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# INTERACTION BETWEEN RISK FACTORS AND MUSCULOSKELETAL DISORDERS AMONG TEACHERS: STRUCTURAL EQUATION MODEL ANALYSIS

**Ng Yi Ming, Peter Voo[2], Ismail Maakip[3], Romzi Ationg[4], Azizi Yahaya[5], Malai Yunus Malai Yusuf[6]**

[1,2,3,4,5,6]Faculty of Psychology and Education, Universiti Malaysia Sabah, 88400 Kota Kinabalu, Sabah, Malaysia
E-mail address: peter@ums.edu.my (P.Voo),

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**ABSTRACT :** One of the occupations that suffered from musculoskeletal disorder (MSD) is the teaching profession. Previous studies suggested that teachers also experienced musculoskeletal disorders (MSD); however, not many studies have been undertaken in Malaysia. Given this, it is not clear regarding the magnitude and impact of the problem towards those in the teaching profession. The present study was to examine physical factors, psychosocial factors, workload, work-life balance, and general well-being factors predict (influence) MSDs among primary school teachers in Kota Kinabalu. Accordingly, this cross-sectional study conducted among primary school teachers in Kota Kinabalu. Information on demographic, physical factors, psychosocial factors, workload, work-life balance, general well-being, and MSDs was collected using a self-administered questionnaire. A Structural Equation Modeling approach was used in which a structurally fitted model, with satisfactory goodness of fit indices, was developed. The strongest correlation was found between physical factors and general well-being towards MSDs among teachers in Kota Kinabalu, Sabah. Physical factors and general well-being are significant predictors of MSDs among teachers. However, the path from psychosocial factors is not apparent to give an impact on MSD. Physical factors served as the predictors of MSD which independently and significantly influence MSD. While psychosocial factors have to work hand in hand with the workload and work-life balance to give the impact slowly through general well-being to MSD. In other words, psychosocial factors, workload, work-life balance, and general well-being is the 4 factors measurement models which they correlated with each other and give the impact to MSD. Thus, u

Understanding the relationship is valuable and will assist those teachers in planning, designing, or implementing preventive intervention programs to reduce the risk of MSDs.

**KEYWORDS:** physical factors, psychosocial factors, general well-being, MSDs

## I. INTRODUCTION

Musculoskeletal disorders (MSDs) are injuries or pain in the body's joints, ligaments, muscles, nerves, tendons, and structures that support limbs, neck, and lower back [1]. The commonly reported sites of MSDs were neck and shoulder, low back, and the upper limbs [2]. The issue of musculoskeletal problems in the adult population is overwhelming [3] and one of the occupations that suffered from MSDs is those in the teaching profession [4]. Increased risk has been shown in occupations with highly repetitive work tasks, forceful exertions, awkward postures, and heavy lifting [5]. Studies have also indicated that MSD is the most common in both the developed and developing countries that affected not only the working population including those in the teaching profession but also the general population [6]. Due to a wide range of duties and activities, teachers are also vulnerable to both physical and emotional issues that were found to be contributed to MSDs [7].

However, one systematic review suggested that research on MSD among teachers is still lacking particularly in developing countries such as Malaysia [8]. This is evident with only four studies on MSD among school teachers in Malaysia that were found in the literature and those studies were assessing low back pain (LBP) and only one study was assessing musculoskeletal pain among those in the teaching profession [9-11]. The lack of study in Malaysia on MSD among teachers signifies the lack of awareness about the impact and effect of this occupational health problem among teachers and responsible parties such as Teachers Union and the government [10]. Given this, it is not known about the impact and effect of MSD among those in the teaching profession are. Further, evidence suggested that MSD is not only experienced individually but also can incur a

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major economic burden in terms of compensation costs and lost wages to the employees and employers respectively [12].

As mentioned earlier, one of the occupations that suffered from MSD is those in the teaching profession [4, 10]. Studies have found school teachers to be an occupational group with a particularly high incidence of MSD [15] reported rates of between 40% and 95% [16]. Whilst, the prevalence rate in Malaysia studies on LBP among primary school teachers ranging between 40.4% and 74.5% [10-12]. Based on these studies, it was reported that teachers are not only engaged in pedagogical work, but also must prepare lessons, evaluate students, and assist with sports and other extracurricular activities. Due to a wide range of duties and activities, teachers are especially vulnerable to both physical and emotional issues that were found to be contributed to MSD [17].

