An Investigation of the Prevalence, Correlates and Potential Intervention Strategies for Musculoskeletal Disorders among School Teachers in Botswana

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Doctor of Philosophy

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Statement of Originality

The thesis contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. I give consent to the final version of my thesis being made available worldwide when deposited in the University's Digital Repository**, subject to the provisions of the Copyright Act 1968.

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Statement of Authorship

I hereby certify that this thesis is submitted in the form of a series of published papers of which I am a joint author. I have included as part of the thesis a written statement from each co-author; and endorsed by the Faculty Assistant Dean (Research Training), attesting to my contribution to the joint publications.

Patience N. Erick Date

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Paper 3: Erick PN, Smith DR. The prevalence and risk factors for musculoskeletal disorders among school teachers in Botswana. *Occupational Medicine & Health Affairs*. 2014;2(4).

Paper 4: Erick PN, Smith DR. Low back pain among school teachers in Botswana, prevalence and risk factors. *BMC Musculoskeletal Disorders*. 2014;15(:359).

Paper 5: Erick PN, Smith DR. The development of an ergonomic training manual to help prevent work-related musculoskeletal disorders in the teaching profession. *Safety and Health at Work*. (Under review).

Paper 6: Erick PN, Smith DR. Musculoskeletal disorders in the teaching profession: an emerging workplace hazard with significant repercussions for developing countries. *Industrial Health*. 2015 Mar 26.

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STATEMENTS

OF

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OF

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List of additional publication

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Abstract

Musculoskeletal disorders (MSD) represent a common occupational problem for working populations throughout the world. Despite their large demographic and associated potential for occupational health problems, few epidemiological studies have investigated MSD among teachers. Hence the overarching aim of this thesis was to investigate the prevalence and risk factors of MSD among school teachers in Botswana.

To address this aim the thesis presents five papers. Paper 1 describes a systematic review of previous research investigating prevalence and risk factors of MSD among teaching staff. Paper 2 describes a critical review of previous literature which investigated risk and protective factors of MSD among school teachers. These reviews were aimed at gaining insight of MSD among school teachers which was eventually used to inform some parts of the thesis. Paper 3 and Paper 4 describe a study of MSD among school teachers in Botswana. Using a cross-sectional study with anonymous self-administered questionnaire, this study aimed to investigate the prevalence and risk factors for MSD among school teachers in Botswana. The study also aimed to investigate the level of low back disability and associated risk factors. The study further investigated the impact of MSD among school teachers in Botswana. Paper 5 describes the development of an ergonomic training manual to help reduce the prevalence, progression and impacts of MSD among teachers. The study was aimed at determining the effectiveness of the training manual and to highlight any areas for improvement. Paper 6 summaries the findings of the study.

The concluding chapter of this thesis reviews and brings together the main findings of these six papers and makes recommendations for future research. The results of this thesis suggest that MSD is reasonably common among school teachers in Botswana, particularly MSD of the back, shoulder and neck. The study also suggests that MSD is complex and multifactorial in nature, and therefore, no single, specific intervention strategy alone would be entirely effective at reducing these disorders among teachers. The development of an ergonomic training manual for teachers as developed in the current study represents a positive step forward in the prevention and management of these disorders especially in developing countries. The results of this study also offer a significant contribution to the existing knowledge of MSD in the teaching profession.

OVERVIEW

OF

THESIS

Overview

This thesis describes a three year investigation of musculoskeletal disorders (MSD) among school teachers in Botswana. It is comprised of an introduction, six scientific articles and a final chapter providing discussion, conclusions and recommendations. At the time of submission, four of the six chapters have been published in peer-reviewed journals, while the other two are still under consideration with appropriate journals. The referencing and formatting styles may vary between chapters as they reflect the individual formatting requirements of each journal where they were published or submitted.

The **Introduction** provides an overview of the education system, the challenges faced by teachers in Botswana, and a review of MSD in the teaching profession globally, and in Botswana. This chapter further outlines the aims and objectives, statement of the problem and significance of this study.

Paper 1: 'A systematic review of musculoskeletal disorders among school teachers' and **Paper 2:** 'Musculoskeletal disorders risk factors in the teaching profession: a critical review' describes systematic and critical reviews of the published literature investigating the prevalence, risk factors and protective factors for MSD in the teaching profession. Paper 1 critically analyses the literature and reports on the prevalence of MSD and possible associated risk factors in the teaching profession while Paper 2 reviews and discusses possible risk and protective factors for MSD, among teachers. These reviews identified a number of gaps and limitations in the current literature. It was found that MSD is most likely an under researched topic among school teachers. While a number of studies have been carried out to specifically investigate back and neck related MSD, few studies have looked at whole body MSD, and even fewer have been carried out to specifically investigate MSD of the lower extremities of teachers. Additionally, sample sizes and response rates were suboptimal in some studies. Many previous studies had measured different musculoskeletal regions of the body using different methods. Few studies investigated the impact of MSD in the teaching profession or prevention and management strategies for these disorders. Paper 1 and Paper 2 have been published in *BMC Musculoskeletal Disorders* and *OA Musculoskeletal Medicine*, respectively.

Paper 3: 'The prevalence and risk factors for musculoskeletal disorders among school teachers in Botswana' describes a study which investigated the prevalence, potential risk factors and the impact of MSD among teachers in Botswana. The study also found that some factors have a protective effect against MSD in this group. This study employed a quantitative research design eliciting quantitative data using an anonymous self-administered questionnaire. To the authors' knowledge, this study is the first of its kind to investigate and analyse the prevalence and distribution of MSD in Botswana. This paper has been published in *Occupational Medicine & Health Affairs*.

Paper 4: 'Low back pain among school teachers in Botswana, prevalence and risk factors' describes a study that investigated and analysed the prevalence of low back pain (LBP) among teachers in Botswana and reported risk factors that influence the development and severity of LBP. The study found a number of risk factors associated with LBP and low back disability while regular physical exercise was found to have a protective effect against LBP. To the authors' knowledge, this study is the first of its kind to analyse and establish the prevalence and risk factors for LBP in Botswana. This paper has been published in *BMC Musculoskeletal Disorders*.

Paper 5: 'The development of an ergonomic training manual to help prevent work-related musculoskeletal disorders in the teaching profession' describes the development of an ergonomic training manual for school teachers. Based on the literature reviews as discussed in Papers 1 and 2, and the results presented in Papers 3 and 4, an ergonomic training manual was developed to help prevent work-related MSD among teachers. After developing the training manual, a pilot study was then conducted to determine its effectiveness and highlight any potential areas for improvement. A copy of the training manual and an anonymous feedback form were sent to participants who were asked to complete and return the form after carefully studying the manual. The results from this study suggest that the training manual has a potential to raise MSD awareness among teachers, which is envisaged, in turn, to help reduce the prevalence, progression and impact of these issues within the teaching profession. This paper was submitted to the journal *Safety and Health at Work* in October, 2014, and is still under review.

Paper 6: 'Musculoskeletal disorders in the teaching profession: an emerging workplace hazard with significant repercussions for developing countries' summaries the results of the entire study (Papers 1-5) with the aim to raise awareness of MSD in the teaching profession. This paper highlights MSD risk factors and the impact of these disorders and suggests that ergonomic training should be introduced in teachers' training institutions. This paper has been published online in *Industrial Health* journal.

The **Discussion** section brings together the results of the six papers included in this thesis. The main findings are then discussed and resulting recommendations for future research are outlined.

BACKGROUND

OF THE

STUDY

Introduction

This research describes an investigation of musculoskeletal disorders (MSD) in the teaching profession that was conducted among primary and secondary school teachers in Botswana. The outcome of this research will provide a detailed training manual on MSD, which might help teachers in reducing the prevalence and severity of these disorders. The study will also discuss the relationship between work and MSD in various body regions. Literature suggests that poor posture and movements can lead to local mechanical stress on the muscles, ligaments and joints, resulting in discomfort in the neck, back, shoulder and other parts of the musculoskeletal system.

Overview of the Education System in Botswana

As Figure 1 shows, Botswana is a landlocked nation lying between countries that have experienced, or are still experiencing, a certain degree of political instability. Until the 1990s, South Africa to the south and Namibia to the west of Botswana have been politically unstable countries. To the northeast of Botswana is Zimbabwe, whose politics are a potential threat to peace and stability in the region. In the 1970s, there was an influx of political refugees from neighbouring Angola and Namibia. Economic refugees from Zimbabwe continue to enter the country in large numbers because of the political heat that has plunged the country into economic turmoil. Despite its geographical vulnerability, Botswana remains an oasis of peace and democracy within a politically volatile surrounding. The good governance of the country is founded and grounded on ideals that respect and uphold the rule of law and on a constitutionally established non-racial democracy that affords all citizens equal rights, freedom of speech, freedom of press, and freedom of association[1].

The basis of the country's democratic practices lies in the following statements by Botswana's former President QKJ Masire. On the formation of a new government in a "new" country, he proclaimed: "For the nation to survive it had to be democratic; it had to be united. We had to be sure that we did not encourage tribalism but rather encouraged nation building.[2]" Despite the presence of many different ethnic groups in the country, ethnocentrism is not an issue of real concern. If it exists, it is at the individual level. On the whole, the different ethnic groups enjoy a harmonious co-existence with one another. Regardless of whether teachers prefer to stay and teach in their hometowns or villages, or to work in areas outside their birth areas, in many ways the system of a centralised teacher posting has contributed immensely to the existing social and cross-cultural fertilisation and diversity among the different ethnic groups. The merit in such a system is that it contributes to national unity[1, 3].

Figure 1: Map of Africa showing Botswana and its neighbouring countries

Adapted from Worldatlas[4]

Historic Development of Education system in Botswana

The Government of Botswana has the responsibility of providing citizens with basic education. This portfolio falls under the Ministry of Education and Skills Development (MoESD). Organised and planned efforts for the realization of basic education started with the goals that were outlined in the first National Policy on Education of 1977. The policy document was drawn from the Education for Kagisano report, which was submitted to the government by the first National Commission on Education (NCE).

The National Policy on Education (1977)

The first National Policy on Education (NPE) was appointed in 1976 as a presidential commission to formulate the country's philosophy of education, set goals for the development of education and training, and to recommend the best strategies to achieve the set goals. From the report of this commission, a national policy on education was developed. The NPE changed the Botswana's education system as it provided a sound framework for educational planning and the provision of education. Quality education was no longer offered to only a few privileged individuals, as was the case before the NPE[5].

Education for Kagisano, which means Education for Social Harmony, was adopted as Botswana's philosophy of education. Social harmony is an important outcome in Botswana because it is based on the national principles of democracy, development, self-reliance and unity. An ideal education system in Botswana is believed to be one that can be instrumental in producing a society whose characteristics reflect the national principles and in pursuit of social harmony. A new strategy was inevitable in order to achieve the set goals on the NPE. This strategy was to increase access to education at all levels, with special emphasis on universal access at the primary level, output of educated human resources to meet the demand, and increase on education expenditure at the primary school level. One of the measures that were introduced was the provision of nine years of schooling with the two last years in day junior secondary schools for all by 1990[5].

Botswana's Education for All Conference, 1991: A Response to Jomtien

In 1990, Botswana was part of the World Conference themed "Education For All" (EFA) held in Jomtien in Thailand. The world community pronounced its commitment to Article 26 of the Universal Declaration of Human Rights and adopted a rights-based approach to the provision of education in its countries. The Jomtien conference resulted in a declaration that is known as the World Declaration on Education For All: Meeting Basic Learning Needs. In 1991, after the Jomtien conference, the MoESD convened a national conference on Education For All in Botswana[6].

The objectives of this conference were to look at the present problems in meeting the basic learning needs of the child, youth and adults; to focus the attention of all stakeholders on the present education system, and to explore realistic means of rapidly extending coverage and improving the quality of Basic Education in Botswana and, finally, to provide a platform for all stakeholders to participate and support government to realise its educational objectives. At the end of this conference, recommendations were made, calling for policies formulation for the provision of pre-primary and Non Formal Education, as proposed by NPE of 1977, and in the area of special education to ensure accessibility of basic education to all groups of disadvantaged children. Furthermore, it was declared that the nine years of basic education be free and compulsory to all Batswana children. It was also recommended that standards of pre-service and in-service teacher preparation and conditions of service be improved for teachers. Curriculum content and delivery, and school environment were also to be improved to facilitate maximum learning benefits[6].

The Revised National Policy on Education (1993)

In 1993, a presidential national commission of enquiry into the education sector was appointed to revise the NPE of 1977. It was necessary to revise the NPE because it had been developed 10 years after Botswana gained independence and, since then, much had changed. For example, when the first NPE was drawn up, most of Botswana's workforce lacked minimal skills and, in 1993, Botswana was faced with a challenge of preparing the workforce for a global economy. The commission reviewed the first NPE, consulted with stakeholders and commissioned a number of studies to investigate topical issues in education and other related issues that needed specific attention in order to come up with the Revised National Policy on Education (RNPE). The Jomtiem Conference Declaration and recommendations of the 1991 Botswana's Education for All Conference were also taken into consideration to align the Botswana's education with the global initiatives of providing education for all citizens of the world[7].

The RNPE aimed at preparing Batswana for the transition from a traditional agro-based economy to the industrial economy that would be able to compete with other countries anywhere in the world. In addition to responding and preparing for the demands of the economy, the government of Botswana considered access to basic education as a fundamental human right. In addition to achieving universal access to basic education through schooling, the RNPE addressed other strategies through which universal access for all would be achieved for both children and adults. These included out-of-school education, education for the poor and disadvantaged, and education for the disabled. While the first NPE had recommended a nine-year basic education programme, the RNPE recommended a ten-year basic education programme made up of seven years of primary and three years of secondary education. It was also recommended that the primary school class sizes be reduced from 45 to 40 and further reducing them to 30 in subsequent years. The RNPE also recommended raising the standard for teacher qualification both in terms of academic and professional qualifications[7].

Overview of Basic Education in Botswana

The government of Botswana considers basic education to be a fundamental right of its citizens. There are three stages of basic education in Botswana as detailed in the following paragraphs.

Primary School

Primary education is the first stage of the ten-year basic education programme and covers Standards I-VII. The minimum entry age is six years in public schools and five years in private schools and the maximum is 10 years. However, flexibility is often exercised to enable pupils in the remote areas to have access to primary education. Teaching in primary schools is regarded as an all-purpose job. Teachers are expected to teach all subjects as they appear in the primary school syllabus. These include core subjects and general subjects: the former including Mathematics, Science, English, Setswana and Social Studies; the latter including Agriculture, Home Economics, Art and Craft, Physical Education, Religious Education and Music. Given the recommended class size in Botswana schools, which is in the ratio of one teacher to forty pupils, primary teaching is characterised by heavy workload[7]. Moreover, primary school teachers teach eight periods every day. This can be strenuous because teachers have to prepare for all eight periods daily.

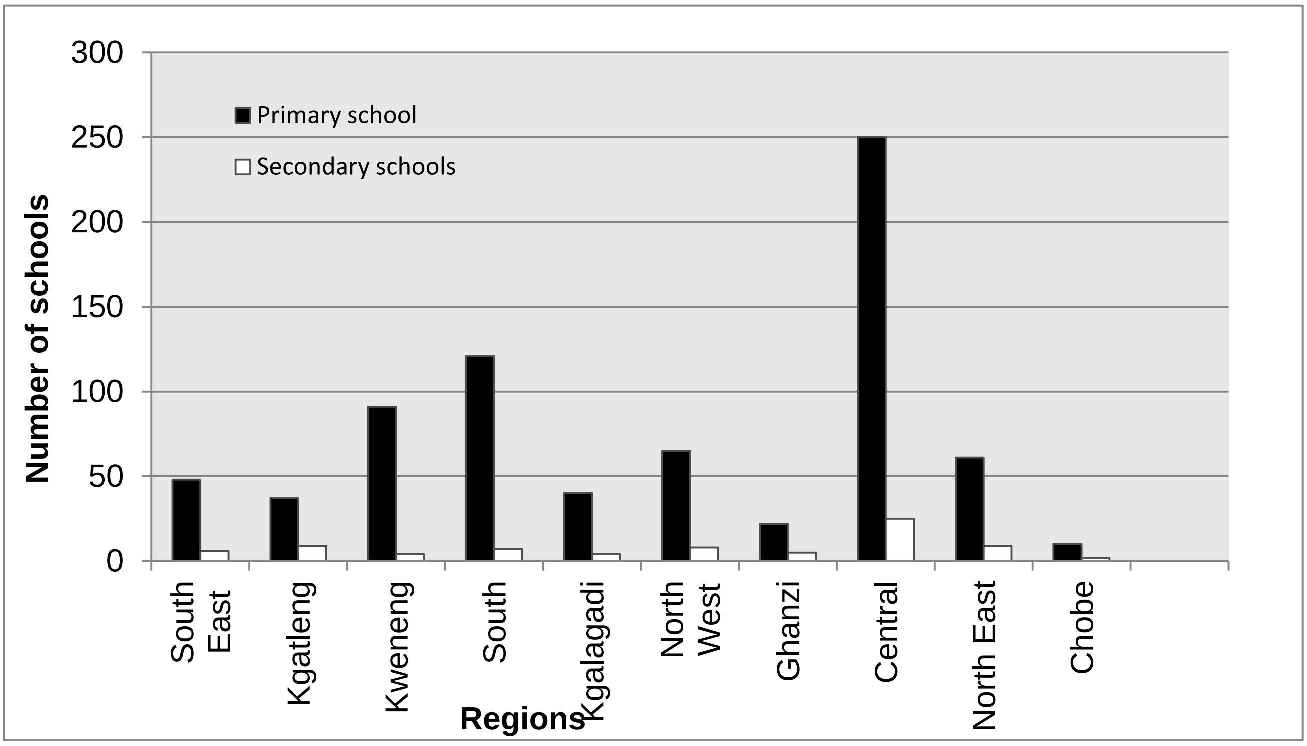
Secondary School

Secondary education in Botswana consists of three years of junior secondary school (completing ten years of basic education), followed by two years of senior secondary school. Progression from the junior secondary to senior secondary is through the Junior Certificate Examination. Junior secondary school used to be two years and senior secondary, three years. The Revised National Policy on Education of 1994, guided by the goals of the World Education Forum, Jongtiem, 1990, ushered in the current Ten Year Basic Education Programme. Senior secondary education culminates in the Cambridge Overseas School Certificate Examination GCE O-level examination that grants access to higher education. In secondary schools, teachers teach subjects that they specialised in at tertiary institutions.

Education Statistics

By 2009, Botswana comprised of ten education regions, as shown in Figure 2. In 2010, there were 752 government primary schools, which allowed all school-age children access to basic education. In the same year, there were 207 community junior secondary schools (CJSS) and 31 senior secondary schools (SSS) in Botswana[8]. Currently, there are 11,711 primary and 13,173 secondary school teachers in the country[9]. Three quarters (75.4%) of all primary school teachers are females[8].

Figure 2: Number of government schools in each education regions of Botswana



Adapted from CSO[8]

General Duties of Teachers in Botswana

According to the Republic of Botswana Teaching Service Act 62:01 Section 16[10], the duty of every teacher shall be to aid and assist the school to which they are attached, posted or transferred to carry out and obey all lawful orders of those persons having lawful authority either over or within that school. The teachers are to exercise the functions of their post impartially, efficiently and without delay, in accordance with the standards of professional conduct expected from teachers, so as to promote the education and welfare of the pupils and the general efficiency of the school. Teachers are also required by law to place the whole of their time at the disposal of the school to which they are attached, posted or transferred, and may not request any additional payment for any official duty or work he is required to perform by the Director, an appointing authority or the person in charge of their school[10].

The job description of teachers therefore does not only include teaching a class and attending to the individual needs of students. Teachers are also expected to perform additional duties and do extracurricular activities with the students. Additional duties include sitting in on different committees in the school such as fundraising, subject panels, examinations committees, health committees, environmental committees and departmental committees. For their contribution to extracurricular activities, teachers are expected to do sporting activities, which include athletics and ball games, conduct music lessons, and lead different clubs such as drama and traditional dance clubs.

Challenges Faced by Teachers in Botswana

To put human development at the heart of socio-economic strategies, the advancement and working conditions of teachers must be addressed. General working conditions include a number of aspects that, if teaching and learning are to take place under unfavourable conditions, improved learning outcomes cannot be realised. The struggle to obtain better conditions of service and improved salaries, job satisfaction, morale and additional benefits has a long history in Botswana[11]. It has been found that morale in the teaching profession in Botswana has been steadily declining due to perceived inadequacies in teachers' working conditions. Research indicates that the quality of an education system of a country depends on teachers. Factors such as workload (including extra-curricular activities), class size and working conditions have been found to determine job satisfaction of teachers in Botswana[12].

Teaching in Botswana appears to be characterized by low levels of job satisfaction, low morale, low status and an attitude that regards the teaching profession as a last resort employment. The refusal by some teachers to be involved in extracurricular activities and study supervision, and constant confrontation with educational authorities are clear signs that there is a problem in the profession. The uncompromising stance taken by teachers is a source of concern to the authorities, to students as recipients of education, to parents as stakeholders, and to the nation at large. It is important to acknowledge that teachers in Botswana are still left disgruntled despite all the attempts to pacify them. It is clear that the teachers' dissatisfaction, low levels of motivation and morale are worrisome, as these have been mentioned in the two National Commissions of Education 1977 and 1993[12].

A study of agriculture teachers has shown that teachers reported that attrition of teachers in Botswana was influenced by remuneration, advancement and working conditions[13]. A study of secondary school teachers showed that teachers were highly dissatisfied and frustrated with conditions of service and workplace environments created by leadership in school. The study also suggested that teachers were significantly dissatisfied with the level and quality of parental involvement, lack of recognition for achievement, poor supervision, and lack of training opportunities, salary and many other predictors. The study further revealed that, in those passing years in Botswana, government has not done enough to meet the needs of secondary school teachers at this level of education in this respect. What makes the situation even worse is that the promotion processes in schools are perceived by teachers as unfair, irrational and not based on competence. If the government remains indifferent to this facet of job satisfaction and does nothing, this will probably continue to be the main source of job dissatisfaction among teachers at junior secondary school[12]. In the following paragraphs, issues that are of concern will be briefly discussed.

Working Hours of Teachers in Botswana

On May 1st, 2010, the new Public Service Act came into force. According to this Act, the public service would consist of persons, among others, who immediately before the commencement of it were part of the teaching service, including teachers in government schools and persons that had held government aided posts in private schools. The Act stated that, all public service workers shall work eight hours a day, and any work in excess of that would be paid as overtime. However, this provision did not include the teaching service cadre. The working hours of teachers were to be communicated after consultation with affected recognised unions[14]. Over the years, teachers had been working long hours, including evenings and on weekends, and further manning the schools without monetary reward from the government. After the enactment of the new Act, the trade unions negotiated with the government through the Directorate of Public Service Management (DPSM) to address issues that included the constitution of the bargaining council, hours of work for teachers, and the issue of nurses performing non-nursing duties[15].

After a long running battle between teachers and the government over the payment of overtime allowances, the trade unions resolved that teachers, like other public service workers, should work for eight hours only. This meant that teachers would not be performing extracurricular activities, which would normally take place after hours and on weekends, unless the government paid them overtime allowances as per the new Public Service Act[16]. This development will not only affect the sporting competitions in schools, but also the Ministry of Youth, Culture and Sports. Teachers play a vital role in sport programmes because they are involved with talent identification and development at schools[17]. While the teachers will be happy to work an eight-hour day, the extracurricular activities that they coach will suffer. It will be interesting to see how this issue will be resolved, as the government has been accused of lacking commitment towards improving the working conditions of teachers[16]. The issue of working hours has been complicated further by the introduction of a 'double shift' in secondary schools.

Double Shift System in Secondary Schools

In January 2006, a 'double shift' system was introduced in ten public secondary schools in a bid to increase access to these schools. Double shift has been used to describe schools which have different pupils in the mornings and afternoons, but the same number of classroom hours as pupils in single-session schools. Although double shift was a pilot project, teachers' unions felt the speed and circumstances of its introduction were not conducive for its successful implementation. The unions felt that issues that would affect the quality of education and teacher and student welfare were not addressed prior to its introduction. The unions argued that teachers' welfare cannot be divorced from issues that affect the education system in Botswana. While it is the mandate of the unions to ensure quality education in schools, they fear that this cannot be fully achieved without taking due consideration of teachers' welfare[18].

Issues of concern included timetabling. According to Ministry of Education, the first morning group was to run from 06:30-12:30 hours, while the afternoon group would run from 12:30–18:30 hours. Unions argued that, with this timetabling, there would be reduced teaching time, which could eventually affect students' performances. Since the afternoon group would use the same classrooms as the morning group, students would no longer have the added time to work on practical subjects and projects, which were mostly done during afternoons[19]. Extracurricular activities were also bound to suffer. It was difficult to see how extracurricular activities were going to fit in to the new timetable, and forming a team to represent the school in clubs and sports was also going to be a problem. Teachers' welfare was also an issue. Although the government felt that schools were overstaffed and that the existing resources could be streamlined, the unions felt the teachers would be exploited because they were already overburdened by a high student-teacher ratio. Additionally, it was not made clear whether two sets of teachers would be used for morning and afternoon shifts or only one set of teachers would be used for both shifts[19].

Finally, however, the double shift system in senior secondary school was abolished in 2010. The main reasons for abolishing the system were that the system was badly received by the public and because of complaints from the parents. The Minister of Education promised that there would be no drop in enrolment rates because three new senior schools had been built. The Minister refuted allegations that the system was abolished because its inherent problems outweighed its benefits. Although the 'double shift' continued in junior secondary schools[20], unions are still calling for its total abolishment because they believe it is not a viable solution and has worsened the quality of education[21].

Class Size

Class size is usually considered to be a desired option when applying the idea of cost effectiveness in the education sector. Class size determines a teacher's workload in terms of the responsibility and working hours because large classes mean a greater amount of time required for preparation, counselling and evaluation of students' work. In Botswana, the pupil-teacher ratio ranges between 19 and 48. The high student-teacher ratio might lead to less concentration of classroom work. It is therefore important that class size be addressed as an important component of teachers' working conditions[22].

Career Development

In Botswana, teachers are paid at the same scale as other civil servants. However, career development of teachers has not been clearly defined. It is reported that education officials have neglected to establish a clear teacher ladder or provide adequate supervision, reflecting their preoccupation with other education issues such as access and material support for schools[23]. In most countries, promotion is based on merit, seniority and increased educational qualifications. Many countries have made efforts to develop or improve the effectiveness of the education system tailored to the teaching profession[23].

In the 1990s, in the quest to improve the status of teaching, the government of Botswana introduced parallel progression. Parallel progression was a system introduced by the government in order to help retain civil servants in the public service by allowing them to progress to highest permissible positions in the schemes of services that contain the career progression and job description of jobs in the public service. Parallel progression was seen as a vehicle through which teachers could remain 'chalk face artists' while receiving the rewards of administrative cadre. This vision was, however, perverted by the way in which the commission investigating parallel progression interpreted the process. The parallel progression report was a setback to the teaching profession, as teachers were classified as technicians not professionals. This led to workers feeling that parallel progression was marred with irregularities. Due to problems such as the improper handling of the parallel progression incentive, teachers' attitudes towards their employer changed dramatically. As a result, teachers left the teaching profession for better jobs in the public and private service [24].

Teacher appraisal system

In addition to parallel progression, to improve the morale of teachers, a teachers' appraisal system was introduced. This was thought to be important because it could lead to improvements in teacher performance and also forming the basis for the promotion of teachers, annual increments and other related benefits. However, it has emerged that many teachers view the current teacher appraisal system as demoralising and even threatening[25]. One positive development with regard to career development in the teaching profession is that the in-service training that was once ad hoc and poorly coordinated is now well integrated and widely available[23].

Physical Facilities and Working Environment

The effectiveness of the teachers' work depends on the effectiveness of the education system as a whole and on the general environment on which teachers work. Bad maintenance of the physical facilities and delays in salary payment and other shortcomings of the system are likely to affect the teacher's performance in a negative way[22]. The conditions should be conducive for teachers to be productive. It has been reported that in some rural areas teachers walk 12 kilometres to and from school because of lack of accommodation in the schools.

The Botswana Public Sector Workers Strike 2011

After negotiations between the government of Botswana and trade unions stalled, the public sector workers went on a strike that became known as “the mother of all strikes.” Under the auspices of the Botswana Federation of Public Sector Unions (BOFEPUSO), five unions—the Botswana Secondary School Union (BOSETU), the Botswana Teachers Union (BTU), the Botswana Public Employees Union (BOPEU), the National Amalgamated Local, Central Government and Parastatal Workers Union (NALCGPWU), and the Botswana Land Boards, Local Authorities and Health Workers Unions (BLLAHWU)—demanded a 16% salary increment. In response, the government offered a 3% salary increase on condition that the economy would have improved by August 2011. The unions argued that they were not necessarily asking for a salary increment but for inflationary adjustment, as there had not been an inflationary adjustment for the previous three years despite rising inflation. The government, however, insisted that the country’s economy was still suffering the effects of global recession[26].

The strike was initially planned for 10 days, from the 18th to 29th April 2011, but continued for eight weeks. Almost 90% of the 105000 public sector workers, including teachers in BOSETU and BTU, were on strike[26]. During the strike all primary and secondary public schools were closed[27]. Consequently, there was a backlog of the syllabus that had to be overcome before the standard 7s, Form 3s and 5s sat for their final examinations while the rest of other levels sat for their end of year examinations. In addressing this, the MoESD proposed that teachers work over weekends to cover for the lost time[28], a solution that teachers did not support because they wanted the Ministry to firstly resolve their issues of working hours and working conditions[16]. The Ministry eventually shortened the school holidays by two weeks to make up for the lost time[28]. However, it is important to note that school holidays are the only time teachers are allowed to take their annual leave.

Additionally, the morale and motivation of teachers in public schools is low[29]. In some schools, principals have been reported to victimise teachers that were on strike upon returning to work[30]. The MoESD, however, refuted allegations of victimisation of teachers that engaged in the strike, stating that promotion of teachers would be carried out based on merit and in accordance with the General Orders[31]. Eventually, in July immediately after the strike, the Minister of Labour and Home Affairs tabled the Statutory Instrument in Parliament that was intended to amend the Trade Dispute Act. The amendment was meant to classify teaching services, veterinary services and the diamond industry as essential services, which would restrict them from participating in industrial action. The motion, however, was annulled because the lawmakers felt the Minister had not consulted stakeholders, and the opposition felt the motion was meant to punish teachers after their involvement in the prolonged public service strike[32]. Nevertheless, the Minister later re-tabled the same Instrument claiming a thorough consultation with the relevant stakeholders[33].

Later on it emerged that the Minister did not consult with the Botswana Federation of Trade Unions (BFTU) prior to re-tabling the proposed law to include teaching as an essential service. The BFTU Secretary General stated that the Minister's claims about consulting the teachers' unions were misleading to parliament. Consequently, the BFTU has vowed to ensure that teachers are not termed as essential services and intended to complain to the International Labour Organisation (ILO) about how the government of Botswana is curtailing the freedom of workers. The BFTU also intended to lobby Members of Parliament (MPs) to reject the legislation[33].

While the BFTU rely on the support of opposition MPs to reject the motion, it has been revealed that the ruling Botswana Democratic Party (BDP), instructed its MPs, especially the backbenchers, to support the motion or face being expelled from the party. The opposition has on the other hand lobbied support from the BDP's backbenchers to reject the amendment[32]. As of 21st June 2011, it is not known whether teachers will be classified as essentials or not, and what that will mean for the future of the government. However, according to the ILO, the education sector is not classified as an essential service[34].

