

## The Prevalence and Risk Factors for Musculoskeletal Disorders among School Teachers in Botswana

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### Abstract

**Background:** Although musculoskeletal disorders (MSD) are one of the prolific reasons for decreased productivity at work due to increased sick leave, absenteeism and early retirement in the teaching profession; scant epidemiological data exists concerning teachers in developing countries. The work tasks of teachers often involve a wide variety of duties and responsibilities that may be carried out under unfavourable working conditions, especially in developing countries. The aim of this study was to investigate the prevalence, risk factors and impacts of MSD among school teachers in Botswana.

**Methods:** A cross-sectional study was conducted among school teachers in seven randomly selected education regions in Botswana. Data were collected using an anonymous self-administered questionnaire, which consisted of three parts, to gather information on MSD, demographic, work-related, physical and psychosocial factors. Chi-squared tests and logistic regression analysis were performed to analyse the data.

**Results:** The prevalence of MSD at anybody site in the previous 12 months was 83.3%. Upper back, shoulder and neck MSD were common and reported at similar rates, (52.6%, 52.5% and 50.8%, respectively), followed by MSD of the ankle/feet (37.8%), knee (33.8%) and wrist/hands (30.7%). The least reported MSD was those of the hips/thighs (18.2%) and elbows (13.3%). Among individual factors, female gender and age were associated MSD. Previous injury was associated with all body site MSD. Physical factors, rapid physical activity and awkward arm position were positively associated with MSD. Among psychosocial risk factors, high psychological job demands were associated with MSD. Regular physical exercise, high supervisor support, and teaching at secondary schools were negatively associated with MSD. MSD caused some teachers to reduce their activities at home, while some were unable to work for several days, and others needed to seek medical attention because of pain.

**Conclusion:** Overall, this study suggests that MSD is reasonably common among school teachers in Botswana, particularly at body sites such as the shoulder, upper back and neck. The complex nature of MSD risk factors found in this study suggests that no single specific preventative or intervention strategy will help in reducing MSD among teachers. Therefore, to help reduce the prevalence, progression, and burden of MSD among Botswana teachers, a greater emphasis should be placed on ergonomics education, regular physical exercise and occupational stress.

**Keywords:** Musculoskeletal disorders; Teachers; Neck pain; Shoulder pain; Back pain; Risk factors

### Background

Musculoskeletal disorders (MSD) represent a major occupational problem in working populations [1] and their risk factors have been extensively investigated in different occupations [2-6]. MSD affects the body's muscles, joints, tendons, ligaments, nerves, bones and the localised blood circulation system. Most work-related MSD develops over time and is caused either by work itself or by the employee's working environment [7,8]. These disorders may range from discomfort, minor aches and pains to more serious and even medical conditions requiring time off work and even medical treatment. In more chronic cases, treatment and recovery are often unsatisfactory with possible results of permanent disability and loss of employment [9]. The pain and physical disability brought about by MSD affects social functioning and mental health, further diminishing the patient's

quality of life [10]. MSD also represents a common health-related reason for discontinuing work and for seeking health care [11,12].

The work tasks of teachers involve a wide variety of duties and responsibilities that may be carried out under unfavourable working conditions, especially in developing countries. These can involve or contribute to prolonged sitting, prolonged standing, use of inappropriate furniture, awkward postures that may be adopted when writing on the board, when helping students with their work or when helping students during extracurricular activities, especially sporting activities. Furthermore, teachers might adopt awkward postures when reading, marking students' work or preparing lessons. The constant loading of the muscles in the neck, shoulders and the back will, in time, lead to aches, pains or discomfort [13,14]. These factors have been correlated with the development of MSD in the teaching profession. In recent times, psychosocial risk factors such as poor mental health, low supervisor or colleague support, low job satisfaction, high job stress and high psychological job demands have also emerged as potential risk factors for MSD [15]. Teaching in

Botswana is characterized by low levels of job satisfaction, low morale, low status and an attitude that regards the teaching profession as a last resort employment [16].

Although research from around the world indicates that teachers are at an increased risk for MSD development [17], there appears to be a deficiency of studies that have been conducted among teachers in the Botswana work context to investigate MSD prevalence and risk factors. The aim of this study was therefore to establish the prevalence, possible associated risk factors and impacts of MSD among teachers in Botswana.

## Materials and Methods

### Location and background

A large cross-sectional study of MSD was conducted among teachers in Botswana between July and November 2012. Seven education regions were randomly selected from a total of ten regions across the country. From these randomly selected regions, schools were stratified into primary or secondary schools and alphabetically compiled into two different lists. Since there was no national data available to show how many school teachers were in each region or school, questionnaires were equally distributed to all regions that formed part of the study. To obtain a sample size of 1550 primary and 1550 secondary teachers, 107 primary and 57 secondary schools were randomly selected. All school teachers in those schools were invited to take part in the study. Permission to conduct the research in the selected schools was sought from school heads. The research was approved by University of Newcastle Human Research Ethics Committee and Ministry of Education and Skills Development in Botswana (MoESD). The data were collected using postal questionnaires with informed consent implied by voluntarily completing and returning the questionnaire. Teachers were also given information sheets describing the procedure and objectives of the study.

### Questionnaire design

Data on demographic characteristics, MSD, and physical and psychosocial exposures during work among teachers were collected using an anonymous self-administered questionnaire, which consisted of three parts. The first part of the questionnaire was about the participants' demographic factors such as gender, age, education level, marital status and tobacco smoking. The second section assessed participants' MSD. MSD of different body regions during the past 12 months was determined using the Standardised Nordic Questionnaire (SNQ) [18]. The last section of the questionnaire assessed psychosocial and physical work demands using the Job Content questionnaire (JCQ) [19].

### Statistical analysis

Data were entered and analysed using statistical package for social sciences (SPSS) 20.0. Basic statistical associations between independent and dependent variables were initially evaluated using Chi-square tests. Subsequently all independent variables that showed significant associations for each body region MSD were evaluated using logistic regression and expressed as Odds Ratios (OR) with 95% Confidence Intervals (95% CI). The level of statistical significance was set to be less than 0.05.