In the literature, scores of studies have reported that the risk factors or predictors associated with MSD are multi-factorial - i.e. physical, psychosocial, and individual factors play a role in the development and exacerbation of MSD. For instance, the contribution of physical factors associated with MSD has been undertaken by numerous studies [18] Work activities that involved heavy lifting, awkward postures, bending, twisting or stooping, prolonged sitting or standing and repetitive motions have contributed to the occurrence and exacerbation of MSD [19]. With regards to the teaching profession, work activities such as sustained sitting of frequent reading, marking of assignments, working and reading in front of a computer, standing up teaching in class, repetitively overhead writing on board are also unsafe act and favorable to the development of MSD such as Neck Shoulder Pain (NSP), Low Back Pain (LBP) and upper limb pain that was mainly found in teachers [12].

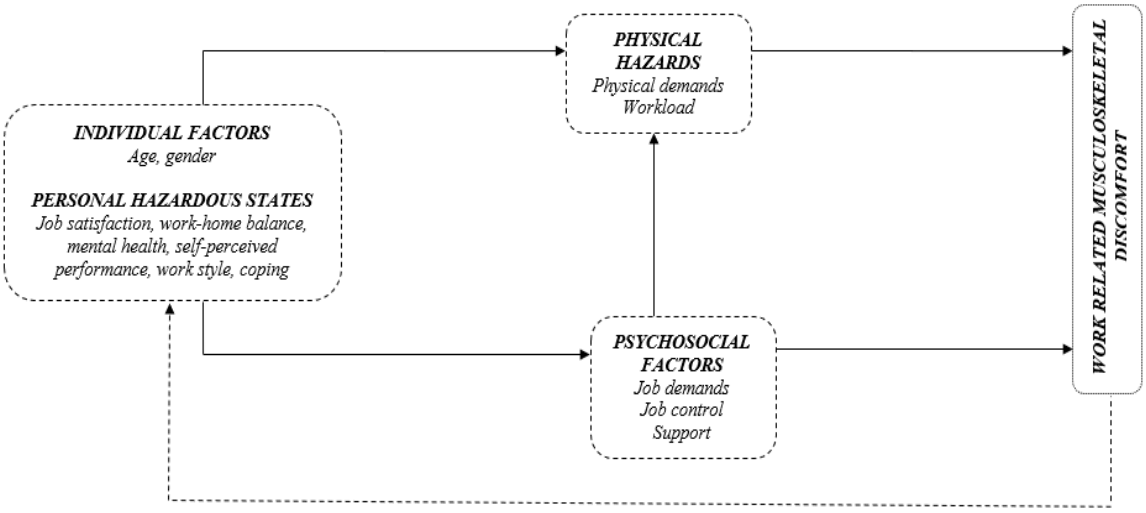
In addition to physical factors, psychosocial factors also play a role in the development and deterioration of MSDs [18-20]. Psychosocial factors such as workload/ demands, perceived stress level, social support, low job control, job satisfaction, and monotonous work were associated with MSDs among school teachers [10]. As a result, an increase in job demand with extra responsibility and additional workload in the teaching profession makes them liable to experience the risk of MSDs [9]. Those who are new to the profession are working nearly 19 hours per week outside school hours, causing many to leave the profession within just a few years of qualifying [21]. Given this, work-life balance is vital to teacher effectiveness and satisfaction in the context of student learning. Therefore, teachers need to know the technique of how to distress to maintain good health and high spirit such as well-being [22]. Well-being is an indicator of having good mental (such as psychological health) and physical health (such as MSDs) and vice versa [10]. Previous studies have found that general well-being is concerned with an individual's judgment regarding his/her continual happiness; satisfaction with his/her physical and mental health, and how it relates to some psychosocial factors such as life satisfaction or work satisfaction [10, 23].

Since most of the study concerning MSD was undertaken in developed countries, it is conceivable that the contribution of predictors associated with MSDs differs from one country to another [18, 19]. Besides that, some theoretical models have proposed that the role of physical and psychosocial factors in the development of MSDs is complex or may involve complex relationships [19, 24-26]. Given this, a model describing the potential contribution of predictor toward MSDs by using Structural Equation Modeling (SEM) could be developed that take into account the socio-cultural aspect of the target population which can be a source of differences between one model to another. Structural Equation Modeling (SEM) is a useful analytic tool for the evaluation of complex causal relationships in social sciences [27]. SEM focuses on the covariance calculated from various sets of variables [27]. Moreover, SEM is increasingly used for the analysis of complex interrelationships between risk factors involved in the development of musculoskeletal disorders [27]. However, it is very rare in Malaysia for the use of SEM in the study of MSDs risk factors. Given this, a model describing the potential contribution of predictors toward MSD could be developed that take into account the socio-cultural aspect of the target population which can be a source of differences between one model to another [28].