It must be noted that the success of any education system depends largely on teachers. They are crucial to the strategy to achieve a more effective and responsive education system. However, this cannot be realised if the working conditions of teachers are not conducive for them to work to their potential. Issues affecting teachers must be amicably resolved or the government will be faced with frustrated and stressed teachers. The issue of working hours of teachers must also be addressed because long working hours and stress have been found to contribute to a high risk of musculoskeletal disorders[35-37].

Musculoskeletal Disorders

Introduction

Musculoskeletal disorders (MSD) represent one of the most common and important occupational health problems in working populations, being responsible for a substantial impact on quality of life and incurring a major economic burden in compensation costs and lost wages[37-39]. MSD decreases productivity at work due to sick leave, absenteeism and early retirement[36, 40, 41], and is also costly in terms of treatment and individual suffering[42]. Moreover, MSD represents a common health-related reason for discontinuing work and for seeking health care[35, 43]. MSD is defined as impairments of bodily structures such as muscles, joints, tendons, ligaments, nerves, bones and the localised blood circulation system, that are caused or aggravated primarily by work and by the effects of the immediate environment in which work is carried out[25, 44]. However, unlike most other workplace health issues, MSD also happens outside the work environment and then can be made worse by work[44]. Whatever the cause MSD can impair ability to work at normal capacity. Initially, sufferers may adopt new ways of performing tasks or adapt tools to reduce discomfort, perhaps avoiding use of an affected limb and thus putting strain on other joints. Most MSD are cumulative disorders, resulting from repeated exposure to high or low intensity loads over a long period of time[44].

MSD is among the most common occupational health problems in both developed and developing countries[45]. The situation is reportedly even worse in developing countries with suboptimal working conditions in many industries[46]. In Africa, for instance, the prevalence of low back pain (LBP) has been found to be rising, which is a concern[47]. MSD has also been found to be an important health and socio-economic problem of occupational diseases in developed countries[41]. There is, therefore, the need for prompt reporting of symptoms so that early intervention can take place to ensure an individual gets the right support and help from their employer such as temporary modified duties or adaptations to their workplace for them to manage their condition. Early intervention such as an organised health and safety programme can help prevent MSD among teaches and therefore reducing the costs associated with MSD.

Teachers' Exposure to MSD

Teachers' exposure to MSD appears to be insufficiently described in the literature, and knowledge regarding MSD in this group is also sparse, although some research has been conducted[36, 43, 48]. The work tasks of school teachers often involve significant use of a 'head down' posture such as frequent reading, marking of assignments, and writing on a blackboard[48, 49]. School teachers, in general, have been demonstrated, relative to other occupational groups, to report a high prevalence of MSD[36], with prevalence rates of between 35% and 95%[36, 43, 50-54]. During the course of their work, teachers may be subjected to conditions that cause physical health problems[51]. It is worth noting that teachers do not just teach: they facilitate learning. They go further than just imparting knowledge, information and understanding. They have to prepare the learners to take in that which is imparted and, at the end, take additional steps to ensure that what is imparted is absorbed. A teacher must be an expert in knowledge acquisition, expert in teaching design, planning and methodology, in classroom assessment and in policing duties. Sometimes they play 'babysitting' roles, and mentoring and coaching roles[12]. Teachers also participate in different school committees. These may cause teachers to suffer adverse mental and physical health issues due to the variety of job functions[51, 55, 56].

A recent literature review of MSD among school teachers found that individual, work-related and psychosocial factors contribute to development of MSD. This review studied 33 studies conducted around the world in the teaching profession. The review showed that the majority of studies focused on MSD of the back, neck/shoulder and upper extremities. MSD of the back pain was found to be the most prevalent among MSD of other body regions[39]. A detailed literature review will be discussed in Chapter 2.

MSD in Various Body Regions

As alluded earlier, the work tasks of teachers involve a wide variety of duties and responsibilities that maybe be carried out under unfavourable working conditions, especially in developing countries. These may 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 during extracurricular activities, especially sporting activities. Sitting down for a considerable time without taking breaks is a significant risk factor for MSD. Teachers may adopt awkward postures when reading, marking students' work, preparing lessons or when helping students with their work. The constant loading of the muscles in the neck, shoulders and the back will, in time, lead to aches, pains or discomfort[36, 51].

Standing for a considerable time has been found to contribute to development of MSD. After standing for some time or walking for a while, muscles need a rest. If not, joints from the neck to the feet become stuck. When this happens regularly, muscles get tired and their tendons and ligaments can be damaged, causing soft tissue injuries. Standing also reduces blood flow to muscles and stops regular muscle movements that return blood from the feet and legs to the heart. When blood and other fluids do not move properly, veins get inflamed and/or feet, ankles and legs swell and muscles start to ache. Footwear can also contribute to MSD. Heels more than 5 cm high can force the body forward and the buttocks back. To keep balance, women have to tense up and lean slightly back, this can cause shortened calf muscles, knee, and back problems[57]. If the chair and desk is not appropriate to one's body size, they may have to hold an awkward posture that leads to symptoms of MSD. Dangling feet brought about by chairs that are too high will impede blood circulation in the legs and contribute to back discomfort. Chair height that is too high also creates discomfort because of increased pressure on ones legs and buttocks. On the other hand, a chair that is too low leads to elevation of the arms and shoulders and discomfort to the legs as one may assume awkward posture in trying to make themselves feel comfortable[58].

Aims and Objectives

The overarching aim of this study is to determine factors that are associated with MSD among primary and secondary school teachers in Botswana. The study will lead to development of a training manual, a potential intervention strategy, which may ultimately lead to an improved working environment for teachers and a healthier workforce. The specific objectives of this study are:

i. To review the relevant literature concerning prevalence, risk factors for MSD (Paper 1 and Paper 2).
ii. To establish the prevalence, distribution and location of MSD among primary and secondary school teachers (Paper 3 and Paper 4).
iii. To ascertain factors that correlate with MSD among primary and secondary school teachers (Paper 3 and Paper 4).
iv. To establish the level of disability due to low back pain and associated risk factors (Paper 4).
v. To develop a prevention and intervention strategy for MSD among school teachers in Botswana (Paper 5).

Statement of the Problem

MSD in Africa

The health of Africans is of global concern, as improvements in health outcomes observed in most Western countries over the past decades has not been achieved in

Africa. This has been attributed more recently to the negative impacts of the HIV and AIDS epidemic, reflecting both the focus shift of health interventions and funding directions in health research[47]. A review of research publications on MSD suggests that most research has been conducted in the developed countries and therefore little is known about the epidemiology of MSD in Africa, a developing continent. MSD has been almost completely neglected for most of sub-Saharan Africa, principally due to the fierce competition for scarce resources[59]. As a result, MSD research receives little attention in Africa. This is unfortunate because there is a huge burden of MSD in Africa. MSD has been found to contribute 3.4% and 1.7% of the total disease burden in the developed and developing world, respectively. However, the burden of MSD in terms of disability-adjusted life years (DALYs) in the developing countries has been estimated to be almost 2.5 times that of the developed countries[59]. The prevalence of low back pain among Africans has been found to be comparable to that in research undertaken in developed countries[47]. Furthermore, the prevalence of work-related MSD in practising oral hygienists in South Africa has been found to be similar to that in developed countries[60]. The literature on MSD in Africa is accumulating with research carried out in different disciplines. MSD research has been carried out among health care workers in South Africa[60-63], Nigeria[64-68], Tunisia[69] and Uganda[70], and among office workers in South Africa[71], and among textile manufacturing industry workers in Botswana[46]. Furthermore, low back pain has been investigated among Ethiopian school teachers[72]. It appears that a majority of studies have been conducted among health care workers in South Africa and Nigeria.

MSD in the Teaching Profession

MSD causes pain, disability and loss of employment for workers in many work environments[38]. Many studies have been carried out to study the relationship between MSD and work[52], as some workers have been found to be at a higher risk of MSD because of the nature of their work or their work environment[36]. Considerable studies on MSD have been carried out among textile industry workers [46, 73, 74], nurses [75-77], dental professionals[78-80] and office workers[81, 82], among other occupations. In the teaching profession, however, the majority of studies that have been carried out focussed mainly on teachers' stress problems[83-86]. It is worth noting that, in addition to the stress problems that teachers may face, they may also be affected by physical health problems that may have been caused or aggravated by their work[51].

MSD has been reported as a relevant health problem among teachers, and conditions due to MSD are the main causes of absenteeism[36]. Indications are that both developed and developing countries continue to record a significant rise in prevalence of MSD among school teachers. A recent literature review of MSD among school teachers suggests that the prevalence of self-reported MSD among school teachers ranges between 39% and 95%[87]. It has been observed that teachers report significant prevalence of the back, neck and upper limbs. Factors such as gender, age, length of employment, and awkward posture have been associated with higher MSD prevalence rates[87]. Although literature suggests that there are few studies carried out to investigate MSD of the back, neck/shoulder and upper extremities, there appears to be even more paucity of studies carried out to investigate MSD of lower extremities. MSD has also been found to be a leading cause of ill-health retirement in Irish and Scottish school teachers, affecting 10%[40] and 18%[88] of teachers, respectively.

Sometimes, teaching is carried out under unfavourable circumstances in which teachers mobilize their physical, cognitive and affective capacity to reach teaching production objectives, over-demanding or generating over-effort to their psycho-physiological functions. If there is not enough time for recovery, pain symptoms are triggered or prompted. As a result, this leads to stress with consequences to physical and mental health and impact on professional performance[36]. Reporting of MSD is common in the education sector and teachers have been found to be at a risk of developing MSD due to the variety of their duties and postures they adopt in carrying out their duties[89]. Although many of the studies reviewed are empirically grounded, the existing literature tends to focus on MSD among teachers around the world, except for Africa. Conceivably, the findings may be influenced by the working conditions of teachers in places where the studies were undertaken. There is a deficiency of research on MSD among teachers in developing countries such as Botswana.

MSD among Teachers in Botswana

Although research from around the world indicates that teachers are at an increased risk for MSD development[87], as far as the researcher is concerned, 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. This is evidenced by the presence of studies conducted among teachers in Botswana investigating, for instance, stress among secondary school teachers[90], perceptions of teachers' different issues[24, 91], teaching strategies[92], and others[93-96], with a paucity of them investigating the physical health problems of teachers. Therefore, there appears like little information is available about the extent of MSD, the factors that place teachers at an increased risk, effective and appropriate therapies for teachers, or the ways in which teachers may prevent or minimise the effects these problems in Botswana.

Since the success of a country's education system depends on teachers, it is crucial to understand their work environment. It has been found that the job nature of school teachers involves a lot of a 'head down' posture and prolonged sitting, especially when reading, marking assignments or preparing for lessons[48, 49]. Teachers may also be involved in extracurricular activities. These are known risk factors for MSD. Therefore, based on this backdrop and the paucity of MSD research among teachers in Botswana, there is need to undertake this study to determine the extent of these disorders and associated risk factors among teachers. The findings of this study will also be helpful in developing and implementing an appropriate prevention and intervention strategy aimed at reducing prevalence and severity of MSD among school teachers.

Significance of the Study

MSD appears as one of the most common occupational health problems in both developed and developing countries. Teachers are at risk of MSD because of the nature of their work and work environment. While there are a number of studies that have been carried out on MSD among school teachers around the world, there is a paucity of such studies focusing on Africa. In this era when the problem of teachers' working conditions has been recognized, it is the need of the time to identify dimensions of this problem in Botswana, where teachers are definitely not satisfied with their working conditions. This study is necessary in order to establish the extent of the problem and to investigate potential intervention strategies suited to circumstances that may prevail in African schools.

Theoretically, this study will extend the general understanding on MSD in the teaching profession. There is a need to constantly study MSD among teachers because the impact on an individual and society is significant, and also to ensure that teachers remain healthy to effectively carry out their duties. As already alluded, there is inadequate amount of studies of MSD among school teachers in Botswana, where teachers face poor working conditions. The findings from this study will provide insight into the extent of MSD in the target population. The study will further promote awareness of MSD among teachers. It is hoped that the findings will encourage curricular developers in teachers' training institutions to incorporate ergonomic principles designed to address the work environment of teachers into curricular for teachers' training. The teachers' unions may use the findings to argue for better teachers' working conditions. The results of this study may be used by the teachers' employer to improve their working conditions. However, the study should be seen to seek to provide insight on the level of awareness of MSD among school teachers in Botswana and should be viewed in the context of an effort to improve occupational health and safety.

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PUBLISHED PAPERS

Paper 1

A systematic review of musculoskeletal disorders among school teachers

Introduction to Paper 1

A clear understanding of the prevalence, distribution and risk factors for musculoskeletal disorders (MSD) is important in the development of cheap, cost effective and appropriately targeted intervention strategies for teachers, especially in developing countries where these issues may not be a high priority. The aim of this study was to determine the risk factors that contribute to the development and progression on MSD among school teachers in Botswana in order to help reduce the prevalence, progression and impact of these problems. There appears to be no review that was previously conducted on MSD among school teachers. Paper 1 aimed to identify the gaps in the literature regarding musculoskeletal disorders among school teachers. To do so, a systematic review of the published literature investigating MSD among school teachers was conducted. In order to add to the overall body of knowledge in this area, papers involving school teachers with musculoskeletal disorders such as low back, neck, shoulder and upper limb pain were included in the review. The review generates valuable information regarding current knowledge in this area and provides information base upon which the subsequent research presented in this thesis builds.

A systematic review of musculoskeletal disorders among school teachers

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Abstract

Background

Musculoskeletal disorders (MSD) represent one of the most common and most expensive occupational health problems in both developed and developing countries. School teachers comprise an occupational group among which there appears to be a high prevalence of MSD. Given that causes of MSD have been described as multi-factorial and prevalence rates vary between body sites and location of study, the objective of this systematic review was to investigate the prevalence and risk factors for MSD among teaching staff.

Methods

The study involved an extensive search of MEDLINE and EMBASE databases in 2011. All studies which reported on the prevalence and/or risk factors for MSD in the teaching profession were initially selected for inclusion. Reference lists of articles identified in the original search were then examined for additional publications. Of the 80 articles initially located, a final group of 33 met the inclusion criteria and were examined in detail.

Results

This review suggests that the prevalence of self-reported MSD among school teachers ranges between 39% and 95%. The most prevalent body sites appear to be the back, neck and upper limbs. Nursery school teachers may be more likely to

report suffering from low back pain. Factors such as gender, age, length of employment and awkward posture have been associated with higher MSD prevalence rates.

Conclusion

Overall, this study suggests that school teachers are at a high risk of MSD. Further research, preferably longitudinal, is required to more thoroughly investigate the issue of MSD among teachers, with a greater emphasis on the possible wider use of ergonomic principles. This would represent a major step forward in the prevention of MSD among teachers, especially if easy to implement control measures could be recommended.

Background

Musculoskeletal disorders (MSD) represent one of the most common and important occupational health problems in working populations, being responsible for a substantial impact on quality of life and incurring a major economic burden in compensation costs and lost wages [1, 2]. MSD decrease productivity at work due to sick leave, absenteeism and early retirement [3-5], and are also costly in terms of treatment and individual suffering [6]. Moreover, MSD represent a common health-related reason for discontinuing work and for seeking health care. In many occupations, MSD include a wide range of inflammatory and degenerative conditions affecting the muscles, ligaments, tendons, nerves, bones and joints; but can also occur from a single or cumulative trauma [7, 8].

The work tasks of school teachers often involves significant use of a 'head down' posture, such as frequent reading, marking of assignments, and writing on a blackboard [9, 10]. Nursery school teachers, however, also perform a wide variety of tasks combining basic health childcare and teaching duties, and those that require sustained mechanical load and constant trunk flexion. Nursery school teachers have been found to have elevated prevalence of neck, shoulder, arm and low back disorders [11, 12], and lower-extremity MSD due to activities which require sustained periods of kneeling, stooping, squatting or bending [11].

School teachers in general, have been demonstrated relative to other occupational groups, to report a high prevalence of MSD [3], with prevalence rates of between 40% and 95% [3, 7, 13-17]. During the course of their work, teachers may be subjected to conditions that cause physical health problems [14]. The work of a teacher does not only involve teaching students, but also preparing lessons, assessing students' work and being involved in extracurricular activities such as sports. Teachers also participate in different school committees. These may cause teachers to suffer adverse mental and physical health issues due to the wide variety of job functions [14]. Despite this, the impact of MSD specifically within the teaching profession has not been given sufficient attention in the literature. Furthermore, comparatively little research has directly investigated the prevalence of MSD in the teaching profession.

The aim of this review was therefore, to critically analyse the literature and report on the prevalence of MSD and possible associated risk factors within the teaching profession. The review focused on nursery, primary and secondary school teachers and teachers of physically and mentally handicapped children.

Methods

Criteria for inclusion and exclusion

Empirical research, case studies, and literature reviews published in peer-reviewed, English language journals were considered for inclusion, with letters to the Editor and conference proceedings excluded. Participants in the studies had to have been listed as school teachers. No restrictions were placed on age, gender, race or socioeconomic status. Only articles that documented the prevalence of MSD and its risk factors were considered. Articles not written in English were excluded from the literature review, as were studies which reported on university academic staff.

Search methods

An extensive literature search was undertaken in MEDLINE and EMBASE databases during 2011. Further searches were performed in occupational health and safety databases such as the CISILO database and the MAK Collection for Occupational Health and Safety. Other relevant databases that were searched included AMED, CINAHL, Scopus, ProQuest and PubMed. Following the initial database search, the reference lists of identified articles were then examined for additional publications. Keywords used for the search were; musculoskeletal disorders, musculoskeletal discomfort, back pain and teachers.

Study selection

For all research articles identified during the search, the titles, keywords and abstracts, where available, were considered for possible relevance to this literature review. Full text copies were obtained for analysis and data extraction from all articles that met the inclusion criteria.

Search results

Following a thorough search of the databases, a total of 80 articles were located, albeit with a number of titles having been duplicated. The titles, keywords and abstracts (where available) were examined for relevance, and assisted in the exclusion of duplicates. Following this process, a total of 40 potentially relevant papers were obtained. After further analysis of these articles, seven papers were excluded from the review as they did not measure the prevalence of MSD or demonstrate possible MSD risk factors among teachers. Articles that did not describe a research study or literature review were also excluded from the review. Following exclusions, a final group of 33 articles were considered suitable.

Results

Description of studies

The 33 studies located during this review had either measured the prevalence of MSD or reported on possible risk factors for MSD among school teachers. All studies had been published in English. Figure 3 provides a flow chart of the literature search methodology.

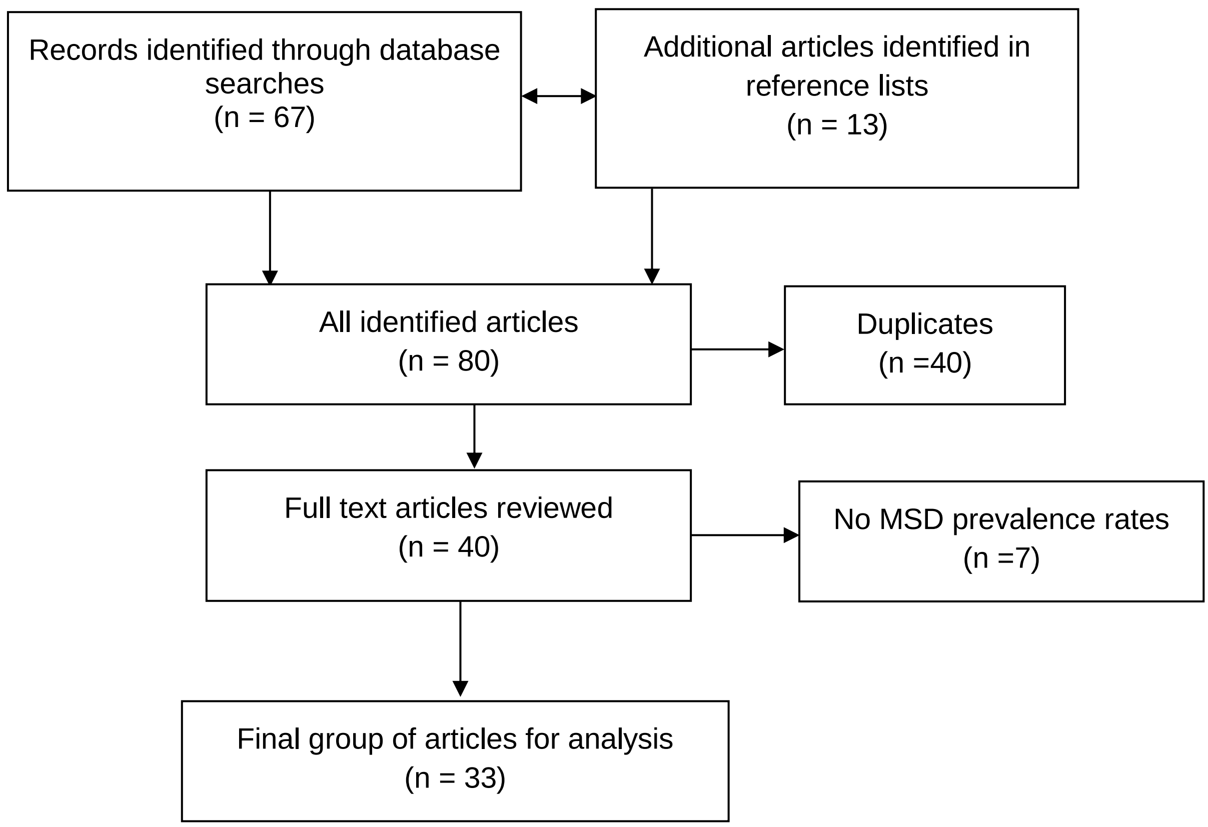

Figure 3: Flow chart of the literature

Prevalence of MSD

International studies on MSD among school teachers have reported a high prevalence of MSD as indicated in Table 1. A number of articles reported a high prevalence of MSD, generally. A study of school teachers in Hong Kong, for example, found that 95.1% had experienced some form of pain in the previous month [14]. In a study carried out in Estonia which looked at physical activity, MSD and cardiovascular risk factors in male physical education teachers (PETs), 66.7% of teachers reported MSD in the previous 12 months, compared to 51.2% of PETs who reported MSD for the same period [16]. Furthermore, a study of Swedish music teachers found that 92% had experienced some form of pain in the previous 12 months [18], and a study of United States (US) music teachers found that 91% had experienced MSD [17]. In another Swedish study, 40% of school teachers and nursery school teachers were found to have reported MSD [13].

In more recent studies, MSD prevalence rates have been found to be 68% for music teachers in Perth, Australia [7], and 55% and 51.4% for school teachers in Brazil [3] and Turkey [15], respectively. Music teachers may be at an increased risk for MSD when compared with other school teachers. In comparison, PETs tended to have low risk of MSD, while preschool teachers have been reported to be at an increased risk of MSD [11]. As most of the studies reviewed had examined prevalence in selected musculoskeletal regions, these results will be examined separately.

Table 1 - International studies reporting the prevalence of MSD among school teachers

Body Site	Prevalence (%)	Recall Period [a]	Participants	Sample size	Response Rate (%) [b]	Country	Year [c]	Study Design [d]	Author (s)
Any	51.4	NS	Primary, secondary and high school teachers		900*	Turkey	2011	CS	Korkmaz *et al* [15]
	95.1	1 month	Primary and secondary school teachers	6 000	28.5	China	2010	CS	Chong & Chan [14]
	68.0	NS	Music teachers	580	87.1	Australia	2010	CS	Allsop & Ackland [7]
	55.0	NS	Primary and secondary school teachers	4 697	95.1	Brazil	2009	CS	Cardoso *et al* [3]
	77.0	12 months	Music teachers	61	77	Sweden	2009	CS	Edling & Fjellman-Wiklund[20]
	91.0	NS	Music teachers	1 600	3.5	US	2008	CS	Yoshimura *et al* [17]
	42.0	NS	School teachers	100	100	Germany	2005	CS	Seibt *et al*[33]
	82	12 months	Music teachers	287	72.5	Sweden	2003	CS	Fjellman-Wiklund *et al* [19]
	66.7	12 months	School teachers	359	74.6	Estonia	2002	CC	Pihl *et al*[16]
	51.2	12 months	Physical education teachers	359	74.6	Estonia	2002	CC	Pihl *et al*[16]
	40.0	NS	Nursery school teachers		224*	Sweden	1998	CS	Brulin *et al*[13]
	40.0	NS	School teachers		510*	Sweden	1998	CS	Brulin *et al*[13]
	92.0	12 months	Music teachers	61	58.1	Sweden	1998	CS	Fjellman-Wiklund & Sundelin[18]
	80.0	12 months	Music teachers	62	98.4	Sweden	1998	CS	Fjellman-Wiklund & Sundelin[18]
	78.0	NS	Preschool teachers	22	95.4	US	1995		Grant *et al*[11]
Neck only	42.5	NS	Primary, secondary and high school		900*	Turkey	2011	CS	Korkmaz *et al* [15]

			teachers						
	68.9	1 month	Primary and secondary school teachers	6 000	28.5	China	2010	CS	Chong & Chan [14]
	47.0	12 months	Music teachers	61	77	Sweden	2009	CS	Edling and Fjellman-Wiklund [20]
	69.3 66.7 59.7	Life-long 12 months Since becoming a teacher	Secondary school teachers	5 680	54.6	China	2007	CS	Chiu & Lam [9]
	68.2 64.4 56.8	Life-long 12 months Since becoming a teacher	Secondary school teachers	1 500	44.8	China	2006	CS	Chiu *et al* [6]
	59.0 30.0	12 months 7 days	Music teachers	287	72.5	Sweden	2003	CS	Fjellman-Wiklund *et al* [19]
	33.3	12 months	School teachers	359	74.6	Estonia	2002	CS	Pihl *et al*[16]
	9.3	12 months	Physical education teachers	359	74.6	Estonia	2002	CS	Pihl *et al*[16]
	44.4	12 months	Music teachers	61	58.1	Sweden	1998	CS	Fjellman-Wiklund & Sundelin[18]
	38.9	12 months	Music teachers	62	98.4	Sweden	1998	CS	Fjellman-Wiklund & Sundelin[18]
Shoulder only	28.7	NS	Primary, secondary and high school teachers		900*	Turkey	2011	CS	Korkmaz *et al* [15]
	73.4	1 month	Primary and secondary school teachers	6 000	28.5	China	2010	CS	Chong & Chan [14]
	28.0	12 months	Music teachers	61	77	Sweden	2009	CS	Edling *et al*[20]
	55.0 31.0	12 months 7 days	Music teachers	287	72.5	Sweden	2003	CS	Fjellman-Wiklund *e al* [19]
	7.8	12 months	School teachers	359	74.6	Estonia	2002	CC	Pihl *et al*[16]

	18.6	12 months	Physical education teachers	359	74.6	Estonia	2002	CC	Pihl *et al*[16]
	55.6	12 months	Music teachers	61	58.1	Sweden	1998	CS	Fjellman-Wiklund & Sundelin[18]
	38.9	12 months	Music teachers	62	98.4	Sweden	1998	CS	Fjellman-Wiklund & Sundelin[18]
	22	After being on duty	Nursery school teachers	1 059	73	Japan	1981	CS	Nagira *et al [32]*
Neck and / or shoulder	25 - 35.4	1 month	Nursery school teachers	1 445	99.5	Japan	2002	CS	Ono *et at*[21]
	33.0		Preschool teachers	22	95.4	United States	1995		Grant *et al*[11]
Upper limbs	8.0 (elbows)	NS	Primary, secondary and high school teachers		900 respondent s	Turkey	2011	CS	Korkmaz *et al* [15]
	13.0 (wrist only)	NS	Primary, secondary and high school teachers		900*	Turkey	2011	CS	Korkmaz *et al* [15]
	43.9 (arm)	I month	Primary and secondary school teachers	6 000	28.5	China	2010	CS	Chong & Chan [14]
	23.7	NS	Primary and secondary school teachers	4 697	95.1	Brazil	2009	CS	Cardoso *et al* [3]
	19.0 (elbows)	12 months	Music teachers	61	77	Sweden	2009	CS	Edling *et al*[20]
	15.0 (hands)	12 months	Music teachers	61	77	Sweden	2009	CS	Edling *et al*[20]
	35.8 33.3 31.8	Life-long 12 months Since becoming a teacher	Secondary school teachers	5,680	54.6	China	2007	CS	Chiu & Lam [9]
	72.1	NS	Teachers for physically and intellectually disabled pupils	1 663	84.8	Japan	2003	CS	Yamamoto *et al*[22]

	18.0 (elbows) 8.0 (elbows)	12 months 7 days	Music teachers	287	72.5	Sweden	2003	CS	Fjellman-Wiklund *et al* [19]
	20.0 (hands) 13.0 (hands)	12 months 7 days	Music teachers	287	72.5	Sweden	2003	CS	Fjellman-Wiklund *et al* [19]
	9.1 - 17.7 (arms)	1 month	Nursery school teachers	1 445	99.5	Japan	2002	CS	Ono *et al*[21]
	22.2 (elbows)	12 months	Music teachers	61	58.1	Sweden	1998	CS	Fjellman-Wiklund & Sundelin[18]
	22.2 (hands)	12 months	Music teachers	61	58.1	Sweden	1998	CS	Fjellman-Wiklund & Sundelin[18]
	11.1 (elbows)	12 months	Music teachers	62	98.4	Sweden	1998	CS	Fjellman-Wiklund & Sundelin[18]
	19.4 (hands)	12 months	Music teachers	62	98.4	Sweden	1998	CS	Fjellman-Wiklund & Sundelin[18]
	11.0 (hand/wrist)	NS	Preschool teachers			US	1995		Grant *et al*[11]
Back	36.9 (upper back)	NS	Primary, secondary and high school teachers		900*	Turkey	2011	CS	Korkmaz *et al* [15]
	43.8 (lower back)	NS	Primary, secondary and high school teachers		900*	Turkey	2011	CS	Korkmaz *et al* [15]
	52.5 (upper back)	1 month	Primary and secondary school teachers	6 000	28.5	China	2010	CS	Chong & Chan[14]
	59.2 (lower back)	1 month	Primary and secondary school teachers	6 000	28.5	China	2010	CS	Chong & Chan[14]
	40.4	12 months	Primary school teachers		272*	Malaysia	2010	CS	Samad *et al*[1]
	32.0 (upper back)	12 months	Music teachers	61	77	Sweden	2009	CS	Edling *et al*[20]
	49.0 (lower back)	12 months	Music teachers	61	77	Sweden	2009	CS	Edling *et al*[20]
	41.1	NS	Primary and	4 697	95.1	Brazil	2009	CS	Cardoso *et al* [3]

			secondary school teachers						
	52.4	NS	Teachers in a special school for the severe handicaps	50	88		2009	CS	Wong *et al*[24]
	53.3	NS	Secondary school teachers	992	52.2	Philippines	2007	CS	Atlas *et al*[8]
	34.8	6 months	School teachers	1 869	52.1	France	2006	CS	Kovess-Masfety *et al* [28]
	45.7	1 month	School teachers for physically and mentally handicapped children	1 869	56.3	Japan	2006	CS	Muto *et al*[25]
	63.0	NS	Physical education teachers		562*	Greece	2004	CS	Stergioulas *et al* [23]
	50.0 40.0 22.0	Life-long 12 months 1 week	Primary school teachers	492	78	China	2004	CS	Jin *et at*[27]
	35.0 (upper back) 21.0 (upper back)	12 months 7 days	Music teachers	287	72.5	Sweden	2003	CS	Fjellman-Wiklund *et al* [19]
	45.0 (lower back) 23.0 (lower back)	12 months 7 days	Music teachers	287	72.5	Sweden	2003	CS	Fjellman-Wiklund *et al* [19]
	76.7	NS	Teachers for physically and intellectually disabled pupils	1 663	84.8	Japan	2003	CS	Yamamoto *et al* [22]
	4.7 (lower back)	12 months	Physical education teachers	359	74.6	Estonia	2002	CC	Pihl *et al*[16]
	11.8 (lower back)	12 months	School teachers	359	74.6	Estonia	2002	CC	Pihl *et al*[16]
	43.0	12 months	Nursery school	10 351	62.7	Japan	2002	CS	Tsuboi *et al*[5]

			teacher						
	20.6	12 months	Elementary, junior and senior high school teachers	10 351	62.7	Japan	2002	CS	Tsuboi *et al*[5]
	33.3 (upper back)	12 months	Music teachers	61	58.1	Sweden	1998	CS	Fjellman-Wiklund & Sundelin[18]
	55.6 (lower back)	12 months	Music teacher	61	58.1	Sweden	1998	CS	Fjellman-Wiklund & Sundelin[18]
	50.0 (lower back)	12 months	Music teacher	62	98.4	Sweden	1998	CS	Fjellman-Wiklund & Sundelin[18]
	25.0 (upper back)	12 months	Music teachers	62	98.4	Sweden	1998	CS	Fjellman-Wiklund & Sundelin[18]
	17.7	1 month	Nursery school teachers	2 829	98.9	Japan	1997	CS	Ono *et al*[26]
	61.0	NS	Preschool teachers	22	95.4	US	1995		Grant *et al*[11]
	39.2 (low back pain)	1 month	Nursery school teachers	1 059	73	Japan	1981	CS	Nagira *et al*[32]
Lower limb/extremities	8.4 (hip)	NS	Primary, secondary and high school teachers		900*	Turkey	2011	CS	Korkmaz *et al* [15]
	32.0 (knees)	NS	Primary, secondary and high school teachers		900*	Turkey	2011	CS	Korkmaz *et al* [15]
	21.8 (ankles)	NS	Primary, secondary and high school teachers		900*	Turkey	2011	CS	Korkmaz *et al* [15]
	54.6 (leg pain during physical activity)	1 month	Primary and secondary school teachers	6 000	28.5	China	2010	CS	Chong & Chan[14]
	41.1	NS	Preschool & primary school teachers	4 697	95.1	Brazil	2009	CS	Cardoso et al [3]
	12.0 (hips) 4.0	12 months 7 days	Music teachers	287	72.5	Sweden	2003	CS	Fjellman-Wiklund *et al* [19]
	16.0 (knees)	12 months	Music teachers	287	72.5	Sweden	2003	CS	Fjellman-Wiklund *et al*

