there appears to be a high prevalence of MSD. A teacher spends the majority of the day standing in the classroom, walking through the classroom and be able to work in tight spaces between desks, teaching students, writing on the blackboard, preparing lessons, grading assignments, and an administrative work, which can cause adverse mental and physical health concerns (Chan AHS et al, 2010; Chong EYL, Chan AHS, 2010). The prolonged static posture, body mechanics, continuous nature of the job without optimum rest intervals put the teachers in a vulnerable position to develop WMSDs (Liping Li et al, 2012). Zahoor Ahmed, et al. (2018) study result shows that the frequency of low back pain (46%) and Neck Shoulder Pain (47%) was among 894 teachers. The frequency of female teachers is higher than male teachers. The self-reporting neck shoulder pain associated with Prolong sitting, standing and Static Posture. The aim of this study is to assess the prevalence of musculoskeletal disorders among faculty members of Sardar Patel University, Gujarat – India.

## II. METHODS AND MATERIALS

A study was conducted among faculty members in lottery randomly selected colleges and department of Anand and Vallabh Vidyanagar area, Sardar Patel University, Gujarat – India. One hundred and fourteen (114) colleges and departments were randomly selected from a list of 140 colleges and departments obtained from the university academics section. All teachers employed in the selected colleges and departments (approximately 3 faculty member per college/department) were invited to participate in the study. A total of 144 self-administered questionnaires were distributed. The questionnaire was constructed according to the demographic

variables, teaching history, and information on MSDs (with possible associated occupational risk factors), formed the basis of the questionnaire.

Ethical considerations: Permission to conduct study within selected colleges and departments was obtained from the Principals and Head of the departments of the selected colleges and departments. The teachers received letters outlining the study, explaining their voluntary participation, and assuring confidentiality of the data provided. A letter of informed consent was signed by each participant. Statistical analyses Data were analysed using the SPSS statistical package (version 22), with statistical significance set at  $p \leq 0.05$ . Descriptive analyses were performed on categorical variables (summarised as frequencies and percentages). An Association of factors with MSDs were assessed using bi-variates analyses (chi-squared tests).

### III.RESULTS AND DISCUSSIONS

TABLE I  
GENERAL CHARACTERISTICS OF RESPONDENTS (N=144)

Age Group	Number	Percentage (%)
24-34	68	47
35-45	53	37
46 & above	23	16
Total	144	100
Gender	Number	Percentage (%)
Male	64	44
Female	80	56
Total	144	100
Education qualification	Number	Percentage (%)
Graduation	10	7
Post-Graduation	75	52
M.Phil.	03	02
Ph.D.	53	37
Any other	03	02
Total	144	100
Class interval	Number	Percentage (%)
2-9	102	71
10-17	32	22
18 & above	10	07
Total	144	100
Marital Status	Number	Percentage (%)
Unmarried	34	24
Married	109	76
Divorced	01	0.7
Total	144	100

(Table I) with regards to age 47% of the total sample was in the 24-34 year of age group and 16% were in the 46 & above years of age group.

The 'gender' distribution of the final sample was 44% males and 56% females. The majority of the study subjects' education qualification' were 37% doctorates followed by 52% post graduates.

The subjects had worked ranging from 2 years to 27 years of experience. Two to nine years of experience has the highest frequency of 102 respondents (71%), 10-17 years of experience has the second highest frequency of 32 respondents (22%) and third highest frequency of 10 respondents was 18 & above years of experience 07%. The majority of the participants were 'married' (76%). Twenty four percent of the participants were 'unmarried'.

TABLE II  
WORKING PATTERN OF RESPONDENTS (N=144)

