

Relationship Between Physical Activity and Musculoskeletal Symptoms Among Educators in Kuala Lumpur

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Abstract

Problems: Musculoskeletal disorder (MSD) are one of the most common health conditions in certain job area, and they have a huge effect on their health and quality of life all over the world. Leisure physical activity has been recommended as one of the strategies for improving musculoskeletal symptoms in adults. The purpose of this study was to evaluate the percentage of musculoskeletal symptom and its relationship with physical activity among educators in Kuala Lumpur. **Approach:** A cross-sectional study was conducted among educators in Sentul, Kuala Lumpur. The educators required to answer 3 questionnaires which were socio demographic, International Physical Activity Questionnaire (IPAQ) long version and Nordic Musculoskeletal Questionnaire (NMQ). **Findings:** This survey included a total of 105 school educators, with an average age of 36.72 ± 8.04 years. Musculoskeletal symptoms were identified by the majority of educators (88.6%), with the shoulders (51.4%), lower back (46.7%), and neck (46.7%) becoming the most common. 46.6% of the educators were moderately active while 26.7% were both highly and low active. Based on two way ANOVA there was significant difference of metabolic equivalent of task (MET)-min/week between gender ($p < 0.05$) and age group ($p < 0.05$). Furthermore there was significant different in musculoskeletal symptom (MSS), MSS-12 score between age group ($p < 0.05$). According to logistic regression, there was no significant relationship between musculoskeletal symptom with socio demographic factors and physical activity ($p > 0.05$). **Conclusion:** In conclusion there was significance difference of musculoskeletal symptom between age group. However, there was no discernible association between musculoskeletal symptoms and levels of physical activity. An intervention study was suggested to raise musculoskeletal symptoms awareness among educators by incorporating other factors such as psychosocial aspects

Keywords: Physical activity, musculoskeletal symptoms, educator, socio-demographic

1. Introduction

The education sector came in sixth place, representing approximately 6.4 percent of Malaysia's workforce (Department of Statistics Malaysia 2011). This demonstrated that teaching is a vital profession in Malaysia. They are in charge of educating and transforming future generations into effective leaders. The educational sector has undergone reforms in recent years, resulting in increased obligations and physical pressures on educators, which may have an effect on their occupational health (Mahmud et al. 2018). Musculoskeletal symptoms are one of the most common health conditions in educators, and they have a

huge effect on educators' health and quality of life all over the world. According to previous study, musculoskeletal symptoms is present in 40–90% of school educators worldwide (Erick & Smith 2011) .

Educators all around the world have participated in several surveys on MSD symptoms. Hong Kong educators had the highest incidence which is 95 % of MSD such as shoulder, neck and lower back pain based on previous finding (Erick & Smith 2011), followed by educators in Saudi Arabia (79.2%) (Darwish & Zuhair 2013) , Estonia (66.7%) (Pihl et al. 2002) , Turkey (51.4%) (Korkmaz et al, 2011) and Germany (42%) (Seibt et al. 2005) .Beside that, the most common side effects of musculoskeletal symptoms in educators were elbows, lower back, and spine. The identified shoulders, lower back and neck were studied as the most prevalent side among educators in Malaysia (Zamri et al. 2017), Saudi (Pihl et al, 2002), China (Yue et al. 2012), Turkey and Hong Kong (Pihl et al. 2002; Elaine et al. 2010) . In addition, several scholars have concentrated on other industries that have musculoskeletal symptoms such as plantation (Mokhtar et al. 2013), automobile production (Deros et al. 2010) , building workers (Deros et al. 2014) and visual display workers (Samsudin& Darius 2013). In Malaysia, research on musculoskeletal symptoms has also focused on other area such as nursing (Amin et al. 2018) , mechanic work (Abdullah et al. 2020) , and students (Ahmad et al. 2020;Harithasan et al. 2022) .