	5.0	7 days							[19]
	9.0 (feet) 3.0	12 months 7 days	Music teachers	287	72.5	Sweden	2003	CS	Fjellman-wiklund *et at* [19]
	2.3 (hip)	12 months	Physical education teachers	359	74.6	Estonia	2002	CC	Pihl *et al*[16]
	3.9 (hip)	12 months	School teachers	359	74.6	Estonia	2002	CC	Pihl *et al*[16]
	14.0 (knees)	12 months	Physical education teachers	359	74.6	Estonia	2002	CC	Pihl *et al*[16]
	7.8 (knees)	12 months	School teachers	359	74.6	Estonia	2002	CC	Pihl *et al*[16]
	8.3 (hips)	12 months	Music teachers	61	58.1	Sweden	1998	CS	Fjellman-Wiklund & Sundelin[18]
	13.9 (knees)	12 months	Music teachers	61	58.1	Sweden	1998	CS	Fjellman-Wiklund & Sundelin[18]
	5.5 (feet)	12 months	Music teachers	61	58.1	Sweden	1998	CS	Fjellman-Wiklund & Sundelin[18]
	13.9 (hips)	12 months	Music teachers	62	98.4	Sweden	1998	CS	Fjellman-Wiklund & Sundelin[18]
	8.3 (knees)	12 months	Music teachers	62	98.4	Sweden	1998	CS	Fjellman-Wiklund & Sundelin[18]
	5.5 (feet)	12 months	Music teachers	62	98.4	Sweden	1998	CS	Fjellman-Wiklund & Sundelin[18]
	33.0	NS	Preschool teachers	22	95.4	US	1995		Grant *et al*[11]

[a] Recall period (NS=Not Specified)
[b] Response rate of the study (*Total number of respondents listed as the response rate was not provided)
[c] Publication year
[d] Study design (CS=Cross sectional, CC=Case Control)

Neck and/or shoulder pain

Most studies have measured neck and shoulder pain separately as being ‘neck pain’ or ‘shoulder pain,’ although a few have combined them as ‘neck and/or shoulder pain’. In a study of secondary school teachers in Hong Kong, the life-long prevalence of neck pain has been reported at 69.3%, with a 12 month prevalence of 66.7%, and the prevalence after becoming a teacher being 59.7% [9]. Similar findings have been demonstrated in another Chinese study where secondary school teachers reported a life-long prevalence of neck pain as 68.2%, 64.4% for 12 months, and neck pain prevalence after becoming a teacher of 56.8% [6]. In a more recent Chinese study, school teachers reported a high neck pain prevalence rate of 68.9% for the previous month [14]. Parallels can be drawn to other studies where 59% of Swedish music teachers reported neck pain in the previous 12 months [19]. Furthermore, in a more recent study of Swedish music teachers, 47% reported having experienced neck pain in the previous 12 months [20]. Similar results have been reported in another study of Swedish music teachers [18] where 44.4% experienced neck pain. In other studies, 42.5% of Turkish school teachers reported having experienced neck pain [15]. In comparison, PETs reported the lowest neck pain prevalence rate of all, being 9.3% [16].

The highest shoulder pain prevalence (73.4%) for the previous month has been reported by Chinese school teachers [14], while in Turkey, 28.7% of school teachers had experienced MSD symptoms in the shoulder area [15]. Furthermore, the prevalence of shoulder pain varied greatly between 28% and 55% in studies of Swedish music teachers carried out between 1988 and 2009 [16, 18-20]. In Estonia, 7.8% of non-PETs and 18.6% of PETs reported pain on their shoulders [16]. In Japan, 25% to 35.4% of preschool teachers had experienced neck and/or shoulder pain in the previous month [21]. Comparable to these findings are the results of a US study in which 33% of preschool teachers reported neck and/or shoulder pain [11].

Upper limbs/extremities

Several studies have investigated MSD in the upper extremities such as the elbows, wrist, arm or hands. Upper limb pain was reported by 72% of Japanese teachers of physically and intellectually disabled pupils [22], and by 23.7% of Brazilian school teachers [3]. In a Chinese study of secondary school teachers, 35.8% reported life-long upper limb pain whilst 33.3% had experienced upper limb pain in the previous 12 months and 31.8% had experienced upper limb pain since becoming a teacher [9]. Elbow pain has been reported as a symptom, mainly by music teachers. From the Swedish studies carried out among music teachers, the prevalence of elbow pain ranged between 11.1% and 22.2%. Pain in the hand region has also been the most prevalent symptom among Swedish music teachers, ranging from 13% to 22.2% of the teachers surveyed [18-20]. Only 8% of school teachers in Turkey reported elbow pain [15], however, a total of 43.9% of primary and secondary school teachers in Hong Kong reported MSD in the arm during the previous month [14]. In contrast, 9.1% to 17.7% of Japanese preschool teachers reported having experienced arm pain, while 11% of US preschool teachers had experienced hand/wrist pain [11]. Wrist pain was a symptom reported by only 13% of the Turkish school teachers [15].

Back pain

Many studies examined in the current review had measured back pain in different ways. Most reported back pain in general, while comparatively fewer studies reported low back and upper back pain separately. For example, 63% of Greece PETs [23] and 52.4% of teachers in a special school for the severely handicapped had reported back pain [24]. Similar results were found in two studies conducted in Japan where, 45.7% of teachers for physically and mentally handicapped children [25] and 76.7% of teachers for physically and intellectually disabled pupils [22] reported higher prevalence rates of back pain. The prevalence of back pain among preschool teachers also varied greatly. In two separate studies of Japanese preschool teachers, 17.7% [26] and 43.3% [5] reported back pain, while a higher prevalence of 61% has been reported among US preschool teachers [11].

In the Philippines and Brazil, 53.3% of secondary school teachers [8], and 41.1% of primary and secondary school teachers [3] have reported back pain, respectively. Parallels can be drawn to other studies where 40.4% of Malay teachers [1] and 40% of Chinese primary school teachers also reported back pain [27] in the 12 months prior to the study. In France, 34.8% of school teachers had experienced back pain in the previous six months [28]. Conversely, only 20.6% of Japanese preschool school teachers had experienced back pain [5].

Lower back pain appears to be more prevalent than upper back pain among teachers. Supporting this hypothesis is a Turkish study which found that 43.8% of school teachers reported low back pain, compared to 36.9% of whom reported upper back pain [15]. Similar results have been demonstrated in a Chinese study where 59.2% teachers reported low back pain compared to 52.5% who reported upper back pain [14]. Furthermore, a number of Swedish studies conducted among music teachers have found similar trends [18-20]. It must be noted, however, that in Estonia, PETs reported a significantly lower prevalence of low back pain (4.7%), when compared to non-PETs (11.8%) [16].

Lower extremities

A few studies have investigated MSD of the lower extremities such as hips, legs, knees, ankles and/or feet among teachers. MSD in the lower extremities have been reported by 41.1% and 33% of Brazilian school teachers [3] and US preschool teachers [11], respectively. In China, 54.6% of school teachers reported having experienced leg pain during physical activity in the previous month [14]. In a recent Turkish study, lower extremity pain had been experienced by 8.4% of teachers in the hip area, 32% in the knees and 21.8% in the ankles [15]. In another study, 12% of Swedish music teachers reported hip pain, 16% knee pain and 9% foot pain in the previous 12 months [19]. In Estonia, 3.9% of non-PETs reported hip pain in the previous 12 months, whilst 2.3% of PETs reported hip pain over the same time period. In comparison, in the same Estonian study, only 7.8% of non-PETs reported knee pain whilst 14% of PETs reported experiencing knee pain [16]. The prevalence of pain in the lower extremities of teachers seems to be relatively low when compared to the prevalence of pain in the upper extremities and the back.

Risk factors

Individual factors

From the reviewed literature, it appears that the prevalence of MSD is positively associated with female gender. Supporting this hypothesis are the results of a Chinese study, where female teachers experienced neck pain ($p<0.001$) and upper limb pain ($p<0.001$) more frequently than their male colleagues [9]. Parallels can be drawn to the results of a Turkish study which reported that female teachers may be at higher risk of neck pain ($p=0.001$), upper back pain ($p=0.004$) and shoulder pain ($p=0.002$), when compared to their male counterparts [15]. In addition, it appears that Chinese female teachers have been more likely to report low back ($p<0.01$), neck ($p<0.001$), shoulder ($p<0.001$), upper back ($p<0.001$), arm pain ($p<0.001$) and leg pain ($p<0.001$) during physical activity [14].

Gender appears to be a significant factor when considering the issue of MSD among music teachers. This is supported by the findings of a Swedish study where female music teachers reported a significantly greater number of problems in the neck ($p=0.02$), upper back ($p=0.01$) and shoulder ($p=0.025$), when compared to male music teachers [20]. These results are in agreement with the findings of a study conducted among music teachers in Australia, where 45.9% of females and 33.8% of males reported MSD ($p<0.05$) [7]. In Sweden, female music teachers reported significantly more symptoms in the neck ($p=0.02$), the shoulders ($p=0.02$), the upper back ($p=0.00$) and the feet ($p=0.01$) [19] than their male colleagues. Contrary to these findings are the results of a Filipino study that did not document any significant gender differences between teachers with and without low back pain ($p>0.05$) [8].

Female gender has also been positively associated with the severity of MSD. A study from Turkey, for example, found that female teachers report more severe pain in the wrist ($p=0.044$), upper back ($p=0.008$) and lower back ($p=0.022$) regions [15]. Similar findings have been reported in a study of Chinese teachers, where female teachers experienced a higher severity of pain in the shoulder when compared to their male counterparts ($p<0.001$) [14].

Conflicting findings have been demonstrated in the relationship between age and MSD. In Brazil, teachers above 40 years of age were more likely to report lower limb pain (Odds Ratio [OR]:1.28, 95% CI:1.01-1.38), back pain (OR:1.20, 95% CI:1.07-1.35) and upper limb pain (OR:1.31, 95% CI:1.10-1.56) [3], while a study of Turkish teachers has found that teachers above 40 years of age were more likely to report MSD ($p<0.001$) [15]. In other studies, however, younger teachers have also been found to experience MSD. This has been demonstrated in the results of a Chinese study where the age group with the highest prevalence of neck pain was 31-35 years, with a significant difference among different age groups in the prevalence of neck pain ($p<0.001$). In the same study, the age groups with the highest prevalence of upper limb pain were 46-50 years and >50 years, with a significant difference among age groups in the prevalence of upper limb pain ($p<0.001$) [9]. In two other Chinese studies, teachers aged 30-39 years had experienced the most low back pain (OR: 1.30, 95% CI: 1.00-1.70) [27], while teachers aged 31-50 years had also reported experiencing upper back pain ($p<0.05$) [14].

Length of employment has been significantly associated with neck pain among Chinese secondary school teachers (OR: 1.11, 95% CI: 1.01-1.23) [6], and also with low back pain among Chinese teachers (OR: 1.80, 95% CI: 1.30-2.40) [29]. Among Brazilian teachers, length of employment has been significantly associated with lower limb (OR: 1.12, 95% CI: 1.01-1.19), back (OR: 1.15, 95% CI: 1.07-1.24) and upper limb pain (OR: 1.34, 95% CI: 1.19-1.50) [3]. In Japan, length of employment has been associated with pain in the neck/shoulders (OR: 1.37, 95% CI: 1.15-1.64) and arms (OR: 1.65, 95% CI: 1.30-2.08) in nursery school teachers [21].

Long working hours have also been significantly associated with MSD. A strong correlation has been reported between low back pain and Greek PETs who spent more than 35 hours per week teaching physical education ($p<0.05$) [23]. In Brazil, working more than 40 hours a week has been associated with pain in the upper and lower limbs ($p<0.05$) [3]. Having more than 30 students in a class has been positively associated with upper limb pain among Brazilian school teachers ($p<0.05$) [3]. Intensive physical activity in leisure time has been correlated with increased knee pain ($p<0.01$) among Estonian PETs [16].

Physical factors

In the US, reduced playing time, having smaller hands and lower strength levels have been associated with MSD among music teachers [17]. Kneeling, stooping, squatting and bending have been significantly associated with MSD among US [11] and Japanese preschool teachers [29]. Intense physical exertion (Prevalence ratio

(PR):1.29, 95% CI: 1.20-1.38) and inappropriate furniture (PR: 1.11, 95% CI: 1.03-1.19) have also been positively associated with back pain among Brazilian teachers [3]. High participation rates in lifting, especially when supporting students on gymnastics apparatus [30] and high participation in sports among Swedish PETs have been shown to be highly correlated with knee pain [31].

Psychosocial factors

Various studies have reported that poor psychosocial factors were potential risk factors for MSD. In a Chinese study of secondary school teachers, low colleague support (OR: 2.00, 95% CI: 1.16-3.47) and high workload (OR: 2.17, 95% CI: 1.58-2.97) have been significantly associated with neck pain [9]. Other studies have also demonstrated a significant association of psychosocial factors and MSD [5, 6, 21]. Furthermore, psychosocial factors such as mental health among Malay school teachers (OR: 1.11, 95% CI: 1.06-1.15) [1] and anxiety levels among Chinese teachers (OR: 1.49, 95% CI: 1.07-2.07) [9] have been associated with higher MSD prevalence rates.

Discussion

Assessment of MSD

Overall, this review suggests that while MSD is most likely an under researched topic among school teachers, teaching itself represents a high risk occupation for MSD. The findings of this literature review have been drawn from 33 papers, each of which had measured different musculoskeletal regions using different methods. As most studies had used self-developed questionnaires [3, 7, 15, 21-23, 26, 28], or the Standardized Nordic Questionnaire [1, 18, 27], it appears that these are commonly accepted methods for measuring the prevalence of MSD. Other methods used included pilot tested surveys and questionnaires such as the Northwick Neck Pain Questionnaire [6, 9], Health Questionnaires [25], Job Content questionnaires [5] and the Subjective Health Complaints Questionnaire [14]. While questionnaires are an inexpensive and convenient mode of data collection, they can introduce recall bias and make follow up difficult, especially when anonymous reporting is utilised. More accurate results might be obtained by physical examination and assessment, although these methods are expensive and time consuming, and therefore, ultimately uncommonly seen in the literature.

Response rate

The response rate among most of the studies examined in this review was acceptable, although one investigation reported a response rate of only 3.5% [17]. For this study, the participants had been recruited during a conference using a poster placed near the main conference rooms. Some conference attendees might not have seen the poster while others might have been too busy with the conference proceedings to participate, consequently leading to the low response rate.

Prevalence

The most prevalent body regions on which teachers reported MSD have been the back [1, 3, 5, 8, 14-16, 18-20, 22-28], neck [6, 9, 14, 15, 18-20] and upper limbs [3, 9, 14, 15, 18-20, 22]. It is important to note that while a number of studies have been carried out to specifically investigate back and neck pain, few studies have specifically looked at whole body MSD, and no studies have been carried out to specifically investigate lower extremity MSD. It is important, however, to note that the reported prevalence of back pain varied greatly across the literature, ranging from 4.7% to 76.7%.

Teachers of physically disabled pupils have reported the highest back pain prevalence [22] and this might be attributed to the lifting of the disabled pupils. On the other hand, PETs had reported the lowest back pain prevalence, and this may be because PETs are physically active and may also be involved in leisure-time physical activity [16]. However, the absence of personal training in order to maintain physical fitness among PETs could contribute to low back pain [23]. PETs have been reported to have a higher prevalence of knee disorders than non-PETs and were more likely to change work due to knee dysfunction [31].

Individual factors

MSD among school teachers has been positively associated with female gender in a number of studies. It has been suggested that women might be more likely to report pain than men because women have lower physical strength, pressure from family and career prospects; or simply the fact that men and women have different traditions and thresholds for when and how they report pain [14]. While MSD has been positively associated with length of employment, research findings are somewhat inconsistent with some studies reporting longer length of employment as being positively associated with MSD, while others have reported that new teachers are more likely to report MSD. It has also been reported that the longer the exposure time to occupational risk factors, the higher the possibility of incurring job-related disorders [9]. This association can be interpreted as the effect of aging or a cumulative effect of workload on the musculoskeletal system of workers [21]. Where teachers with lesser teaching experience had reported MSD, it has been suggested that this may occur because new teachers might not be adapting well to the new working environment, and that physical and psychological stress might be affecting the wellbeing of their musculoskeletal conditions [9]. Further studies will be needed to investigate such a hypothesis.

Physical factors

The use of a 'head down' posture has been significantly associated with neck pain (OR: 2.17, 95% CI: 1.38-2.74) and this may impact on teachers who spend considerable time correcting students' work [9] and preparing for lessons. Neck pain among teachers has been positively correlated with computer processing posture [9]. It has been hypothesised that working with a 'poking chin' posture during computer processing might induce considerable load on the posterior, leading to increased loading on non-contractile structures and posterior cervical structures, thereby resulting in neck pain [9].

Psychosocial factors

Psychosocial factors have been positively associated with MSD among school teachers, and the current review suggests that psychosocial factors such as high workload/demands, high perceived stress levels, low social support, low job control, low job satisfaction and monotonous work are most likely associated with MSD among school teachers [1, 5, 6, 9, 21]. This may occur because teachers often work in stressful conditions with large classes, a lack of educational resources, and limited reward for their work [3].

Limitations

A number of limitations were identified in this review. Recall bias and self-reporting can be considered as limitations for a number of studies, given that many used anonymous survey for data collection [3, 7-9, 15, 19, 20, 25, 27, 28, 32, 33]. Cause and effect inferences cannot be ascertained, however, given that a number of studies used a cross-sectional study design [3, 7-9, 19, 27]. Sample sizes and response rates were suboptimal in some studies [14, 17, 18]. Additionally, it must be noted that the review considered articles that were written in English only.

Conclusion

This literature review clearly suggests that school teachers are at risk for developing MSD. The prevalence among them is not uniform, however. Music teachers for example, have been known to retire before their retirement age due to MSD, while primary and secondary school teachers appear to be more prone to neck, shoulder and back pain. Further studies, preferably longitudinal, are required to more thoroughly investigate the issue of MSD among school teachers, with a greater emphasis on ergonomic factors. This would represent a major step forward in prevention of MSD among teachers, especially if easy to implement control measures could be recommended.

Competing interests

The authors declare no competing interests.

Authors' contributions

PNE conceived and designed the study and carried out data collection and analysis. PNE and DRS read and approved the final manuscript.

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Paper 2

Musculoskeletal disorder risk factors in the teaching profession: a critical review

Introduction to Paper 2

As identified in Paper 1, it appears that few studies have been conducted to investigate musculoskeletal disorders (MSD) among teachers. The majority of research included in the review had used anonymous self-administered questionnaires for data collection with few studies employing qualitative research design. Anonymous self-administered questionnaires can result in recall bias and make follow-up impossible. Cause and effect inferences cannot be ascertained given that a number of studies used cross-sectional study design. Few studies were identified that investigated the issue of whole body MSD among teachers.

Paper 2 aimed to identify risk factors associated with the development and progression of MSD specifically for primary and secondary school teachers. The paper also aimed to identify from the literature, MSD protective factors. To do so a critical review of literature investigating factors associated with MSD among school teachers was conducted. In order to add significantly to the body of knowledge in this area and to build a base for other parts of this thesis, published papers investigating MSD among primary and secondary school teachers including music and physical education teachers were included in the review. Nursery school teachers, teachers of physically and mentally handicapped children and university teaching staff were excluded. This review included some of the papers included in Paper 1 and those published after publication of Paper 1.

Musculoskeletal disorder risk factors in the teaching profession: a critical review

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Abstract

Introduction

Musculoskeletal disorders (MSD) have been recognized as a considerable problem in the teaching profession and various risk factors have also been documented. The aim of this review was to review and discuss MSD risk factors among teachers.

Discussion

Individual factors such as female gender, age and teaching experience have been positively correlated with MSD in a number of studies. Poor posture, inappropriate furniture, lifting and carrying have also been associated with a high prevalence of MSD. Psychosocial factors such as poor colleagues and supervisor support, low job satisfaction and high job stress are known to be associated with MSD. On the other hand, regular physical exercise has been shown to be a protective factor in some studies.

Conclusion

Given the high burden of MSD documented in the teaching profession, further studies are now required to develop and implement effective intervention strategies to help reduce, and ultimately prevent, these conditions.

Introduction

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. It has been suggested that the prevalence of self-reported MSD among teachers ranges between 39% and 95%[1]. The work of a teacher does not only involve teaching students but also preparing lessons, assessing students' work and also being involved in extracurricular activities such as sports. Teachers also participate in different school committees. Teachers are essential for the effective functioning of the education system and for improving the quality of learning processes[1,2]. In some areas, teaching is done under unfavourable circumstances, in which teachers must mobilize their physical, cognitive and affective capability to reach a teaching production objective, over demanding or generating effort to their psycho-physiology functions. If there is insufficient time for recovery, pain symptoms may be triggered or prompted. As a result, this may lead to stress, with consequences to physical and mental health and impact on professional performance[3].

Several work-related factors have been correlated with to the development of MSD in the teaching profession. These factors include high workload, for example, excessive paperwork, class preparation and students' evaluation, lack of communication in the workplace, excessive demands from colleagues and supervisors. Work postures have also been related to MSD in the teaching profession[4]. In recent times, psychosocial factors have also emerged as potential risk factors for MSD. Despite their large demographic and the associated potential for occupational health problems, few studies have investigated MSD risk factors among teachers. An investigation of risk factors of MSD in the teaching profession is important for appropriate preventative and management strategies to be put in place.

The aim of this review was to critically analyse the literature and report on the possible associated risk and protective factors among teachers. The review focused on primary and secondary teachers including music and physical education teachers; and aimed to identify all articles that reported MSD risk factors among teachers. Nursery schools and tertiary institutions were excluded from the review. Empirical research in peer-reviewed English journals was included in the review, whereas letters to the Editor, conference proceedings and literature reviews were excluded.

Discussion

The authors have referenced some of their own studies in this review. These studies have been conducted in accordance with the Declaration of Helsinki (1964) and the protocols of these studies have been approved by the relevant ethics committees related to the institution in which they were performed. All human subjects, in referenced studies, gave informed consent to participate in these studies.

MSD is the result of the interaction between an affected person and a host of risk factors including those that are personal, physical and psychosocial in nature. The most notable risk factors among teachers include gender, age, smoking, weekly working hours, length of employment and awkward posture. Table 2 shows the risk factors that have been identified in this review.

Individual factors

Various studies suggest that the prevalence of MSD is often positively associated with the female gender. Females, representing a higher proportion of teachers often have a higher prevalence of MSD. This has been supported by findings from a number of studies where female teachers reported neck pain[2,5,-11], shoulder pain[2,5,10,11], upper limb pain[2,3,8,12], back pain[2,3,5,7,10,11,13], and lower limb pain[2,3,7,14] more often than their male counterparts. In one study from Ethiopia, for example, this difference has been attributed to the nutritional status of females as they were seen to have been obese than males[13]. Another possible reason was that males were found to be involved in regular physical exercise more often than females[5,13]. However, in a study involving Chinese teachers, females might be suffering more emotional exhaustion compared with men because male teachers had a higher body mass index, longer employment than females, a significant higher proportion of smokers and often worked for more than 40 hours a week. This study also found that women bore more heavy housework responsibilities than men in daily life. Differences in household task participation may also explain musculoskeletal differences between men and women[6].

In a study from Brazil, female school teachers were reported to have a higher MSD prevalence rate due to their working conditions. It was reported that although the majority of teachers are females, they are less qualified with low salaries, high work demands and have less control over their work than their male counterparts[3]. Among female music teachers, it is suggested that they suffer from MSD more often than their male colleagues because they are of a slighter build with less muscle power and thus need greater effort when playing. There are, however, other factors that should also be taken into consideration such as individual differences, anatomic variations, size, flexibility, and relationship to the instrument[15]. In addition, women may be more likely to report any pain problem than men as women tended to have a lower pain threshold than men. It has also been suggested that women are more likely to report pain than men because of pressure from family and career endeavours or simply because men and women have different traditions and thresholds for when and how to report pain[2]. It is concerning that results which show that female teachers are at an increased risk of MSD as the teaching profession is predominately female.

While MSD has been positively associated with age, research findings are somewhat inconsistent with some studies reporting increasing age as being associated with MSD, whereas others have reported that younger teachers are more likely to report MSD. A number of studies have reported a positive association between increasing age and the development of MSD. These studies found that teachers aged 40 years or over were more likely to report MSD of different body sites[3,7,8,11,16]. However, some studies have found that younger teachers have also reported MSD. Supporting this are the results of some Chinese studies where teachers aged 30 to 39 years reported the highest lower back pain prevalence[17] and where teachers aged 31 to 35 years reported the highest neck pain prevalence[8].

Table 2: Risk factors associated with musculoskeletal disorders of the body site

Symptom	Factor	Participants	OR *	95%CI #	*p*-value	Author
Neck pain	Female gender	School teachers	1.54	1.03-2.31		Baskurt et al[7]
		Primary, secondary and high school teachers			<0.0001	Korkmaz[11]
		Primary and secondary school teachers			0.001	Chong & Chan[2]
		Music teachers			0.020	Edling[10]
		Secondary school teachers	2.39	1.97-2.91	0.001	Chiu & Lam[8]
		Secondary school teachers	2.01	1.26-3.20	0.003	Chiu *et al*[9]
		Music teachers			0.02	Fjellman-Wiklund *et al*[14]
	Age (increasing)	Secondary school teachers	3.01	2.08-4.37	0.0001	Chiu & Lam[8]
	Teaching experience (increasing)	Secondary school teachers			0.0001	Chiu & Lam[8]
		Secondary school teachers	1.11	1.01-1.23	0.004	Chiu *et al*[9]
		School teachers	2.70	1.63-4.47		Baskurt et al[7]
	Teaching level (primary school)	Primary and secondary school teachers			0.01	Chong & Chan[2]
	Working in head down posture – average length of time > 4hours	Secondary school teachers	2.17	1.38-2.74	0.0001	Chiu & Lam[8]
	Working in head down posture with maximal sustained time between 15-30 minutes	Secondary school teachers	1.72	1.16-2.53		Chiu & Lam[8]
	Working in head down posture with maximal sustained time between 1 and 2 hours	Secondary school teachers	1.70	1.14-2.53		Chiu & Lam[8]
	Taking no breaks during work	Secondary school teachers	1.36	1.03-1.82		Chiu & Lam[8]
	Taking breaks after 3 hours of working	Secondary school teachers	1.37	1.07-1.44		Chiu & Lam[8]
	Low physical activity in leisure time among non-PETs	Non physical education teachers			0.01	Pihl *et al*[24]
	Intensive physical activity in leisure time among PETs	Physical education teachers			0.05	Pihl *et al*[24]

	Maximal time of sustained computer work	Secondary school teachers	1.69	1.33-2.16	<0.001	Chiu *et al*[9]
	Physical activity	School teachers			<0.05	Durmus & Ilhanli[5]
	High workload	Secondary school teachers	2.17	1.58-2.97		Chiu & Lam[8]
		Secondary school teachers	1.72	1.12-2.65	0.013	Chiu *et al*[9]
	Very low colleague support	Secondary school teachers	2.00	1.16-3.47		Chiu & Lam[8]
		Secondary school teachers	1.73	1.36-2.20	<0.001	Chiu *et al*[9]
	High anxiety	Secondary school teachers	1.49	1.07-2.07		Chiu & Lam[8]
	High job stress	Secondary school teachers	1.97	1.45-2.70	<0.001	Chiu *et al*[9]
	Low job satisfaction	Secondary school teachers	1.30	1.04-1.63	0.020	Chiu *et al*[9]
Shoulder pain	Female gender	Music teachers			0.025	Edling[10]
		Primary, secondary and high school teachers			0.002	Korkmaz[11]
		Music teachers			0.02	Fjellman-Wiklund *et al*[14]
		Primary and secondary school teachers			0.001	Chong & Chan[2]
	Teaching experience (1-15)	Primary and secondary school teachers			0.001	Chong & Chan[2]
	Teaching level (primary school)	Primary and secondary school teachers			0.001	Chong & Chan[2]
Neck/shoulder pain	Female gender	School teachers	1.84	1.25-2.71		Yue *et al*[6]
	Teaching at high school compared to Primary and secondary schools	School teachers	2.35	1.43-3.84		Yue *et al*[6]
	Prolonged standing	School teachers	1.74	1.03-2.95		Yue *et al*[6]
	Prolonged sitting	School teachers	1.76	1.23-2.52		Yue *et al*[6]
	Prolonged static posture	School teachers	2.25	1.56-3.24		Yue *et al*[6]
	Uncomfortable back support	School teachers	1.77	1.32-2.55		Yue *et al*[6]
	Perceived health (worse than others) - (female music teachers only)	Music teachers	3.6	1.1-13.8		Fjellman-Wiklund *et al*[14]
	Physical exercise during leisure time - (female music teachers	Music teachers	3.3	1.1-9.6		Fjellman-Wiklund *et al*[14]

	only)					
	Teaching at many schools per week (more than 4 per week) - (female music teachers only)	Music teachers	2.7	1.1-6.8		Fjellman-Wiklund *et al*[14]
	Lifting instruments and music equipment (>6 times per day) – Male music teachers only	Music teachers	4.2	1.6-10.7		Fjellman-Wiklund *et al*[14]
	Playing guitar as a main instrument – Male music teachers only	Music teachers	3.2	1.2-8.1		Fjellman-Wiklund *et al*[14]
	High psychological demands (female teachers only)	Music teachers	6.0	1.1-32,4		Fjellman-Wiklund *et al*[14]
	Low social support (male teachers only)	Music teachers	3.1	1.0-9.7		Fjellman-Wiklund *et al*[14]
Upper extremities						
Arm pain	Female gender	Primary and secondary school teachers			0.001	Chong & Chan[2]
	Teaching level (primary school)	Primary and secondary school teachers			0.001	Chong & Chan[2]
Elbow pain	Female gender	Physical education teachers	1.60	1.10-2.30		Sandmark[12]
Wrist pain	Using computer per day	School teachers			<0.05	Durmus & Ilhanli[5]
Upper limbs pain	Female gender	Secondary school teachers	1.89	1.54-2.33	0.001	Chiu & Lam[8]
		School teachers	1.74	1.18-2.56		Baskurt *et al*[7]
		Primary and secondary school teachers	1.59[a]	1.22-2.07	<0.001	Cardoso *et al*[3]
	Age (increasing)	Secondary school teachers	3.80	2.33-6.21	0.0001	Chiu & Lam[8]
		Primary and secondary school teachers	1.31[a]	1.10 – 1.56	0.01	Cardoso *et al*[3]
	Teaching experience (21-25 years)	Secondary school teachers			0.0001	Chiu & Lam[8]
	Teaching experience (increasing)	Primary and secondary school teachers	1.39[a]	1.39-1.59	<0.001	Cardoso *et al*[3]
	Time working at school (>5years)	Primary and secondary school teachers	1.34[a]	1.19 – 1.50	0.001	Cardoso *et al*[3]