## Results

### Demographic items

A total of 1747 (56.3%) questionnaires were returned from a total of 3100 distributed. Fifteen incomplete questionnaires were excluded, leaving 1732 participants suitable for analysis. Out of the total respondents, 1260 (72.7%) were females. The average age of participants was 38.5 years (standard deviation (SD): 8.62 years), with an average body mass index of 26.65 (SD: 6.76), 53.0% were single and 26.8% had more than two children under the age of six years. The majority of teachers worked for 40 hours per week, with only 12.7% working for more than 40 hours per week, and had an average working experience of 12.48 years (SD:8.34 years). The majority of teachers (57.9%) were teaching at primary schools, while 32.3% and 9.8% were teaching at junior and senior secondary schools, respectively. About 18.1% of male teachers practiced physical exercise more than five hours per week and 69.9% were involved in extracurricular activities at school compared to 10.4% and 65.4% of female teachers respectively. Detailed descriptive statistics for demographic and work-related characteristics of female and male teachers are shown in Table 1.

Characteristics	Male (n=472)	Female (n=1260)	Total (n=1732)	P-value
Age	36.29 ± 7.02	39.34 ± 9.02	38.50 ± 8.62	<0.001
Body mass index	24.75 ± 5.78	27.55 ± 7.00	26.65 ± 6.76	<0.001
Length of employment	10.14 ± 6.31	13.36 ± 8.82	12.48 ± 8.34	<0.001
Marital status				0.004
Single	58.7	50.9	53	
Married	37.5	42.5	41.2	
Separated/divorced/widowed	3.8	6.6	5.8	
Educational level				<0.001
Certificate	1.7	6.8	5.4	
Diploma	54.9	60.2	58.7	
Bachelor degree	43.4	33	35.9	
Number of children less than 6 years				0.21
1	70.3	74.9	73.2	
≥2	29.7	25.1	26.8	
Smoking				<0.001
Smokers	10.8	0.4	3.2	
Ex-smokers	13.6	2.1	5.3	
Never smoked	75.6	97.5	91.5	
Physical exercise per week (>5 hours)	18.1	10.4	12.8	<0.001
School level				<0.001

Primary school	36.2	66	57.9	
Junior secondary	46.4	27	32.3	
Senior secondary	17.4	7	9.8	
Work hours per week (>40 hours)	14.6	12	12.7	0.166
Number of students (>40)	11.4	9.5	10	<0.001
Involved in extracurricular activities	69.9	65.4	66.6	0.086
P values calculated using independent t-tests for quantitative data and Pearson's Chi-square test for categorical data, values statistically significant at p<0.05				

**Table 1:** Descriptive statistics of individual, life style and work characteristics among male and female teachers in Botswana

### MSD prevalence

As shown on Table 2, the 12-month self-reported prevalence of MSD at any of the body sites among Botswana teachers was 83.3%. MSD was commonly and equally reported at upper back (52.6%), shoulder (52.5%), and neck (50.8%). The prevalence rate of ankles/feet MSD was 37.8%. The least reported MSD was at knees (33.3%), followed by wrists/hands (30.7%), hips/thighs (18.2) and elbows (13.3%).

Body region	Prevalence (%)
Anybody region	83.3
Neck	50.8
Shoulders	52.5
Upper back	52.6
Elbows	13.3
Wrists/hands	30.7
Hips/thighs	18.2
Knees	33.8
Ankles/feet	37.8

**Table 2:** Prevalence of MSD in the previous 12 months among teachers in Botswana

Table 3 shows that prevalence of MSD in this study was higher among female teachers for neck (52.5% vs. 42.2%, p=0.021), shoulder (56.2% vs. 42.8%, p<0.001), upper back (57.0% vs. 40.9%, p<0.001) and ankle/feet (39.5% vs. 33.3%, p=0.019) MSD when compared to their male colleagues. The results suggest that the age group with the highest prevalence of different body regions was >50 years. There were significant differences among different age groups in the prevalence of neck MSD (p=0.014), shoulder MSD (p=0.003), elbow MSD (p<0.001), hip/thigh MSD (p<0.001), knee MSD (p<0.001) and ankle/feet MSD (p<0.001). Teachers with body mass index  $\geq 30$  had higher prevalence rates of neck, shoulder, wrist/hand, hip/thigh and ankle/feet MSD at statistically significant levels. Teachers with teaching certificate had a statistically significant higher prevalence of upper back MSD (54.3%), elbow MSD (21.3%) and knee MSD (44.7%) than those with higher

degrees. Teachers with two or more children less than six years had a significantly higher prevalence of elbow MSD (p=0.021) when compared to those with one child. Prevalence rates of all body regions MSD in this study were highest on teachers who reported previous injury on particular body areas (p<0.001). Teachers who had never smoked had a significantly higher prevalence shoulder MSD (53.4%, p=0.039). Higher prevalence rates of neck and upper back MSD were observed among teachers with five or less hours of physical exercise per week at statistically significant levels.

Variable	% neck MSD	% shoulder MSD	% upper back MSD	% elbow MSD	% wrist/hand MSD	% hip/thigh MSD	% knee MSD	% ankle / feet MSD
Gender								
Male	46.2	42.8	40.9	11.4	27.8	15.9	31.1	33.3
Female	52.5	56.2	57	14	31.8	19	34.8	39.5
p-value	0.021	<0.001	<0.001	0.193	0.115	0.148	0.164	0.019
Age (years)								
$\leq 30$	46.5	48.5	51.8	9.2	31.4	16.2	26.1	32.5
31-40	48.5	49.5	49.5	10.6	28.7	14.4	28.5	34.4
41-50	55.4	57.1	57.1	17.9	32	21.5	41.7	44
>50	56.4	61.3	52.1	19.6	35.6	27	47.2	44.8
p-value	0.014	0.003	0.076	<0.001	0.325	<0.001	<0.001	<0.001
Body mass index (BMI)								
<18.5	50.7	40.6	46.4	11.6	29	17.4	27.5	33.3
18-24.9	46.8	50.1	50.7	10.9	30.4	14.5	31.5	36.3
25-29.9	51.4	54.2	52.3	15.3	33.1	19.2	34.7	34.7
$\geq 30$	59.3	59.9	58.2	19.9	34.3	23.5	39.1	46.5
p-value	0.008	0.007	0.129	0.004	0.608	0.013	0.104	0.008
Marital status								
Single	50.2	52.1	51.2	12.4	30.2	19.1	32.2	37.5
Married	50.5	52.3	52.9	14.2	31.7	17.5	34.8	38.1
Separated, divorced, widowed	58.4	58.4	63.4	14.9	28.7	14.9	41.6	38.6
p-value	0.287	0.474	0.066	0.524	0.726	0.488	0.133	0.948
Education level								
Certificate	46.8	56.49	54.3	21.3	28.7	20.2	44.7	43.6
Diploma	52.3	52.9	54.9	13.8	31.2	18.6	34.1	38.2
Bachelor's degree	49	51.4	48.6	11.3	30.3	17.2	31.7	36.2