ISSN- 2394-5125 VOL 7, ISSUE 14, 2020

## II. THEORETICAL FRAMEWORK

**Figure 1:** A modified version of the ecological model of MSD in office work




Source: Maakip et al. (2015)

The above model suggested by Maakip and colleagues [19] which a modified version of the ecological model of musculoskeletal disorders in office work was proposed by Sauter and Swanson [29]. In this model, all of the factors such as psychosocial hazards, individual factors, and personal hazardous states are independent variables while MSD as the outcome also dependent variable.

From this model, physical hazards such as physical workload, including posture and repetition. While job-related and organizational factors (e.g., job demands, control, and support) as psychosocial job factors refer to nonphysical work factors. Few studies have examined that these factors that were assumed to directly impact on musculoskeletal discomfort [30-31].

Nevertheless, this model also proposed that individual characteristics including age and gender whilst personal hazardous states such as job satisfaction, mental health; coping, and work style might influence the occurrence of musculoskeletal discomfort in office workers. This also supported by previous studies reported that coping and working through pain is associated with musculoskeletal disorders [32-33].

From this model, personal responses to psychosocial and physical hazards may place individuals at increased risk of developing a musculoskeletal disorder. The experience of adverse physical and psychosocial hazards at workplaces puts individuals at higher risk of stress and illness that lead to hazardous states such as lack of job satisfaction, poor work-life balance, adverse work style which in turn increased the risk of musculoskeletal disorder.

## III. RESEARCH OBJECTIVE

The present study was to examine physical factors, psychosocial factors, workload, work-life balance, and general well-being factors that predict MSDs among primary school teachers in Kota Kinabalu.

## RESEARCH HYPOTHESES

$H_1$: Physical factors significantly predict MSD among primary school teachers in Kota Kinabalu.
$H_2$: Psychosocial factors significantly predict MSD among primary school teachers in Kota Kinabalu.
$H_3$: Workload significantly predicts MSD among primary school teachers in Kota Kinabalu.
$H_4$: Work-life balance significantly predicts MSD among primary school teachers in Kota Kinabalu.
$H_5$: General well-being significantly predicts MSD among primary school teachers in Kota Kinabalu.

ISSN- 2394-5125 VOL 7, ISSUE 14, 2020

## IV. METHODS

### Sampling procedures

This cross-sectional survey was conducted among primary school teachers in 11 primary schools in Kota Kinabalu. Specifically, to identify probability while selecting a sampling unit such as district, Probability Proportional to Size (PPS) was utilized to measure sample that is proportional to the size of the specific population. The steps in applying PPS are listed as below:

1. The sample size was determined through the calculation method suggested by Cohen, Manion, and Morrison [34]. The sample size for the present study was calculated using the web-based sample size determination formula [35]. The formulas used in the sample size calculator is:

$$\text{Sample Size (Ss)} = \frac{Z^{2*}(p)^{*}(1-p)}{c^2}$$

Where:
Z = Z value (e.g. 1.96 for 95% confidence level)
p = percentage picking a choice expressed as a decimal (.5 used for sample size needed)
c = confidence interval expressed as a decimal
(e.g., .05)

**Table 1 Sample size calculation**

| Determine Sample Size | |
|---|---|
| Confidence Level | 95% |
| Confidence Interval | 5 |
| Population (large) | 3565 |
| The sample size needed | 347 |

Source: Creative Research System (2003)

Based on the web-based calculation, the sample size needed for the present study is 347 respondents (see Table 1). A minimum sample size of 347 is considered as adequate for any population that is greater than 2,000 which 3,565 from primary school (within 95% confidence level and a confidence interval of 5) [34]. In social science research, missing data and incomplete questionnaires were predicted; therefore, the sample size was increased by another 20%. Thus, a total of 416 respondents were required in the present study. The total of 416 was then rounded to 420 respondents.

2. As in social science, missing data and incomplete questionnaires were predicted. Thus, to achieve adequate statistical power for analysis and representation, the former calculated sample size was increased by another 20%.

3. Next, the number of schools was determined. The present current study intended to visit 11 schools for conducting surveys, with a minimal sample size of 347 respondents' primary school teachers who were needed in each randomly selected school.

4. The total population of primary school teachers located at Sabah was identified (Table 2).

**Table 2: Population of primary schools teachers at Sabah**

| District | Population | Cumulative Population |
|---|---|---|
| Kota Kinabalu | 2,537 | 2,537 |
| Penampang | 1,028 | 3,565 |

5. The number of the total population (3565) was divided by 11 (selected number of primary schools), such that 3,565/11= 324, which was labeled as Sampling Interval (SI).