Working hours of job	Number	Percentage (%)
6 Hours	73	51
7 Hours	46	32
8 Hours	20	14
Any Other(5 Hours)	05	03
Total	144	100
Teaching Hours	Number	Percentage (%)
3 Hours	67	46
4 Hours	56	39
5 Hours	21	14
Total	144	100
Number of Practicals	Number	Percentage (%)
2 Hours	27	19
3 Hours	42	29
4 Hours	06	04
Any Other(No Practical)	69	48
Total	144	100
Teaching Schedule	Number	*Percentage (%)
Continuous	47	33
Alternate Hours	59	41
Combination Of Theory & Practical	44	31
Any Other (Practical)	01	0.6
Rest break between activity	Number	*Percentage (%)
Yes	113	78
5 To 10 Minutes	71	49
10 To 20 Minutes	20	14
20 To 30 Minutes	14	08
>30	06	4
No	32	22
During rest break	Number	*Percentage (%)
Sitting In A Staffroom/Cabin	68	47
Work For The Next Teaching Class	60	42
Exercises	05	03
Refreshment	52	36
Any other (paper work)	01	0.6
Lunch Break Time	Number	Percentage (%)
30 Minutes	79	55
20 Minutes	21	15
1 Hour	25	17
Any Other(40 Minutes)	19	13
Total	144	100
Travel	Number	Percentage (%)
Car	36	25
Public Transport	34	24
Walk	08	05
Any Other(Two Wheeler)	66	46
Total	144	100
Any Other (No Practicals)	69	48
Total	144	100

Table II with regards to daily ‘Working hours’ almost fifty one (51%) of the teachers spent 6 hours daily on teaching while 32% spent at least 7 hours Fourteen percent respondents spent 8 hours daily. The result in table 4.3 shows that the majority of the teachers (45%) teach 3 hours class per day, while 38% of the teachers teaches 4 hours per day. In addition almost 29% teachers take 3 hours practicals per day, 19% takes 2 hours practicals per day. Only four percent takes 4 hours Practical Per day. The result in table 4.3 also shows that the majority of the teachers (41%) have had ‘alternate’ teaching lectures per day, 33% have had ‘continuous’ teaching lectures per day while, 31% teachers have had the combination of theory and practical both. The data also reveals that teachers take rest between activities most commonly of 5 to 10 minutes duration. Whereas 47% of the respondents ‘sits in a staff cabin’ during rest break, Forty two percent of the respondents ‘work for the next teaching classes. The majority of the respondents (55%) lunch breaks time are of 30 minutes followed by the ‘1 hours’ (17%), ‘20 minutes’ (15%). Travelling by two-wheeler was the most common transportation mode to reach the college by 46% of the respondents.

Work related Musculoskeletal Disorder experienced by the Respondents

Table III Complain of Musculoskeletal Disorder (N=144)

Musculoskeletal disorder during job	Number	Percentage (%)
Yes	115	80
No	29	20
Total	144	100
Experienced musculoskeletal years	Number	*percentage (%) (n=115)
Less than 3 years	35	30
4 to 7 years	40	35
8 and above	40	35
Pain due to	Number	*percentage (%)
Writing on black board	30	26
Standing	60	52
Sitting	14	12
Carrying books	05	04
Any other (carrying laptop)	06	05
Day of pain	Number	*percentage (%) (n=115)
Morning	10	09
Afternoon	22	19
Evening	69	60
Any other (night)	14	12
Total	115	100

Medical Visit	Number	*Percentage (%)
Yes	60	52
Hospitalization	07	06
O.P.D.	30	26
On Medication	05	04
Any other (Exercise And Physiotherapy)	03	03
No	10	09

Awareness topics	Number	Percentage (%)
Ergonomics	27	19
Musculoskeletal Disorder	56	39
Postural Problem	40	28
Any Other(No)	21	14
Total	144	100
Foot Wear during job hours	Number	Percentage (%)
High heels	04	03
Platform heels	31	22
Flat Chappals	76	52
Any other (Shoes)	33	23
Total	144	100

\*(Total exceeds due to multiple answers)

Table III presents the musculoskeletal disorder occurrence during job. It was reported by 80% of the respondents had the musculoskeletal disorder during job. Where, 75% of the respondents experienced pain since last four years. Prolonged standing during job hours has caused the musculoskeletal disorders among respondents (52%), whereas, 26% respondents complained of musculoskeletal disorders due to writing on black board. Further, majority of the respondents (60%) complained the occurrence of musculoskeletal disorders during ‘evening’ phase of the day. Majority of the respondents were aware of the term musculoskeletal disorder (39%) and postural problem (28%). Data reveals that 52% of the respondents’ worn flat chappals at work whereas 23% and 22% of the respondents wear shoes and platform heels respectively.