p-value	0.305	0.621	0.047	0.022	0.847	0.688	0.045	0.352
Number of children <6 years								
1	46.2	46.4	49.1	9.1	25.6	14.8	27.8	30.6
≥2	42.5	42.5	47.8	15.6	28.5	15.6	25.3	29
p-value	0.437	0.411	0.834	0.021	0.511	0.888	0.568	0.696
Previous injury								
No	48	50.5	49.4	12.2	28.5	16.2	30.3	32.9
Yes	89.7	88.2	91.6	48.1	65	68.2	73.9	74.4
p-value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Tobacco smoking								
Smokers	35.7	39.3	39.3	14.3	23.2	21.4	28.6	32.1
Ex-smokers	51.6	45.1	46.2	11	29.7	23.1	31.9	35.2
Never smoked	51.3	53.4	53.4	13.4	31	17.8	34.1	38.2
p-value	0.071	0.039	0.051	0.788	0.448	0.363	0.634	0.57
Physical exercise (hours/week)								
≤5	52.9	53.3	53.7	14.1	32.9	17.8	33.1	39.8
>5	42.4	48.6	44.4	8.3	25	15.3	30.6	32.6
p-value	0.023	0.345	0.046	0.077	0.072	0.536	0.609	0.118
Statistical associations between independent variables and MSD were evaluated using chi-square, values statistically significant at p<0.05								

**Table 3:** The 12-month prevalence of MSD among teachers in Botswana in relation to individual and lifestyle factors

As shown on Table 4, the results suggest that there were significant differences among different school levels in the prevalence of neck (p<0.001), shoulder (p<0.001) (p=0.001), upper back (p<0.001), elbow (p<0.005), hip/thigh (p<0.016) and knee (p<0.034) MSD. Moreover, results suggested that working for 21-30 years had the highest prevalence of neck, upper back and elbow MSD, while working for more than 30 years was associated with higher prevalence rates of shoulder, wrist/hand, hip/thigh, knee and ankle/feet MSD. In addition, the prevalence of upper back and ankle/feet MSD was higher among teachers who reported working more than 40 hours a week than those who worked 40 hours per week. The prevalence of elbow MSD was higher for teachers with 26-30 students in class (17.7%, p=0.004). No significant association was found between taking part in extracurricular activities and MSD of all body regions.

Variable	% neck MSD	% shoulder MSD	% upper back MSD	% elbow MSD	% wrist / hand MSD	% hip/ thigh MSD	% knee MSD	% ankle / feet MSD
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School level								
Primary school	55	55.8	58.6	15.6	32.1	20.4	36.2	39.7
Junior secondary school	45.6	46.2	44.4	10.4	29	14.8	31.5	34.9
Senior secondary school	42.9	54.1	44.1	9.4	28.2	15.9	27.6	36.5
p-value	<0.001	0.001	<0.001	0.005	0.334	0.016	0.034	0.161
Length of employment (years)								
≤10	46.8	48.4	50.7	10.3	30.8	15.1	27.8	33.5
Nov-20	52.5	53.2	51.1	14.5	27.8	19	33.9	39.9
21-30	58.3	61.6	61.3	19.6	35.4	22.5	48.7	44.3
>30	58.1	67.4	55.8	16.3	39.5	39.5	58.1	53.5
p-value	0.005	<0.001	0.018	0.001	0.082	<0.001	<0.001	0.001
Hours of work per week								
40	50.3	52.1	51.5	13.1	30.6	17.7	33.5	36.7
>40	54.5	55.5	60	14.5	31.4	21.4	36.4	45.5
p-value	0.265	0.393	0.023	0.627	0.885	0.225	0.44	0.015
Average number of students taught								
≤25	44.8	49.5	49.1	11.8	31.1	14.2	31.6	36.8
26-30	53.1	48.8	52.7	17.1	31.4	19	39.1	41.1
31-35	54.8	56.2	55.6	14	32	20.2	33.1	39
36-40	50.2	52.6	52.5	14.1	29.8	19.2	33.3	36.6
>40	46	51.1	48.9	4.6	28.7	12.6	32.8	35.1
p-value	0.08	0.295	0.437	0.004	0.907	0.098	0.402	0.639
Extracurricular activities								
No	49.5	54.2	51	12.8	30.3	18.3	33.4	40
Yes	51.5	51.7	53.4	13.5	30.9	18.1	34.1	36.7
p-value	0.465	0.368	0.385	0.735	0.822	0.96	0.825	0.211
Statistical associations between independent variables and MSD was evaluated using chi-square, values statistically significant at p<0.05								

**Table 4:** The 12-month prevalence of MSD among teachers in Botswana in relation to work-related factors

As shown in Table 5, the results suggest that teachers who have reported that their job required lots of physical effort, rapid physical activity, awkward body and awkward arm position had a higher prevalence of MSD of all body sites. The findings were statistically significant for all body sites, except for much physical effort and knee MSD and awkward body position and hip/thigh MSD. A higher proportion of teachers reported lifting heavy loads but was not statistically associated with any of body site MSD.

Variable	% neck MSD	% shoulder MSD	% upper back MSD	% elbow MSD	% wrist/hand MSD	% hip/thigh MSD	% knee MSD	% ankle / feet MSD
Much physical effort								
No	44.5	48	47.9	10.3	24.6	14.9	36.9	33.1
Yes	55.1	55.2	55.9	15.1	34.2	20.3	35	40.7
p-value	<0.001	0.005	0.004	0.013	<0.001	0.016	0.305	0.005
Lift heavy loads								
No	49.2	51.4	52.2	12.3	29.1	17.8	32.6	37
Yes	59.5	57.7	55.8	18.2	37.6	20.1	40.1	42
p-value	0.007	0.101	0.299	0.031	0.006	0.629	0.049	0.303
Rapid physical activity								
No	45	47.5	48.1	10.4	25.4	14.4	30.4	33.5
Yes	59.6	59.6	59.6	17.4	37.8	23.6	38.6	44
p-value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	<0.001
Awkward body position								
No	48	49.5	49.4	12.2	28.4	16.8	31.8	35
Yes	58.5	59.7	61.2	16.1	36.8	21.6	38.8	44.9
p-value	<0.001	<0.001	<0.001	0.092	0.001	0.054	0.015	0.001
Awkward arm position								
No	47.3	48.8	47.8	11.5	26.9	16.6	31.4	34.1
Yes	60.5	61.8	65.6	17.8	39.7	22.1	39.9	47.3
p-value	<0.001	<0.001	<0.001	0.003	<0.001	0.026	0.003	<0.001
Decision latitude								
Low	49	52.7	58.1	13.8	32.2	16.4	32.6	38.3
High	51.3	52.3	51.5	13.1	30.1	18.4	33.9	37.5