	Number of students per class (>30 students)	Primary and secondary school teachers	1.14[a]	1.02-1.28	0.05	Cardoso *et al*(3)
	Weekly schedule (40 hours)	Primary and secondary school teachers	1.12[a]	1.01-1.26	0.05	Cardoso *et al*(3)
	Intense physical activity	Primary and secondary school teachers	1.42[a]	1.27-1.59	0.001	Cardoso *et al*(3)
	Working in head down posture – average length of time > 2.5 – 5.5 hours	Secondary school teachers	1.91	1.20-3.04	0.0001	Chiu & Lam(8)
	Working in head down posture – average length of time > 4hours	Secondary school teachers	2.17	1.38-2.74	0.0001	Chiu & Lam(8)
	Working in head down posture with maximal sustained time between 1 and 2 hours	Secondary school teachers	1.72	1.07-2.75		Chiu & Lam(8)
	High workload	Secondary school teachers	2.07	1.41-3.04		Chiu & Lam(8)
	Very low colleague support	Secondary school teachers	2.15	1.32-3.50		Chiu & Lam(8)
	High anxiety	Secondary school teachers	1.75	1.28-2.39		Chiu & Lam(8)
	Smoking	School teachers	1.49	1.01-2.63		Baskurt *et al*(7)
Back pain	Female gender	Music teachers			0.02	Fjellman-Wiklund *et al*(14)
		Primary and secondary school teachers	1.58[a]	1.31-1.90	<0.001	Cardoso *et al*(3)
	Age (30-39 years)	School teachers	1.30	1.00-1.70		Jin(17)
	Age (increasing)	Primary and secondary school teachers	1.20[a]	1.07-1.35	<0.01	Cardoso *et al*(3)
	Teaching experience (increasing)	Primary and secondary school teachers	1.20	1.09-1.59)	<0.001	Cardoso *et al*(3)
		School teachers	1.80	1.3-2.4		Jin(17)
	Teaching at high school compared to Primary and secondary schools	School teachers	2.01	1.24-3.27		Yue *et al*(6)
	Prolonged sitting	School teachers	1.42	1.01-2.02		Yue *et al*(6)
	Prolonged static posture	School teachers	1.60	1.11-2.31		Yue *et al*(6)
	Posture characterised by twisting	School teachers	1.93	1.30-2.87		Yue *et al*(6)

	Uncomfortable back support	School teachers	1.62	1.13-2.32		Yue *et al*[6]
	Time working at school (>5years)	Primary and secondary school teachers	1.15[a]	1.07-1.24	<0.001	Cardoso *et al*[3]
	Physical activity	School teachers	1.71	1.09-2.68	<0.05	Durmus & Ilhanli[5]
	Intense physical activity	Primary and secondary school teachers	1.29[a]	1.20-1.38	<0.001	Cardoso *et al*[3]
	Inappropriate furniture	Primary and secondary school teachers	1.11[a]	1.03-1.19	<0.001	Cardoso *et al*[3]
Upper back pain	Female gender	Primary, secondary and high school teachers			0.004	Korkmaz[11]
		Primary and secondary school teachers			0.001	Chong & Chan[2]
		Music teachers			0.01	Edling[10]
		Music teachers			0.00	Fjellman-Wiklund *et al*[14]
	Age (31-50)	Primary and secondary school teachers			0.05	Chong & Chan[2]
Low back pain	Female gender	Primary and secondary school teachers			0.01	Chong & Chan[2]
		School teachers	2.50	1.67-3.72		Baskurt *et al*[7]
		School teachers	3.23	2.10-5.26	0.001	Beyen *et al*[13]
	Age (years)	School teachers			<0.0001	Durmus & Ilhanli[5]
		School teachers	2,34	1.34-4.07	0.008	Beyen *et al*[13]
	Working hours per day (5-6 hours/day)	Secondary school teachers	1.88			Atlas *et al*[22]
	Working hours per day (7-8 hours/day)	Secondary school teachers	2.5			Atlas *et al*[22]
	Teaching experience ≥10 years	School teachers	2.78	1.71-4.56		Baskurt *et al*[7]
	Previous injury	School teachers	1.96	1.04-3.69	0.037	Beyen *et al*[13]
	Working time >35 hours/week	Physical education teachers			<0.05	Stergioulas[25]
	Poor mental health status	Primary school teachers	1.11	1.06-1.15	0.001	Samad *et al*[19]
	Stress	Secondary school teachers	4.15			Atlas *et al*[22]
		School teachers	2.18	1.36-3.50		Beyen *et al*[13]
	Helping students into flexing	Physical education teachers	3.0	1.1 – 7.2	<0.05	Stergioulas[25]

	posture					
	Lifting gym instruments	Physical education teachers	2.6	1.2 – 5.8	<0.05	Stergioulas[25]
	No personal training	Physical education teachers	2.5	1.2 – 5.3	<0.05	Stergioulas[25]
	Smoking	School teachers	2.65	1.11-6.32	0.028	Beyen *et al*[13]
Lower limb pain						
Leg pain	Female gender	Primary and secondary school teachers			0.001	Chong & Chan[2]
	Teaching level (primary school)	Primary and secondary school teachers			0.001	Chong & Chan[2]
Lower limb pain	Female gender	Primary and secondary school teachers	1.98[a]	1.57-2.38	<0.001	Cardoso *et al*[3]
		Primary and secondary school teachers	1.28[a]	1.01-1.38	<0.001	Cardoso *et al*[3]
	Age (≥40 years)	School teachers	2.75	1.70-4.44		Baskurt *et al*[7]
	Teaching experience (increasing)	Primary and secondary school teachers	1.14[a]	1.04-1.24	<0.01	Cardoso *et al*[3]
	Time working at school (>5years)	Primary and secondary school teachers	1.12[a]	1.03-1.19	<0.01	Cardoso *et al*[3]
	Weekly schedule (40 hours)	Primary and secondary school teachers	1.09[a]	1.01-1.18	<0.05	Cardoso *et al*[3]
	Weekly working hours ≥25 hours	School teachers	2.06	1.43-3.17		Baskurt *et al*[7]
	Intense physical activity	Primary and secondary school teachers	1.42[a]	1.32-1.52	<0.001	Cardoso *et al*[3]
	Smoking	School teachers	1.71	1.12-2.63		Baskurt *et al*[7]
Feet	Female gender	Music teachers			0.01	Fjellman-Wiklund *et al*[14]
Knee pain	Body mass index	School teachers	1.09	1.02-1.16	<0.01	Durmus & Ilhanli[5]
	Intensive physical activity in	Physical education teachers			<0.01	Pihl *et al*[24]

	leisure time					
Any	Female gender	Primary and secondary school teachers			0.001	Chong & Chan[2]
		Music teachers			<0.05	Allsop & Ackland[16]
	Age	Female secondary school teachers			0.002	Darwish *et al*[23]
	Teaching level (primary school)	Primary and secondary school teachers			0.001	Chong & Chan[2]
	Teaching experience (1-15[23])	Primary and secondary school teachers			0.005	Chong & Chan[2]
	Teaching experience	Female secondary school teachers			0.003	Darwish *et al*[23]
	Not doing exercise regularly	Primary, secondary and high school teachers			0.000	Korkmaz[11]
	Warm-up before practice	Music teachers			<0.05	Yoshimura *et al*[26]
	Physical warm-up time spent	Music teachers			<0.01	Yoshimura *et al*[26]
	Years of playing (increasing)	Music teachers			<0.05	Allsop & Ackland[16]
	Practice hours (increasing)	Music teachers			<0.05	Allsop & Ackland[16]
	Age (increasing)	Music teachers			<0.01	Allsop & Ackland[16]
	Using elevated shoulder posture when playing	Music teachers			<0.05	Allsop & Ackland[16]
	Using neutral wrist posture	Music teachers			<0.01	Allsop & Ackland[16]
	Taking 2 or more breaks during practice session	Music teachers			<0.05	Allsop & Ackland[16]

* Odds ratio. # Confidence Intervals. a Prevalence ratio

It has been suggested that the likely reason for a higher prevalence of MSD among older teachers is that as people age, there is a gradual decline in muscle mass and they lose connective tissue elasticity and undergo a thinning of the cartilage between joints. However, tissue healing also declines with advancing age whilst the body is simultaneously dealing with a lifetime of accumulated soft tissue damage[3,11,18]. Apart from natural wear and tear on the body, MSD among older teachers may also be influenced by work environment and the organisation of work[3]. It has been suggested that older teachers generally have reduced physical capabilities and slower physiological response when compared with their young colleagues[19]. In cases where younger teachers reported symptoms of MSD, it has been suggested that younger teachers face greater work demands thereby being exposed to more risk factors as they take more activities and tasks at the beginning of their careers[3].

Contradicting findings have been reported in the relationship between length of employment and the development of MSD. In some studies, longer length of employment has been associated with neck pain[7-9] and lower back[3,5,7]. However, conflicting findings were found in a Chinese study where the prevalence of shoulder pain was significantly higher for teachers with 1 to 15 years of teaching experience ($p < 0.005$) while those with 16 to 20 years teaching experience reported lower prevalence ($p < 0.001$)[2]. It has been suggested that the longer the exposure time to occupational risk factors, the higher the chance of getting job-related disorders[20]. This association may also be interpreted as an effect of aging or a cumulative effect of workloads on the musculoskeletal system of the workers[21]. Where teachers with lesser teaching experience have reported MSD, it has been suggested that may occur because new teachers may not be adapting well to the new working environment and physical and psychological stress might affect the wellbeing of their musculoskeletal conditions[8]. For new female teachers reporting MSD, it has been suggested that marriage and child care may be contributing factors[11]. Long working hours have also been positively associated with MSD in various studies[7,22,23].

Long weekly working hours expose teachers to factors such as prolonged standing, prolonged sitting or awkward posture all of which have been associated with back pain[22]. A number of other individual factors have also been correlated with MSD. In a Chinese study, for example, primary school teachers were more likely to experience neck pain ($p < 0.01$), shoulder pain ($p < 0.001$), leg pain during physical activity ($p < 0.001$) and arm pain ($p < 0.001$) than secondary school teachers[2]. Having more than 30 students in a class has been associated with upper limb pain (PR: 1.14, 95% CI: 1.02-1.28), while working at the same school for more than 5 years has been associated with lower limbs (PR: 1.12, 95% CI: 1.03-1.19), upper limbs (PR: 1.34, 95% CI: 1.19-1.50) and back pain (PR: 1.15, 95% CI: 1.07-1.24) among Brazilian school teachers[3]. In another Chinese study, taking no breaks during work (OR: 1.36, 95% CI: 1.02-1.82) and taking breaks after 3 or more hours of working (OR: 1.37, 95% CI: 1.07-1.75) were been associated with neck pain among school teachers[8]. Similarly, lack of exercise was significantly associated with MSD among school teachers in Turkey ($p = 0.000$)[11], whereas low physical activity in leisure time has been significantly correlated with neck pain among non-PE teachers in Estonia ($p = 0.01$)[24]. In addition, no personal training has been associated with increased risk for lower back pain among PE teachers (OR: 2.5, 95% CI: 1.2-5.3)[25].

Furthermore, perceiving one's health worse than others (OR: 3.6, 95% CI: 1.10-13.6), physical exercise during leisure time (OR: 3.3, 95% CI: 1.10-9.60) and teaching at many schools more than 4 times per week (OR: 2.7, 95% CI: 1.10-6.8) have been significantly associated with neck/shoulder pain among female music teachers in Sweden[14]. Warm-up before practice has been associated with pain after playing piano ($p < 0.01$), while physical warm-up time spent has been associated with pain when playing ($p < 0.05$) and pain after playing ($p < 0.01$) among U.S. piano teachers[26]. In addition, other individual factors such as previous injury[13], smoking[7,13,19] body mass index[5], number of children[3,23] [and teaching at high school compared with primary or secondary school[6] have also been positively associated with the development of MSD.

Physical factors

The known high prevalence of MSD among school teachers may be due to physical factors at work. This review has found that lifting heavy loads has been reported as a risk factor for shoulder, back and elbow pain among Turkish teachers[5]. In China, prolonged sitting and static posture and uncomfortable back support have been positively associated with neck/shoulder and lower back pain among teachers. Posture characterised by twisting has also been associated with development of lower back pain, whereas prolonged standing has been closely associated with neck/shoulder pain[6]. In another Chinese study, working with a 'head down' posture for more than 4 hours has been found to contribute to the development of neck pain among school teachers[8]. Among Swedish music teachers, lifting instruments and music equipment more than six times a day has been correlated with neck/shoulder pain[14]. In Brazil, intense physical activity and inappropriate furniture have been associated with back pain among teachers[3]. Helping students into flexing posture and lifting instruments among Greek school teachers has been shown to be highly correlated to lower back pain[25].

Psychosocial factors

There is increasing evidence for an association between psychosocial factors and MSD among teachers. Poor mental health status has been significantly associated with lower back pain among Malay primary school teachers ($p < 0.001$)[19], while stress significantly increased the risk of back pain among Filipino teachers by approximately four fold[22]. In a Chinese study of secondary school teachers, low colleague support, high anxiety, and high workload were significantly associated with neck pain. In the same study, high workload, very low colleague support and high anxiety were positively correlated with upper limb pain[8]. In addition, another study of Chinese secondary school teachers found a positive association between high workload, low colleague support, high job stress, low job satisfaction and neck pain[9]. Having stress among Ethiopian teachers was found to be a risk factor for lower back pain[13]. These associations may occur because teachers work in stressful conditions with large classes, lack of educational resources and limited reward for their work[3]. It has been reported that, the more psychological demands needed for a certain task, the greater the possibility to develop MSD regardless of the anatomical area[13].

Protective factors

Table 3 describes factors that have been negatively correlated with MSD, that is, protective factors. Physical exercise for 7 or more hours a week, for example, has been found to have a protective role against neck/shoulder pain in one study[6]. Regular physical exercise was also found to be a protective factor for lower back pain[13] neck and upper extremities[7]. It has been suggested that physical exercise may prevent lower back pain recurrences or chronicity. There is also strong evidence that endurance training including running, swimming, cycling or aerobic training might help prevent lower back pain. Interestingly, teachers aged 40 or above were found to be less likely to report neck and lower back pain in a study of Turkish teachers[7]. Another interesting finding was reported in a study of Turkish teachers, where body mass index was found to have a slight protective role for back pain. It has been suggested that this finding could be due to the tendency of people with higher body mass index to avoid prolonged standing and exertional activities. Medium job satisfaction was found to be protective factors against back pain among Chinese school teachers[17]. Having another paid activity acted as a protective factor against upper and lower limbs pain among Brazilian teachers[3]. Having own office and satisfaction with working environment and culture were negatively correlated to lower back pain among Ethiopian teachers[13].

Table 3: Protective factors for musculoskeletal disorders by body site

	Factor	OR*	95% CI[#]	*p* value	Author
Neck	Regular physical exercise	0.35	0.22–0.56		Baskurt et al.[7]
	Age (≥40 years)	0.55	0.37–0.83		Baskurt et al.[7]
Neck/shoulder	Physical exercise per week ≥ 7 hours	0.55	0.35–0.85		Yue et al.[6]
Back pain	Regular physical exercise	0.52	0.34–0.82	0.004	Beyen et al.[13]
	Age (≥40 years)	0.66	0.44–0.99		Baskurt et al.[7]
	Satisfaction with working environment and culture	0.55	0.36–0.86	0.009	Beyen et al.[13]
Upper extremities	Regular physical exercise	0.51	0.33–0.76		Baskurt et al.[7]
	Having other paid activity	0.81	0.66–0.99[a]		Cardoso et al.[3]
Lower extremities	Having other paid activity	0.86	0.76–0.99[a]		Cardoso et al.[3]

[*]Odds ratio.

[#]Confidence intervals.

[a]Prevalence ratio.

Conclusion

An increasing body of evidence suggests a strong correlation between MSD and individual, physical and psychosocial factors in teaching. Individual factors such as gender, age, length of employment, working hours, smoking and body mass index are known to be associated with MSD. Among the physical factors, lifting heavy loads, prolonged sitting or standing, awkward postures and inappropriate furniture have been shown to be significant risk factors. Psychosocial risk factors have included poor mental health, low colleague support, high anxiety and low job satisfaction. Undertaking regular exercise, medium job satisfaction and satisfaction with working environment and culture have been found to contribute to reduction of MSD among teachers. This review has also identified some potential protective factors for MSD. As such, there is need to develop and implement effective intervention strategies that are aimed at curbing the development of MSD within the education profession. Appropriate intervention strategies may include ergonomically designed workplaces, proper equipment and training and reasonable job demands and workload, among others.

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Paper 3

The prevalence and risk factors for musculoskeletal disorders among school teachers in Botswana

Introduction to Paper 3

As identified in Papers 1 and 2, despite their large demographic around the world and their potential exposure to development of MSD, few studies have investigated MSD among teachers and very limited research is available on any intervention and preventive measures. This is a concern given, that teachers present an occupational health group among which there appears to be a high prevalence of MSD. If appropriate intervention and preventative strategies are to be introduced to curb MSD among school teachers, it is important to have a clear understanding of possible risk and protective factors for these disorders in this study population.

Paper 3 aimed to investigate the prevalence, risk factors and impacts of MSD among school teachers in Botswana. To improve upon previous research, this study investigated the issue of whole body MSD among school teachers in Botswana. It was also determined that a quantitative research design with a cross-sectional survey approach employing the use of self-administered questionnaires would be appropriate way to achieve the aims of the study. This approach allows the research to establish the extent and distribution of MSD and factors associated with MSD and the impact of these disorders among school teachers in Botswana. This approach also pragmatically, allowed for data to be collected from a large, geographically dispersed population. It improves upon previous research and contributes significantly to the overall body of knowledge regarding the prevalence and distribution of MSD, risk and protective factors for MSD and the impact of these disorders among school teachers in Botswana, as it appears to be one of the first to investigate these disorders in the Botswana work context.

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 any body 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 than 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 may 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 4.

Table 4: Descriptive statistics of individual, life style and work characteristics among male and female teachers in Botswana

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	53.0	
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	33.0	35.9	
Number of children less than				0.210

6 years old				
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	66.0	57.9	
Junior secondary	46.4	27.0	32.3	
Senior secondary	17.4	7.0	9.8	
Work hours per week (>40 hours)	14.6	12.0	12.7	0.166
Number of students (>40)	11.4	9.5	10.0	**<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 $p<0.05$

MSD Prevalence

As shown on Table 5, 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%).

Table 5: Prevalence of MSD in the previous 12 months among teachers in Botswana

Body region	**Prevalence (%)**
Any body 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 6 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 ≥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.

Table 6: The 12-month prevalence of MSD among teachers in Botswana in relation to individual and lifestyle factors

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	57.0	14.0	31.8	19.0	34.8	39.5
p-value	**0.021**	**<0.001**	**<0.001**	0.193	0.115	0.148	0.164	**0.019**
Age (years)								
≤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	32.0	21.5	41.7	44.0
>50	56.4	61.3	52.1	19.6	35.6	27.0	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
≥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	49.0	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 old								
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	29.0
p-value	0.437	0.411	0.834	**0.021**	0.511	0.888	0.568	0.696
Previous injury								

No	48.0	50.5	49.4	12.2	28.5	16.2	30.3	32.9
Yes	89.7	88.2	91.6	48.1	65.0	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	11.0	29.7	23.1	31.9	35.2
Never smoked	51.3	53.4	53.4	13.4	31.0	17.8	34.1	38.2
p-value	0.071	**0.039**	0.051	0.788	0.448	0.363	0.634	0.570
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	25.0	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 $p<0.05$

As shown on Table 7, 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.

Table 7: The 12-month prevalence of MSD among teachers in Botswana in relation to work-related factors

Variable	**% neck MSD**	**% shoulder MSD**	**% upper back MSD**	**% elbow MSD**	**% wrist/ hand MSD**	**% hip/ thigh MSD**	**% knee MSD**	**% ankle/ feet MSD**
School level								
Primary school	55.0	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	29.0	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
11-20	52.5	53.2	51.1	14.5	27.8	19.0	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	60.0	14.5	31.4	21.4	36.4	45.5
p-value	0.265	0.393	**0.023**	0.627	0.885	0.225	0.440	**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	19.0	39.1	41.1
31-35	54.8	56.2	55.6	14.0	32.0	20.2	33.1	39.0
36-40	50.2	52.6	52.5	14.1	29.8	19.2	33.3	36.6
>40	46.0	51.1	48.9	4.6	28.7	12.6	32.8	35.1
p-value	0.080	0.295	0.437	**0.004**	0.907	0.098	0.402	0.639
Extracurricular activities								
No	49.5	54.2	51.0	12.8	30.3	18.3	33.4	40.0
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	0.960	0.825	0.211

Statistical associations between independent variables and MSD was evaluated using chi-square, values statistically significant at $p<0.05$

As shown in Table 8, 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.

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.

Table 8: The 12-month prevalence of MSD of different body regions among teachers in Botswana in relation to various physical and psychosocial factors

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	48.0	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	35.0	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	37.0
Yes	59.5	57.7	55.8	18.2	37.6	20.1	40.1	42.0
p-value	**0.007**	0.101	0.299	**0.031**	**0.006**	0.629	**0.049**	0.303
Rapid physical activity								
No	45.0	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	44.0

p-value	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**0.002**	**<0.001**
Awkward body position								
No	48.0	49.5	49.4	12.2	28.4	16.8	31.8	35.0
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	49.0	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	0.110	0.391	0.460	0.482
Psychological job demands								
Low	44.1	41.6	37.7	12.0	27.1	14.0	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	0.050	0.055	0.587	0.226
Job insecurity								
Low	50.0	52.0	50.9	12.2	30.5	18.2	33.2	37.4
High	54.3	54.0	58.6	16.4	30.7	18.1	36.2	39.0
p-value	0.092	0.682	**0.014**	0.071	0.537	0.966	0.471	0.801
Co-worker support								
Low	56.6	52.0	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	37.0
p-value	**0.022**	0.971	0.135	0.545	0.052	0.193	0.679	0.380
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	36.0
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	13.0	35.6	18.6	32.0	40.3

High	50.0	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	48.0	12.4	27.3	15.6	33.2	36.8
High	54.4	55.2	56.0	13.8	33.0	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 $p<0.05$

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 6-8. 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 9, 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.

Table 9: Self-reported MSD risk factors among teachers in Botswana

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	1.50	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	2.00	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	0.020
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	1.70	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	1.70	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

MSD Protective Factors

Interestingly, as shown in Table 10, 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).

Table 10: Protective factors against development of MSD on different body regions among teachers in Botswana

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 ≥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

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 11.

Table 11: Impact of MSD among teachers in Botswana

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	≥8	Everyday			1-7	≥8	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

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±9.0 vs 36.3±7.0 years, p<0.001) and had a significantly longer length of employment in comparison to their male counterparts (13.4±8.8 vs 10.1±6.3 years, p<0.001). In addition, female teachers were more overweight when compared to their male colleagues (27.6±7.0 vs 24.8±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) and1.59 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 any body 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 than 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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Paper 4

Low back pain among school teachers in Botswana, prevalence and risk factors

Introduction to Paper 4

The results of Papers 1 and 2 suggest that school teachers are at a high risk of MSD and that they appear to be more prone to this disease at the neck, shoulder and back. Paper 1 suggests that LBP appears to be more prevalent than upper back pain among teachers. A wide range of risk factors for MSD among teachers have been reported in both papers. Paper 2 further identified factors reported to have a decreased odds of reporting LBP.

Paper 4 aimed to conduct one of the first epidemiological investigations of LBP among school teachers in Botswana. It aimed to investigate the prevalence and establish risk factors for LBP and low back disability. This paper aims to generate information to inform the development of more effective and appropriate intervention and prevention strategies for LBP among teachers in Botswana. While it might have been ideal to conduct a qualitative research design employing the physical examination of participants to determine their level of low back disability, this was not realistic due to financial constraints. A cross-sectional survey was instead conducted with a self-administered questionnaire used for data collection. This study adds significantly to the overall body of knowledge in this area as it appears to be one of the first to investigations of LBP among school teachers in Botswana.

Low back pain among school teachers in Botswana, prevalence and risk factors

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Abstract

Background

Although low back pain (LBP) represents a common occupational problem, few epidemiological studies have investigated the prevalence and risk factors for LBP among school teachers, particularly in Africa. School teachers are known to represent an occupational group among which there appears to be a high prevalence of LBP. The objective of this study was, therefore, to conduct one of the first epidemiological investigations of LBP among teachers in Botswana.

Methods

A cross-sectional study was conducted among teachers in Botswana using self-administered questionnaires which were distributed to 3100 randomly selected school teachers and collected over a five-month period between July and November 2012. The questionnaire included low back pain information, demographic data, lifestyle, work-related characteristics and psychosocial factors. Data were analyzed using Chi-squared and logistic regression models. The 12 month prevalence and LBP disability and associated risk factors were also analyzed.

Results

A total of 1747 teachers returned completed questionnaires, yielding a response rate of 56.3%. The 12-month prevalence of LBP was 55.7%, with 67.1% of them

reporting minimal disability. The results of logistic regression analysis revealed that female gender [OR: 1.51, 95%CI: 1.14-2.00] and previous back injury [OR: 9.67, 95%CI: 4.94-18.93] were positively correlated to LBP. Awkward arm position [OR: 1.81, 95%CI: 1.24-2.62] and high psychological job demands [OR: 1.40, 95%CI: 1.02-1.93] were also significantly associated with LBP. Regular physical exercise was negatively associated with LBP [OR: 0.63, 95% CI: 0.43-0.93]. Female gender [OR: 2.67, 95%CI: 1.52-3.99] and previous back injury [OR: 3.01, 95%CI: 1.92-4.74] were also positively associated with LBP disability.

Conclusion

The prevalence of LBP appears to be high among school teachers in Botswana. A wide variety of LBP risk factors were identified in this study. Female gender and previous injury were both associated with LBP presence and disability. The complex nature of LBP risk factors found in this study suggests than no single specific preventative or intervention strategy will help in reducing these conditions. As such, to help reduce the prevalence, progression and burden of LBP among Botswana teachers, a greater emphasis should now be placed on ergonomics education, regular physical exercise and occupational stress.

Background

Low back pain (LBP) is widely acknowledged as an important health and socio-economic problem which plagues a large segment of the population in industrialized countries [1]. The situation is reportedly even worse in developing countries, with suboptimal working conditions in many industries and an acute lack of awareness of ergonomics issues, education and training programmes [2]. LBP does not only lead to a poorer quality of life for individuals, but also decreased labour productivity due to time off work, increased absenteeism and early retirement. Moreover, LBP is also associated with escalating medical costs [1]. This condition often occurs as a result of cumulative trauma and can affect the bones, muscles and their attachments, as well as nerves and blood supply [3]. Considerable focus has been on back injuries and musculoskeletal disorders of workers in health care [3-5] and other industries [2,6]. However, a significant body of research has also recently suggested that school teachers are at an increased risk of musculoskeletal disorders [7], with prevalence rates reported at between 12% and 84% [8,9].

Work-related tasks are widely considered to be a major cause of LBP among teachers. It is postulated that awkward posture, prolonged sitting when working on students' work and when preparing for lessons [10], and inappropriate furniture [11] are contributing factors for LBP among teachers. An increasing body of research has demonstrated important links between not only physical demands of one's job, but also the psychosocial and structural factors that influence workers' lives at work [4,12-14]. Despite these facts, there are few studies examining which of the wide spectrum of risk factors are predictive of LBP in the teaching profession. It is important in policy making to investigate factors that relate to LBP among teachers and thereafter take measures to prevent such conditions so as to protect teachers' health and the quality of education that their students receive.

Despite their large demographic and associated potential for occupational health problems, few epidemiological studies have investigated LBP prevalence and risk factors among teachers. Hence the aim of this study was to analyse the prevalence and distribution of LBP among teachers in Botswana and to establish risk factors that influence the development and the extent of their symptoms.

Methods

Location and background

A large cross-sectional study of musculoskeletal disorders was conducted among teachers in Botswana between July 2012 and November 2012. From ten education regions in the country, seven regions were selected in order for the study to be representative of all teachers in Botswana and also it was not have been feasible to sample all education regions. The regions were taken as clusters and numbered one to 10. Using a random sequence generator, the seven first regions were selected. From these randomly selected regions, schools were stratified into primary or secondary schools and alphabetically compiled into two different lists. There was no national data available to show how many school teachers were in each region. As such, questionnaires were equally distributed to all regions that formed part of the study. In 2010, there were 11,711 primary and 13,173 secondary school teachers employed by the government of Botswana through Department of Public Service Management (DPSM) [15]. Power calculations indicated that a sample size of 1537 each group would be required to calculate result at the 95% significance level. This number was then rounded up to 1550 for practical purposes. A total of 1550 primary and 1550 secondary teachers were invited to participate from randomly selected 107 primary and 57 secondary schools. All school teachers in those schools were invited to take part in the study. The number of teachers in schools varied from one school to the other depending on the level of the school and the number of students. In primary schools, for instance, one school can have about six teachers while another school can have 27 teachers and, in senior secondary schools, one school can have as many as 120 teachers. Permission to conduct the research in the selected schools was sought from school heads. Not all agreed to participate; however, and where a school head declined to participate, their school was then replaced by another from the randomization list. The study commenced after obtaining ethical clearance from University of Newcastle Human Research Ethics Committee and a research permit from Ministry of Education and Skills Development in Botswana (MoESD). Postal questionnaires were used to collect data from participants and informed consent was implied by voluntarily completing and returning the questionnaire. Teachers were also given information sheets describing the procedure and objectives of the study.

Questionnaire design

An anonymous self-administered questionnaire was used to assess the demographic and individual data, low back pain, low back disability, and physical and psychosocial exposures during work among teachers. The five page questionnaire was divided into four sections with the first section covering demographic items such as gender, age, education level, marital status and tobacco smoking. The second section assessed participants' low back complaints and previous low back injury using the Standardized Nordic Questionnaire (SNQ) [16]. Questions addressing the perceived level of low back disability constituted the third component and were adapted from Oswestry Disability Index (ODI) [17]. The last section of the questionnaire assessed psychosocial and physical work demands using the Job Content questionnaire (JCQ) [18]. To make the questionnaire easy to complete, it consisted of a number of tick-box style and anatomical diagram with shaded areas. The questionnaire was administered in English.