Table IV Types of posture adopted during work (N = 144)

Sr. No.	Types of posture adopted	Number	*Percentage (%)
Sitting posture			
1	Bending	70	49
2	Stretching	72	50
3	Side back bending	35	24
4	Neck bending	25	17
5	Side neck bending	20	13
6	Uneven legs standing	20	13
7	Raised shoulder	22	15
8	Twisted	15	10
9	Stooping	25	17
Standing Posture			
1	Bending	35	24
2	Stretching	50	35
3	Side back bending	54	37
4	Neck bending	50	35
5	Side neck bending	39	28
6	Uneven legs standing	36	25
7	Raised shoulder	26	19
8	Twisted	35	24
9	Stooping	19	14

\*(Total exceeds due to multiple answers)

Table IV shows that stretching (72%), bending (70%) was more observed at work in a sitting posture by the respondents. Further, side back bending (54%), stretching (50%), neck bending (50%) were the frequent adopted postures by the respondents while standing at workplace. Since due to different activities like frequent reading, marking of assignments, writing on black board might force them to adopt such postures.

Table V Types of furniture in the class rooms (N = 144)

Sr. No.	Existing furniture in the class rooms	Number	*Percentage (%)
1	Non-adjustable Chair	64	44
2	Adjustable chair	46	32
3	Wooden Platform	103	71
4	Racks	02	01
5	Shelves	23	16
6	Table	103	71
7	Table with Drawer	05	03
8	De-attachment stool	02	01
9	Cupboard	27	19
10	White Board	46	32
11	Black Board	112	78
12	Electric Board	02	01

\*(Total exceeds due to multiple answers)

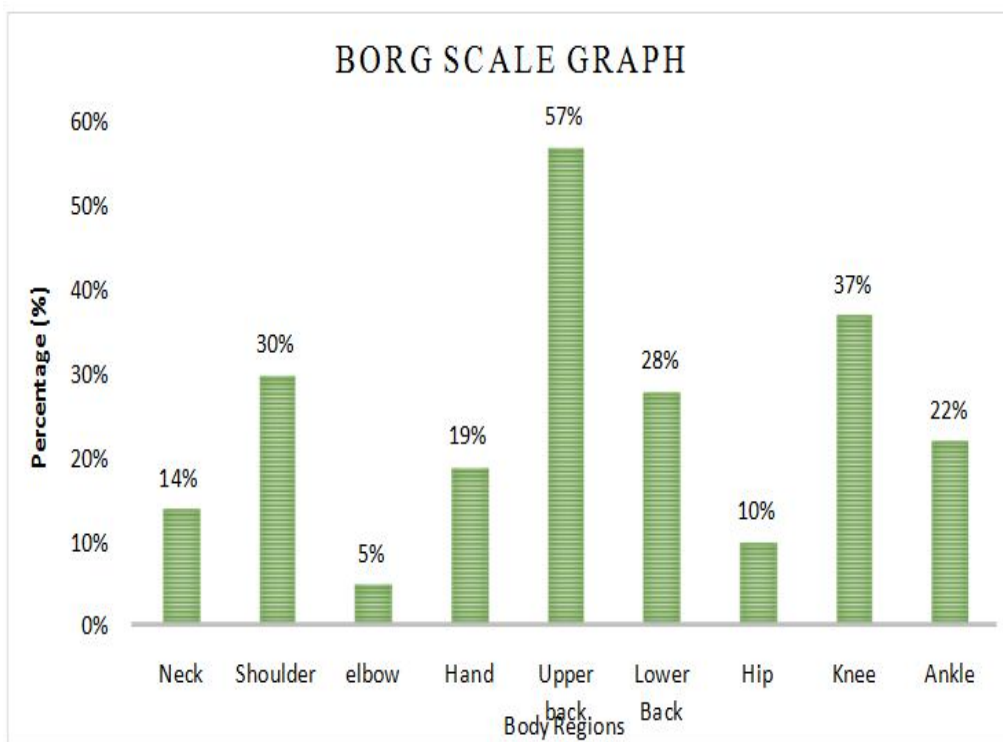
Table V shows the different types of furniture used by the faculty members in the classrooms. One can see that old style black board (78%) was still used by most of the faculty members. It could be one of the reasons of pain in shoulder and neck region. Wooden platform board (71%) was observed in most of the colleges/departments. Non-adjustable chairs (44%) were observed and this also could be one of the reasons of musculoskeletal disorders.