The socio-demographic and job features is assumed to contribute to the musculoskeletal symptom in educators. Women are at greater risk of developing musculoskeletal symptoms than males (Yue et al. 2012' Guo et al. 2004) .In addition, working hours also lead to this symptom, as shown by previous study (Stergioulas et al. 2004). Physical activity(PA) has, however, been suggested as one of the methods for reducing musculoskeletal symptoms in adults. Previous study indicated that analyzing PA, BMI, and smoking indicated that lower PA and obesity a significant predictor to musculoskeletal symptoms among kitchen workers in Finland (Haukka et al. 2012) . Another study among older adults indicated that the numbers of back pain were associated with low PA (Murata et al. 2019) . Other cross-sectional study among student indicated that hip pain was associated with low intensity of PA among adults in the United Kingdom (Pan et al. 2019) . Based on meta-analysis study the results indicated that neck and shoulder pain have a significant reduction especially in workplaces that promote healthy lifestyle such as PA programs. However based on the results of meta-analysis, there was no significant evidence for low back pain, hand, elbow and others in relation to PA program intervention in the workplace (Moreira et al. 2016)

Due to the hectic lifestyle in the workplace, many adults do not have enough time to do PA. Educators workload has reduced their chances to do PA due to heavy workload on teaching, preparing materials for teaching, advising students, assessing students' work and others. The work task of school educators mostly head down due to reading and marking assignments which may have caused neck pain (Arvidsson et al. 2016)

Therefore to fill in the gap of knowledge on the potential role of PA with the musculoskeletal symptoms, we examined a cross-sectional study of associations of PA with musculoskeletal, BMI and sociodemographic factors among educators in Kuala Lumpur. The objective of this research was to determine the percentage of musculoskeletal symptoms and their relationship to PA among school educators working in Kuala Lumpur.

2. Methodology

A cross-sectional study was conducted to determine the level of musculoskeletal symptoms and PA among educators. The educators were selected by simple random sampling from six schools in Kuala Lumpur. The number of educators in each school was calculated using the proportion of educators in each school. The sample size calculation was based on the formulas (Cochran 1977)

$n = (Z_{\alpha/2})^2 p(1-p) / D^2$, p is the prevalence of educators who developed musculoskeletal 40.4 % (Samad et al. 2010) and Δ is the margin of error which is 0.09. Therefore, the sample size $n = (1.96)^2 (0.404 \times 0.596) / (0.09)^2 = 114$ participants.

The subjects were required to fill in consent form and three types of questionnaire which were International Physical Activity Questionnaire, Nordic Musculoskeletal Questionnaire and Sociodemographic questionnaire. Nordic Musculoskeletal Questionnaire was used to assess the musculoskeletal symptoms in nine regions of the body included neck, shoulders, upper back, lower back, elbows, wrists/hands, hips/thighs, knees, ankles/feet. While the International Physical Activity Questionnaire (IPAQ) long version was used to assess the PA. This questionnaire had five domains which were PA related to work, transportation, domestic, leisure time activity and sitting time. The PA was measures in metabolic equivalent tasks (MET)-min/week.

This study was approved by the Universiti Kebangsaan Malaysia Research Ethics Committee (UKM PP/111/8/JEP-2016-692). The suitable educators received a self-administered and facilitated questionnaire that included sociodemographic background information about age, length of time as a teacher, type of schools, and the International Physical Activity Questionnaire (IPAQ)-long form. A form confirming the informed consent was signed by the subject who consented to take part in the study. The inclusion criteria for educators were that they are at least 18 years old, have no disabilities and have worked for at least a year. Subjects who had musculoskeletal symptoms prior to starting their careers or who were pregnant were excluded from the study. Through a series of interviews, the International Physical Activity Questionnaire (IPAQ)-long form was used to evaluate PA. Other researchers have evaluated the questionnaire's validity and reliability among Malaysia's Malay population (Shamsuddin et al. 2015). This questionnaire had five domains which were PA related to work, transportation, domestic, leisure time activity and sitting time. The PA was measures in MET-min/week

$\text{MET-min/week} = \text{min of activity / day} \times \text{day per week} \times \text{MET level}$