p-value	0.492	0.322	0.116	0.757	0.11	0.391	0.46	0.482
Psychological job demands								
Low	44.1	41.6	37.7	12	27.1	14	31.6	34.1
High	52.8	55.3	56.6	13.6	31.4	19.2	34.4	38.7
p-value	0.008	<0.001	<0.001	0.685	0.05	0.055	0.587	0.226
Job insecurity								
Low	50	52	50.9	12.2	30.5	18.2	33.2	37.4
High	54.3	54	58.6	16.4	30.7	18.1	36.2	39
p-value	0.092	0.682	0.014	0.071	0.537	0.966	0.471	0.801
Co-worker support								
Low	56.6	52	56.9	14.8	35.5	21.7	35.2	41.1
High	49.9	52.7	51.9	12.9	29.4	17.4	33.7	37
p-value	0.022	0.971	0.135	0.545	0.052	0.193	0.679	0.38
Supervisor support								
Low	57.1	56.9	58.4	14.4	34.8	22.1	37.5	41.6
High	48.3	50.5	50.2	12.7	28.6	16.4	32.2	36
p-value	0.001	0.044	0.003	0.576	0.012	0.017	0.104	0.071
Social support								
Low	56.6	52.6	58.5	13	35.6	18.6	32	40.3
High	50	52.5	51.8	13.3	29.6	18.1	34.1	37.2
p-value	0.073	0.991	0.051	0.945	0.037	0.974	0.803	0.438
Job dissatisfaction								
Low	46.4	48.6	48	12.4	27.3	15.6	33.2	36.8
High	54.4	55.2	56	13.8	33	20.2	34.2	38.6
p-value	0.003	0.013	0.005	0.473	0.019	0.051	0.814	0.765
Statistical associations between independent variables and MSD was evaluated using chi-square, values statistically significant at p<0.05								

**Table 5:** The 12-month prevalence of MSD of different body regions among teachers in Botswana in relation to various physical and psychosocial factors

The prevalence of neck MSD was higher on teachers with high psychological job demands (58.2%) than those with low psychosocial job demand (44.1%), with a statistical difference of p<0.05. Similar

findings were reported for shoulder, upper back and wrist/hand MSD. Results further suggest that teachers with high job insecurity had a significant higher prevalence of upper back MSD (58.6% vs. 50.9%,  $p=0.014$ ). Prevalence of neck MSD was highest among teachers with low co-worker support (56.6%) than those with high co-worker support (49.9%),  $p=0.022$ . In addition, teachers with low supervisor support had a higher prevalence of neck, shoulder, upper back, wrist/hand and hip/thigh MSD than those with high supervisor support. Moreover, teachers with low social support had higher prevalence of MSD on all body regions; however, the difference was statistically significant only in the prevalence of wrist/hand MSD ( $p=0.037$ ). The results further showed that higher prevalence of MSD on different body regions was reported by teachers with high job dissatisfaction than with low job dissatisfaction. The differences were statistically significant in the prevalence of neck (0.003), shoulder (0.013), upper back (0.005) and wrist/hand (0.019) MSD.

### MSD risk factors

Chi-squared tests were conducted to initially examine which independent variables had any statistical associations with different body regions at a significance level of  $<0.05$ . Independent variables that were significantly associated with MSD of different body sites are shown in Tables 3-5. A logistic regression model was then used to test the predictive power and assess the relative contribution of independent variables that had shown significant association with MSD of different body regions when using chi-square tests. As shown in Table 6, not all factors that were initially statistically associated with MSD by chi-squared tests remained statistically significant when evaluated in the logistic regression model. Among individual factors, female gender, increasing age, and previous injury remained positively associated with some MSD. Of work-related factors, only length of employment was significantly associated with some MSD. Physical risk factors of rapid physical activity and awkward arm position remained positively associated with MSD. Of all psychosocial risk factors, only high psychological job demands remained a statistically significant risk factor for MSD.

Body Region	Significant Risk Factors	Odds Ratio	95% Confidence Interval	P-value
Neck	Previous injury	9.39	3.92-22.46	<0.001
Shoulder	Female gender	1.69	1.26-2.25	<0.001
	Previous injury	7.83	3.78-16.22	<0.001
	Rapid physical activity	1.38	1.03-1.85	0.029
	Awkward arm position	1.44	1.02-2.02	0.037
	Psychosocial job demands	1.37	1.01-1.85	0.041
Upper pack	Female gender	1.5	1.12-2.02	0.007
	Previous injury	14.04	5.90-33.41	<0.001
	Awkward arm position	1.71	1.17-2.51	0.005
	Psychosocial job demands	2	1.42-2.80	<0.001

Elbows	Number of children less than 6 years	1.94	1.07-3.51	0.028
	Previous injury	3.94	1.24-12.52	0.02
Wrists/hands	Previous injury	5.04	3.24-7.85	<0.001
	Rapid physical activity	1.51	1.15-1.97	0.003
	Awkward arm position	1.59	1.18-2.14	0.002
Hips/thighs	Previous injury	10.73	5.65-20.38	<0.00
	Rapid physical activity	1.7	1.18-2.45	0.004
Knees	Age (years)			
	41-50	1.91	1.25-2.93	0.003
	>50	1.85	1.06-3.23	0.031
	Length of employment (years)			
	21-30 years	1.7	1.12-2.60	0.013
	>30 years	2.25	1.02-4.99	0.045
	Previous injury	7.61	4.99-11.61	<0.001
Ankles/feet	Previous injury	3.51	2.28-5.42	<0.001

**Table 6:** Self-reported MSD risk factors among teachers in Botswana

### MSD protective factors

Interestingly, as shown in Table 7, a number of factors that were investigated in this current study displayed a protective effect against MSD among Botswana teachers. High supervisor support was associated with a decreased odds for reporting neck (OR: 0.55, 95% CI: 0.39-0.77), upper back (OR: 0.73, 95% CI: 0.43-0.93) and hips/thighs (OR: 0.69, 95% CI: 0.50-0.96) MSD in comparison with those with low supervisor support. Teaching at junior (OR: 0.61, 95% CI: 0.44-0.84) and senior (OR: 0.63, 95% CI: 0.42-0.97) secondary schools was associated with upper back MSD and shoulder MSD, respectively, when compared to teaching at primary schools. Physical exercise of more than five hours per week was associated with decreased odds of reporting upper back MSD (OR: 0.65, 95% CI: 0.43-0.97).