6. A number between 1 and 324 (SI) was randomly selected. The number of 1 was randomly selected and named as Random Start (RS).

7. The following series was calculated: SI + RS; 2SI+ RS; .... 11SI+RS. For example, 11SI+RS was calculated as 11 times the sampling interval and added with a random start, 1. The result showed 11(324) + 1=3,565.

8. All 11 numbers were matched with Sabah's primary schools' list. For instance, the first number of the series, S1+RS= 325 fell within the range of 1to 2,537 in Penampang District. Then the 10th number of the series was 10SI+RS= 3,241 fell within the range of 2,537 to 3,565 in Penampang District. Repeating with this similar pattern, the number of schools needed for the specific districts were identified (see Table 3).

**Table 3: Determining the number of schools from two districts**

| District | Population | Cumulative Population | Number of schools |
|---|---|---|---|
| Kota Kinabalu | 2,537 | 2,537 | 9 |
| Penampang | 1,028 | 3,565 | 2 |

9. Finally, based on the calculation, a total of 11 primary schools were required to participate in the present study. There were 6 primary schools from SJKC, 3 primary schools from SK located at Kota Kinabalu district while 1 primary school from SJKC and 1 from SK which located in Penampang district. The district of Kota Kinabalu and Penampang has been chosen as till date there has no research regarding MSD has been conducted among primary school teachers in Sabah. The schools were randomly chosen within Kota Kinabalu and Penampang. Schools were chosen after getting permission from the Principles of the schools. Most of the school principals from SK reject the study offer to participate in this study. So, the researcher resort to randomly pick again from the list of schools within Kota Kinabalu.

Boomsma recommended 400 as an adequate sample size [36]. The greater the sample size the mode like it is one can validate the model using cross-validation. Therefore, 460 respondents participated in the present study considered as adequate to perform the (SEM) analysis. In the present study, there were 460 (response rate = 76.6%) primary school teachers who participated in the study. The survey was conducted between September and November of 2019.

**Sample**

There were 460 respondents (n = 460), comprised of 44 (9.6%) males and 416 (90.4%) females. Most of the respondents from the middle-aged group (age group of 31–40 (46.3%)). The respondents' background is shown in Table 4. There was only one respondent at the age of 19-20, who is a temporary school teacher which is 20 years old also participated in the present study.

**Table 4: Respondents background**

| Variables | N (%) |
|---|---|
| **Gender** | |
| Male | 44(9.6%) |
| Female | 416(90.4%) |
| **Age** | |
| 19-20 | 1 (0.2%) |
| 21-30 | 28 (6.1%) |
| 31-40 | 213 (46.3%) |
| 41-50 | 150 (32.6%) |
| 51 and above | 68 (14.8%) |

## V. RESULTS

### a) Structural equation modeling

A two-step SEM approach, measurement model, and structural model were employed to confirm the reliability and validity of the measures before examining the structural relationship between constructs. This study used a maximum approach to parameter estimation problems that can be developed for a large variety of estimation situations.

ISSN- 2394-5125 VOL 7, ISSUE 14, 2020

**b) Measurement model**

The measurement model was assessed via the evaluation of the reliability, convergent validity, and discriminant validity of the construct measures.

**c) Reliability analysis**

The reading of Cronbach's alpha and composite reliability for all the variables, as presented in Table 5 is greater than 0.50, in relation to the expected factors, symbolizing higher reliability among the indicators.

**d) Convergent validity**

Construct validity is explored by investigating the relationship of a construct with another in terms of relatedness and the unrelated [37]. The standardized loading items as revealed in Table 2 were considered significant as they reach at least 0.50 and more which reflect convergent validity [38]. The average variance extracted (AVE) of the latent construct exceed the recommended threshold value of 0.50 [38] ranged from 0.567 to 0.728. The items were selected based on the loadings and model fit. Thus, the current data have good convergent validity.