According to the recommendations of IPAQ, the level of PA is divided into three categories: low (600 MET-minutes/week), moderate (600 - 3000 MET-minutes/week), and high (3000 MET-minutes/week) (WHO 2010)

Statistical analyses were carried out using All the data were analyzed using SPSS version 23 statistical software package (IBM Corporation, Somers, NY, USA). In order to determine the interaction between age group and gender for total PA and total score of musculoskeletal symptoms for 12 months musculoskeletal symptom (MSS), (MSS-12), ANOVA Two-Way was used. Relationship between musculoskeletal symptoms with PA was measured using logistic regression, with musculoskeletal symptom as dependent variable and socio PA as independent variables. In logistic regression, for respondents will be categorized into two. Respondent that at least one musculoskeletal symptom will be indicated as having musculoskeletal symptoms, if no musculoskeletal symptom will be defined as not having musculoskeletal.

3. Results

This study involved 105 educators in Kuala Lumpur, with an average age of 36.72 ± 8.040 years, 11.24 ± 8.325 years of experience, and 8.17 ± 2.01 hours of work a day. Table 1 shows that the majority of the educators were female (72.0%), Malays (98.0%), and worked in secondary schools (57.0%). Musculoskeletal symptoms were identified by 88.6% of educators in this sample. A survey in Botswana, it was found that 83.3 percent of the population suffers from musculoskeletal symptoms. This happened as a result of the nodding posture used when marking assignments, reading, and writing on the blackboard by teachers. The situation is exacerbated by educators' increased workloads, a lack of resources, and dissatisfaction with their employment (Erick & Smith 2014; Chiu et al. 2007; Hornig et al. 2008).

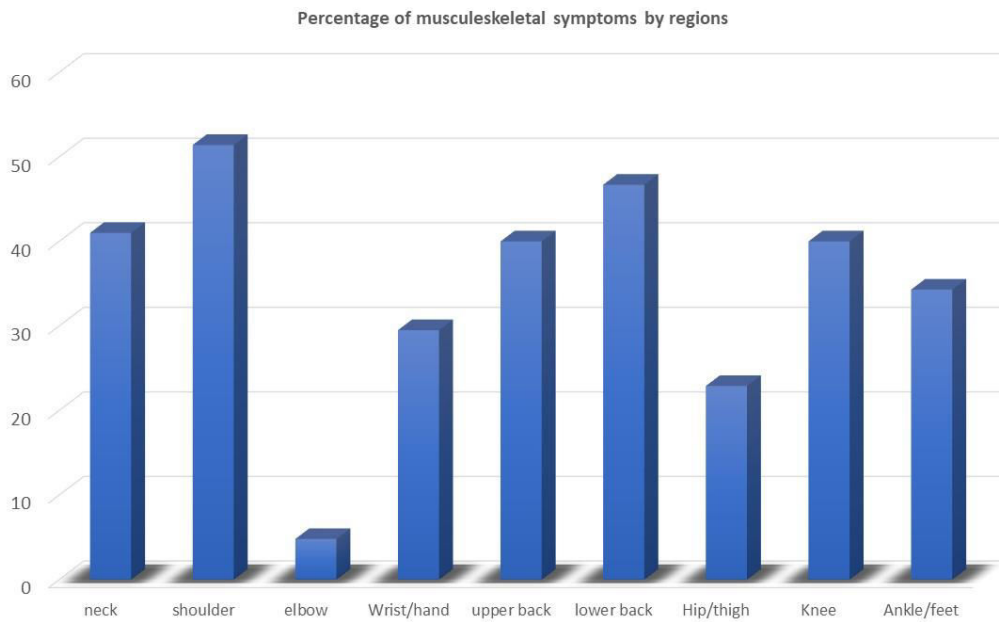


Fig. 1 Percentage of Musculoskeletal Symptoms

Figure 1 reveals the percentage of musculoskeletal symptoms by nine regions of the body. Shoulders pain showed the highest percentage among nine regions of the body is due to overuse of the muscles, abduction activities, and lifting the arm more than the position of the shoulders. The second highest percentage of musculoskeletal symptoms was shoulder (50%) followed by lower back and neck .