Body region	Protective factors	Odds Ratio	95% Confidence Intervals	p-value
Neck	High supervisor support	0.55	0.39-0.77	0.001
Shoulder	Teaching at senior secondary school	0.63	0.42-0.97	0.035
Upper back	Physical exercise $\geq 5$ hours per week	0.65	0.43-0.97	0.036

	Teaching at junior secondary school	0.61	0.44-0.84	0.003
	High supervisor support	0.73	0.55-0.99	0.041
Hips/thighs	High supervisor support	0.69	0.50-0.96	0.026

**Table 7:** Protective factors against development of MSD on different body regions among teachers in Botswana

### Impact of MSD

More than half (51.4%) of those who reported upper back MSD had seen a nurse, doctor or physiotherapist because of pain, with more

than 40% of teachers with neck, shoulder, hip/thigh, knee and ankle/feet MSD also having reported seeing a nurse, doctor or physiotherapist because of pain in these areas. For all MSD of different body regions, the majority of teachers reported experiencing MSD for 1-7 days. Among the different MSD of the body studied, 16.2% of teachers with hip/thigh MSD had to change jobs/duties because of pain, which was higher than any other MSD. More than one-third of teachers who reported upper back, elbow, wrist/hand, knee and ankle/feet MSD reported cutting down on activity at home because of these disorders in the last 12 months. About one-quarter (27.4%), 28.2% and 31.0% of teachers reported being unable to work because of upper back, wrist/hand and neck MSD, respectively, in the last 12 months. However, a high percentage of teachers were not able to work for 1-7 days due to elbow MSD (37.4%) and hip/thigh MSD (36.2%). Refer to Table 8.

Body region	Prevented from carrying out normal activities	Seen a nurse, doctor or physio because of pain	Number of days teachers experienced pain			Needed to change jobs/duties because of pain	Needed to cut down activity at home because of pain	Number of days teachers were unable to work because of pain in the last 12 months		
			1-7 days	≥8 days	Everyday			1-7 days	≥8 days	Everyday
	%	%	%	%	%	%	%	%	%	%
Neck	19.0	45.5	71.9	13.5	12.7	9.7	27.7	31.0	7.0	2.7
Shoulders	20.7	43.4	58.9	18.7	19.7	11.1	28.8	24.3	7.5	3.7
Upper back	28.4	51.4	53.5	20.9	23.3	13.3	38.1	27.4	9.9	4.6
Elbows	21.7	37.4	65.2	16.1	18.3	13.0	32.2	37.4	10.0	4.3
Wrists/hands	25.4	36.8	62.0	18.8	16.0	14.8	36.8	28.2	11.3	4.5
Hip/thigh	24.1	42.2	63.5	18.1	18.1	16.2	36.2	36.8	12.1	5.1
Knees	25.1	43.0	57.8	21.0	18.1	13.0	30.4	26.8	8.7	4.1
Ankle/feet	26.4	46.1	55.4	23.7	19.1	12.5	35.0	28.5	12.8	5.3

**Table 8:** Impact of MSD among teachers in Botswana

## Discussion

### MSD prevalence

The first aim of this study was to estimate the 12-month prevalence of MSD among school teachers in Botswana. The prevalence of MSD at any body region was 83.3%, which was similar to previous research conducted among Swedish music teachers, (82% and 80%) [20,21]. However, this prevalence was relatively higher when compared to results of studies that have been conducted worldwide among school teachers [13,22-28]. A higher prevalence of MSD was reported by primary and secondary school teachers in China (95.1%) [14]. The prevalence rate of MSD in this study was comparable to that of MSD among music teachers even though music teachers have been suggested to be at an increased risk for MSD when compared with other school teachers [17]. These results suggested that MSD is a significant cause of concern among teachers in Botswana or even more so than for their international counterparts.

By individual body regions, upper back, shoulder and neck MSD were equally reported MSD, affecting 52.6%, 52.5% and 50.8% of Botswana teachers, respectively. With regard to upper back MSD, parallels can be drawn to a Chinese study where 52.2% of primary and secondary school teachers reported having experienced upper back pain [14]. The 12-month prevalence of upper back pain among Turkish school teachers ranged between 36.9% and 42.7% [24,27,29]. Music teachers in Sweden reported upper back pain prevalence of 35.0%, 33.3% and 32.0% [20,21,30]. A higher prevalence of upper back pain was reported in a study of Iranian high school teachers (62.8%) [31]. With regard to shoulder MSD, parallels can be drawn to studies that were conducted in Slovenia [32] and Turkey [27]. Shoulder pain is an occupational problem among teachers worldwide and has been previously reported at rates between 7.8% in Estonia [25] and 73.4% in China [14]. Lower prevalence of shoulder pain has been reported in some previous research [24,26,29,31,33].

In the current study, neck MSD affected half of Botswana teachers (50.8%). This result was similar to previous research carried out in China (48.7%) [34] but higher than studies that were conducted in

Turkey (42.5%, 42.1% and 41.4%) [24,27,29], Saudi Arabia (47.9%) [26] and Estonia (33.3%) [25]. However, in Iran, a higher 12-month neck pain prevalence rate of 61.3% was reported by high school teachers [31]. Similarly, in China, studies of primary and secondary school teachers reported 12-month prevalence rates of 66.7% and 64.4% [35,36] and a one-month prevalence rate of 68.9% [14]. A relatively higher prevalence of neck pain was reported in a study of teachers in India (73.5%) [28]. Ankles/feet MSD in this study was reported by 37.8% of teachers. This was relatively higher than other studies carried out among primary and secondary school teachers in Turkey (21.8% and 7.3%) [24,29] and music teachers in Sweden (9.0%, 5.5%) [20,21]. However, the ankle/feet MSD prevalence of this study was relatively lower when compared with that found in studies of Iranian high school teachers (46.8%) [31] and physical education teachers in Slovenia (60.0%) [32]. Similar to upper back and shoulder MSD, it appears as though Botswana teachers are at risk of development of ankle/feet MSD at reasonably high rates when compared with their international counterparts.