Adjustable chair (32%) and white board (32%) were observed in few of the colleges/departments. This type of chair gives a comfort zone while working and due to white board less of shoulder and neck pain was recorded.

Relationship between man and machine has played a vital role in any profession. Here, in this recent study data states that 64% of the chair was fixed, which an individual has to sit and work in an unnatural body posture.

Graph I Complain of Musculoskeletal disorder at different Body Regions

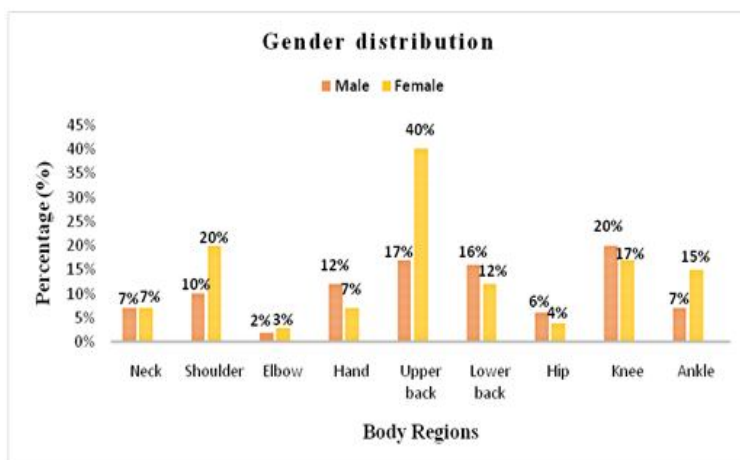
(N=144), (n=115)



Graph I indicates that most of the respondents have complained upper back (57%), knee joint pain (37%) and shoulder pain (30%).

Graph II Gender Distribution Access to Body Regions

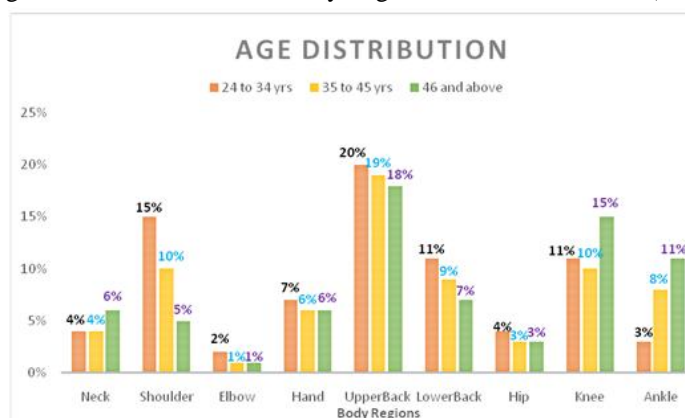
(N=144), (n=115)



Graph II shows the gender distribution of the final sample was 40% females (upper back), 20% (shoulder pain), whereas 20% males (knee joint pain), 17% (upper back).

Graph III Age Distribution Access to Body Regions

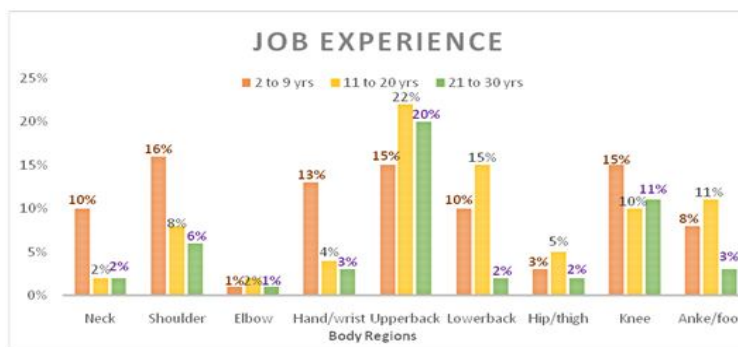
(N=144) (n=115)



Graph III shows the age distribution of the respondents were upper back was complained by 20% of the 24-34 years of age group people 11% knee joint pain, 15% shoulder pain whereas 19% 'upper back' was found in 35-45 years age group and 18% upper back, and 11% ankle joint was recorded in 46 and above age groups.