Table 1 Sociodemographic Factors and working experience

Sociodemographic and work characteristic	Number (n)	Total (n=105)	Mean±SD
Age (years old)			
20 – 29	22	21.0	36.72± 8.04
30 – 39	48	45.7	
≥40	35	33.3	
Gender			
Male	33	31.4	
Female	72	68.6	
Marriage status			
Not married	19	18.1	
Married	86	81.9	
Ethnic			
Malay	98	93.2	
Chinese	3	2.9	
Indian	1	1.0	
Others	3	2.9	

Smoking Status			
Yes	99	5.7	
No	6	94.3	
Types of school			
Primary	48	45.7	
Secondary	57	54.3	
Work experience (years)			11.24± 8.33
1 – 10	63	60.0	
11- 20	22	21.0	
>20	20	19.0	
Working days (day/week)			5.14 ± 0.45
Working hours (hour/day)			8.17 ± 2.01

Meanwhile in Table 2 the two way ANOVA analysis indicating there was significant mean difference of total MET/min in week between gender ($p=0.02$, $\eta^2=0.05$) with moderate effect. Meanwhile the results revealed there was significant mean difference of MET-min/week in week between age group ($p=0.02$, $\eta^2=0.07$) with moderate effect. However there was no significant difference statistically for interaction effect($p=0.84$, $\eta^2=0.004$) with no effect. Furthermore for total score MSS12 there was no significant difference between gender ($p=0.21$, $\eta^2=0.053$) with moderate effect, age group ($p= 0.631$, $\eta^2=0.009$) with no effect and there was no significant interaction effect(gender x age ; $p=0.985$, $\eta^2=0.000$) no effect. However working hours, working experience, age, type of school and marriage status was not significant influence the probability of musculoskeletal symptoms($p>0.05$). There was significance mean difference of musculoskeletal symptoms total score between gender.

Table 2 Mean and SEs of total MET/week(minutes) and Score of MSS-12 among gender and age group

	Mean±Std error	F	p	η^2
Total MET/week (minutes)				
Gender				
Male	3443.75±593.76	5.84	0.02*	0.05
Female	1969.65±252.60			
Age group				
20-29	3381.68±642.34	3.99	0.02*	0.07
30-39	2744.33±424.43			
>40	2744.34±424.43			
MSS -12				
Gender				
Male	2.42±0.35	5.49	0.21	0.05
Female	3.49±0.25			
Age group				
20-29	2.95±0.50	.46	0.63	0.01
30-39	3.10±0.28			
>40	3.34±0.38			

Table 3 explains the predication of musculoskeletal symptoms based on PA. Based on this spss output report the Cox-Snell=0.153 and Nagerlkerke R square=0.25 25% of the variation in the outcome can be explained by this model. Based on the output Hosmer and Lemeshow test the predictor fit the model as it is not significant.($p=0.261>0.05$). The model has 85.7% accurate prediction of developing the musculoskeletal symptom. Hosmer and Lemeshow test results confirmed that the model was good fit for the data $\chi^2=10.06$, $p>0.05$. As indicates in Table 3, the biggest factor contributed to musculoskeletal symptoms was MET-min/week moderate and MET-min/week for housework ($p<0.05$).

Table 3 Associations between age, gender, working hours, working experience, marriage status, and type of school with musculoskeletal symptoms

Factor	B	SE	Wald	OR (95% CI)
Time spend on transportation using motor vehicle in a week	.002	.001	2.954	1.002(1.000-1.004)
MET-min week (transportation)	.002	.002	.957	1.002(.998-1.006)
MET-min/week housework, house maintenance and caring for family.	.002	.001	5.742*	1.002(1.000-1.003)
MET-min/week for moderate PA	-.001	.000	6.957*	.999 (.998-1.000)
MET-min/week for active PA	.000	.000	.705	1.000(1.000-1.000)
Constant	.902	.527	2.932	