Statistical analysis

All data were coded and entered into SPSS 20.0 and analyzed. Independent t-test and Chi-squared test were used to analyze quantitative and categorical data, respectively. Basic statistical associations between demographic, physical and psychosocial variables were initially evaluated using Chi-squared tests. Risk factors were then evaluated using logistic regression and expressed as Odds Ratios (OR) with 95% Confidence Intervals (95% CI). LBP was used as the dependent variable, with demographic items, lifestyle, workplace, physical and psychosocial factors used as independent variables. Probability values below 0.05 were regarded as statistically significant throughout all analyses.

Results

Participant demographics

A total of 3100 questionnaires were distributed to teachers from whom 1747 were returned, yielding a response rate of 56.3%. Fifteen questionnaires were excluded from analysis because they were not completed, leaving 1732 respondents, and giving an overall coverage rate of 55.9%. Of these respondents, 1003 (57.9%) were primary school teachers, while 559 (32.3%) and 170 (9.8%) were junior and senior secondary school teachers, respectively. The participants comprised of a higher proportion of female (72.7%) than male teachers (27.3%). The majority of respondents had ≤10 years of teaching experience (48.4%): 68.9% taught in junior secondary and 42.9% in senior secondary; while 38.0% taught in primary school. Table 12 lists the participants' main demographic characteristics.

Table 12: Demographic, life style and work characteristics of primary (n = 1003), junior secondary (n = 559) and senior secondary teachers (n = 170) in Botswana

Characteristics	**Primary school teachers**	**Junior secondary school teachers**	**Senior secondary school teachers**	**Overall**
	%	**%**	**%**	**%**
Gender				
Male	17.0	39.2	48.2	27.3
Female	83.0	60.8	51.8	72.7
Age (years)				
≤30	15.6	34.3	10.2	21.1
31-40	29.5	49.4	53.6	38.3
41-50	40.4	14.1	31.7	31.0
>50	14.5	2.2	5.4	9.6
Body mass index				
<18.5	5.0	7.1	3.7	5.6
18-24.9	35.7	51.9	43.7	42.1
25-29.9	29.3	25.1	34.8	28.5
≥30	30.0	15.9	17.8	23.9
Marital status				
Single	53.8	54.7	42.4	53.0
Married	38.7	42.8	50.6	41.2
Separated/ divorced/widowed	7.5	2.5	7.1	5.8

Education level				
Certificate	9.2	0.2	0.6	5.4
Diploma	71.7	53.1	0.6	58.7
Bachelors' degree	19.1	46.7	98.8	35.9
Number of children less than 6 years				
1	73.9	72.5	73.0	73.2
≥2	26.1	27.5	27.0	26.8
Hours of physical exercise per week (hours)				
≤5	89.5	84.3	84.6	87.2
>5	10.5	15.7	15.4	12.8
Length of employment (years)				
≤10	38.0	68.9	42.9	48.4
11-20	34.0	28.3	47.1	33.4
21-30	24.1	2.5	8.8	15.6
>30	3.9	0.4	1.2	2.5
Work hours per week (hours)				
40	88.8	85.7	83.5	87.3
>40	11.2	14.3	16.5	12.7
Number of students taught on average				
≤25	5.2	25.8	9.4	12.2
26-30	20.4	8.1	4.7	14.9
31-35	39.4	11.3	15.3	27.9
36-40	32.6	32.6	55.9	34.9

>40	2.4	22.4	14.7	10.0
Extracurricular activities				
No	22.6	45.8	55.9	33.4
Yes	77.4	54.2	44.1	66.6

As shown in Table 5, the results suggest that there was a significant difference in age distribution for males (M = 36.29, SD = 7.02) and females (M = 39.34, SD = 8.62), $p < 0.001$. Similarly, there was a significant difference in body mass index (BMI) distribution for males and females (24.75 ± 5.78 vs 27.55 ± 7.00). A higher proportion of the single teachers were male (58.7%), while 42.5% of female teachers were married. The majority of teachers had a diploma (58.7%), and most of the teachers with a bachelor's degree were male (43.4%), compared to 33.0% of female teachers. Similarly, the majority of males (46.4%) taught in junior secondary schools, while a higher proportion of female teachers (66.0%) taught in primary schools.

A higher proportion of male teachers (18.1%) reported doing physical exercise for more than five hours a week, compared with females (10.4%). In addition, 11.4% of males taught more than 40 students in class, compared with females (9.5%). These findings were statistically significant. Similarly, a higher proportion of male teachers reported being involved in extracurricular activities when compared to female teachers. However, this finding was not statistically significant. There were no statistically significant differences between gender and having children less than 6 years and working for more than 40 hours a week.

Table 5 Descriptive statistics of individual, life style and work characteristics among male and female teachers in Botswana

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**
Cigarettes/day	5.88 ± 4.78	2.80 ± 1.64	5.59 ± 4.68	0.163
Marital status				**0.004**
Single	58.7	50.9	53.0	
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	33.0	35.9	
Number of children less than 6 years				0.210
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	66.0	57.9	
Junior secondary	46.4	27.0	32.3	
Senior secondary	17.4	7.0	9.8	
Work hours per week >40 hours	14.6	12.0	12.7	0.166
Number of students >40	11.4	9.5	10.0	**<0.001**
Involved in extracurricular activities	69.9	65.4	66.6	0.086

P values were derived from either independent t-test for quantitative data or chi-squared test for categorical data. Statistically significant differences ($p<0.05$) are marked in bold.

LBP prevalence

The 12-month self-reported prevalence of LBP among Botswana teachers was 55.7%. As shown in Table 13, female teachers had a significantly higher prevalence rate when compared to males (58.7% vs 47.7%, $p < 0.001$). Results demonstrated that teachers with previous back injury had the highest prevalence of LBP. There was a significant difference between teachers with and without previous injury in the prevalence of LBP ($p < 0.001$). Teachers who reported doing physical exercise ≤5 hours per week had the highest prevalence of LBP, compared to those who had more than 5 hours of physical exercise per week. Similarly, there were significant differences between hours of physical exercise in the prevalence of LBP ($p = 0.024$).

Table 13 The 12 month prevalence of LBP among Botswana teachers in relation to individual and lifestyle factors

Risk factors[a]	**% with LBP**	***P* value**
Gender		**<0.001**
Male	47.7	
Female	58.7	
Age (years)		0.356
≤30	53.5	
31-40	54.5	
41-50	58.9	
>50	56.4	
Body mass index		0.673
<18.5	50.7	
18-24.9	54.1	
25-29.9	56.5	
≥30	57.2	
Marital status		0.220
Single	53.7	
Married	57.9	
Separated/divorced/widowed	57.4	
Education level		0.515
Certificate	51.1	
Diploma	55.3	

Bachelor's degree	57.0	
Number of children <6 years		0.562
1	55.2	
≥2	58.1	
Previous injury		**<0.001**
No	51.7	
Yes	91.8	
Tobacco smoking		0.120
Smokers	42.9	
Ex-smokers	52.7	
Never smoked	56.3	
Regular physical exercise (hours per week)		**0.024**
≤5	57.6	
>5	47.2	
School level		0.176
Primary school	57.5	
Junior secondary school	52.8	
Senior secondary school	54.1	
Length of employment (years)		0.307
≤10	53.8	
11-20	56.1	
21-30	60.1	
>30	58.1	

Hours of work per week		**0.002**
40	54.2	
>40	65.5	
Average number of students taught		0.591
≤25	51.4	
26-30	57.0	
31-35	57.9	
36-40	55.0	
>40	55.2	
Extracurricular activities		0.623
No	56.6	
Yes	55.2	

[a] Statistical associations between independent variables and LBP were evaluated using chi-squared. Statistically significant differences ($p < 0.05$) are marked in bold.

The results suggest that teachers who reported that their job required high physical effort, rapid physical activity, awkward body and awkward arm had a higher prevalence of LBP (Table 14). These findings were statistically significant. The prevalence of LBP was higher among teachers with high psychosocial job demands (57.4%) and high job dissatisfaction (58.6%) when compared to those with low psychosocial job demands (48.9%) and low job dissatisfaction (51.7%), respectively; with a statistical difference of $p < 0.05$.

Table 14 The 12 month prevalence of LBP among Botswana teachers in relation to physical and psychosocial factors

Risk factors[a]	**% with LBP**	***P* value**
Much physical effort		**0.012**
No	51.3	
Yes	58.5	
Lift heavy loads		0.832
No	55.4	
Yes	57.3	
Rapid physical activity		**<0.001**
No	51.2	
Yes	62.2	
Awkward body position		**<0.001**
No	52.2	
Yes	64.6	
Awkward arm position		**<0.001**
No	51.4	
Yes	66.9	
Decision latitude		0.275
No	59.7	
Yes	54.7	
Psychosocial job demands		**0.015**
Low	48.9	

High	57.4	
Job insecurity		0.388
Low	54.9	
High	58.3	
Co-worker support		0.105
Low	60.9	
High	54.7	
Supervisor support		0.394
Low	58.1	
High	54.6	
Social support		0.897
Low	56.9	
High	55.5	
Job dissatisfaction		**0.017**
Low	51.7	
High	58.6	

[a] Statistical associations between independent variables and LBP were evaluated using chi-squared. Statistically significant differences (p<0.05) are marked in bold.

Risk factors for LBP

As shown in Table 15, the logistic regression model contained ten independent variables. Only six of these independent variables made a unique, statistically significant contribution to the model. The strongest predictor of reporting LBP was previous low back injury, with an adjusted odds ratio of 9.67. Female gender and increasing age were also significantly associated with LBP. Regular physical exercise, with more than 5 hours of exercise per week, remained associated with decreased odds of reporting LBP, compared to those with less hours of physical exercise. Awkward arm position and high psychological job demands also remained associated with LBP in the final, adjusted, model.

Table 15 Risk factors for LBP among Botswana teachers

Risk factors[a]	**Logistic OR (95% CI)**	**Corrected OR (95%CI)[b]**	***P* value**
Gender			
Male	1	1	
Female	1.51 (1.14-2.00)	1.42 (1.12-1.77)	**0.004**
Age (years)			
≤30	1	1	
31-40	1.25 (0.89-1.75)	-	0.203
41-50	1.56 (1.08-2.24)	1.47 (1.07-1.97)	**0.017**
>50	1.46 (0.83-2.55)	-	0.185
Previous injury			
No	1	1	
Yes	9.67 (4.94-18.93)	1.92 (1.74-2.02)	**0.001**
Hours of physical exercise per week (h)			

≤5	1	1	
>5	0.63 (0.43-0.93)	0.64 (0.45-0.93)	**0.021**
Much physical effort			
No	1		
Yes	1.10 (0.81-1.49)	-	0.539
Rapid physical activity			
No	1		
Yes	1.12 (0.82-1.53)	-	0.475
Awkward body position			
No	1		
Yes	1.09 (0.75-1.59)	-	0.649
Awkward arm position			
No	1	1	
Yes	1.81 (1.24-2.62)	1.39 (1.14-1.63)	**0.002**
Psychosocial job demands			
Low	1	1	
High	1.40 (1.02-1.93)	1.34 (1.02-1.76)	**0.040**
Job dissatisfaction			
Low	1		
High	1.23(0.95-1.60)	-	0.119

[a] Risk factors evaluated simultaneously using logistic regression and expressed as Logistic Odds Ratios (OR) with 95% Confidence Intervals (95%CI). All OR adjusted for gender and age.

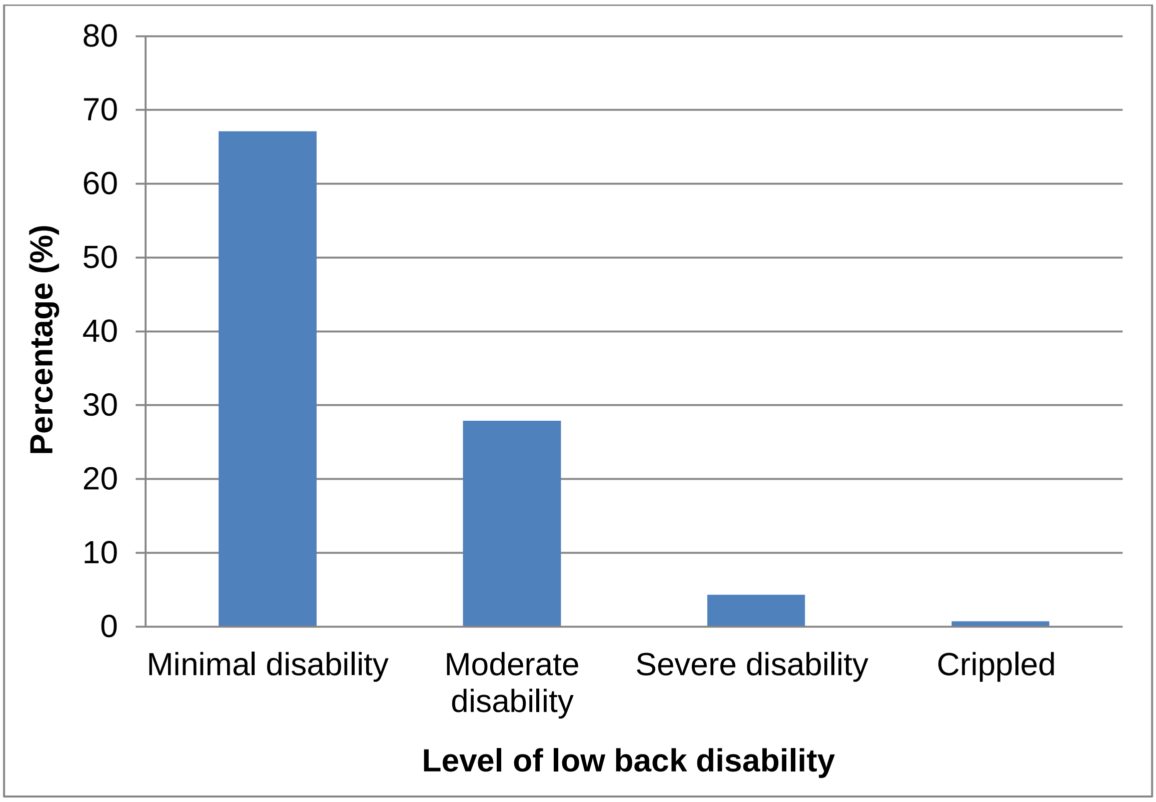
[b] Odds ratios with statistically significant results corrected using the formula of Zhang & Kai [30].

Statistically significant differences (p<0.05) are marked in bold.

LBP disability

As shown in Figure 4, the majority of teachers with LBP (67.1%) reported minimal disability. Moderate disability was reported by almost a quarter of teachers with LBP (27.9%). Severe disability and being crippled were reported by a relatively low proportion of teachers with LBP; being 4.3% and 0.7%, respectively.

Figure 4 Level of low back disability among Botswana school teachers with LBP



Risk factors for LBP disability

Various factors were statistically associated with LBP disability during chi-squared tests. Among individual factors, gender, age, body mass index, education level and previous low back injury were significantly associated with LBP disability all with p-values of less than 0.001. Lifestyle factors included tobacco smoking (p = 0.022).

Work related factors included the level of school at which teachers taught (p < 0.001) and length of employment (p = 0.001). Refer to Table 16. Chi-squared tests for independence with Yates Continuity Correlation indicated a significant association between LBP disability and physical effort (p <0.001), lifting heavy loads (p = 0.030), rapid physical activity (p < 0.001), awkward arm (p <0.001) and awkward arm (p < 0.001) (Table 17). As shown in Table 18, LBP disability was associated with psychosocial job demands, job insecurity and supervisor support. However, not all factors remained statistically significant when evaluated in the logistic regression model. Of all the evaluated variables, only female gender (OR: 2.47, 95% CI: 1.52-3.99, p <0.001) and previous low back injury (OR: 3.01, 95% CI: 1.92-4.74, p < 0.001) were shown to be significant contributors to LBP disability (Table 19).

Table 16 Individual factors associated with LBP disability among Botswana school teachers

Risk factors[a]	**Minimal disability**	**Moderate/severe disability /crippled**	**Total**	***P* value**
	%	**%**	**%**	
Gender				**<0.001**
Male	27.7	14.5	23.3	
Female	72.3	85.5	76.7	
Age				**<0.001**
≤30	23.5	13.3	20.2	
31-40	38.4	35.3	37.4	
41-50	29.1	40.1	32.7	
>50	9.0	11.3	9.7	

Body mass index				**<0.001**
<18.5	5.6	4.1	5.1	
18-24.9	46.3	30.3	41.1	
25-29.9	27.2	33.0	29.1	
≥30	21.0	32.6	24.7	
Marital status				0.337
Single	52.7	47.9	51.1	
Married	41.7	45.1	42.8	
Separated/ divorced/widowed	5.6	6.9	6.0	
Educational level				**<0.001**
Certificate	3.7	7.6	5.0	
Diploma	55.5	64.0	58.3	
Bachelors' degree	40.8	28.4	36.7	
Number of children less than 6 years				1.000
1	72.3	71.8	72.2	
≥2	27.7	28.2	27.8	
Previous injury				**<0.001**
No	88.3	74.4	83.7	
Yes	11.7	25.6	16.3	
Tobacco smoking				**0.022**
Never smoked	91.0	95.6	92.5	
Ex-smokers	6.2	2.5	5.0	
Current Smokers	2.8	1.9	2.5	

Hours of physical exercise per week (h)				0.700
≤5	88.8	90.1	89.2	
>5	11.2	9.9	10.8	
School level				**<0.001**
Primary school	55.0	69.7	59.9	
Junior secondary	33.2	25.2	30.6	
Senior secondary	11.7	5.0	9.5	
Length of employment (years)				**0.001**
≤10	50.9	38.5	46.8	
11-20	32.0	37.2	33.7	
21-30	15.3	20.2	16.9	
>30	1.9	4.1	2.6	
Working hours per week (hours)				1.000
40	85.0	85.2	85.1	
>40	15.0	14.8	14.9	
Number of children taught				0.060
≤25	12.8	8.2	11.3	
26-30	15.5	14.8	15.2	
31-35	28.3	30.6	29.0	
36-40	32.5	38.5	34.4	
>40	11.0	7.9	10.0	
Extracurricular activities				0.309
No	35.1	33.9	33.9	

Yes	64.9	68.5	66.1

[a] Statistical associations between independent variables and LBP disability was evaluated using chi-squared. Statistically significant differences (p<0.05) are marked in bold.

Table 17 Physical factors associated with LBP disability among Botswana school teachers

Risk factors[a]	**Minimal disability**	**Moderate/severe disability /crippled**	**Total**	***P* value**
	%	**%**	**%**	
Much physical effort				**<0.001**
No	41.4	26.8	36.6	
Yes	58.6	73.2	63.4	
Lift heavy loads				**0.030**
No	85.4	79.6	83.5	
Yes	14.6	20.4	16.5	
Rapid physical activity				**<0.001**
No	59.9	43.9	54.6	
Yes	40.1	56.1	45.4	
Awkward body position				**<0.001**
No	71.9	58.9	67.6	
Yes	28.1	41.1	32.4	
Awkward arm position				**<0.001**
No	71.2	58.3	66.9	
Yes	28.8	41.7	33.1	

[a] Statistical associations between independent variables and LBP disability were evaluated using chi-squared. Statistically significant differences (p<0.05) are marked in bold.

Table 18 Psychosocial factors associated with LBP disability among Botswana school teachers

Risk factors[a]	Minimal disability %	Moderate/severe disability/crippled %	Total %	*P* value
Decision latitude				0.541
Low	19.3	17.5	18.7	
High	80.7	82.5	81.3	
Psychosocial job demands				**0.040**
Low	20.3	14.6	18.4	
High	79.7	85.4	81.6	
Job insecurity				**0.010**
Low	76.9	68.8	74.2	
High	23.1	31.2	25.8	
Co-worker support				0.071
Low	17.8	22.9	19.5	
High	82.2	77.1	80.5	
Supervisor support				**0.037**
Low	30.3	37.3	32.6	
High	69.7	62.7	67.4	
Social support				0.128

Low	13.8	17.8	15.2	
High	86.2	82.2	84.8	
Job dissatisfaction				0.069
Low	42.2	35.8	40.1	
High	57.8	64.2	59.9	

[a] Statistical associations between independent variables and LBP disability were evaluated using chi-squared. Statistically significant differences (p<0.05) are marked in bold.

Table 19 Individual, physical and psychosocial factors associated with LBP disability among Botswana school teachers

Risk factors[a]	**Odds ratio (OR)**	**95%CI confidence intervals (95% CI)**	***P* value**
Gender			
Male	1		
Female	2.47	1.52-3.99	**<0.001**
Age (years)			
≤30	1		
31-40	1.39	0.77-2.51	0.280
41-50	1.53	0.74-3.20	0.255
>50	1.03	0.39-2.73	0.954
Body mass index			
<18.5	1		
18.5-24.9	1.19	0.49-2.88	0.707
25.0-29.9	1.63	0.66-4.00	0.291

≥30	1.80	0.72-4.49	0.208
Education level			
Certificate	1		
Diploma	0.88	0.39-2.02	0.769
Bachelor degree	0.53	0.22-1.29	0.160
Previous injury			
No	1		
Yes	3.01	1.92-4.74	**<0.001**
Tobacco smoking			
Never smoked	1		
Ex-smoker	0.36	0.13-1.02	0.054
Current smoker	1.64	0.53-5.09	0.393
School level			
Primary school	1		
Junior secondary	0.99	0.63-1.57	0.974
Senior secondary	0.83	0.38-1.85	0.656
Length of employment (years)			
≥10	1		
11-20	1.20	0.73-1.97	0.484
21-30	1.18	0.59-2.36	0.631
>30	1.22	0.35-4.34	0.755
Much physical effort			
No	1		

Yes	1.31	0.82-2.07	0.256
Lifting heavy loads			
No	1		
Yes	0.93	0.56-1.55	0.776
Rapid physical activity			
No	1		
Yes	1.31	0.85-2.03	0.220
Awkward body position			
No	1		
Yes	1.06	0.65-1.72	0.811
Awkward arm position			
No	1		
Yes	1.57	0.98-2.51	0.062
Psychosocial job demands			
Low	1		
High	1.31	0.79-2.17	0.295
Job insecurity			
Low	1		
High	1.31	0.86-1.98	0.211
Supervisor support			
Low	1		
High	0.74	0.50-1.09	0.123

[a] Risk factors evaluated simultaneously using logistic regression and expressed as Odds Ratios (OR) with 95% Confidence Intervals (95% CI). All OR adjusted for gender and age. Statistically significant differences (p<0.05) are marked in bold.

Discussion

LBP prevalence

The first aim of this study was to estimate the 12-month prevalence of LBP among school teachers in Botswana. This study found a 55.7% prevalence of LBP among teachers. Parallels can be drawn to other studies where 53.3% of Filipino [19], 53.8% of Ethiopian [20] teachers and 59.2% of Chinese primary and secondary school teachers [21] reported having LBP. The prevalence of LBP found in this study was relatively lower than those reported in studies conducted among female secondary school Saudi (63.8%) [22], Indian (66.2%) [23], Iranian (71.9%) [24] and Turkish teachers (74.9%) [25]. A relatively high prevalence of LBP, 84.0%, was found among Slovenian physical education teachers in a previous study [8]. The LBP prevalence rate in this study was, however, higher than that reported in another Turkish study (51.4%) [26] and other studies carried out among Chinese, Brazilian and Malaysian teachers with LBP prevalence rates of 45.6%, 41.1% and 40.4%, respectively [10,11,19]. Lower LBP prevalence levels have also been reported in studies that were conducted among teachers in Malaysia (40.4%) [27], China (40.0%) [28] and France (34.8) [29]. Lower levels of LBP prevalence were further reported among school teachers in Japan (20.6%) [1] and Estonia (11.8%) [9].

LBP risk factors

Another aim of this study was to determine risk factors associated with LBP among school teachers in Botswana. Chi-squared tests were initially used to determine basic associations between LBP and risk factors. Logistic regression was used to analyze the association of factors that were positively associated with LBP when using chi-squared tests. Logistic regression analysis revealed a number of interesting correlations between LBP and individual, lifestyle, physical and psychosocial factors. Odds ratios with statistically significant results were further corrected using the formula of Zhang and Kai [30].

Individual factors

In this study, female teachers reported a significantly higher prevalence of LBP (58.7% vs 47.7%) when compared to their male counterparts. Female teachers were one-and-a-half times more likely to experience LBP (OR: 1.51, 95%CI: 1.14-2.00), which is consistent with some previous studies conducted in the teaching profession [20,26] and elsewhere [31,32]. Female teachers appear to consistently report more LBP than their male colleagues. Supporting this hypothesis are the results of a study of self-reported musculoskeletal symptoms among Turkish teachers which found that female teachers were 2.50 times more likely to report back pain when compared to their male counterparts [33]. In addition, Ethiopian female teachers were found to be more than three times likely to develop LBP in comparison to their male colleagues (OR: 3.23, 95%CI: 2.10-5.26) [20]. A similar link has been found between female gender and LBP among school teachers in Brazil (OR: 1.54, 95%CI: 1.22-2.07) [11]. Similar findings were also documented in a study conducted in Iran where more female teachers reported lower back pain (77.0% vs 69.0%) in comparison to their male colleagues [24]. In a Chinese study of school teachers, the percentage of female teachers was higher than that of their male counterparts in reporting LBP (52.6% vs 45.1%, $p < 0.01$) [21]. Conversely, a study of Filipino teachers did not show any gender differences between teachers with or without LBP [19]. Similar results were found in a study of university staff where gender was not significantly associated with LBP ($p = 0.226$) [34]. Furthermore, no significant association has been found between gender and LBP (OR: 1.15, 95%CI: 0.77-1.72) among physical education teachers in Slovenia [8].

One possible reason for gender differences in this study could be the nutritional status of female teachers, given that a higher proportion was found to be overweight when compared with their male counterparts. Even though BMI was not significantly associated with LBP in this study, females had a higher average BMI than males (27.6 ± 7.0 vs 24.8 ± 5.8, $p < 0.001$). Older age and long teaching experience might also be contributing factors, as females were significantly older than males (39.3 ± 9.0 vs 36.3 ± 7.0 years, $p < 0.001$) and had a significantly longer working experience than their male colleagues (13.4 ± 8.8 vs 10.1 ± 6.3 years, $p < 0.001$). Another reason could be that male teachers were involved in more regular physical exercise than females (18.1% vs 10.4%, $p < 0.001$).

The results of this study suggest that increasing age increases the odds of developing LBP. Teachers who were 41–50 years were 1.56 times more likely to report LBP when compared to those who were 30 years or younger. This result is consistent with a study conducted in Brazil in which teachers aged 40 years and above reported having more back pain than their younger colleagues [11]. Parallels could also be drawn to the results of a Turkish study where teachers over the age of

40 years reported having experienced musculoskeletal pain ($p < 0.001$) [26]. Increasing age has also been positively associated with LBP in another study of Turkish teachers (OR: 1.05, 95%CI: 1.02-1.08) [25]. Similarly, in a study carried out in Ethiopia, teachers who were 40 years and above were 2.34 times more likely to develop LBP while those in the age group of 30 to 40 years were 1.70 times more likely to develop LBP, compared to those who were less than 30 years [20]. In addition, increasing age was found to increase the odds of LBP (OR: 1.05, 95%CI: 1.03-1.07) [8]. It has been suggested that the likely reason for higher prevalence of LBP among older teachers is that, as people age, there is a gradual decline in muscle mass and they lose connective tissue elasticity and undergo a thinning of the cartilage between joints. On the other hand, healing slows down with advancing age while the body is simultaneously dealing with lifetime accumulated soft tissue damage [11,26,35].

Logistic regression analysis revealed that prior injury was independently and significantly associated with LBP among Botswana teachers (OR 9.67, 95%CI 4.94-18.93). However, when this logistic odds ratio was corrected teachers who reported prior injury were found to be 1.92 times more likely to report LBP in comparison to those who did not report priory injury (95%CI: 1.74-2.02) . This finding was similar to the results of a study conducted in Ethiopia where it was reported that teachers with a history of low back injury were 1.96 times more likely to develop LBP than those who had no history of low back injury (OR: 1.96, 95%CI: 1.04-3.96) [20]. A similar link has been demonstrated between prior injury and upper extremities, back and lower extremities among male steelworkers in Korea [36] and between prior injury and subsequent injury [37]. Previous musculoskeletal clinical history has also been linked with the development of MSD among Italian health care workers [38].

On the other hand, results of this study suggest that regular physical exercise was negatively associated with LBP. Teachers who reported more than 5 hours of physical exercise a week were less likely to report LBP (OR: 0.63, 95%CI: 0.43-0.93), compared to those who exercised less than 5 hours per week. 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 low back pain, compared to those who did not engage in regular physical activity (OR: 0.52, 95% CI: 0.34-0.82) [20]. A similar link has also been demonstrated between habitual physical activity as athletic and MSD among Thai university staff [34]. In a study of Estonian athletes, regular physical exercise 6–11 times per month has been associated with a lower prevalence of knee and hip problems, compared to those who exercised less than 6 times per month. On the other hand, a previous study from Australia found that undertaking no exercise was associated with almost five-fold risk of LBP [39].

Physical and psychosocial factors

Teachers who reported awkward arm positions at work reported the highest prevalence of LBP in the current study, when compared to those who did not adopt awkward arm positions, which is consistent with some previous research [38,40,41]. Teachers who had high psychological job demands were 1.40 more times likely to report LBP than those with low psychological job demands. Similarly, teachers who have reported having stress were 4.15 and 2.18 times more likely to experience LBP in the Philippines and Ethiopia, respectively, than those without stress [19,20]. High psychological job demands have also been positively correlated to development of musculoskeletal disorders among Polish workers [42]. Additionally, poor mental health has been associated with LBP among Malaysian secondary school teachers (OR: 1.11, 95%CI: 1.06-1.15) [27]. High job demands have also been correlated to LBP among female teachers at a school for the handicapped and among male teachers for classrooms for the handicapped in Japan [1]. On the other hand, a previous study conducted in China among teachers found no statistically significant association between high job demands and LBP [43]. Similar findings have been found for a study conducted in Italy [44].

A possible explanation for the association documented in the current study could be because teachers often work in stressful conditions with large classes, with a lack of educational resources and limited reward for their work [11]. Teachers have also been found to face a high amount of stress during teaching and handling young students and their stress level also increases when having to deal with students with emotional and behavioural problems [23]. It has also been suggested that the more psychological demands needed for a particular task, the greater the possibility to develop any kind of musculoskeletal disorder regardless of the anatomical area [45]. Some research from Japan suggests that this may relate to group dynamics, as well as individual factors [46]. Surprisingly, psychosocial factors such as low decision latitude, high job insecurity, low co-worker, low supervisor and low social support, and high job dissatisfaction were not positively associated with development of LBP in the current study.

LBP disability

Of those teachers who reported LBP, two-thirds (67.1%) reported experiencing minimal disability while 27.9% reported moderate disability, 4.3% severe disability, and 0.7% reported being crippled. The results of this study demonstrated that none of the respondents had been bed ridden or might have exaggerated their level of pain. This may imply that the majority of teachers probably experienced their LBP at a tolerable level. Conversely, in a study of high school teachers in the Philippines, the majority of teachers were found to experience pain at a barely tolerable level. Of those teachers that reported back pain, 14.5% reported minimal disability, 49.4% reported moderate disability, 25.0% reported severe disability, and 6.0% reported being crippled, while 5.0% reported being bed ridden. The results further indicated that 11% of the teachers may have exaggerated their pain level [19]. In Saudi Arabia, a study of female school teachers found that more than half (53.3%) of the teachers with LBP reported suffering from significant/disabling pain, while 25.9% and 20.8% reported non disabling pain and no pain, respectively [22]. In Slovenia, 19.0% of teachers reported experiencing LBP very often, 30.0% often and 34.0% rarely [8]. Moreover, in the US, 55.0% of preschool workers who reported back pain described it as very or extremely uncomfortable [47]. In a study of Turkish hospital staff, only 11.1% reported mild LBP whereas 63.0% reported moderate pain, 23.1% severe pain and 2.7% very severe pain [48]. Although majority of respondents with LBP in the current study reported minimal disability, strategic measures must be put in place to minimise the progression of their disability from minimal to significant disability. These measures should also be aimed at reducing the level of pain for those with moderate/severe disability to minimal disability.