Graph IV Job Experience Distribution Access to Body Regions

(N=144), (n=115)



Graph IV states that 22% and 20% (upper back) was seen more by the respondents whose job experience was of 11-20 years and 21-30 years group age.



Table VI (a) Association between respondents Age and Musculoskeletal Disorder (N=144), (n=115)

Body Regions		24-34 Years	35-45 Years	46 and above years	p-value
Shoulder Pain	Yes	76 (84.4%)	29 (64.4%)	5 (55.6%)	8.963 P<0.05=0.03
	No	14 (15.6%)	16 (35.6%)	4 (44.4%)	
	Total	90 (100%)	45 (100%)	9 (100%)	
Upperback pain	Yes	23 (51.1%)	<b>50 (55.6%)</b>	5 (55.6%)	2.46 P<0.05=0.01
	No	22 (48.9%)	40 (44.4%)	4 (44.4%)	
	Total	45 (100%)	90 (100%)	9 (100%)	
lowerback pain	Yes	<b>73 (81.1%)</b>	34 (75.6%)	5 (55.6%)	3.279 P<0.05=0.03
	No	17 (18.9%)	11 (24.4%)	4 (44.4%)	
	Total	90 (100%)	45 (100%)	9 (100%)	
Knee joint Pain	Yes	30 (66.7%)	<b>66 (73.3%)</b>	6 (66.7%)	0.726 P<0.05=0.02
	No	15 (33.3%)	24 (26.7%)	3 (33.3%)	
	Total	45 (100%)	90 (100%)	9 (100%)	

\* Statistical Significance at P=< 0.05

Table VI (b) Association between Gender and Musculoskeletal Disorder (N=144), (n=115)

Body Regions		Male	Female	p-value
Shoulder Pain	Yes	50 (78.1%)	<b>60 (75%)</b>	0.193 P <0.05=0.03
	No	14 (21.9%)	20 (25%)	
	Total	64 (100%)	80 (100%)	
Upper Back Pain	Yes	36 (56.3%)	<b>42 (52.5%)</b>	0.201 P <0.05=0.01
	No	28 (43.8%)	38 (47.5%)	
	Total	64 (100%)	80 (100%)	
Hip/thigh	Yes	61 (95.3%)	72 (90%)	1.422 P <0.05=0.01
	No	3 (4.7%)	8 (10%)	
	Total	64 (100%)	80 (100%)	
Lower Back Pain	Yes	51 (79.7%)	<b>61 (76.3%)</b>	0.243 P <0.05=0.03
	No	13 (20.3%)	19 (23.8%)	
	Total	64 (100%)	80 (100%)	
Knee joint Pain	Yes	42 (65.6%)	<b>60 (75%)</b>	1.513 P < 0.05=0.02
	No	22 (34.4%)	20 (25%)	
	Total	64 (100%)	80 (100%)	

\*Statistical Significance at P=< 0.05

Table VI (c) Association between Job Experienced and Musculoskeletal Disorder (N=144), (n=115)

Body Regions	2-9 Years	10-17 Years	18 and above years	p-value
Shoulder Pain	Yes <b>53 (77.9%)</b>	48 (76.2%)	9 (69.2%)	0.462
	No 15(22.1%)	15 (23.8%)	4 (30.8%)	
	Total 68 (100%)	63 (100%)	13 (100%)	
upperback pain	Yes <b>35 (51.1%)</b>	33 (52.4%)	10 (76.9%)	2.992
	No 33 (48.5%)	30 (47.6%)	3 (23.1%)	
	Total 68 (100%)	63 (100%)	13 (23.1%)	
lowerback pain	Yes <b>53 (77.9%)</b>	48 (76.2%)	11 (84.6%)	0.445
	No 15 (22.1%)	15 (23.8%)	2 (15.4%)	
	Total 68 (100%)	63 (100%)	13 (100%)	
knee joint pain	Yes 45 (71.4%)	<b>50 (73.5%)</b>	7 (53.8%)	2.066
	No 18 (28.6%)	18 (26.5%)	6 (46.2%)	
	Total 63 (100%)	68 (100%)	13 (100%)	

\* Statistical Significance at P=< 0.05

A. Discussions

Table VI (a) data is categorized by Age and musculoskeletal disorder. It showed a statistical difference between shoulders, upper back, lower back and knee joint pain and the age factor.