* $p<0.05$

Discussion

According to the study's findings, the shoulder and lower back were the two most common musculoskeletal symptoms. The lower back and shoulder make up the biggest percentage of musculoskeletal symptoms among educators, according to another study (Grabara 2023). Many surveys of percent of lower back pain educators around the world have found comparable findings, with 40.4 per cent in Malaysia , 43.8 per cent in Turkey , and 45.6 per cent among educators in China (Samad et al; 2010; Korkmaz et al. 2011; Yue et al. 2012) . In addition, neck pain ranked third in terms of percentage. Neck pain is exacerbated by improved cervical muscle and shoulder and neck proprioception, according to the report Global Year Against Musculoskeletal Pain (2010) (Craig 2010). This is similar to a prior study where the neck and shoulder were the most affected areas(Damayanti et al. 2017; Ojukwu et al. 2018). This is because educators spend the majority of their working hours bending forward or backward and

moving their arms and fingers above shoulder level while writing on white boards, which can result in musculoskeletal symptoms.

Furthermore there was significant difference of musculoskeletal symptom between gender . This is parallel to other research (Guo et al. 2004;Darwish et al. 2013) . Females were more likely than males to have musculoskeletal symptoms and had poorer pain resistance, allowing them to experience more pain (Elaine et al. 2010) . However, certain studies of educators have shown that gender factor has not been correlated with low back pain risk factors (Zamri et al. 2017). In this analysis, the risk of developing musculoskeletal was higher among older age groups, but was not significant. This is parallel to other studies of various educators where older age groups between 35 and 50 years of age are at greater risk of developing musculoskeletal symptoms (Ojukwu et al. 2018). Another research in Malaysia also found that the risk of experiencing low back pain was substantially higher among older age groups between 30 and 49 years of age compared to 20 and 29 years of age (Zamri et al. 2017)

The results of the study showed a significant association between musculoskeletal symptoms with MET-min/week for domestic work and moderate PA. This conclusion is consistent with research among Polish educators, where individuals with more MSD symptoms were more likely to have mild PA(Grabara 2023) This result is consistent with research on physiotherapies, which showed that people who engaged in more frequent, intense physical activity were less likely to experience musculoskeletal pain.in 2020 (Ezzatyar et al. 2020).

The results of the moderate to vigorous physical activities (MVPA) were lower than 150 min/week as recommended by WHO (2010) .This is because educators have a heavy workload and therefore little time for PA (Muda et al. 2012). These results are consistent with earlier research, which revealed that most educators have low levels of PA (Zulkepli et al. 2019). As mentioned in the previous report, educators are not only responsible for educating young children, but are also responsible for preparing teaching assistance, preparing for lessons, and engaging in administrative work (Muda et al. 2012) . In addition, the teachers used time after school to prepare for the layout of the lessons (Norashid& Hamzah 2012) . This restricts them from having physical exercise during their spare time.

In comparison, nearly half of the educators (46.7%) were moderate;y active while 26.7% were physically active and 26.6 %physically inactive. Leisure physical exercise, MVPA and intense PA were substantially high among male educators.There was no significant association in this sample between the level of musculoskeletal symptoms and the degree of PA. This is parallel with a previous study among housewives, which revealed that there was no significant association between musculoskeletal and level of PA (Saat et al. 2022). These findings are in comparison to the other studies which have indicated that musculoskeletal symptoms have a detrimental association to PA (Hulsegge et al. 2011 & Hayden et al. 2005).

PA can improve the circulation of blood which is vital to the healing process. On the other hand, there was a favorable association between a total of nine regions of musculoskeletal symptoms and transport-related behavior and domestic activity. This can be caused by the overuse of muscle, which leads to musculoskeletal symptoms (Yhi et al. 2018; Kamada et al. 2014). Another study by a previous researcher indicated that low PA and working hours of 6 to 10 hours a day have a significant effect on the risk of musculoskeletal pain among academic staff (Meaza et al. 2020). The working hours a day on average in this study was 8 hours. However, it was not significant in predicting PA and musculoskeletal symptoms. This may be due to routine activity during teaching-learning process, most of the activity was prolonged standing and prolonged sitting to do work on computers. It contributes to neck and shoulder pain and also low back pain (Zamri et al. 2017).