**Table 5 Convergent Validity**

| Construct | Item | Loading | Cronbach's Alpha | CR | AVE |
|---|---|---|---|---|---|
| Physical factors | P4 | 0.85 | 0.84 | 0.84 | 0.57 |
| | P5 | 0.86 | | | |
| | P6 | 0.67 | | | |
| | P8 | 0.61 | | | |
| Psychosocial factors | S7 | 0.77 | 0.96 | 0.90 | 0.59 |
| | S12 | 0.75 | | | |
| | S16 | 0.74 | | | |
| | S18 | 0.73 | | | |
| | S19 | 0.80 | | | |
| | S23 | 0.81 | | | |
| Workload | W1 | 0.73 | 0.88 | 0.89 | 0.67 |
| | W2 | 0.88 | | | |
| | W3 | 0.90 | | | |
| | W4 | 0.76 | | | |
| Work-life balance | WLB17 | 0.91 | 0.90 | 0.91 | 0.73 |
| | WLB18 | 0.87 | | | |
| | WLB19 | 0.84 | | | |
| | WLB21 | 0.79 | | | |
| General well-being | G2 | 0.79 | 0.93 | 0.91 | 0.66 |
| | G3 | 0.79 | | | |
| | G4 | 0.84 | | | |
| | G6 | 0.87 | | | |
| | G9 | 0.76 | | | |
| Musculoskeletal disorder | M6 | 0.50 | 0.81 | 0.75 | 0.65 |
| | M7 | 0.71 | | | |
| | M8 | 0.80 | | | |
| | M10 | 0.58 | | | |

**e) Discriminant validity**

Discriminant validity is the degree to which two conceptually similar concepts are distinct [38]. Discriminant validity is conducted to ensure that the instrument used for the study does not overlap with each other. Hence, an instrument with good discriminant validity is reflected by having a low correlation. It is an indicator of a low correlation between the questions that form a construct and other questions that form another construct [38]. Evidence of discriminant validity is determined by the Average Variance Extracted (AVE) with more than 0.50 as shown in Table 6 while Table 3 for discriminant validity. These results are based on the final data.

ISSN- 2394-5125 VOL 7, ISSUE 14, 2020

**Table 6: Discriminant validity**

| Item | Construct | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| 1 | Physical factor | **0.75** | | | | | |
| 2 | Psychosocial factor | -0.18 | **0.79** | | | | |
| 3 | Workload | 0.27 | -0.53 | **0.82** | | | |
| 4 | Work-life balance | 0.38 | -0.30 | 0.23 | **0.85** | | |
| 5 | General well-being | 0.27 | 0.50 | 0.53 | 0.43 | **0.81** | |
| 6 | Musculoskeletal disorder | 0.40 | -0.04 | 0.04 | 0.03 | 0.40 | **0.86** |

**f) Structural model**

The structural model in the SEM was performed and evaluated by examining fit indices and variance explained estimates. A variety of indices were used to assess the model's overall fit (See Table 7). The indices value for comparative fit index (CFI), the goodness of fit index (GFI), Index of fit (IFI), Parsimony goodness of fit index (PGFI), and Tucker-Lewis index (TLI) were above 0.90 and root mean square error of approximation (RMSEA) below 0.08 [39-40], indicating a satisfactory fit. Therefore, the hypothesized model was a good fit and acceptable. As a consequence, the results are a sign of an adequate model fit between the proposed research model and the empirical data.

As shown in Figure 2, the revised structural model discloses the direct effects of the path coefficient between physical factors and MSD were positive and statistically significant with $\beta$=.318, $p<0.001$, and Critical Ratio (CR) >1.96. While general well-being and MSD were positive, statistically significant with $\beta$=.428, $p<0.001$ as well as Critical Ratio (CR) >1.96. (see Table 7). However, the path from psychosocial factors is not apparent to give an impact on MSD. Thus, psychosocial factors have to work hand in hand with the workload and work-life balance to give the impact slowly through general well-being to MSD. In other words, psychosocial factors, workload, work-life balance, and general well-being is the 4 factors measurement models which they correlated with each other and give the impact to MSD. While physical factors served as the predictors of MSD which independently and significantly influence MSD. Hence the standardized regression weight for the observed variables showed practical importance with a value more than .1.

Additionally, the latent factor correlations were checked and found to be correlated and significant. For example, r=-.499 (Psychosocial↔Workload), r=-.312 (Psychosocial↔WLB), r=.482 (Psychosocial↔GWB), r=.507 (Workload↔GWB), r=.455 (WLB↔GWB), r=.214 (Workload↔WLB), Moreover, none of the correlations are above r=0.85, hence supporting discriminant validity for the model. It can be concluded that H19 and H23 are supported while H20, H21, and H22 are rejected.