Knee and wrist/hand MSD were equally prevalent disorders, affecting almost one-third of Botswana teachers, 33.3% and 30.7%, respectively in the last 12 months. Similar knee MSD prevalence rates have been reported in two separate studies conducted among teachers in Turkey (30.9% and 32.0%) [24,27], but higher than that of another study conducted in Turkey (18.6%) [29] and Estonia (7.8%) [25]. In Sweden, studies of music teachers reported a 12-month prevalence of knee pain at 16.0% and 13.9% [20,21], while 14.0% of Estonian physical education teachers reported having experienced knee pain [25]. In addition, in Iran, about 20.8% high school teachers reported experiencing knee pain [31]. This prevalence was however, lower than prevalence of knee pain among physical education teachers in Slovenia (48.0%) [32] and teachers in India (55.2%) [28]. In this study, the prevalence rate of wrists/hands was relatively higher than those found in studies conducted among primary and secondary school teachers in Turkey. Teachers from these studies reported wrist pain prevalence of 23.9%, 23.4% and 13.0% [24,27,29]. In Sweden, music teachers reported a 12-month prevalence of wrist/hand pain at 22.2%, 19.4% and 15.0% [20,21,30]. The prevalence of this study was also relatively higher than in a study carried out among preschool teachers in the US (11.0%) [37]. A higher wrist/hand pain prevalence was found in a study of teachers in Slovenia (35.0%) [32], while the highest prevalence was recorded among Indian teachers (66.6%) [28].

Almost one-fifth of teachers in this study reported having experienced hip/thigh MSD in the past 12 months (18.2%). This prevalent rate was higher than those reported in some previous research [20,21,24,25,27,29]. A slightly higher prevalence was recorded in studies of high school teachers in Iran (23.4%) [31] and physical education teachers in Slovenia (25.5%) [32]. The results of this study show a relatively high prevalence of hip/thigh MSD among Botswana teachers as compared to their international colleagues. Elbow MSD was the least reported disorder among Botswana teachers, affecting 13.3% of them, which is similar to the results of previous studies conducted in Turkey in which 11.4% and 13.2% of teachers reported elbow pain [27,29], but higher than another Turkish study (8.0%) [24]. These results are, however, lower than other studies among Swedish music teachers [20,21,30]. Elbow pain prevalence rates of 28.5% and 38.5% have been documented in research conducted among Slovenian physical education teachers [32] and high school teachers in Iran [31], higher than the findings of this study.

## MSD risk factors

Another aim of this study was to determine risk factors associated with MSD among Botswana teachers. Logistic regression analysis revealed a number of interesting associations between MSD and individual, lifestyle, physical and psychosocial factors.

## Individual Risk Factors

### Gender

Of the individual factors, female gender was positively associated with development of MSD. Female teachers were 1.50 times more likely to experience upper back MSD (OR: 1.50, 95% CI: 1.12-2.02) and 1.69 times more likely to report shoulder MSD (OR: 1.69, 95% CI: 1.26-2.25), which is consistent with some previous research [9,14,24,29]. Female teachers appear to consistently report more shoulder and upper back MSD than their male colleagues [20,27,30,31,34]. A possible explanation for gender differences in the current study could be attributed to the nutritional status, age and teaching experience of female teachers and the level of schools they were teaching at. Female teachers were significantly older than their male colleagues ( $39.3 \pm 9.0$  vs.  $36.3 \pm 7.0$  years,  $p < 0.001$ ) and had a significantly longer length of employment in comparison to their male counterparts ( $13.4 \pm 8.8$  vs.  $10.1 \pm 6.3$  years,  $p < 0.001$ ). In addition, female teachers were more overweight when compared to their male colleagues ( $27.6 \pm 7.0$  vs.  $24.8 \pm 5.8$ ,  $p < 0.001$ ). A higher proportion of female teachers taught in primary schools in comparison to their male counterparts (66.0% vs. 36.2%,  $p < 0.001$ ). On the other hand, male teachers were more likely to be involved in physical exercise than female (18.1% vs. 10.4%,  $p < 0.001$ ).

### Age

In this current study, increasing age was positively associated with development of knee MSD. Teachers who were 41-50 years and over 50 years were 1.91 times and 1.85 times more likely to develop knee MSD respectively, when compared to those who were 30 years or younger. These results are in agreement with the findings of Turkish studies, where teachers over the age of 40 years reported having experienced musculoskeletal pain ( $p < 0.001$ ) [24] and were 2.75 times more likely to experience MSD of lower extremities (OR: 2.75; 95% CI: 1.70-4.44) [29]. Parallels could be drawn to the results of Slovenian physical educators, where increasing age was reported to increase the odds of developing knee pain (OR: 1.07, 95% CI: 1.04-1.10) [32]. In other studies, however, there was no significant association found between age and development of knee pain [14,27,31]. A possible explanation for increased MSD risk among older teachers, apart from the natural wear of the body, could be that MSD among older teachers may be influenced by the work environment and the organisation of the work [13]. It is suggested that older teachers generally have reduced physical capabilities and slower physiological response when compared with their young colleagues [38].

### Previous injury

Among individual factors in this study, previous injury to a particular body site was also a risk factor for the development of MSD on that body site. Previous injury on the neck, shoulder, upper back, elbows, wrist/hand, hip/thigh, knee and ankles/feet was positively associated with MSD of the neck (OR: 9.39, 95%CI: 3.92-22.46), shoulder (OR: 7.83, 95%CI: 3.78-16.22), upper back (OR: 14.04,



95%CI: 5.90-33.41), elbows (OR: 3.94, 95%CI: 1.24-12.52), wrist/hand (OR: 5.04, 95%CI: 3.24-7.85), hip/thigh (OR: 10.73, 95%CI: 5.65-20.38), knees (OR: 7.61, 95%CI: 4.99-11.61) and ankles/feet (OR: 3.52, 95%CI: 2.28-5.43), respectively. This finding is consistent with some previous studies conducted in the teaching profession [9] and elsewhere [39-41]. When compared with other risk factors revealed in this study, previous injury was the strongest predictor for all MSD of different body regions with odds ranging between 3.24 and 14.04.