Risk factors for LBP disability

The results of logistic regression analysis have shown that female gender generally increases the odds for LBP disability among Botswana teachers. Female teachers were 2.47 times more likely to experience moderate/severe disability or being crippled than their male colleagues (OR: 2.47, 95% CI: 1.52-3.99, $p < 0.001$). The corrected logistic odds ratio showed that female teachers were 2.31 times more likely to report moderate/severe disability or being crippled than male teachers (95%CI: 1.53-3.49). Similar findings have also been found in a study of Turkish teachers where females reported more severe pain than their male counterparts in the upper back ($p = 0.008$) and lower back ($p = 0.022$) [26]. Contrary to these results are the findings of a Chinese study that did not find any significant difference in the LBP disability among teachers. That study rather found that female teachers experienced a higher pain intensity in the shoulder than male teachers ($p < 0.001$) [21].

A history of low back injury was strongly associated with low back disability in the chi-squared and multiple logistic regression analyses of data in the current study. Previous injury at the lower back region was positively associated with LBP disability among teachers who had reported experiencing LBP (OR: 3.01, 95%CI: 1.92-4.74, p

< 0.001), with corrected logistic odds ratios 2.02 (95%CI: 1.57-4.47). Parallels can be drawn to the results of a study carried out among high school students from Starr County, Texas, where previous back injury was positively associated with severe back pain (OR: 9.04, 95%CI: 3.55-23.01) [49]. The literature suggests that, although research has been carried out to determine the prevalence and risk factors of LBP among school teachers, little research has been conducted to establish the level of disability caused by these disorders in the teaching profession.

Limitations

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 LBP. It is not clear if participants correctly remembered the presence of LBP in the last 12 months which could lead to over or under estimation. The presence of LBP depends solely upon the subjective self-report of the participants and not based upon an objective clinically verified diagnosis of a specialist. There could also be underestimation of the role of the risk factors assessed due to the large number of independent variables within the logistic regression analysis.

Conclusions

Overall, this study has shown that LBP is reasonably common among teachers in Botswana and comparable to the prevalence rates documented in other countries. A wide variety of LBP risk factors were identified during logistic regression analysis, suggesting that the aetiology of this condition is complex and multifactorial in nature. Female gender and previous injury were both positively associated with LBP presence and disability. The complex nature of LBP risk factors found in this study suggests than no single specific preventative or intervention strategy will help in reducing these conditions. As such, to help reduce the prevalence, progression and burden of LBP among Botswana teachers, a greater emphasis should now be placed on ergonomics education, regular physical exercise and occupational stress.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

PNE and DRS conceived and designed the study. PNE carried out data collection and analysis and wrote the first draft of the paper. PNE and DRS read and approved the final manuscript. All authors read and approved the final manuscript.

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Paper 5

The development of an ergonomic training manual to help prevent work-related musculoskeletal disorders in the teaching profession

Introduction to Paper 5

As previously suggested in Paper 1, that teachers around the world appear to be at a high risk of MSD, Papers 3 and 4 suggest that MSD is reasonably common among teachers in Botswana, a developing country. This suggests that MSD is probably as common among teachers in Botswana as it is elsewhere, similar to the rates suggested in Paper 1. Papers 1-4 suggest that MSD in multifactorial in nature and Papers 2, 3 and 4 have found that some factors have a protective effect against MSD. These findings are important in the selection and introduction of appropriate intervention strategies for MSD among teachers in Botswana. Based on the results reported in Papers 3 and 4 and also the results of the review articles conducted for this project (Papers 1 and 2), an ergonomic training manual was developed to help raise the awareness of MSD among school teachers.

Paper 5 describes a quantitative study that was carried out to determine the effectiveness of an ergonomic training manual developed to help prevent MSD among teachers and also highlight any potential areas for improvement. This paper highlights areas of importance in the training manual, and significantly contributes to the overall body of knowledge, being a positive step forward in the prevention and management of MSD for teachers.

The development of an ergonomic training manual to help prevent work-related musculoskeletal disorders in the teaching profession

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Abstract

Background

This paper describes the development of an ergonomic training manual to help prevent work-related musculoskeletal disorders (WMSDs) among teachers. Although WMSDs represent a common occupational problem for workers throughout the world including teachers, very few studies have been conducted on the prevention and intervention strategies for these disorders among teachers. The aim of this study was therefore to develop cost effective, easy to implement solutions to help reduce the prevalence, progression and impacts of WMSDs among teachers.

Methods

A training manual was developed to assist teachers to conduct a basic ergonomic evaluation of their work tasks and workstations, to identify possible risk factors for WMSDs, and to help them carry out simple but effective improvements. A questionnaire was then administered to 21 teachers across 7 educational regions in Botswana to test the effectiveness of the manual among this group.

Results

The results indicated that the manual has a potential to raise WMSDs awareness among teachers, with the mean score for the contents of the training being 9.0 out of a possible 10. The participants indicated that teachers will benefit from the manual because most had little knowledge of how to identify and prevent WMSDs.

Conclusion

The development of a WMSDs training manual may be seen as positive step forward in the prevention and management of these disorders among teachers, especially in developing countries.

Keywords

Ergonomic training, exercise therapy, musculoskeletal disorders, teachers,

1. Introduction

Work-related musculoskeletal disorders (WMSDs) are highly prevalent in almost all job categories and have, therefore, become one of the most common workplace health issues in the world today (1, 2). Teachers represent a large occupational group among whom there appears to be a high prevalence of WMSDs (3, 4). WMSDs decrease productivity at work due to sick leave, absenteeism and early retirement (5-7), they are responsible for a substantial impact on quality of life; and also incur a major economic burden due to compensation costs and lost wages(8, 9). By definition WMSDs include a wide range of inflammatory and degenerative conditions affecting the muscles, ligaments, tendons, nerves, bones and joints; and can occur from a single or cumulative trauma (10, 11).

A recent literature review revealed that the prevalence of WMSDs among teachers ranges from 39% to 95% around the world (3). Teachers typically spend long hours on various activities such as face to face teaching, marking or correcting students' work, helping students with their work, preparing for lessons and taking part in extracurricular activities. Their WMSDs are therefore, complex and multifactorial in nature, and several work-related factors have been associated with the development of WMSDS in the teaching profession. Ergonomic issues such as poor posture, inappropriate furniture, lifting and carrying have been associated with a high prevalence of WMSDS (5, 12-14). Psychosocial factors such as job demands, poor colleagues and supervisor support, low job satisfaction and high job stress are also known to be associated with WMSDS in the teaching profession (1, 8, 15-17). Despite their large demographic around the world and the associated potential for occupational health problems, few studies have investigated WMSDS among teachers and even fewer have proposed any realistic solutions, especially in developing countries.

1.1. Rationale for Developing a Training Manual

From a medical, social and economic point of view, the cost of WMSDs is substantial and there is, therefore, an urgent need to develop effective control measures for their prevention and management (18). As previously described the literature indicates that WMSDs are probably caused by a wide range of factors (2, 19, 20). In view of these findings, different ergonomic intervention strategies would clearly need to be deployed to prevent WMSDs and progression of their symptoms among teachers. Current knowledge suggests that WMSDs prevention can be divided into three aspects: primary, secondary and tertiary prevention. Primary prevention refers to interventions and strategies that are implemented before WMSDs occurs and should be initiated at the beginning of a teaching career, perhaps even during teacher training. These can help prevent WMSDs and preserve career longevity (21). Secondary prevention on the other hand, comprises of interventions and strategies implemented after the occurrence of WMSDs, but before chronic symptoms occur (22). Such measures include early diagnosis and aggressive treatment of WMSDs. In practice, the secondary prevention of WMSDs generally targets biomechanical risk factors even though previous research suggests that psychosocial and individual risk factors play an essential role in WMSDs development, severity and disability (23). Lastly, tertiary prevention includes successful rehabilitation after injury (21).

1.2. WMSDs Prevention

There is an increasing body of evidence to suggest that WMSDs can be prevented by using an occupational health and safety hierarchy of controls, including engineering, administrative and personal protective interventions (24). Engineering interventions relate to the physical manipulations of hazards or routes of exposure to physical hazards such as adjustable office equipment. Administrative interventions focus on changing the duties or the design of the work such as job rotation while personal interventions concentrate on the worker's behaviour or capacity (25). Engineering interventions are, in most cases permanent, they affect all workers on the job and are unlikely to be bypassed under time pressures when compared to administrative and personal interventions. As a result, engineering interventions are usually recommended as a primary control measure while administrative controls are recommended only if job design changes cannot be instituted or further risk reduction is required. Personal interventions, and or, protective equipment should be recommended as the last resort in control of risk factors.

Despite these facts however, in the real world, administrative and personal interventions are usually put in place before engineering controls in the workplace. This occurs conceivably because engineering controls are usually expensive and take time to implement (25). Considering the costs of introducing engineering control measures, especially in developing countries where most government health spending is focused on public health, it is appears prudent to recommend less expensive, practical and easy to implement control measures which may lead to the prevention and reduction of WMSDs among teachers. Again, borrowing from the popular saying that, ‘prevention is better than cure,’ one would ideally make teachers aware of WMSDs before and during the course of their careers before they develop WMSDs and/or become significantly affected by them. It is against this backdrop that a training manual was developed to raise awareness among teachers regarding WMSDs by highlighting risk factors associated with their duties and help implement appropriate and cost-effective prevention strategies.

2. Materials and Methods

2.1. Aims

The aim of the study was to develop a cheap, simple and effective training manual to provide ergonomic education which can help raise awareness of WMSDs among teachers. This would, ideally, help reduce the prevalence of WMSDs in the teaching profession and help improve health outcomes for those teachers who are already affected by WMSDs. Our ultimate aim would be to reduce the prevalence and impact of WMSDs among teachers on a national and international scale.

2.2. The training manual

In order to integrate appropriate control measures in the workplace, there is firstly a need to carry out an ergonomic risk assessment. Risk assessment involves different stages, namely; hazard identification, hazard characterization, exposure assessment and estimation of risk (24). It can sometimes be a tedious and difficult process, especially if undertaken by someone who has not been trained in ergonomic risk assessment or not conversant with the subject. Given that out manual targeted the teachers themselves, simple ergonomic risk assessment aspects were incorporated to enable teachers to conduct a basic ergonomic evaluation of their own work tasks and work spaces. The manual was developed in such a way that the steps taken for teachers to improve their workplace were practical and easy to follow, and this was achieved by incorporating the following areas:

1. Action check points (A checklist of problems for teachers to recognise by themselves)
2. Teachers' tasks and duties and WMSDs (An explanation of general WMSDs risk factors in the teaching profession)
3. WMSDs prevention and intervention strategies (Proposal for improvements applicable to the teaching profession)

2.3. Significance of the Training Manual

Although our training manual was predominantly designed to raise ergonomic awareness among school teachers, it is also envisaged that curricular developers may ultimately introduce courses or modules on ergonomics awareness and adopt the manual for use among student teachers. The manual may also be adopted for the training of teachers on WMSDs. Our training manual is envisaged to be effective in helping to prevent and minimise the effects of WMSDs as it may enable teachers to perform simple ergonomic evaluations of what they do on daily basis and conduct a basic assessment of their work environments.

2.4. Pilot study

After developing the training manual, a pilot study was then conducted to determine its effectiveness and highlight any potential areas for improvement. The training manual was pre-tested in order to:

- Determine whether the training manual can raise WMSDs awareness.
- Assess whether the proposed improvement plans will be implemented.
- Assess whether its contents are suitable and relevant for teachers.
- Identify any other problems and consider solutions for improvement.

2.4.1. Pilot study procedure

An earlier study had already been conducted in the seven educational regions of Botswana to determine the prevalence and risk factors for WMSDs among primary, junior and senior secondary school teachers. As such, it was considered appropriate to conduct the pilot study in these same seven regions and also in the different school categories. For practical reasons, three participants were invited from each educational region, one from a primary school, one from a junior secondary school and one from a senior secondary school. This was to enable the researcher to receive feedback on the training manual from all education regions that formed part the initial study and from all school categories. From the existing contacts, the teachers were grouped according to the educational regions they taught in, and within those regions, further grouped into the school levels in which they taught. From each school category, one teacher was randomly selected and invited to participate in the pilot study. Convenience sampling was used for this part of the study, given that the main purpose of the pilot study was to improve the training manual.

A copy of the training manual and a feedback form were provided to each teacher as attachments to the emailed Participant Information Statement. Upon receiving these documents, participants were required to read the Participant Information Statement which outlined why the study was being conducted, as well as highlighting the participants' right to withdraw at any time. Additionally and most importantly, participants were asked to carefully study the training manual and provide their candid feedback. The feedback form comprised seven questions, with the first three being answered using a 10-point Likert scale to establish teachers' knowledge on WMSDs before and after reading the manual and to rate its contents. Questions 4 to 6 established if the contents of the training manual were easily understandable, if they would apply what they learnt from the manual, and if the teachers themselves would recommend it to their colleagues. These were yes or no questions. Lastly, question 7 asked for any additional comments that participants may have had regarding the training manual. The survey was distributed by email in 2014, with participants given 2 weeks to respond.

3. Results

From the 21 participants invited to take part in the pilot study, around half, 11 (52.4%) completed and returned their feedback forms within the prescribed follow up period. In the 10-point Likert scale, the mean score for WMSDs knowledge before and after reading the manual were 3.18 and 8.82 respectively. These results suggest that participants had limited WMSDs knowledge before reading the manual. The differences between mean scores suggest that after reading the manual, the teachers in this study improved knowledge on WMSDs. It can therefore be deduced that our ergonomic training manual has the potential to raise WMSDs awareness among teachers, which from the start, was an overarching aim for this study. The mean score given by the participants for the contents of the training manual was 9.0 out of a possible of 10. From this result, it can be surmised that the participants found the contents of the manual to be relevant, informative and useful.

All participants indicated that the contents of the manual were easily understandable, that they will now apply what they have learnt in their workplace, and that they would also recommend the manual to their colleagues. From this, we surmised that the training manual was indeed suitable for teachers and easy for them to follow through. Most importantly, the participants indicated that they will now the new ergonomic knowledge they have learned. This is likely to help participants implement some improvement plans that can help reduce the prevalence and severity of WMSDs among teachers. Participants described how the training manual was an ‘eye opener’ for them and how teachers will definitely benefit from this kind of ergonomic manual, given that most were not very aware of the risk factors for WMSDs in their workplaces. Participants said they appreciated the availability of this kind of training manual and recommended the further training of teachers on WMSDs, hoping that this kind of training will help to improve their health, and ultimately, their performance for students.

4. Discussion

This study describes the development of a relatively simple and yet, very practical ergonomics training manual for teachers in a developing country for what appears to be one of the first times. It is worth noting that in many developing countries, WMSDs issues are not usually given a high priority when compared to other more urgent health issues such as non-communicable/chronic diseases such as cardiovascular diseases, cancers, respiratory diseases and diabetes. Of late, more attention has been given to these diseases as they have been found to affect low and middle income countries where nearly 80% (29 million) of non-communicable diseases occur and their deaths have been projected to increase significantly in Africa by 2020 (26). While it is commendable and logical to focus on such diseases with high death rates, it is equally important not to neglect non-fatal health issues such as WMSDs, as they may prove to be costly and difficult to manage in future. In fact, although musculoskeletal conditions rarely cause death and rank only seventh in the numbers of patients admitted to hospital, they do however rank fifth for drug costs, third for chronicity, second for total health costs and first for health consultations and are the most disabling conditions in developed countries (27). In the US for example, the annual costs associated with the diagnosis and care of musculoskeletal trauma amounts to tens of billions of dollars. Moreover, these costs are continuing to increase at an alarming rate, so much that, WMSDs are, now the leading cause of work disability in the US (28).

In the teaching profession, WMSDs has been shown to lead to ill health retirement of school teachers in for example, developed countries such as Ireland (6) and

Scotland(29). In developing countries, however, the true burden of WMSDs and its impact on workers' productivity is not known. One can imagine that the burden is probably high. In a recent study of school teachers in Botswana, for example, it was found that WMSDs prevented some teachers from carrying out their normal activities, and caused some to change jobs or duties, reduce their activity at home and seek medical attention. Some teachers reported that experiencing these disorders made them unable to work for several days Therefore, if preventative control measures are not put in place to curb WMSDs and the progression of symptoms, governments of all countries might find themselves battling with more widespread disabilities and increased health costs associated with WMSDs in future.

Awareness and knowledge of the relationship between school teaching and WMSDs are important for preventing WMSDs and minimising their progression in the teaching profession. In this regard it has been found that employee education/training is a primary way to prevent WMSDs in the workplace. A main assumption of ergonomic training principles is that knowledge of appropriate ergonomic arrangements and usage practices can lead to positive actions and a consequential positive impact on risk factors(30). Occupational health education for workers has often been considered one of the more effective prevention measures in the workplace (31-35). However, considering the evidence that ergonomic training alone may not effectively reduce WMSDs (22, 36), exercise therapy was also incorporated in the training manual we have designed for this study. Exercise therapy was chosen over other possible intervention measures because some previous research suggests that exercise therapy can help prevents WMSDs in the general population (18, 22, 37-41). Furthermore, exercise therapy has been found to likely improve pain and function in chronic non-specific low back pain, especially if it includes stretching and strengthening aspects(42). Regular physical exercise has also been found to have a protective effect against WMSDs among teachers (14, 15, 43), and as such, was also deemed appropriate for the current study.

5. Conclusions

The development of a WMSDs training manual for teachers represents a positive step forwards in the prevention and management of these disorders in developing countries. Teachers play a crucial role in the production of vibrant, robust and active citizens who can effectively and efficiently partake in growing their countries. Therefore, it is crucial to consider the ergonomic aspects of teaching at the forefront of public health efforts, and more importantly, their occupational health and safety issues. This will go a long way in helping the risk factors that teachers are exposed to whilst carrying out their daily job tasks.

Conflict of Interest

The authors declare that there are no conflicts of interest.

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Paper 6

Musculoskeletal disorders in the teaching profession: an emerging workplace hazard with significant repercussions for developing countries

Introduction to Paper 6

Paper 6 provides a summary of the results of the entire study. The paper includes the findings of the literature review and results of the study, as described in Papers 3 and 4. The main aim of the paper is to raise awareness of MSD in the teaching profession. The paper highlights the body sites prone to the development of MSD, associated risk factors and the impacts. It suggests that because MSD is multifactorial in nature, any single intervention strategy would likely be suboptimal in reducing the prevalence, progression and impacts these disorders among school teachers. The paper also suggests that to help reduce MSD in the teaching profession, ergonomic training must be introduced for student teachers, while refresher courses highlighting work tasks and the working environment should also be introduced for in-service teachers.

Musculoskeletal disorders in the teaching profession: an emerging workplace hazard with significant repercussions for developing countries

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Musculoskeletal disorders (MSD) represent one of the most common and important occupational health problems in the teaching profession, which although long neglected, has attracted increasing concern in recent years[1, 2]. By definition, MSD include a wide range of inflammatory and degenerative conditions affecting the muscles, joints, tendons, ligaments, nerves, bones and the localised blood circulation system, that may be caused by or aggravated by work tasks and by the effects of the immediate environment in which work is carried out[3]. School teachers in general, have been demonstrated relative to other occupational groups, to report high rates of MSD[4] of between 40% and 95%[5]. The work of a teacher involves not only teaching students, but also preparing lessons, assessing students' work and extracurricular activities, such as sports. These activities may cause teachers to suffer adverse mental and physical health issues due to their unique and wide variety of job functions[6].

By body site, school teachers appear to be more prone to suffer MSD of the back, neck and upper limbs[4, 6-8]. While a number of studies have been carried out to specifically investigate back and neck related MSD, few studies have looked at whole body MSD, and even fewer have been carried out to specifically investigate MSD of the lower extremities. The literature suggests that the cause of MSD is multifactorial[5, 9, 10], with individual factors such as female gender [1, 11], smoking, sleep disturbance, previous injury and number of children having been found to contribute[12]. While MSD has been positively associated with length of employment, research findings are somewhat inconsistent in this regard, with some studies reporting longer length of employment as being positively associated with MSD; while others have found that new teachers are more likely to report MSD. Similar, albeit conflicting, findings have also been observed for age[5]. Work-related factors such as school level, prolonged standing, sitting and awkward posture are known to be positively associated with MSD[1, 12, 13]. Research suggests that psychosocial factors such as high workload/demands, high perceived stress levels, low social support, low job control, low job satisfaction and monotonous work are most likely associated with MSD among school teachers[5, 11]. On the other hand, factors such as regular exercise and satisfaction with one's work environment may have a protective effect against MSD within this occupational group[11].

In the teaching profession, MSD has been shown to lead to ill health retirement of school teachers in, for example, developed countries such as Ireland[14] and Scotland[15]. In developing countries, however, the true burden of MSD and its impact on workplace productivity is not well known. One can hypothesise that the burden is probably high. In a recent study of school teachers in Botswana, for example, it was found that MSD prevented some teachers from carrying out their normal activities, and caused some to change jobs or duties, reduce their activity at home and seek medical attention. Some teachers in this study also reported that MSD resulted in them being unable to work for several days[1]. This clearly suggests that if preventative control measures are not put in place to curb the burden of MSD and the progression of symptoms; governments of all countries will likely find themselves battling with more widespread disabilities and increased health costs in future.

The complex nature of MSD risk factors in developed and developing countries suggests that any single intervention strategy would probably be suboptimal in reducing MSD among school teachers. In fact, if little or nothing is done to reduce the prevalence rate of this crucial workplace problem, MSD may potentially lead to reduced teachers' performance which may contribute to poor students' performance, increased sick leave, ill-health, early retirement or increased health care costs. Cost-effective intervention strategies are particularly important for developing countries. Therefore, to help alleviate the burden among teachers in these regions, as elsewhere, a greater emphasis needs to be placed on raising MSD awareness. Awareness and knowledge of the relationship between school teaching and MSD are important for preventing MSD and minimising their progression.

In addressing the serious issue of MSD in the teaching profession, ergonomics training specific to MSD risk factors and prevention should now be introduced into teachers' training institutions, while refresher courses relating to the work tasks and workstations of teachers should also be introduced for in-service teachers. As the majority of MSD studies conducted among teachers have focused on recall information and self-reported MSD, future research may involve clinical diagnosis of MSD and its severity, ideally undertaken with longitudinal studies. Future research should employ a mixed-methods approach, to include a more rigorous quantitative approach such as observational studies which include the physical observation of teachers when carrying out their work tasks and inspection of their workstations for further identification of risk factors. Future research should also consider the epidemiological profile and medical causes of ill-health or early retirement of teachers in both developed and developing countries. The implementation of these measures will go a long way in helping to alleviate the significant burden of workplace injury amongst this important occupational group.

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DISCUSSION

AND

CONCLUSIONS

Discussion

Musculoskeletal disorders (MSD) represent a common occupational problem among school teachers both in developed and developing countries. To implement effective intervention and prevention strategies for these disorders, it is important to understand not only the magnitude, but also the factors that influence the development and progression of these disorders among teachers. It is equally important to understand factors that may have a protective effect against MSD. The literature suggests that few studies have been carried out to investigate whole body MSD among school teachers[1]. Furthermore, there is paucity of studies that have been carried out to establish the level of disability caused by these disorders[2]. The aim of this research project was to address this knowledge gap and investigate whole body musculoskeletal disorders among teachers in Botswana. A cross-sectional study using self-administered questionnaires was conducted in seven educational regions in Botswana between 2012 and 2013. The use of a number of standardised questionnaires allowed this study to capture demographic and individual data of participants, their musculoskeletal discomfort, low back disability and their physical and psychosocial work demands.

This discussion brings together the findings of the papers included in this thesis and discusses them in the context of the main aims of the thesis. Firstly, the findings of the literature review are outlined. Secondly, the prevalence and distribution of MSD are discussed. Thirdly, a discussion of the findings regarding factors associated with MSD is made. This is followed by a discussion on the low back disability and its associated risk factors. The development of an ergonomic training manual for the prevention and management of MSD among teachers is also discussed. Lastly, recommendations, strengths and potential limitations of this research are discussed.

The literature review

The first aim of this study was to review all relevant literature concerning the prevalence and risk factors for MSD in the teaching profession. This literature review which is described in Papers 1[1] and 2[3] was undertaken to gain insight into MSD in the teaching profession which was then used to inform other parts of the thesis. The literature review identified gaps and limitations in previous studies. One strength of the existing literature identified was that although MSD is most likely an under-researched topic among school teachers; there is nevertheless a wealth of information available regarding the prevalence and risk factors for MSD. Paper 2 identified protective factors for MSD among teachers[3]. The majority of studies reviewed in Papers 1 and 2 investigated MSD among different school levels and also among teachers of different subjects' teachers. A careful assessment of studies included in Paper 1 indicates that teachers are at a high risk of MSD, and both papers found that MSD is multifactorial in nature. Similar results have been reported in Papers 3[4] and 4[2].

A major limitation of previous research is the paucity of studies conducted on whole body MSD. The majority of studies included in Papers 1 and 2 investigated low back pain[5-11] and upper extremities pain[12-16]. Of the studies included in Paper 1, only three had investigated whole body MSD among teachers[17-19]. In Paper 2, two more studies were found to have investigated whole body MSD[20, 21]. Another weakness of the literature is that, even though low back pain has been reported to be one of the most common musculoskeletal conditions in the general population and among school teachers, there is lack of studies which have investigated the level of low back disability among teachers. Another weakness identified is that studies included in this review tended to measure different musculoskeletal regions by using different methods. The majority of studies have utilised self-developed questionnaires[7, 9, 16, 19, 22-25] while others used standardised questionnaires such as the Standardized Nordic Questionnaire[5, 8, 18], Neck Pain Questionnaire[12, 13], Health[6] and Job Content Questionnaire[10]. However, the review helped gain valuable insight into data collection tools that have been used previously and informed the development of new measuring tools which are described in the methods and material sections of Papers 3 & 4.

The prevalence and risk factors for MSD in the teaching profession

Paper 1 suggests that although MSD is most likely an under researched topic among school teachers, teaching itself represents a high risk occupation for MSD. The review found that the prevalence of self-reported MSD among school teachers ranges between 39% and 95%[1]. The review also revealed that the MSD prevalence rate among teachers is, however, not uniform. For example, physical education teachers have been found to have low prevalence of MSD at other body regions except for the knee, while music teachers appear to be at an increased risk of MSD. Music teachers have also been known to retire before their retirement age due to MSD. Paper 1 suggests that primary and secondary school teachers are more prone to neck, shoulder and back pain, with back pain being the most prevalent form of MSD. Paper 1 revealed that low back pain appears to be more prevalent than upper back pain. A relatively low prevalence has been found for MSD of the lower limbs, a possible explanation as to why these disorders appear to have been less well researched[1].

Papers 1 and 2 suggest a strong association between MSD and individual, physical and psychosocial factors among teachers. Individual factors such as gender, working hours, smoking and body mass index were associated with MSD. However, conflicting findings have been reported for age and length of employment. Physical factors such as lifting heavy loads, prolonged sitting or standing, awkward postures and inappropriate furniture were found to be significant risk factors. The literature reviews covered in Papers 1 and 2 further shows that psychosocial risk factors such as poor mental health, low colleague support, high anxiety and low job satisfaction are associated with MSD[1, 3]. On the other hand, Paper 2 suggests that undertaking regular exercise, job satisfaction and satisfaction with their working environment and culture can all contribute to a reduction of MSD among teachers[3].

The prevalence of MSD among school teachers in Botswana

Another aim of this study was to establish the prevalence and distribution of whole body MSD among school teachers in Botswana in order to develop an easy to implement and cost-effective intervention. This aim is addressed in Papers 3 and 4, which investigated the prevalence of MSD and lower back MSD among school teachers in Botswana, respectively. The prevalence of MSD at any body site was 83.3% among school teachers in Botswana[4]. In the systematic review described in Paper 1, the prevalence of MSD for any body region was not uniform, with rates ranging between 39% and 95%. The prevalence of any body MSD in this thesis is analogous to that reported among music teachers even though music teachers have been suggested to be at an increased risk of MSD when compared with other school teachers[1]. When compared to the findings of studies included in the review, the prevalence in this study was relatively high. A study of school teachers in Sweden found that 40% of teachers reported experiencing MSD[26], while in Germany prevalence of MSD among school teachers was 42%[27]. A slightly higher prevalence was reported among primary and secondary school teachers in Turkey (51.4%)[19], Brazil (55.0%)[23] and Estonia (66.7%)[28]. In more recent studies, the prevalence of MSD was found to be 60.3% and 67.9% for teachers in Samsun, Turkey[21] and India[29], respectively and 79.2% for secondary school Saudi female teachers[30]. On the other hand, prevalence found in the current study is lower than that reported by primary and secondary school teachers in China (95.1%)[17]. The finding of this thesis suggests that teachers in Botswana are at high risk of reporting MSD.

By individual body regions, the 12-month self-reported prevalence of lower back, upper back, shoulder and neck MSD among teachers in Botswana was 55.7%[2], 52.6%, 52.5% and 50.8%[4], respectively. The results of this study suggest that lower back MSD is slightly prevalent than upper back MSD, which is consistent with results of a Turkish study which found that 43.8% of school teachers reported low back pain, compared to 36.9% of whom reported upper back pain[19]. Analogous results have been demonstrated in a Chinese study where 59.2% teachers reported low back pain compared to 52.5% who reported upper back pain[17]. These results are consistent with some previous research among school teachers[20, 21, 31]. Furthermore, a number of Swedish studies conducted among music teachers have found similar trends[14, 15, 18]. About 37.8% of teachers described in this thesis reported MSD of the ankles/feet. Knee and wrists/hands MSD were equally reported MSD subtypes affecting 33.3% and 30.7% of teachers, respectively. MSD of the hip/thigh was reported by almost one-fifth of teachers (18.2%). This study shows that MSD of the elbows was the least reported of all the MSD categories, affecting only 13.3% of Botswana school teachers[4]. The prevalence rates reported in Paper 3 and Paper 4 are similar to some studies included in Paper 1, but higher than in some other studies[1].

The results of this thesis confirm that teachers are clearly at risk of developing MSD. From the basic prevalence rates, it can be seen that MSD contributes a high degree of morbidity to Botswana teachers, in most cases even more so than for their international counterparts[1, 2, 4]. It appears that MSD of the back and neck/shoulder are the most prevalent when compared to MSD of the upper and lower limbs, a trend that has been identified in other studies that investigated whole body MSD[1]. Similar results have been found in a more recent study of teachers in China where 58%, 49%, 37% and 25% of school teachers reported neck/shoulder, low back, lower limbs and upper limbs pain, respectively[32]. The lower prevalence of MSD for upper and lower limbs could be a possible explanation of limited literature on upper and lower limbs MSD, as compared to MSD in other body regions. In order to address the issue of MSD among teachers in Botswana, there is a need to develop prevention and intervention strategies aimed at helping to reduce the prevalence, progression and impact of MSD. However, to develop such appropriate intervention and prevention strategies, it is imperative to identify factors that are associated with MSD in the study population. Hence, factors that are associated with MSD among school teachers in Botswana are discussed in detail in the following section.