**Table 7: Model fit analyses and cut off values used for model fit**

| Fit Indices | Recommended cut off values | Revised Model |
|---|---|---|
| $\chi^2$/df | 1.00 - 5.00 | 1.922 |
| P value | >.05 | .000 |
| GFI | >.80 | .881 |
| CFI | >.90 | .945 |
| TLI | >.90 | .938 |
| RMSEA | <.08 | .058 |

**Source: Hair et al., (2010)**; **Lowry and Gaskin (2014)**

**Table 8: Standardized regression for a structural model of physical factors, psychosocial factors, workload, work-life balance, general well-being, and MSD**

| **Path** | **B** | **Critical Ratio (CR)** | ***P*** | |
|---|---|---|---|---|
| MSD ←Physical | .318 | 4.638 | *** | |

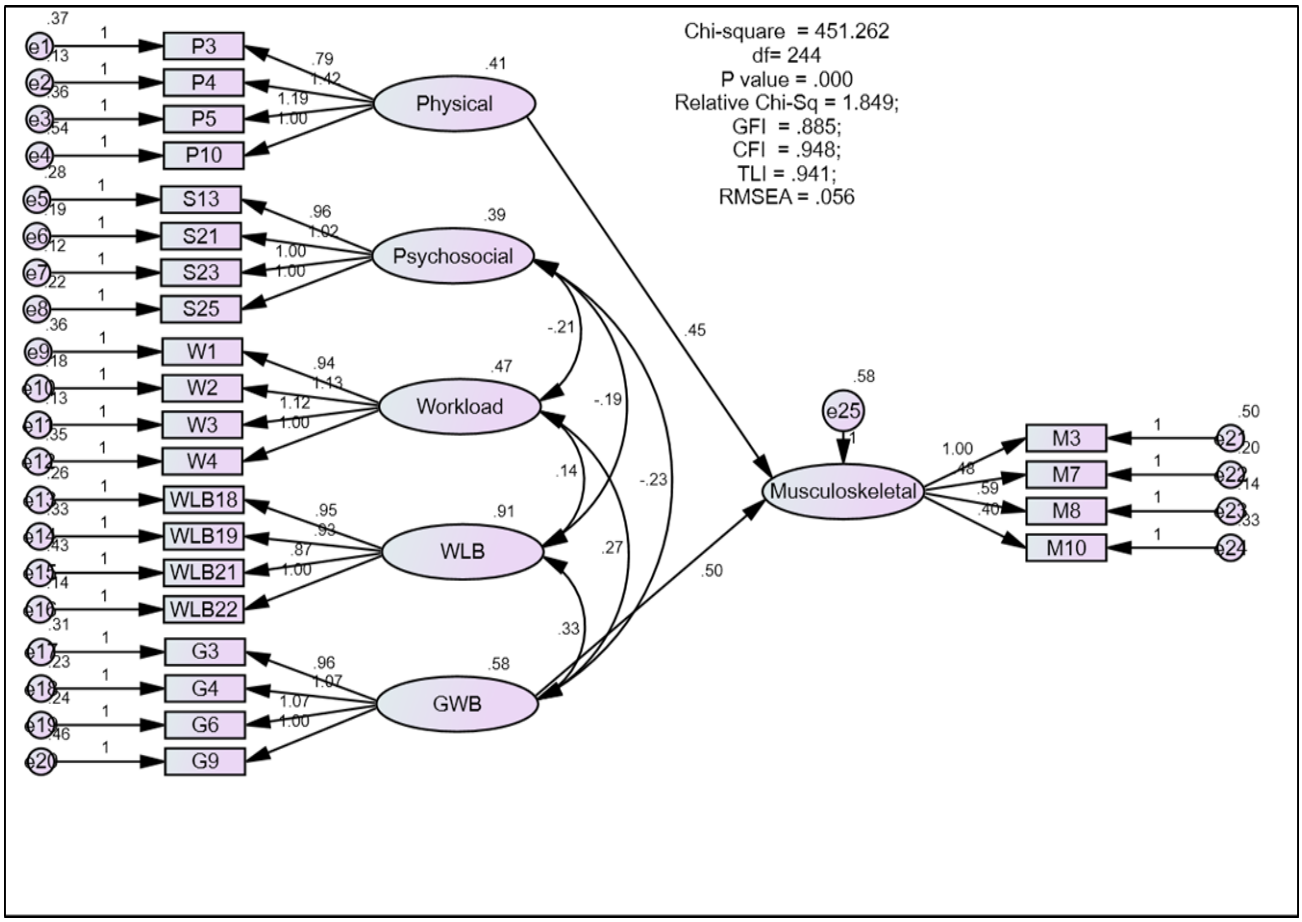
ISSN- 2394-5125 VOL 7, ISSUE 14, 2020

| | | | | |
|---|---|---|---|---|
| MSD ← GWB | .428 | 5.156 | *** | |
| **Correlation** | **R** | **Critical Ratio (CR)** | ***P*** | |
| Workload ↔ GWB | .507 | 6.160 | *** | |
| WLB ↔ GWB | .455 | 6.000 | *** | |
| Workload ↔ WLB | .214 | 3.159 | .002 | |
| Psychosocial ↔ Workload | -.499 | -6.172 | *** | |
| Psychosocial ↔ GWB | -.482 | -5.977 | *** | |
| Psychosocial ↔ WLB | -.312 | -4.436 | *** | |
| | | | | |
| **Construct** | **Item** | **Loading (Standardized)** | **Critical Ratio (CR)** | ***P*** |
| **Physical factors** | P3 | .643 | NA | NA |
| | P4 | .917 | 11.653 | *** |
| | P5 | .792 | 10.895 | *** |
| | P10 | .675 | 9.623 | *** |
| **Psychosocial factors** | S13 | .749 | NA | NA |
| | S21 | .822 | 13.574 | *** |
| | S23 | .871 | 14.335 | *** |
| | S25 | .797 | 13.136 | *** |
| **Workload** | W1 | .731 | NA | NA |
| | W2 | .878 | 14.343 | *** |
| | W3 | .904 | 14.685 | *** |
| | W4 | .755 | 12.299 | *** |
| **Work-Life Balance** | WLB18 | .867 | NA | NA |
| | WLB19 | .836 | 18.066 | *** |
| | WLB21 | .790 | 16.384 | *** |
| | WLB22 | .936 | 21.904 | *** |
| **General well-being** | G3 | .794 | 15.775 | *** |
| | G4 | .865 | NA | NA |
| | G6 | .855 | 17.635 | *** |
| | G9 | .749 | 14.448 | *** |
| **Musculoskeletal disorder** | M2 | .783 | NA | NA |
| | M3 | .938 | 15.630 | *** |
| | M5 | .592 | 9.981 | *** |
| | M8 | .689 | 11.901 | *** |

Note: error variance free from violation (<.80)

ISSN- 2394-5125 VOL 7, ISSUE 14, 2020

**Figure 2:** A revised Structural model of physical factors, psychosocial factors, workload, work-life balance, general well-being, and MSD




## VI. DISCUSSION

This study aimed to examine the factors that are most contributed and related most to MSDs among primary school teachers in Kota Kinabalu. Findings in the study found that physical and general well-being are the factors that contributed to the musculoskeletal disorder. While general well-being was the strongest predictor contribute to musculoskeletal disorder among