### Number of children less than six years

Having two or more children less than six years of age was significantly associated with elbow MSD in the current study (OR: 1.94, 95% CI: 1.07-3.51). In a study carried out in Brazil, having two children showed increase in prevalence of upper limb pain but the association was not statistically significant. However, having three or more children was significantly associated with upper limb pain (OR: 1.32, 95% CI: 1.12-1.56) [13]. Similarly, having children has been positively associated with musculoskeletal pain among secondary school Saudi female teachers [26]. Having children has also been identified as a risk factor for MSD of the neck in a study of Japanese nurses [3] and back pain among police officers and firemen [42].

In this study, having two or more children under the age of six years was associated with elbow MSD but failed to produce significant association with MSD of other body regions. It appears that teachers in Botswana bear children at an older age. It has been documented that the mean age for childbearing for women who completed senior secondary school is 29.3 years compared to 27.0 years of those who never attended school. These differentials indicate that education delays the age of childbearing [43]. Bearing this in mind, one can hypothesize that the childbearing age of teachers with Diploma and Bachelor degree, which most hold, could be delayed by the time they take to obtain their tertiary qualifications resulting in a mean age for childbearing of more than 29.3 years. The mean age of female teachers in this study (39.3 years) suggests that any children they may have would be young. If so, the increased elbow MSD risk could be attributed to the type of constant lifting and carrying that raising small children might require [3]. This relationship could also be due to increased recreational activities undertaken when one has children [42].

### Length of employment

Among work-related risk factors, length of employment was positively associated with knee MSD among Botswana teachers. Teachers who worked for 21-30 years were 1.71 times more likely to develop knee pain when compared to those with less working experience. This result is consistent with the results of a study conducted in Brazil, where teachers with more than 14 years working experience were 1.17 times more likely to develop lower limb pain (OR: 1.17, 95% CI: 1.09-1.26) [13]. A similar link has been found in a study of Indian teachers, where 70% of teachers who had more than 20 years of teaching experience reported pain in joints of legs [28]. Conversely, research conducted in Turkey among teachers failed to produce any statistically significant association between teaching experience and lower extremities [27,29].

This association can be interpreted as the effect of aging or a cumulative effect of workloads on musculoskeletal system of workers [44]. In this study, age and length of employment were correlated and it is difficult to separate their effects. However, the mean age of

teachers was 38.5 years (SD: 8.6 years) and this would be relatively young to develop prevalent degenerative changes of musculoskeletal system or reduction of muscular strength sufficient to induce frequent musculoskeletal injuries. As thus, the cumulative effect of workloads appears to be more likely to contribute to knee MSD than ageing [44]. It is worth noting that most of Botswana teachers start teaching at an early age, possibly as early as at 21 years of age, especially those with a Diploma, which takes three years compared to four years of Bachelor degree. The majority of teachers in this study held a Diploma (58.7%). It has been suggested that the longer the exposure time to occupational risk factors the higher the chance of getting job-related disorders [45]. It has also been established that occupational diseases do not happen suddenly, but rather happen over time, and almost with a predictive pattern [33].

## Physical Risk Factors

### Rapid physical activity

In this study, teachers who reported that their job required rapid physical activity were found to be at increased risk of shoulder, wrist/hand and hip/thigh MSD. Teachers with rapid physical activity were 1.38 times more likely to develop shoulder MSD, 1.51 times more likely to report wrist/hand MSD and 1.70 times more likely to report hip/thigh MSD when compared to those who did not report rapid physical activity in their work. Parallels can be drawn to a study that was conducted among school teachers in Brazil, where intense physical activity was reported as a risk factor for upper and lower limb pain [13]. On the contrary, in a study of Chinese teachers, physical activity was not significantly associated with development of shoulder and wrist pain ( $p > 0.05$ ) [27].

### Awkward arm position

Teachers who reported adopting awkward arm position during work were more likely to develop MSD of the shoulder, upper back and wrist/hand. These teachers were 1.44 times more likely to develop shoulder MSD (OR: 1.44, 95% CI: 1.02-2.02), 1.71 times more likely to develop upper back MSD (OR: 1.71, 95% CI: 1.17-2.51) and 1.59 times more likely to develop wrist/hand MSD (OR: 1.59, 95% CI: 1.18-2.14). Using elevated posture when playing has been found to be a risk factor for development of MSD among Swedish music teachers ( $p < 0.05$ ) [11]. Work-related awkward postures have been associated with increased risk of developing MSD among a group of health care workers in Italy [40]. Furthermore, frequently working in an uncomfortable posture has been found to increase experiencing pain in the neck region among office workers in Thailand [46]. Conversely, the study of Chinese teachers failed to produce statistically significant association between working with hands above shoulder and development of neck/shoulder pain (OR: 1.21, 95% CI: 0.86-1.71) [34].

Teachers have also been found to be at an increased risk of developing musculoskeletal symptoms as they are exposed to physical factors which have been associated with the development of musculoskeletal disorders [29]. It has been hypothesised that shoulder pain may occur when working with raised arms unsupported for a long time and this is normally observed in teachers' daily routine. Teachers' activities involve the frequent use of the arm above shoulder to write on the board. This mechanism causes teachers to develop discomfort in the cervicobrachial regions, which is even made worse by daily overwork and less rest time [33]. Lifting of hands and head

during writing on the black board may be causative factor for shoulder pain and also pain in hands and joints of hands [28].

## Psychosocial Risk Factors

### Psychological job demands

The results of this study showed that of all psychosocial risk factors under study, only psychological job demands was positively associated with shoulder and upper back MSD. Teachers who reported high psychological job demands were 1.37 times more likely to experience shoulder MSD (OR: 1.37, 95% CI: 1.01-1.83) and 2.00 times more likely to develop upper back MSD (OR: 2.00, 95% CI: 1.42-2.80) when compared to those with low psychological job demands. Parallels can be drawn to a study of music teachers in Sweden, where female teachers who had high psychological demands were six times more likely to report experiencing neck/shoulder pain [20]. High workload has been statistically associated with neck pain among Chinese teachers (OR: 1.72, 95% CI: 1.12-2.65) [36]. Similar results have been documented in the health care sector around the world [2-4,47-50]. High physiological demand has also been independently associated with musculoskeletal pain among Canadian workers [51]. Similarly, psychological demands have been significantly correlated to neck, shoulder and back disorders among employees of different occupations [52]. A possible explanation for this association in the current study could be because teachers often work in stressful conditions with large classes, a lack of educational resources, and limited reward for their work [13].