Table VI (b) statically significant relationship was found between Gender and Musculoskeletal disorder. Pain was most associated 'male' teachers than the females.

Table VI (c) found associated between job experience and musculoskeletal disorders. Investigator has found that more pain was associated to the respondents of 2-9 years (77.9%) for both Shoulder and Low Back Pain.

Table VI (d) association was found more in 'Married' category respondents. Shoulder (76.1%) and low Back Pain (78.9%) was seen more than other body regions.

Table VI (e) statically difference was found between shoulder, low back pain, knee pain and number of teaching hours. Most respondents spend hours per day; the greater majority with low back pain (83.8%) and shoulder (78.4%) were complained by them.

Table VI (d) Association between Marital Status and Musculoskeletal Disorders (N=144), (n=115)

Body Regions	Married	Unmarried	Divorced	p-value
Shoulder Pain	Yes <b>83 (76.1%)</b>	26 (76.5%)	0 (0.0%)	0.131
	No 26 (76.5%)	8 (23.5%)	1 (100%)	
	Total 109 (100%)	34 (100%)	1 (100%)	
upper back pain	Yes <b>57 (52.3%)</b>	20 (58.8%)	0 (0.0%)	1.297
	No 52 (47.7%)	14 (41.2%)	1 (100%)	
	Total 109 (100%)	34 (100%)	1 (100%)	
Lower back pain	Yes <b>86 (78.9%)</b>	25 (73.5%)	0 (100%)	0.720
	No 23 (21.1%)	9 (26.5%)	1 (100%)	
	Total 109 (100%)	34 (100%)	1 (100%)	
Knee Pain	Yes <b>17 (15.6%)</b>	7 (20.6%)	0 (0.0%)	2.457
	No 92 (84.4%)	27 (79.4%)	1 (100%)	
	Total 8 (7.3%)	2 (5.9%)	1(100%)	

\* Statistical Significance at P=< 0.05

Table VI (e) Association between working hours and musculoskeletal disorder

(N=144), (n=115)

Body Regions	6 hours	7 hours	8 hours	Any other	p-value
Shoulder pain	Yes <b>58(78.4%)</b>	30(65.2%)	18(94.7%)	4 (80%)	6.928 P<0.05=0.04
	No 16(21.6%)	16(34.8%)	1 (5.3%)	1 (20%)	
	Total 74 (100%)	46 (100%)	19 (100%)	5 (100%)	
Upperback pain	Yes <b>41(55.4%)</b>	28(60.9%)	11(57.9%)	1 (20%)	4.343 P<0.05=0.02
	No 33(44.6%)	46 (100%)	19 (100%)	4 (80%)	
	Total 74 (100%)	46 (100%)	19 (100%)	5 (100%)	
Lowerback pain	Yes <b>62(83.8%)</b>	32(69.6%)	15(78.9%)	3 (60%)	4.269 P<0.05=0.03
	No 12(16.2%)	14(30.4%)	4 (21.1%)	2 (40%)	
	Total 74 (100%)	32(69.6%)	19 (100%)	5 (100%)	
Knee Pain	Yes <b>50(67.6%)</b>	33(71.7%)	16(84.2%)	3 (60%)	2.330 P<0.05=0.04
	No 24(32.4%)	13(28.3%)	3 (15.8%)	2 (40%)	
	Total 74 (100%)	46 (100%)	19 (100%)	5 (100%)	

\* Statistical Significance at P=< 0.05

#### IV. CONCLUSIONS

This study revealed prevalence of 57% for upper back, Knee joint pain of 37% and shoulder pain 30% among the faculty members of colleges/department of Sardar Patel University. Since the investigator has not come across to any such type of studies so far thus she conducted on faculty members of Sardar Patel University. This study cannot be accurately compared to others, but it does add new information to the current literature.

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