teachers in Kota Kinabalu, Sabah. This finding was supported by a study [41] suggested that the strongest correlations were found between physical factors and work-related musculoskeletal disease among male shipyard workers. Many studies have examined the relationship between physical hazards and MSDs; however, there was a lack of study examined the relationship between risk factors and MSDs by using SEM, and most have focused on studies undertaken in developed countries. For example, lifting heavy loads have been reported as a risk factor for shoulder, back, and elbow pain among Turkish teachers [3].

Among Swedish music teachers, lifting instruments, and music equipment more than six times a day has been correlated with neck/shoulder pain [42]. In Brazil, intense physical activity and inappropriate furniture have been associated with back pain among teachers [15]. Helping students into flexing posture and lifting instruments among Greek school teachers is highly correlated to lower back pain [43]. For the physical factors, the study [15] showed that intense physical exertion and inappropriate furniture have also been positively associated with back pain among Brazilian teachers. Parallels can be drawn to the results of Botswana suggested that teachers who reported that their job required high physical effort, rapid physical activity, awkward body, and awkward arm had a higher prevalence of MSDs [44]. Furthermore, frequently working in an uncomfortable posture has been found to increase experiencing pain in the neck region among office workers in Thailand [45]. These findings were statistically significant in contribution to the development of MSDs in the teaching profession.

ISSN- 2394-5125 VOL 7, ISSUE 14, 2020

The above findings were also consistent with a previous study conducted in Malaysia [9] reported that the main task reported to contribute to low back pain in schools was lifting loads. The loads were namely working books, exam papers, and some heavy sports equipment carried by the physical education teachers. Prolonged sitting was the second contributing factor to the low back pain (25.2%), followed by prolonged standing (23.4%). Marking exams, assignments, and workbooks resulted in prolonged sitting. Activities during physical education sessions and walking up and down the stairs were the fourth contributing factor to low back pain (13.5%). Finally, working with a computer was the fifth contributing factor (6.3%) [9]. Given this, the physical aspects of the teaching profession may place an increased risk of MSDS development among teachers. However, limited studies concerning this issue might dampen the need to develop specific strategies in minimizing MSDs.