MSD risk factors

Another aim of this study was to determine the risk factors associated with MSD among school teachers in Botswana. During data analysis, chi-squared tests were initially used to determine basic associations between MSD and risk factors. Logistic regression was then used to analysis the statistical associations between factors that were positively associated with MSD when using the chi-squared test. Detailed logistic regression revealed a number of interesting associations between MSD and individual, lifestyle, physical and psychosocial factors in this study. Factors such as female gender, age, previous injury, number of children under six years of age, length of employment and high psychological job demands were positively associated with MSD among school teachers in this thesis[2, 4].

Individual risk factors

Female gender

In this study, female teachers in Botswana showed a statistically significant higher prevalence of shoulder (56.2% vs 42.8%), upper back (57.0% vs 40.9%) and lower back (58.7% vs 47.7%) MSD when compared to their male counterparts. Female teachers were more likely to experience upper back MSD (Odds Ratio [OR]: 1.50, 95%CI: 1.12-2.02), lower back MSD (OR: 1.51, 95%CI: 1.14-2.00) and shoulder MSD (OR: 1.69, 95%CI: 1.26-2.25) more than male teachers[2, 4] which is consistent with previous studies conducted in the teaching profession[1, 3]. Similar findings have also been found in recent studies of MSD among school teachers in China[33], Ethiopia[34] and Iran[31]. One possible reason for gender differences in this study could be the nutritional status of female teachers, given that a higher proportion were found to be overweight when compared with their male counterparts. Females had a higher average BMI than males (27.6±7.0 vs 24.8±5.8, $p<0.001$). Older age and extensive teaching experience could also be contributing factors as females were significantly older than males (39.3±9.0 vs 36.3±7.0 years, $p<0.001$) and had a significantly longer working experience than their male colleagues (13.4±8.8 vs 10.1±6.3 years, $p<0.001$). Moreover, males were involved in more regular physical exercise than female teachers (18.1% vs 10.4%, $p<0.001$)[4].

Other possible reasons for female teachers to report MSD at higher rates than male teachers could be that women were more likely to suffer from emotional exhaustion compared with their male colleagues[35]. It has also been suggested that women might be more likely to report pain than men because women have lower physical strength, pressure from family and career prospects; or simply the fact that men and women have different traditions and thresholds for when and how they report pain[17]. Other possible reasons could be that men are embarrassed or reluctant to report their health problems even though they experience them; or conversely, the overstatement or exaggeration of the female respondents[17]. Moreover, it has been found that women bore more heavy housework responsibilities than males in their daily life and research suggests that differences in household task participation may explain MSD differences between men and women[36, 37]. Given that female teachers dominate the teaching profession in Botswana[38], it is concerning that they appear to be at a higher risk of back and shoulder MSD when compared to their male counterparts.

Age

While previous research findings are somewhat inconsistent with some studies reporting increasing age as being associated with MSD, whereas others have reported that younger teachers are more likely to report MSD[5, 12,17]; in this study, increasing age was positively associated with lower back and knee MSD. The results of this study suggest that increasing age increases the odds of developing lower back and knee MSD. Teachers aged 41-50 years were 1.56 and 1.91 times more likely to report lower back and knees MSD respectively, when compared to those who were 30 years of age or younger. Additionally, teachers who were more than 50 years of age were 1.85 times more likely to experience knee MSD when compared to those who were aged 30 years or younger[2, 4]. These results are consistent with previous research which also found that increasing age contributes to MSD of the lower back and knees among school teachers[1, 3]. In addition, increasing age has been reported by others to increase the odds of lower back and knee pain among Slovenian physical educators[39].

It has been suggested that the likely reason for a higher prevalence of MSD among older teachers is that as people age, there is a gradual decline in muscle mass, and they lose connective tissue elasticity and undergo a thinning of the cartilage between joints. On the other hand, healing slows down with advancing age whilst the body is simultaneously dealing with a lifetime of accumulated soft tissue damage[19, 23, 40]. Apart from the natural wear of the body, MSD among older teachers may be influenced by the work environment and the organisation of work[23]. It has been suggested that older teachers generally have reduced physical capabilities and slower physiological response when compared with their young colleagues[8]. Against this backdrop, it is not surprising to find that older teachers in Botswana were at increased risk of lower back and knee MSD. Botswana teachers, especially in primary schools, are subjected to a heavy workload which is characterised by extracurricular activities which might lead to extended hours of work, leading to decreased rest and recovery time. In addition, more than half of the teachers in Botswana in this study were overweight or obese (BMI ≥25)[4], a factor that has been significantly associated with knee pain among school teachers in some previous research[21].

Previous injury

Previous injury to a particular body site was also a risk factor for the development of MSD at that particular body site. In this study, previous injury was strongly associated with all MSD of different body regions, with the odds ranging between 3.24 and 14.04[2, 4]. This finding was similar to results of a study conducted in Ethiopia where it was reported that teachers who had history of low back injury were 1.96 times more likely to develop low back pain than those who had no history of low back injury (OR: 1.96, 95% CI: 1.04-3.96)[34]. A similar link has also been demonstrated between prior injury and upper extremities, back and lower extremities among male steelworkers in Korea[41] and between prior injury and subsequent injury[42]. Previous musculoskeletal clinical history has also been linked with the development of MSD among Italian health care workers[43].

Number of children under six years of age

Having two or more children under the age of six years was statistically significantly associated with MSD of the elbows among school teachers in Botswana[3]. These results are consistent with previous research which also found the number of children to be associated with elbow joint pain and upper limb pain among secondary school teachers in Saudi Arabia[30] and school teachers in Brazil, respectively[23], Japanese nurses[44] and among police officers and firemen[45]. As previous alluded to in this thesis, there is deficiency of studies that have reported on elbow MSD hence a comparison of prevalence rates was not limited to number of children and elbow MSD only but also with other body site MSD or overall MSD. 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 for those who never attended school. These differentials indicate that education delays the age of childbearing[46]. Bearing this in mind, one can hypothesize that the childbearing age of teachers with Diploma or Bachelor degrees, which most teachers 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[4]. If so, the increased elbow MSD risk could be attributed to the type of constant lifting and carrying that raising small children might require[44]. This relationship could also be due to increased recreational activities undertaken when one has children[45].

Work-related risk factors

Length of employment

This study found that, among work-related risk factors, there was a statistically significant association between increasing length of employment and knee MSD. Increasing length of employment was not positively associated with any other body site MSD in the current study. Teachers with 21-30 years and more than 30 years working experience were 1.70 times and 2.25 times more likely to develop knee related MSD when compared to those with 10 years working experience[4]. This result is analogous to a previous study conducted among Brazilian teachers 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)[23]. A similar link has also 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[29].

This association might be interpreted as an effect of aging or a cumulative effect of workloads on the musculoskeletal system of workers[16]. Age and length of employment were statistically associated in this study and it is difficult to separate their effects. The results of this study show that teachers aged 41-50 years and above 50 years old were found to be at increased risk of knee MSD[3]. At this age, teachers would be likely to develop prevalent degenerative changes of their musculoskeletal system or a reduction of muscular strength sufficient to induce frequent musculoskeletal injuries[4]. Additionally, it appears that the cumulative effect of workloads would also likely contribute to knee MSD. It is worth noting that most Botswana teachers start teaching as early as 21 years of age. At the age of 41 years, one will have had about 20 years of teaching experience, and will have had sufficient time of exposure and/or have been likely affected by factors associated with their work tasks and workstations[4]. It has been suggested that the longer the exposure time to occupational risk factors, the higher the chance of getting job-related disorders[47]. It has also been established that occupational diseases do not happen suddenly, but rather they happen over time, and almost with a predictive pattern[48]. Therefore, the association of knee MSD and length of employment among teachers in Botswana can be attributed to effects of ageing and workloads of teachers.

Physical risk factors

Teachers who reported that their job required rapid physical activity were found to be at an increased risk of shoulder, wrist/hand and hip/thigh MSD, while those who reported adopting awkward arm position at work were more likely to develop MSD of the lower back, upper back, shoulder and wrist/hand[2, 4]. These findings are similar to that reported among school teachers in Brazil were intense physical activity was positively associated with MSD[23]. Previous research has also found a strong association between work-related awkward postures and MSD[43, 49]. It has been hypothesised that shoulder pain may occur when working with raised arms unsupported for a long time, and this is a task often observed in teachers' daily routine[12]. Teachers' activities involve 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. Lifting of hands and head during writing on the black board may be a causative factor for shoulder pain and also pain in hands and joints of hands among school teachers in Botswana [4].

Psychosocial risk factors

The results of this study suggest that of all the psychosocial risk factors investigated; only high psychological job demands were positively associated with shoulder, upper back and lower back MSD. Teachers who had high psychological job demands were more likely to report shoulder, upper back and lower back MSD than those with low psychological job demands[2, 4]. 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[15]. Similarly, teachers who reported having stress were 4.15 and 2.18 times more likely to experience low back pain in the Philippines and Ethiopia, respectively than those without stress[34, 50]. High workload has been statistically associated with neck pain among Chinese teachers[13]. In a more recent study, psychological job demands were associated with MSD of any body region among school teachers[32]. The literature review of MSD among school teachers suggests 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[1, 3]. 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 any body region[2, 4].

A possible explanation for the positive association between high psychological job demands and shoulder, upper back and lower back MSD could be that teachers often work in stressful conditions with large classes, with a lack of educational resources and limited reward for their work. The results of this study demonstrated that the majority of teachers (72.8%) taught more than 30 students in each class[2, 4]. Another possible reason might be that, Botswana teachers are dissatisfied and frustrated with the conditions of services and workplace environments created by school management. They may feel a lack of recognition for achievement, lack of training opportunities, poor supervision and poor parental involvement in schools, and perhaps feel that the government is not doing enough to address their concerns. Moreover, Botswana teachers might perceive the promotion process in schools is unfair and not reflecting competence. Teachers have also been found to face a high amount of stress during teaching and handling young students and their stress level also increases when having to deal with students with emotional and behavioural problems[29]. It has also been suggested that the more psychological demands needed for a particular task, the greater the possibility to develop any kind of MSD regardless of the anatomical area[51].

MSD protective factors

High supervisor support

Teachers who reported that they had high supervisor support were less likely to report MSD of the neck, upper back and hip/thigh when compared to those with low supervisor support[4]. Similar results have been found among Australian female workers where workers with supervisor support were less likely to experience neck pain[52]. High supervisor support has also been negatively associated with neck and knee pain in a study that was conducted among patient care workers from two large hospitals in the greater Boston area in the US[53]. Parallels can also be drawn to the results of the study of employees of a steel company in Iran where supervisor support was negatively correlated with musculoskeletal symptoms[54]. In Japan, nursery school teachers who reported poor supervisor support were 1.58 more likely to develop neck/shoulder pain than those reporting high supervisor support (OR: 1.58, 95%CI: 1.15-2.16)[16]. Low management support has been found to predict back pain and general musculoskeletal pain among Norwegian automobile repair garage workers[55]. Furthermore, in the US, low supervisor support for work/family balance has been associated with an increased prevalence of employee-reported pain in extended-care facilities[56]. However, a study of psychosocial work characteristics among the working population in the Netherlands failed to produce statistically significant associations between supervisor support and neck pain in one study[57].

Teaching at secondary schools

A protective effect against MSD was also noted for secondary schools teachers in Botswana during the current study. Senior secondary school teachers were less likely to report MSD of the shoulder when compared to primary school teachers. On the other hand, junior secondary school teachers were less likely to report upper back pain, when compared to their primary counterparts[4]. Parallels can be drawn to the results of a Chinese study among school teachers which found that, primary school teachers were more likely to report shoulder pain than secondary school teachers[17]. In Slovenia, primary school physical education teachers were found to be almost two times more likely to experience lower back pain when compared to secondary school physical education teachers[39].

A possible explanation for the increased risk for MSD among primary school teachers in Botswana could be because of workload. In Botswana, primary school teaching appears to be characterised by heavy workloads. Primary school teachers are expected to teach many different subjects, emphasize child-centred teaching methodologies such as 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]. Moreover, primary school teachers' activities involve frequent use of the arm above the shoulder to write on the board. Such a mechanism probably causes teachers to experience levels of discomfort in the cervicobrachial region, which becomes worse with daily over work. 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.

Similarly, Slovenian primary school teachers were found to be at an increased risk of MSD when compared to secondary school teachers because of their higher physical work load[39].

It is interesting to note that, although 16.5% of senior secondary school teachers work more than 40 hours a week in comparison to 14.3% and 11.2% of junior secondary and primary school teachers respectively, primary school teachers were at an increased risk of MSD. Furthermore, about 74.4% of primary school teachers taught more than 30 students on average per class as compared to 66.3% and 85.9% of junior and senior secondary school teachers who taught more than 30 students per class. A possible explanation for this could be that primary school teachers teach more hours per week. In Botswana, primary school teachers teach all eleven primary school subjects over eight 40 minutes periods every day. Secondary school teachers, on the other hand, teach at most two subjects of their specialization and at most four 40 minutes periods a day. A study from Slovenia found that primary school physical education teachers were at an increased risk of MSD when compared to secondary school teachers because they had to teach 22 hours per week, compared to 20 hours a week for secondary school teachers[39].

Moreover, in Brazil it has been established that most elementary school teachers (81.3%) undertake a 40 hour-teaching week. In the same study, 61% of the teachers indicated that they use their weekends to carry out educational activities, thereby reducing their time to rest, to exercise and to have leisure[48]. In Botswana, primary school teachers still use blackboards and chalk. The use of blackboards for a considerable amount of time in an inappropriate posture could cause pain especially if the teachers do not have enough time to rest[29]. Comparatively, primary school teachers may be exposed to prolonged standing and prolonged writing on the board, (which are documented risk factors for MSD) more so than for secondary school teachers.

Another reason for the decreased odds of developing MSD among secondary school teachers could be, as shown by the results, the majority of primary school teachers (77.4%) were involved in extracurricular activities in their schools, when compared to junior (54.2%) and senior (44.1%) secondary school teachers[2,4]. Depending on how small or large primary schools are, some have as few as 7 teachers and some as many as 27 teachers, while junior secondary schools have at least 30 teachers and as many as 120 teachers in senior secondary schools. Extracurricular activities are part of the responsibilities of teachers in schools. Because of the relatively few teachers in primary schools, most end up being involved in these activities when compared to in secondary schools, where teachers can volunteer for the activities they prefer. Slovenian primary school teachers have also been found to be more involved with additional in school activities[39].

Female gender and age are also contributing factors. The majority of primary school teachers (83.0%) were females versus 60.8% and 51.8% in junior and senior secondary schools respectively[2,4]. Research has shown that female teachers are at an increased risk of MSD when compared to their male counterparts[19, 20, 23, 34]. Although in this study, age was not associated with MSD of the shoulder and upper back, the majority of primary school teachers were above 40 years (54.9%), while the majority of both junior (83.7%) and senior (63.8%) secondary school teachers were aged 40 years or less. The literature suggests that increasing age generally increases the chances of most of occupational health problems, especially those relating to MSD[16, 39].

Regular physical exercise

The results of this study suggest that exercising for five or more hours per week was negatively associated with MSD of the upper and lower back. Teachers who reported more than five hours of physical exercise per week were less likely to report MSD of the upper back and lower back compared to those who exercised less than five hours per week[2, 4]. These results are consistent with some research included in Paper 2 which found that regular physical exercise has negative effect against MSD[3]. Similar findings have been demonstrated in previous research where school teachers who have indicated doing regular physical activity were less likely to report MSD compared to those who did not engage in regular physical activity in Ethiopia[34], Estonia[59] and Sweden[15]. A similar link has been demonstrated between habitual physical activity such as athletic and MSD among Thai university staff[60]. It has been suggested that physical exercises may prevent lower back pain recurrences or chronicity. Research shows that shortened and weak muscles can cause back pain, as they cause misalignment of spine. Exercise on the other hand, can strengthen, lengthen and make muscles of the back strong to support and keep spine in perfect alignment for proper functioning. There is also strong evidence that endurance training including running, swimming, cycling or aerobic training might help prevent lower back pain[3].

Low back disability

Of those teachers who reported low back MSD, two thirds (67.1%) reported experiencing minimal disability, while 27.9% reported moderate disability, 4.3% severe disability and 0.7% reported being completely incapacitated. The results of this study indicated that none of the respondents had been bed ridden or might have exaggerated their level of pain. These results suggest that the majority of teachers probably experienced their lower back MSD at a tolerable level[2]. As discussed in Paper 4[2], teachers in Botswana appear to experience lower back MSD at tolerable levels when compared to their counterparts in the Philippines[50], Saudi Arabia[30] and Turkey[50]. Although the majority of respondents with lower back MSD in this thesis reported minimal disability, intervention strategic measures must be put in place to minimise the progression of their disability from minimal to significant disability. These measures should also be aimed at reducing the level of pain for those with moderate/severe disability to minimal disability.

Risk Factors for Low Back disability

Female gender

The results of this study indicate that female gender was positively associated with the level of low back disability among teachers in Botswana. Female teachers were more than twice more likely to experience moderate/severe disability or being completely incapacitated than their male colleagues (OR: 2.47, 95%CI: 1.52-3.99, p<0.001)[2]. These results are similar to findings of a Turkish study of teachers where females reported more severe pain than their male counterparts at the wrist (p=0.0044), upper back (p=0.008) and lower back (p=0.022)[19]. Contrary to these results, are the findings of a Chinese study that did not find any significant difference in the severity of low back pain among teachers[17].

Previous injury

A history of low back injury was strongly associated with low back disability in the current study. Previous injury at the lower back region was positively associated with the lower back disability among teachers who had reported experiencing lower back MSD (OR: 3.01, 95%CI: 1.92-4.74, p<0.001)[2]. Parallels can be drawn to the results of a study carried among high school students from Starr County, Texas, where previous back injury was positively associated with severe back pain (OR: 9.04, 95%CI: 3.55-23.01)[61]. The literature suggests that, although research has been carried out to determine the prevalence and risk factors for MSD among school teachers, relatively little research has been conducted to establish the level of disability caused by these disorders in the teaching profession[2].

The impact of MSD

This study indicates that of all the different MSD of the body, lower back MSD was the most common disorder that prevented teachers from carrying out normal activities. One third (33.4%) of teachers who reported lower back MSD reported being prevented from carrying out normal activities because of this disorder, while upper back MSD prevented 28.4% of those who reported this disorder. One quarter of those who reported wrist, hip, knee and ankle/feet MSD reported being prevented from carrying out normal duties because of pain in the respective areas. These results are relatively higher when compared to that reported among Turkish teachers. About 25.2%, 13.7% and10.0% of teachers who indicated discomfort and pain during the last 12 months were unable to work due to pain on the lower back, wrist/hand and neck pain, respectively[20].

More than half of those teachers with lower back and upper back MSD reported seeking medical attention from nurses, doctors or physiotherapists because of these disorders, with 23% reporting experiencing these disorders every day. About 45.5% of those with neck MSD reported consulting a nurse, doctor or physiotherapist because of this disorder. Similar findings have been found in China, where 56% and 41% of secondary school teachers had consulted doctors and physiotherapists for neck and upper limb pain, respectively; and some respondents indicated that they took sick leave as a way of coping with neck and upper limb pain[12]. Moreover, about 27% of university staff who reported neck pain received medical treatment for the pain with 60% of respondents reportedly visiting doctors while 30% and 6% consulted physiotherapists and chiropractors, respectively[47]. In Iran, 65.0% of male and 22.0% of female teachers reported visiting a physician, 18.0% of male and 7.0% of female teachers needed to use physiotherapy services, and 40.0% of male and 5.0% of female teachers had to take medical rest due to musculoskeletal symptoms. In the same study, it was reported that 35.0% of male and 15.0% of female teachers had been on sick leave due to musculoskeletal symptoms in the past two years[31].

Musculoskeletal problems have also been found to be an underlying cause of long term sick leave among school teachers Sweden[26]. In Saudi Arabia, for example, 5.4% of teachers with MSD reported 6-10 days of absenteeism[30].

The majority of teachers with neck MSD (71.9%) reported having experienced pain for 1-7 days with 31.0% reporting that they were unable to work because of neck MSD for 1-7 days in the past 12 months. In China, among university academic staff, the mean number of days for which neck pain was experienced was seven days per month[47]. About 56.3% of Saudi female teachers reported experiencing musculoskeletal pain for more than six months while 10.0% and 12.9% reported musculoskeletal pain for 3-6 months and less than 3 months respectively[30]. Among the different MSD sites of the body studied, 16.2% of teachers in Botswana with hips/thighs MSD had to change jobs/duties because of this disorder which was more than any other MSD. About 41.8% of teachers in the study with lower back MSD reported having had to reduce activity at home, with 6.7% reporting to be unable to work every day because of this back disorder in the last 12 months.

Further statistical analysis have shown that elbows and writs/hands MSD were the most likely disorders to prevent teachers in Botswana from carrying out their normal activities in comparison to MSD of other body sites. On the one hand, hips/thighs and knee and neck MSD were the most likely to cause teachers with these disorders to seek medical attention, be it from nurses, doctors or physiotherapists. On the other hand, shoulder MSD was the only disorder statistically associated with the need to change job or duties among teachers in Botswana. This is not surprising, as the work tasks of a teacher involves considerable marking of assignments and writing on the board with arms lifted above the head. In fact, the results of this study suggest that factors such as awkward arm position, rapid physical activity and psychological job demands were statistically associated with shoulder MSD. Upper back and lower back MSD were most likely to cause teachers with these disorders to reduce their activity at home because of these disorders. From the results of this study, it appears that the effects of ankles/feet MSD were not substantial when compared to other body sites MSD. Ankles/feet MSD was the least associated with the need for medical treatment and the need to reduce their activity at home.

From the results of this study it is evident that MSD negatively affects the wellbeing of teachers in Botswana, and probably the teaching profession itself at a broader level. It can be seen from these results that MSD may potentially lead to poor quality of life of teachers and lost time at work due to disorders they experience more that some reported experiencing these disorders daily and also with some reporting being unable to work for more than a week or every day. These disorders may also affect professional performance or productivity at work and family life. Lost time at work and poor professional performance may ultimately affect the country's education system, but most importantly, their students. Lost time at work may lead to unfinished syllabus at the end of the year, affecting student performance. Moreover, MSD will lead to continuing consumption of health care resources.

The literature suggests that MSD contribute to musculoskeletal disability worldwide and are an enormous burden in terms of quality of life, productivity and employee absenteeism[60]. The burden of MSD is considered to be significant and increasing, especially in low-income continents like Africa. Billions of dollars spent annually on managing MSD further constrains the fragile health care system in Africa, which is already ravaged by the HIV epidemic[62]. The performance of teachers and students may be affected especially where a teacher may be experiencing significant pain every day, or be unable to work. These sentiments are in agreement with what has been documented in the literature. Research suggests that MSD does not only lead to a poor quality of life among affected individuals[63] but also decreases the capability to perform occupational activities due to off work, absenteeism and early ill-health retirement[8, 10, 64]. MSD has been shown to be an important health and social-economic problem of occupational diseases which affects a large proportion of population especially adults of working age[8, 10, 64]. It has also been noted that female teachers with MSD are more likely to take sick leave than male teachers[19], which should be a concern given that the teaching profession is predominantly female[23, 48].

MSD can lead to major losses in work-time with reduced work days or hours often adopted as coping mechanisms for this health problem. MSD also impact on the social life of individuals which could lead to decreased participation in social activities[8]. The economic loss caused by MSD is considered to be high and does not only affect the individual, but also their organization and society at large[31]. MSD have also been found to cause ill-health retirement of school teachers in Ireland [65]. In Scotland, MSD caused ill-health retirement of 18% of school teachers[66]. Reported MSD cannot be dismissed as minor problems not requiring ongoing care in view of their long duration, disabling impact, and continuing consumptions of health care resources[67, 68].

The development of an ergonomic training manual to help prevent work-related musculoskeletal disorders in the teaching profession

Another aim of this study was to develop effective control measures for the prevention and management of MSD among teachers in Botswana. As previously described, the literature indicates that MSD are probably caused by a wide range of factors[1-4]. In view of these findings, different ergonomic intervention strategies would clearly need to be developed to help prevent MSD and the progression of their symptoms among teachers in Botswana[69]. As previously noted in Paper 5, the prevention and management of MSD can be divided into three aspects; primary, secondary and tertiary prevention. Primary prevention refers to interventions and strategies that are implemented before MSD occurs and should be initiated at the beginning of a teaching career, perhaps even during teacher training[69]. These can help prevent MSD and preserve career longevity[70]. Secondary prevention on the other hand, comprises of interventions and strategies implemented after the occurrence of MSD, but before chronic symptoms develop[71]. Such measures include early diagnosis and the aggressive treatment of MSD. However, in practice, the secondary prevention of MSD generally targets biomechanical risk factors even though previous research suggests that psychosocial and individual risk factors play an essential role in MSD development, severity and disability[72]. Lastly, tertiary prevention includes successful rehabilitation after injury[70].

The literature suggests that there is an increasing body of evidence describing how MSD can be prevented by using an occupational health and safety hierarchy of controls, including engineering, administrative and personal protective interventions[73]. Engineering interventions relate to the physical manipulations of hazards or routes of exposure to physical hazards such as adjustable office equipment. Administrative interventions focus on changing the duties or the design of the work such as job rotation while personal interventions concentrate on the worker's behaviour or capacity[74]. Engineering interventions are, in most cases permanent, they affect all workers on the job and are unlikely to be bypassed during time pressure, when compared to administrative and personal interventions. As a result, engineering interventions are usually recommended as a primary control measure, while administrative controls are recommended only if job design changes cannot be instituted or if further risk reduction is required. Personal interventions and/or protective equipment should be recommended as the last resort in control of risk factors[69].

Despite these facts, however, in the real world, administrative and personal interventions are usually put in place before engineering controls in the workplace[69]. This occurs conceivably because engineering controls are often expensive and take time to implement[74]. Considering the costs of introducing engineering control measures, especially in developing countries like Botswana where most government health spending is focused on public health, it is appears prudent to recommend less expensive, practical and easy to implement control measures which may lead to the prevention and reduction of MSD among teachers. Again, borrowing from the popular saying that, 'prevention is better than cure,' one would ideally make teachers aware of MSD before and during the course of their careers before they develop MSD and/or become significantly affected by them[69]. Furthermore, after a careful assessment of the academic teaching courses for student teachers offered at colleges of education and the University of Botswana, it appears that little occupational health and safety training is offered to student teachers to alert them to risk factors that might be associated with their upcoming profession.

Additionally, it appears that there is limited evidence to suggest that student teachers and in-service teachers have been exposed to ergonomic training during their studies or in the course of their careers, respectively. As a result, ergonomic training of some description is clearly needed for Botswana teachers. In fact, ergonomic training must be integrated into academic teaching courses of student teachers in Botswana to help prevent these disorders and preserve career longevity. In-service teachers may be made aware of these disorders by organising refresher courses or workshops to help prevent and/or reduce the progression and impacts of MSD on those who are already affected and help those who might be, or have already been critically affected with return to work programs after long periods of sick leave. From this point of view, a training manual developed specifically for teachers in Botswana will make an important contribution not only to the teaching profession, but also in the occupational health and safety discipline.

Awareness and knowledge of the relationship between teaching and MSD are important for preventing MSD and minimising their progression. Occupational health education for workers has been considered to be one of the effective measures to prevent for example, fatigue in VDT work[75]. Moreover, ergonomic training has been found to be the best initial strategy to educate office workers about office ergonomics[76]. It has been found that employee education/training is a primary way to prevent MSD in the work place. The assumption of educational training principle is that knowledge of proper ergonomic arrangement and usage practices will lead to positive actions and a consequent impact on risk factors[77]. In California, US, a study conducted at Amdahl Corporation a company with a high percentage of high risk computer users found that ergonomic training programs increased user knowledge of correct computer equipment placement and use in both the short and long term. The results further indicated that training resulted in greater number of self-reported correct workstation adjustments and positive use/habits[77]. It could be hypothesized that correct workstation adjustments and positive use will lead to reduced risks of MSD hence reduced prevalence and severity of MSD.

Research conducted on the effectiveness of office ergonomic training reported improvements in knowledge, workstation habits and a reduction in MSD[78]. Educational interventions such as posters, emails, workshops, information booklets, pictures of stretching and stress relief activities have been found to increase workers' knowledge of cumulative trauma disorders and resulted in workers changing hand/wrist and neck/shoulder posture when using computers[79]. Moreover, studies using different methods of ergonomic training have reported positive results. Supporting this are the results of a study of employees of a centralised reservation facility in US where participants who received education programs either participatory or traditional training reported less pain/discomfort and a positive perception of work stress when compared to those who did not receive training[80].

However, in one study of ergonomic intervention among office workers, training alone did not reduce MSD symptoms among respondents. The study found that workers who had received a highly adjustable chair and office ergonomics training had reduced symptom growth over the workday[81]. In Italy, the results of the study conducted among nursery school teachers found that ergonomic training alone might not be effective for the prevention and management of truck complaints and disability. The results however, indicated that extension-oriented exercise program can be decisive in the prevention and management of low back and neck complaints and in reducing consequent low back pain functional disability among nursery school teachers[71].

Considering the evidence that ergonomic training alone may not effectively reduce MSD[71, 81], exercise therapy was also incorporated in the training manual. Exercise therapy was chosen over other possible intervention measures for a number of reasons. Firstly, the results of this study have shown that previous injury was the strongest predictor of MSD for all body sites, with increased odds of MSD raging between 3 and 14. Apart from medical treatment, regular stretching and strengthening exercises may help and allow affected body regions to heal. Secondly, this study found that regular physical exercise has a protective effect against MSD of the upper and lower back among teachers in Botswana. This study found that teachers who reported exercising for more than five hours per week were less likely to report upper back MSD (OR: 0.65, 95%CI: 0.43-0.97)[4] and lower back MSD (OR: 0.62, 95%CI: 0.42-0.91)[2]. Over and above helping to reduce the prevalence and progression of MSD among teachers in Botswana, regular physical exercise may have additional advantages such as weight loss. The results of this study suggest that over half of the teachers (52.4%) were overweight and obese with BMI of 25-29.9 and ≥30, respectively[2,4].

Thirdly, previous research suggests that ergonomic training and exercise may be effective in reducing MSD[81]. Lastly, exercise therapy is suggested over other possible intervention strategies such as adjustable chairs and desks, use of overhead projectors instead of writing boards because of costs associated with introduction and implementation of these other intervention strategies. Taking into consideration the number of schools and teachers in the country it might prove to be expensive to implement some control measures. As of 2010, there were 11,711 and 13,173 primary and secondary school teachers respectively; employed in 752, 203 and 31 primary, junior and senior secondary schools, respectively[82]. Changing desks and chairs for them, for example would come at huge cost.

It is worth noting that in Botswana, like many developing countries, MSD issues are not usually given a high priority when compared to other more urgent health issues such as non-communicable/chronic diseases, including cardiovascular diseases, cancers, respiratory diseases and diabetes[69]. Of late, more attention has been given to these diseases as they have been found to affect low and middle income countries where nearly 80% (29 million) of non-communicable diseases occur and their deaths have been projected to increase significantly in Africa by 2020[83]. In Botswana, considerable attention is given to communicable diseases such as tuberculosis and HIV/AIDS, as well as prenatal and nutritional conditions which amounted to 60% of deaths in the country in 2010. Non-communicable diseases and injuries amounted to 31% and 9% of deaths, respectively, in the same year[84]. While it is commendable and logical to focus on such diseases with high death rates, it is equally important not to neglect non-fatal health issues such as MSD, as they may prove to be costly and difficult to manage in the future[69]. In fact, although musculoskeletal conditions rarely cause death and rank only seventh in the number of patients admitted to hospital, they do however, rank fifth for drug costs, third for chronicity, second for total health costs, and first for health consultations, and are the most disabling conditions in developed countries[63]. In the US for example, the annual costs associated with the diagnosis and care of musculoskeletal trauma amounts to tens of billions of dollars per year. Moreover, these costs are continuing to increase at an alarming rate so much that, MSD is, now the leading cause of work-related disability in the US[85].