Psychosocial risk factors have been previously associated with MSD among school teachers. Reviews of musculoskeletal disorders among school teachers have indicated that psychosocial risk factors such as high workload/demands, high perceived stress level, low social support, low job control, low job satisfaction and monotonous work are most likely associated with MSD among teachers [15,17]. Surprisingly, in this study, psychosocial risk factors such as low decision latitude, high job insecurity, low co-worker, low supervisor and low social support and high job dissatisfaction were not significantly associated with development of MSD of anybody region.

### MSD protective factors

A number of factors that were investigated in the current study displayed a protective effect against MSD among school teachers.

### High supervisor support

Teachers who reported high supervisor support were less likely to report MSD of the neck (OR: 0.55, 95% CI: 0.39-0.77), upper back (OR: 0.73, 95% CI: 0.55-0.99) and hip/thigh (OR: 0.69, 95% CI: 0.50-0.96) than those teachers who reported low supervisor support. Similar results have been found among Australian female workers, where workers with supervisor support were less likely to experience neck pain (OR: 0.5, 95% CI: 0.3-0.9) [53], and in the United States of America [54] and Iran [55]. In Japan, nursery school teachers who have reported poor supervisor support were 1.58 more likely to develop neck/shoulder pain than those with high supervisor support (OR: 1.58, 95% CI: 1.15-2.16) [44]. Low management support has been found to predict back pain and general musculoskeletal pain among Norwegian automobile repair garage workers [56]. However, a study of psychosocial work characteristics among the working population in

the Netherlands failed to produce statistically significant association between supervisor support and neck pain [57].

### Teaching at secondary schools

A protective effect was also noted for teachers in Botswana secondary schools. Senior secondary school teachers were less likely to report shoulder MSD when compared to primary school teachers (OR: 0.63, 95% CI: 0.42-0.97). On the other hand, junior secondary school teachers were less likely to report upper back MSD when compared to their primary school counterparts (OR: 0.61, 95% CI: 0.44-0.84). Parallels can be drawn to the results of a Chinese study, which found that primary school teachers were more likely to report shoulder pain than secondary school teachers (72.8% vs. 65.1%,  $p < 0.001$ ) [14]. In Slovenia, primary school physical education teachers were found to be almost two times more likely to experience back pain when compared to secondary school physical education teachers (OR: 1.83, 95% CI: 1.21-2.75) [32].

In this study, primary school teachers suffered significantly higher risks of shoulder and upper back MSD. A probable explanation could be that, in Botswana primary school teaching is characterised by heavy workload. Primary school teachers are expected to teach eleven subjects, emphasize child-centred teaching methodologies like project methods and breakthrough to Setswana, which require individualised teaching, maintain a continuous assessment record of each child and undertake remedial teaching for slow learners [58]. Primary school teachers' activities involve the frequent use of the arm above the shoulder to write on the board. Such a mechanism causes teachers to start experiencing some kind of discomfort in the cervicobrachial region, which becomes worse due to daily overwork. Secondary school teachers, on the other hand, conduct their classes in a more expository way, following a textbook and hence less writing on the blackboard [33].

### Regular physical exercise

This study shows that exercising for five or more hours a week was negatively correlated with MSD of the upper back in this study. Teachers who reported more than 5 hours of physical exercise a week were less likely to report MSD of the upper back (OR: 0.65, 95% CI: 0.43-0.97) compared to those who exercised less. Similar findings have been demonstrated in a study of school teachers in Ethiopia where teachers who have indicated doing regular physical activity were 0.52 times less likely to report back pain compared to those who did not engage in regular physical activity (OR: 0.52, 95% CI: 0.34-0.82) [9]. A similar link has been demonstrated between habitual physical activity as athletic and MSD among Thai university staff [59]. However, in a study of Estonian athletes, no significant association was found between regular physical exercise and back pain [60]. In Greece, male physical education teachers who had reported no personal training were 2.5 times more likely to experience back pain [61].

### The impacts of MSD

The results of this study showed that MSD do not only affect an individual, but also their families, workplace and the health care system. Some of the teachers who reported MSD in this study reported; being prevented from carrying out normal activities, seeking medical attention, experiencing pain for a number of days, changing jobs/duties because of pain, cutting down activities at home and even being unable to work for several days because of pain. Similar findings

have been reported in previous research [26,29,31,35,45]. In some previous research, some respondents indicated that they took sick leave as a way of coping with neck and upper limb pain [35]. Furthermore, musculoskeletal problems have also been found to be an underlying cause of long term sick leave among school teachers Sweden [22]. In Saudi Arabia, 5.4% of teachers with MSD reported 6-10 days of absenteeism [26]. From these results it is evident that MSD negatively affects the wellbeing of teachers and probably the teaching profession itself.

### Limitation

A number of limitations were identified in the current study. As a cross-sectional study, only associations can be established but no inferences of causality can be made. Further limitations of this study that need to be acknowledged are the possibility of recall bias and self-reporting of MSD. It is not clear if participants correctly remembered the presence of MSD in the last 12 months which could lead to over or under estimation. The presence of MSD depends solely upon the subjective self-report of the participants and not based upon an objective clinically verified diagnosis of a specialist.

### Conclusion

To the authors' knowledge, this study is the first of its kind to investigate and analyse the prevalence and distribution of MSD among teachers in Botswana. Overall, this study has shown that MSD is reasonably common among teachers in Botswana, particularly those of the shoulder, upper back and neck. MSD of the lower limb was less prevalent when compared to MSD at other body sites, a trend that has been documented in previous research of MSD among school teachers. This study also identified a wide range of MSD risk factors, suggesting that the aetiology of this condition is complex and multifactorial in nature. Female gender, increasing age and length of employment, previous injury and having more than two children of six or less years increased the odds of MSD. Rapid physical activity and awkward arm position were the only physical factors positively associated with MSD. Among psychosocial risk factors, psychological job demands was the only one positively associated with MSD.

Interestingly and equally important, was that a number of factors were shown to have a protective effect against reported MSD in this study. MSD prevented teachers from carrying out their normal activities, caused them to seek medical attention from nurses, doctors or physiotherapies or change duties and cut down on activities at home because of pain. Moreover, some teachers reported being unable to work for days because of MSD. The complex nature of MSD risk factors found in this study suggests that no single specific preventative or intervention strategy will help in reducing MSD among teachers. As such, to help reduce the prevalence, progression and burden of MSD among Botswana teachers, a greater emphasis may be placed on ergonomics education, regular physical exercise, and occupational stress.

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### Authors' contributions

Patience Erick and Derek Smith conceived and designed the study. Patience Erick was involved in data collection, statistical analysis and drafting the manuscript. Both authors read and approved the final manuscript.

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