In addition to physical factors, findings of the study also found that general well-being was the strongest indicator of musculoskeletal disorder. Few studies have examined the relationship between general well-being (mental health) and MSDs, few have focused on studies undertaken in developed countries. Evidence shows that the most impactful variables on the well-being of teachers are included being highly motivated, having social needs met in the school environment, having sufficient didactic and technical skills, and having positive relationships with students, colleagues, and administrators [32]. Hence general well-being (e.g. mental health) is related to the musculoskeletal disorder.

Even though, psychosocial factors were not shown to have an impact on MSD in the present study, significant associations were found between workload, work-life balance, and general well-being. A study conducted in South Korean workers reported finding that psychosocial factors affected general well-being, in that lack of support at work correlated with poor well-being [33]. Moreover, the study also found a correlation between workload, work-life balance, and general well-being. In other words, a low level of support at work can cause emotional issues that can also affect family life, worsening the work-life balance further and reducing general well-being [33]. Another study of school teachers in Botswana conducted by Erick and Smith found a similar association between a heavy workload and MSD of the shoulder and upper back [31]. In other words, with lower workloads, employees can spend less time at work, and more time at home, improving their well-being. Also, the association between work-life balance and general well-being may be explained by individuals have fixed amounts of time and energy for multiple roles [34]. Consequently, increased roles lead to higher role conflict, overload, and negative psychological repercussions As a result, sufficient time available for work and private life will affect well-being if personal needs are met only within that time. Conversely, insufficient time or conflict within the work and non-work domains may decrease the level of well-being due to needs frustration.

## VII. CONCLUSIONS

In line with the literature review, the findings from the present study support the idea that physical factors and general well-being are significant predictors of MSDs among teachers. Besides, the strongest correlation was found between general well-being and MSDs. The present study is the first study that examined predictors associated with MSDs by using structural equation modeling among those in the teaching profession, particularly in Kota Kinabalu, Sabah, Malaysia. However, the present study also has limitations. One of the limitations in this study was all variables were assessed using self-reports measure which means that a general negativistic view of the work situation and health status (negative affectivity) might have contributed to the results. However, the reports were only from the teachers' perspectives might not offer accurate measures of the construct. Another limitation was this is the cross-sectional study and it does not provide a good basis for establishing causality.

Recommendations for future studies are based on the contributions and limitations as previously outlined. First and foremost is that longitudinal studies are necessary to be able to draw firm conclusions about the causal relationships between predictors and MSDs. Such studies would enable greater exploration of the relationship between other potential predictors and MSDs. Secondly, understanding this relationship is valuable and will assist those teachers in planning, designing, or implementing preventive intervention programs to reduce the risk of MSDs. This study also provides awareness for teachers and those parties involved such as the Malaysian Ministry of Education regarding the issues of MSDs at the workplace. Currently, procedures and guidelines on good ergonomic movements for industrial workers involved with manual handlings are readily available but not for teachers. Detailed and specific guidelines on good ergonomic guidelines for teachers are worth to be

developed to minimize the prevalence and effects of MSDs among teachers. Third, future intervention studies on how to reduce MSDs among teachers is therefore warranted. Lastly, in addition, the research design can also be improved by using a mixed-method research design to further compliment the findings than depending on quantitative data alone as it lacks certain meaning which can only be gotten via a qualitative method.

The prevention of musculoskeletal discomfort is challenging. MSDs are complex with a multifactorial etiology. In practical terms, the findings of this thesis support that intervention strategies to reduce the prevalence of MSDs and its consequences in the workplace should consider addressing both physical and psychosocial factors. For the practical implication, this study has highlighted the role of work-life balance as an important area for further research and possible consideration in MSD risk management strategies, along with the physical, psychosocial, workload, work-life balance and general well-being in the workplace to reduce the extent of self-reported MSD pain. Thus, a workable work-life balance policy that considers a balance between work and home must be implemented by considering the nature of a job particularly those in the teaching profession. For example, less workload and ability to unwind after work concerning physiological and muscle relief and relaxation technique should be taught to teachers in alleviating their physiological and psychological impact of imbalance between work and home.

In a nutshell, the results in the present study add new knowledge to the important area of MSD research. The study examined a wide range of predictors on MSD in Malaysia. Its results found similarities between the predictors with previous studies reported in the literature however a notable difference in the perceptions of psychosocial factors, workload, work-life balance and general well-being as psychosocial factors have to work hand in hand with the workload and work-life balance to give the impact slowly through general well-being to MSD among teachers

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