In the teaching profession, MSD has been shown to lead to ill health retirement of school teachers in for example, Ireland[65] and Scotland[66]. In developing countries, however, the real burden of MSD and its impact on workers' productivity is not known. One can imagine that the burden is probably high. The current study of school teachers in Botswana has found that MSD prevented some teachers from carrying out their normal activities, and caused some to change jobs or duties, reduce their activity at home and seek medical attention. Some teachers reported that experiencing these disorders made them unable to work for several days[4]. Therefore, if preventative control measures are not put in place to curb MSD and the progression of symptoms, the government of Botswana might find itself battling with more widespread disabilities and increased health costs associated with MSD in the future. It was against this backdrop and based on the results of this study[2,4], that a training manual was developed to raise awareness among teachers regarding MSD risk factors associated with their duties and help develop and implement appropriate and cost-effective prevention strategies.

The Training manual

The aim of this training manual was to provide a cheap, simple and effective ergonomic education which can help raise awareness of MSD among teachers in Botswana (Appendix E). This would, ideally, help raise awareness help reduce the prevalence of MSD in the teaching profession and help improve health outcomes for those teachers already affected by MSD[69]. The ultimate aim would be to reduce the prevalence and impact of MSD among teachers in Botswana.

After the training manual was developed, it was piloted to determine its effectiveness and also to improve it. The results of the pilot study indicated that the contents of the manual were relevant, informative and useful for teachers. The manual was found to be suitable for teachers and was easy to follow. The participants also indicated that they would use the new ergonomic knowledge they had learned[69]. It is envisaged that the use of this acquired ergonomic knowledge will help reduce the prevalence, progression and impacts of MSD among school teachers in Botswana.

Conclusions and Recommendations

Conclusions

To the author's knowledge, this study is the first of its kind to investigate and analyse the prevalence and risk factor for MSD among school teachers in Botswana. This study has examined the prevalence, risk factors and impacts of MSD among school teachers in Botswana, and examined these factors with respect to nine different body sites. The study questionnaire was divided in four sections; personal information, musculoskeletal symptoms, disability questionnaire and job content. All things considered, the study achieved a commendable response rate. Overall, the study has shown that MSD is reasonably common among school teachers in Botswana, particularly that of the lower back, shoulder, upper back and neck. The prevalence rate recorded was, in some instances, higher than the prevalence rates documented in some previous research. MSD of the lower limb was less prevalent when compared to MSD of the back and upper limb, a trend that has been documented in other studies of MSD among school teachers. Additionally, lower back MSD was slightly higher than upper back MSD, a trend that has been observed in some studies. In view of the relatively high prevalence rates found in this study, it may be concluded that MSD prevalence rates are fairly high among Botswana teachers and present an increasingly important issue in workplace health and safety.

This study examined a wide range of factors for MSD of all different body sites among school teachers in Botswana. Based on a quantitative questionnaire survey, this study has made a major contribution to the teaching profession by linking MSD in specific body sites with a wide range of risk factors. This suggests that the aetiology of this condition is complex and multifactorial in nature as already alluded in the literature review. Among individual risk factors, female gender was statistically significantly associated with shoulders, upper back and lower back MSD. Previous injury was associated with all body regions MSD and was, in all cases, the greatest predictor of MSD. Increasing age and length of employment were positively associated with knee MSD. Among physical risk factors, awkward arm positions were positively associated with shoulder, upper back, wrists/hands and lower back MSD, while rapid physical activity was positively associated with shoulder, wrist/hands and hips/thighs MSD. Of all the psychosocial risk factors, only psychological job demands were positively associated with MSD in this study, and we positively associated with MSD of the shoulder, upper back, and lower back regions. The identification of these risk factors is consistent with previous research carried out in other parts of the world. Interestingly and equally importantly, was that this study found a number of factors which had a protective effect against reported MSD among Botswana teachers. These factors included regular physical exercise, teaching at secondary school and high supervisor support. Borrowing from the popular saying that, “Prevention is better than cure,” ergonomic training to raise awareness on MSD should be offered to teachers throughout their careers. Ergonomic training could be offered during teachers training, at the beginning of their careers, and as well as refresher courses during the course of their careers. These may help raise MSD awareness in the teaching profession and help teachers to be cautions when carrying out their work tasks and responsibilities.

The current study suggests that of those teachers that reported MSD of the lower back, the majority were experiencing minimal disability, with female gender and previous injury identified as risk factors for low back disability. This study suggests that none of the respondents had been bed ridden or might have exaggerated their level of pain. Overall, the majority of teachers with lower back MSD experienced pain at a ‘tolerable’ rate. Physical and psychosocial risk factors in the current study were not statistically associated with lower back disability. Although the majority of respondents with lower back MSD reported having minimal disability, prevention and intervention strategies still must be put in place to minimise the progression of their disability from minimal to significant disability. These measures should also be aimed at helping to reduce the level of pain for those with significant disability to minimal disability.

The impact of MSD among school teachers in the current study is significant and the reporting of MSD should not be ignored. MSD prevented teachers from carrying out their normal activities, caused them to seek medical attention, or change duties and cut down on activities at home because of these disorders. Through the use of a quantitative research survey in Botswana, the results appear to have achieved the aim of this research, which was to determine the prevalence and risk factors among school teachers in Botswana with the intent to develop appropriate prevention and intervention strategies.

The identification of distribution, location of MSD, risk and protective factors and the impacts of these disorders in this study was paramount in the development of an intervention strategy. The complex nature of MSD risk factors found in the current study suggests than no single specific preventative or intervention strategy will help in reducing MSD among teachers. It was against this backdrop and careful assessment of the curriculum at teachers' training colleges and the University of Botswana that a MSD training manual for Botswana teachers was developed. This training manual was developed to raise awareness on MSD and to assist teachers to conduct an evaluation of their work tasks and workstations, to identify possible risk factors for MSD, and to help them carry out appropriate improvements. It is envisaged that the training manual may eventually help to reduce the prevalence, progression, severity and impacts of MSD among Botswana teachers.

Recommendations

The following recommendations have been made based on the findings of the current study and taking into consideration both MSD risk factors and protective factors.

Recommendations for the Ministry of Education and Skills Development

- Ergonomics training specific to MSD risk factors and prevention should be introduced in teachers' training institutions.
- Refresher courses highlighting the work tasks and workstations of teachers should be introduced for in-service teachers.
- Teachers who hold leadership positions should be trained on leadership management covering occupational stress and occupational health issues.
- To reduce the heavy workload of primary school teachers in Botswana, the Ministry of Education and Skills Development should more carefully consider the subject specialization of teachers at this level.

Recommendations for Supervisors and Teachers

- Supervisors should develop and maintain a conducive work relationship with subordinates that allows them to voice concerns without fear of intimidation and victimisation. Supervisors are advised to show support for their subordinates.

- Teachers should undertake manageable workloads and should be able to communicate with their supervisors if they feel overwhelmed by their workload.
- Teachers should conduct an evaluation of their work tasks and work stations, to identify possible risk factors and carry out improvements in order to help reduce MSD and its progression.
- Teachers should consider increasing their levels of regular physical exercise. This may involve regular jogging, swimming and even extracurricular activities, in particular vigorous sporting activities.

Recommendations for Future Research

- As this study focused on recall information and self-reported injury rates, future research may consider involving clinical diagnosis of MSD and its severity among teachers; ideally in longitudinal studies.
- The current study can be replicated to employ a mixed methods approach, to include a more rigorous quantitative approach, such as an observational study which includes the observation of teachers when carrying out their work tasks and an inspection of their workstations for the further identification of risk factors.
- Additional research should investigate the epidemiological profile and medical causes of ill-health or early retirement of teachers in Botswana. Future studies could also offer additional suggestions on the extent of MSD impacts in the teaching profession.

Limitations of the study

The current study was undertaken as a descriptive cross-sectional survey. Cross-sectional studies may be limited in that they are conducted at one time point and do not provide robust evidence regarding the direction of cause and effect relationship. Recall bias and self-reporting may also have been limitations of the study. Participants were required to recall and report on MSD for the previous 12 months. Non-response is also a common problem in these kinds of studies. The use of postal questionnaires might be a limitation as it could have contributed to the response rate that was found in this study. Data collection was limited to in-service teachers, a limitation in the sense that teachers who might be suffering from MSD may have been on sick leave or left the teaching profession because of work-related health issues. The time when this study was conducted appears to have negatively affected the response rate. Data collection coincided with a busy time period in the annual Botswana school calendar. At the time of data collection, schools had just reopened for Term 2. Teachers were reported to be busy at that time of the school term. Future research conducted among school teachers will need to consider these issues.

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LIST

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APPENDICES

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APPENDIX A

EVIDENCE

OF

PUBLISHED PAPERS

List of published papers (as of November 2014)

Erick PN, Smith DR. A systematic review of musculoskeletal disorders among school teachers. *BMC Musculoskeletal Disorders*. 2011;12(1):260.

Erick PN, Smith DR. Musculoskeletal disorder risk factors in the teaching profession: a critical review. *OA Musculoskeletal Medicine*. 2013 Dec;1(3):29.

Erick PN, Smith DR. The prevalence and risk factors for musculoskeletal disorders among school teachers in Botswana. *Occupational Medicine & Health Affairs*. 2014;2(4).

Erick PN, Smith DR. Low back pain among school teachers in Botswana, prevalence and risk factors. *BMC Musculoskeletal Disorders*. 2014;15(:359).

Erick PN, Smith DR. Prevalence of tobacco smoking among school teachers in Botswana. *Tobacco induced diseases*. 2013;11(1):24.

APPENDIX B

ETHICS APPROVAL

FOR

RESEARCH INVOLVING

HUMANS

List of Ethics Approvals

Human Research Ethics Committee Certificate of Approval: H-2014-0193

Human Research Ethics Committee Certificate of Approval: H-2012-0074

Ministry of Education and Skills Development, Botswana, Research Permit

Human Research Ethics Committee Certificate of Approval: H-2014-0193

THE UNIVERSITY OF NEWCASTLE AUSTRALIA

HUMAN RESEARCH ETHICS COMMITTEE
Certificate of Approval

Applicant: (first named in application)	Professor Derek Smith
Co-Investigators / Research Students:	Mrs Patience Erick
Protocol:	An Investigation of the Prevalence, Correlates and Potential Intervention Strategies for Musculoskeletal Disorders among School Teachers in Botswana

In approving this protocol, the Human Research Ethics Committee (HREC) is of the opinion that the project complies with the provisions contained in the *National Statement on Ethical Conduct in Human Research, 2007*, and the requirements within this University relating to human research.

Note: Approval is granted subject to the requirements set out in the accompanying document ***Approval to Conduct Human Research***, and any additional comments or conditions noted below.

Details of Approval

HREC Approval No: H-2014-0193	**Date of Initial Approval:** 17-Jul-2014

Approval

Approval will remain valid subject to the submission, and satisfactory assessment, of annual progress reports. If the approval of an External HREC has been "noted" the approval period is as determined by that HREC.

Progress reports due: Annually.

If the approval of an External HREC has been "noted", the reporting period is as determined by that HREC.

Approval Details

Initial Application

20-Aug-2014

Approved

The Committee ratified the approval granted by the Deputy Chair on 17 July 2014 under the provisions for expedited review.

Authorised Certificate held in Research Services

Professor Allyson Holbrook
Chair, Human Research Ethics Committee

Human Research Ethics Committee Certificate of Approval: H-2012-0074

THE UNIVERSITY OF NEWCASTLE AUSTRALIA

HUMAN RESEARCH ETHICS COMMITTEE
Certificate of Approval

Applicant: (first named in application)	Professor Derek Smith
Co-Investigators / Research Students:	Mrs Patience Erick
Protocol:	An Investigation of the Prevalence, Correlates and Potential Intervention Strategies for Musculoskeletal Disorders among School Teachers in Botswana

In approving this protocol, the Human Research Ethics Committee (HREC) is of the opinion that the project complies with the provisions contained in the *National Statement on Ethical Conduct in Human Research, 2007*, and the requirements within this University relating to human research.

Note: Approval is granted subject to the requirements set out in the accompanying document ***Approval to Conduct Human Research***, and any additional comments or conditions noted below.

Details of Approval

HREC Approval No: H-2012-0074	**Date of Initial Approval:** 24-Apr-2012

Approval

Approval will remain valid subject to the submission, and satisfactory assessment, of annual progress reports. If the approval of an External HREC has been "noted" the approval period is as determined by that HREC.

Progress reports due: Annually.

If the approval of an External HREC has been "noted", the reporting period is as determined by that HREC.

Approval Details

Variation

18-Jul-2012

Variation to:

1. Increase the participant sample size to 3100.

2. Increase the proposed time to complete the questionnaire to 20 minutes.

3. Change the contact details for the student researcher from Australia to Botswana.

4. Amend the wording of some questions within Section A of the participant questionnaire.

5. Remove questions about Musculoskeletal Disorders experienced within the last 7 days.

6. Amend the layout of the questionnaire in order to reduce the total number of pages.

- Participant Information Statement, version submitted 31.5.12
- Invitation Letter, version submitted 31.5.12
- Participant Questionnaire, version submitted 31.5.12

Approved

The Committee ratified the approval granted by the Deputy Chair on 12 June 2012 under the provisions for expedited review.

Initial Application

16-May-2012

Approved

The Committee ratified the approval granted by the Deputy Chair on the 24th of April 2012 under the provisions for expedited review.

Authorised Certificate held in Research Services

Professor Allyson Holbrook
Chair, Human Research Ethics Committee

Ministry of Education and Skills Development, Botswana, Research Permit

TELEPHONE: 3655469
TELEX: 2944 THUTO BD
FAX: 3185167

REPUBLIC OF BOTSWANA

MINISTRY OF EDUCATION
AND SKILLS DEVELOPMENT
PRIVATE BAG 005
GABORONE

REFERENCE : E1/20/2 XX (7)

7th May 2012

Patience N Erick
P O Box 4533
Gaborone

Dear Madam/Sir

RE: REQUEST FOR A PERMIT TO CONDUCT A RESEARCH STUDY

We would like to acknowledge receipt of your application for research permit to conduct a study. This serves to grant you permission to conduct your study in the sampled areas in Botswana to address the following research objectives/question/topic:

An Investigation Of The Prevalence, Correlates And Potential Intervention Strategies Of Musculoskeletal Disorders Among School Teachers In Botswana.

It is of paramount importance to seek **Assent** and **Consent** from the Regional Education Office, Department of Primary Education, School Heads, Teachers, of schools that you are going to collect data from. We hope that you will conduct your study as stated in your proposal and that you will adhere to research ethics. Failure to comply with the above stated, will result in immediate termination of the research permit. The validity of the permit is from **7th May 2012 to 6th May 2013.**

You are requested to submit a copy of your final report of the study to the Ministry of Education and Skills Development, in the Department of Educational Planning and Research Services, Botswana.

Thank you.

O A Mmereki
For / Permanent Secretary

APPENDIX C

PERMISSION LETTER

FOR

JOB CONTENT

QUESTIONNAIRE

One University Ave Kitson 200
Lowell, Massachusetts 01854-5109
tel: 978.934-3250
Fax: 978-452-5711
Web site: http://www.uml.edu/college/she/WE/

University of Massachusetts
UMASS Lowell

DEPARTMENT OF WORK ENVIRONMENT

October 13, 2011

Patience Erick
University of Newcastle
BE Bldg Office 160 Health preceinct
Ourimbah Campus
Ourimbah, New South Wale 2258
Australia

Dear Ms. Erick:

Thank you for your interest concerning the "Job Content Instrument: Questionnaire and User's Guide." We have received your "JCQ Data Base Form" and your signed permission form.

I hereby send our questionnaire and validation report and research literature as requested. We look forward to supplying you with information that may assist in your research.

You may find more references and information in our book, Robert Karasek and Tores Theorell: Healthy Work, published by Basic Books, 1990.

Sincerely,

Robert A. Karasek, Ph.D.
Professor, Work Environment

Enclosures: JCQ User's Guide and Questionnaire
w/Global Economy and new Psychological Strain Scales
w/Karasek, et al, NIOSH, 1982
Karasek, et al (1983/ U.S., QES 1970's) Validation Report
Karasek and Thorell (1990 Healthy Work, Appendix 1)
Karasek, Schwartz, Theorell, Final NIOSH Report (1982)
Kristenssen (1995) Stress Med.
Kristenssen (1996) J Occ Hlth Psych
Schnall, Landsbergis, Baker (1994) Annual of Pub. Health.
Kawakami (1996), Industrial Health
Karasek (1979), Administrative Science Quarterly

APPENDIX D

QUESTIONNAIRE

PLEASE ANSWER ALL THE QUESTIONS ON THIS FORM BY TICKING THE APPROPRIATE BOX OR FILLING IN THE APPROPRIATE INFORMATION
Your reply is important to us!

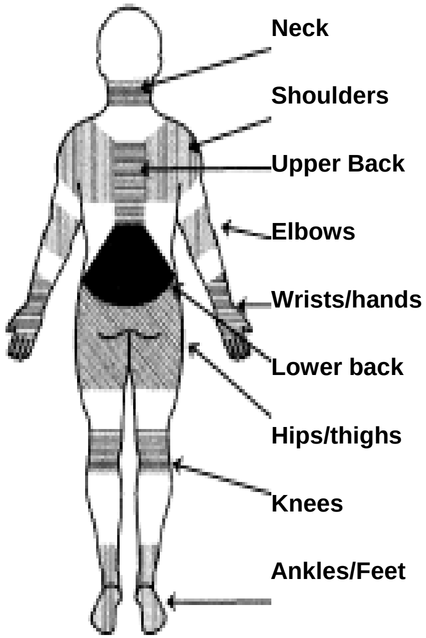
Section A: Personal Information

1. Gender: ☐Male ☐Female	**2.** Age: …………… (yrs)
3. Height: …………… (cm)	**4.** Weight: …………… (kg)
5. Marital status: ☐Single ☐Married ☐Separated ☐Divorced ☐Widowed	
6. Education: ☐Certificate ☐Diploma ☐Bachelor's degree ☐Other …………………..	
7. Do you smoke tobacco? ☐Yes, currently ☐I did before, but quit ☐I never have	
8. If yes, how many cigarettes do you smoke per day, on average: ….………. (cigarettes)	
9. How many years have you smoked ...., or how many years since you quit .... (yrs)	
10. How many children under the age of 6 years do you have: ………. (children)	
11. How regularly do you exercise per week, on average: …………… (hours per week)	
12. Where do you teach: ☐Primary School, and which standard: ………………………………. ☐CJSS, and which subjects (s): ………………………………. ☐Primary School, and which subject (s): ………………………………..	
13. How long have you been teaching (at any school): ………. (yrs)	
14. How many hours do you work per week, on average: ………. (hrs)	
15. How many subjects do you teach, on average: ………. (subjects)	
16. How many classes do you teach a week, on average: ………. (classes)	
17. How many students do you have in each class, on average: ………. (students)	
18. Are you involved in school extra-curricular activities: ………. if so, which ones: ……………………	

Section B: Musculoskeletal symptoms

Please answer by ticking the appropriate box for each body area and please complete even if you have never had trouble in any part of your body in the last 12 months

In the past 12 months, have you ….



	Had trouble, e.g. ache, pain, or discomfort		**Been prevented from carrying out normal activities**		**Seen a nurse, doctor or physio because of:**		**How many days trouble have you had for: (please tick)**	
B1. NECK	☐ No	☐ Yes	☐ No	☐ Yes	☐ No	☐ Yes	☐ 1-7 days ☐30 days plus	☐ 8-28 days ☐ everyday
B2. SHOULDERS	☐ No	☐ Yes	☐ No	☐ Yes	☐ No	☐ Yes	☐ 1-7 days ☐30 days plus	☐ 8-28 days ☐ everyday
B3. UPPER BACK	☐ No	☐ Yes	☐ No	☐ Yes	☐ No	☐ Yes	☐ 1-7 days ☐30 days plus	☐ 8-28 days ☐ everyday
B4. ELBOWS	☐ No	☐ Yes	☐ No	☐ Yes	☐ No	☐ Yes	☐ 1-7 days ☐30 days plus	☐ 8-28 days ☐ everyday
B5. WRISTS/HANDS	☐ No	☐ Yes	☐ No	☐ Yes	☐ No	☐ Yes	☐ 1-7 days ☐30 days plus	☐ 8-28 days ☐ everyday
B6. LOWER BACK	☐ No	☐ Yes	☐ No	☐ Yes	☐ No	☐ Yes	☐ 1-7 days ☐30 days plus	☐ 8-28 days ☐ everyday
B7. HIPS/THIGHS	☐ No	☐ Yes	☐ No	☐ Yes	☐ No	☐ Yes	☐ 1-7 days ☐30 days plus	☐ 8-28 days ☐ everyday
B8. KNEES	☐ No	☐ Yes	☐ No	☐ Yes	☐ No	☐ Yes	☐ 1-7 days ☐30 days plus	☐ 8-28 days ☐ everyday
B9. ANKLES/FEET	☐ No	☐ Yes	☐ No	☐ Yes	☐ No	☐ Yes	☐ 1-7 days ☐30 days plus	☐ 8-28 days ☐ everyday

PLEASE CAREFULLY CHECK THAT YOU HAVE READ EVERY QUESTION AND ANSWERED THEM WHERE APPROPRIATE
Your reply is important to us!

Have you ever:

	Injured this body-part through an accident		Needed to changed jobs/duties because of pain		Needed to cut down activity at home because of pain		How many days have you been unable to work because of pain in the last 12 months	
B10. NECK	☐ No	☐ Yes	☐ No	☐ Yes	☐ No	☐ Yes	☐ 1-7 days ☐ 30 days plus	☐ 8-28 days ☐ everyday
B11. SHOULDERS	☐ No	☐ Yes	☐ No	☐ Yes	☐ No	☐ Yes	☐ 1-7 days ☐ 30 days plus	☐ 8-28 days ☐ everyday
B12. UPPER BACK	☐ No	☐ Yes	☐ No	☐ Yes	☐ No	☐ Yes	☐ 1-7 days ☐ 30 days plus	☐ 8-28 days ☐ everyday
B13. ELBOWS	☐ No	☐ Yes	☐ No	☐ Yes	☐ No	☐ Yes	☐ 1-7 days ☐ 30 days plus	☐ 8-28 days ☐ everyday
B14. WRISTS/HANDS	☐ No	☐ Yes	☐ No	☐ Yes	☐ No	☐ Yes	☐ 1-7 days ☐ 30 days plus	☐ 8-28 days ☐ everyday
B15. LOWER BACK	☐ No	☐ Yes	☐ No	☐ Yes	☐ No	☐ Yes	☐ 1-7 days ☐ 30 days plus	☐ 8-28 days ☐ everyday
B16. HIPS/THIGHS	☐ No	☐ Yes	☐ No	☐ Yes	☐ No	☐ Yes	☐ 1-7 days ☐ 30 days plus	☐ 8-28 days ☐ everyday
B17. KNEES	☐ No	☐ Yes	☐ No	☐ Yes	☐ No	☐ Yes	☐ 1-7 days ☐ 30 days plus	☐ 8-28 days ☐ everyday
B18. ANKLES/FEET	☐ No	☐ Yes	☐ No	☐ Yes	☐ No	☐ Yes	☐ 1-7 days ☐ 30 days plus	☐ 8-28 days ☐ everyday

Section C: Oswestry Disability Questionnaire

Please answer by ticking ONE box in each section for the statement which best applies to you

C1	**Pain intensity**	**C2**	**Lifting**
C1.1	☐ I have no pain at the moment	C2.1	☐ I can lift heavy weight without extra pain
C1.2	☐ The pain is very mild at the moment	C2.2	☐ I can lift heavy weights but it gives extra pain
C1.3	☐ The pain is moderate at the moment	C2.3	☐ Pain prevents me from lifting heavy weights off the floor, but I can manage if they are conveniently placed e.g. on a table
C1.4	☐ The pain is fairly severe at the moment	C2.4	☐ Pain prevents me from lifting heavy weights, but I can manage light to medium weights if they are conveniently positioned
C1.5	☐ The pain is very severe at the moment	C2.5	☐ I can lift very light weights
C1.6	☐ The pain is the worst imaginable at the moment	C2.6	☐ I cannot lift or carry anything at all
C3	**Personal care (washing, dressing etc)**	**C4**	**Walking**
C3.1	☐ I can look after myself normally without causing extra pain	C4.1	☐ Pain does not prevent me walking any distance
C3.2	☐ I can look after myself normally but it causes extra pain	C4.2	☐ Pain prevents me from walking more than 2 kilometres
C3.3	☐ It is painful to look after myself and I am slow and careful	C4.3	☐ Pain prevents me from walking more than 1 kilometre
C3.4	☐ I need some help but manage most of my personal care	C4.4	☐ Pain prevents me from walking more than 500 metres

C3.5	☐ I need help every day in most aspects of self-care	C4.5	☐ I can only walk using a stick or crutches
C3.6	☐ I do not get dressed, I wash with difficulty and stay in bed	C4.6	☐ I am in bed most of the time
C5	**Sitting**	**C9**	**Sex life (if applicable)**
C5.1	☐ I can sit in any chair as long as I like	C6.1	☐ My sex life is normal and causes no extra pain
C5.2	☐ I can only sit in my favourite chair as long as I like	C6.2	☐ My sex life is normal but causes some extra pain
C5.3	☐ Pain prevents me sitting more than one hour	C6.3	☐ My sex life is nearly normal but is very painful
C5.4	☐ Pain prevents me from sitting more than 30 minutes	C6.4	☐ My sex life is severely restricted by pain
C5.5	☐ Pain prevents me from sitting more than 10 minutes	C6.5	☐ My sex life is nearly absent because of pain
C5.6	☐ Pain prevents me from sitting at all	C6.6	☐ Pain prevents any sex life at all
C7	**Standing**	**C8**	**Social life**
C7.1	☐ I can stand as long as I want without extra pain	C8.1	☐ My social life is normal and gives me no extra pain
C7.2	☐ I can stand as long as I want but it gives me extra pain	C8.2	☐ My social life is normal but increases the degree of pain
C7.3	☐ Pain prevents me from standing for more than 1 hour	C8.3	☐ Pain has no significant effect on my social life apart from limiting my more energetic interests e.g., sport
C7.4	☐ Pain prevents me from standing for more than 30 minutes	C8.4	☐ Pain has restricted my social life and I do not go out as often
C7.5	☐ Pain prevents me from standing for more than 10 minutes	C8.5	☐ Pain has restricted my social life to my home
C7.6	☐ Pain prevents me from standing at all	C8.6	☐ I have no social life because of pain
C9	**Sleeping**	**C10**	**Travelling**
C9.1	☐ My sleep is never disturbed by pain	C10.1	☐ I can travel anywhere without pain
C9.2	☐ My sleep is occasionally disturbed by pain	C10.2	☐ I can travel anywhere but it gives me extra pain
C9.3	☐ Because of pain I have less than 6 hours sleep	C10.3	☐ Pain is bad but I manage journeys over two hours
C9.4	☐ Because of pain I have less than 4 hours sleep	C10.4	☐ Pain restricts me to journeys of less than one hour
C9.5	☐ Because of pain I have less than 2 hours sleep	C10.5	☐Pain restricts me to short necessary journeys under 30 minutes
C9.6	☐Pain prevents me from sleeping at all	C10.6	☐ Pain prevents me from travelling except to receive treatment

Section D: Job Content Questionnaire

		Strongly agree	Agree	Disagree	Strongly disagree
Please answer each question by ticking the ONE answer that best fits your job situation. Sometimes none of the answers fits exactly. Please choose the answer that comes closest.					
D1	My job requires that I learn new things	☐	☐	☐	☐
D2	My job requires a lot of repetitive work	☐	☐	☐	☐
D3	My job requires me to be creative	☐	☐	☐	☐
D4	My job requires a high level of skill	☐	☐	☐	☐
D5	I get to do a variety of different things on my job	☐	☐	☐	☐
D6	I have an opportunity to develop my own special abilities	☐	☐	☐	☐
D7	My job allows me to make a lot of decisions on my own	☐	☐	☐	☐
D8	On my job, I have very little freedom to decide how I do my work	☐	☐	☐	☐
D9	I have a lot of say about what happens on my job	☐	☐	☐	☐
D10	My job requires working very fast	☐	☐	☐	☐
D11	My job requires working very hard	☐	☐	☐	☐
D12	I am not asked to do an excessive amount of work	☐	☐	☐	☐
D13	I have enough time to get the job done	☐	☐	☐	☐
D14	I am free from conflicting demands that others make	☐	☐	☐	☐
D15	My job requires long periods of intense concentration on the task	☐	☐	☐	☐
D16	My tasks are often interrupted before they can be completed, requiring attention at a later time	☐	☐	☐	☐
D17	My job is very hectic	☐	☐	☐	☐
D18	Waiting on work from other people or departments often slows me down	☐	☐	☐	☐
D19	My job requires lots of physical effort	☐	☐	☐	☐
D20	I am often required to move or lift very heavy loads	☐	☐	☐	☐
D21	My work requires rapid and continuous physical activity	☐	☐	☐	☐
D22	I am often required to work for long periods with my body in physically awkward positions	☐	☐	☐	☐
D23	I am required to work for long periods with my head and arms in physically awkward positions	☐	☐	☐	☐
D24	My supervisor is concerned about the welfare of those who work under them	☐	☐	☐	☐
D25	My supervisor pays attention to what I say	☐	☐	☐	☐
D26	I am exposed to hostility and conflict from my supervisor	☐	☐	☐	☐

D27	My supervisor is helpful in getting the job done	☐	☐	☐	☐
D28	My supervisor is successful in getting people to work together	☐	☐	☐	☐
D29	People I work with are competent in doing their jobs	☐	☐	☐	☐
D30	People I work with take personal interest in me	☐	☐	☐	☐
D31	I am exposed to hostility and conflict from the people I work with	☐	☐	☐	☐
D32	People I work with are friendly	☐	☐	☐	☐
D33	The people I work with encourage each other to work together	☐	☐	☐	☐
D34	People I work with are helpful in getting the job done	☐	☐	☐	☐
D35	My job security is good	☐	☐	☐	☐
D36	My prospects for career development and promotions are good	☐	☐	☐	☐
D37	In 5 years my skills will still be valuable	☐	☐	☐	☐
D38	How likely is it that during the next couple of years you will lose your present job?	Not at all likely ☐	Not too likely ☐	Somewhat likely ☐	Very likely ☐
D39	How steady is your job?	Regular & steady ☐	Seasonal ☐	Frequent layoffs ☐	Both seasonal and layoffs ☐
D40	During the past year how often were you in a situation where you were faced with job loss or layoff?	Never ☐	Faced the possibility once ☐	Faced the possibility once ☐	Constantly ☐
D41	How satisfied are you with your job?	Not at all ☐	Not too ☐	Somewhat ☐	Very ☐
D42	Would you advice a friend to take this job?	Advise against ☐	Have doubts about it ☐	Strongly recommend ☐	
D43	Would you take this job again?	Take without hesitation ☐	Have second thoughts ☐	Definitely not ☐	
D44	How likely is it that you will have a new job in the next year?	Very likely ☐	Somewhat ☐	Not at all ☐	
D45	Is this job like what you wanted when you applied for it?	Very much ☐	Somewhat like ☐	Not very much ☐	

We thank you for your participation in this important study

PLEASE RETURN YOUR QUESTIONNAIRE IN THE REPLY PAID ENVELOPE

Your reply is important to us!

APPENDIX E

TRAINING MANUAL