This study's cross-sectional research approach has several limitations because it is unable to ascertain the causative significance of the musculoskeletal symptoms. Additionally, it is advised that intervention programmes be conducted among educators for future research. Therefore, including educators in their preventative programs requires considerable thought on the part of occupational health specialists. These interventions ought to promote the benefits of PA for treating musculoskeletal issues in the field of education. Additional variables, such as physical risk factors, depression, and stress, can be used in future studies.

Conclusion

The results of this study showed a high percentage of musculoskeletal symptoms especially on lower back . Incorporating educators into prevention programs requires further consideration on the part of occupational health professionals. In order for the authorities to act efficiently, these interventions should promote the value of physical activity to relieve musculoskeletal symptoms in the education field.

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References

1. Abdullah, S., Deros, B. M., Khamis, N. K., Ghani, J. A., and Abdullah, S. 2020. An Approach to Work Design: In-Depth: Audit to Determine the Modifiers of Musculoskeletal Disorder Symptom among Vehicle Maintenance Personnel. *JurnalKejuruteraan*. 2: 281-287.
2. Ahmad, N. S., Abang Abdullah, A. A., Thyng, O. K., and Xin, T. L. 2020. Musculoskeletal Disorders among Dental Students, *J Res Med Dent Sci*. 8(3): 32-38.
3. Althomali, O. W., Amin, J., Alghamdi, W., and Shaik, D. H. 2021. Prevalence and Factors Associated with Musculoskeletal Disorders among Secondary Schoolteachers in Hail, Saudi Arabia: a Cross-sectional Survey. *International Journal of Environmental Research And Public Health*. 18(12): 6632.
4. Amin, N. A., Quek, K. F., Oxley, J. A, Noah, R., and Nordin, R. 2018. Emotional Distress as a Predictor of Work-Related Musculoskeletal Disorders in Malaysian Nursing Professionals. *Int J Occup Environ Med*. 9(2): 69-78.
5. Arvidsson, I., Simonsen, J. G., Dahlqvist, C., Axmon, A., Karlson, B., Björk, J., and Nordander, C. 2016. Cross-sectional Associations Between Occupational Factors and Musculoskeletal Pain in Women Teachers, Nurses and Sonographers. *BMC Musculoskeletal Disorders*. 17: 35
6. Chiu, T. T. W., and Lam, P. K. W. 2007. The Prevalence of and Risk Factors for Neck Pain and Upper Limb Pain among Secondary School Teachers in Hong Kong. *Journal of Occupational Rehabilitation*. 17: 19-32.
7. Damayanti, S., Zorem, M., and Pankaj, B. 2017. Occurrence of Work Related Musculoskeletal Disorders among School Teachers in Eastern and Northeastern Part of India. *International Journal of Musculoskeletal Pain prevention*. 2(1): 187-192.
8. Department of Statistics Malaysia. 2011. *Taburanperatuspendudukbekerjamengikutindustri, strata dan jantina, Malaysia. Labour Force Survey Report Malaysia 2011*
9. Darwish, M. A., and Al-Zuhair, S. Z. 2013. Musculoskeletal Pain Disorders among Secondary School Saudi Female Teachers. *Pain Research and Treatment*. Article ID 878570.
10. Deros, B. M., Daruis, D. D. I., Ismail, A. R., Sawal, N. A., and Ghani, J. A. 2010. Work-Related Musculoskeletal Disorders among Workers' Performing Manual Material Handling Work in an Automotive Manufacturing Company. *American Journal of Applied Sciences*. 7(8): 1087-1092.

11. Deros, B. M., Khamis, N. K., and Mohd Fauzi, A. F. 2014. Driver's Perception on Electric Vehicles and its Commercial Marketability in Malaysia. *Applied Mechanics and Materials*. 663: 632–637.
12. Elaine, Y. L. Chong, and Alan H. S. Chan. 2010. Subjective Health Complaints of Teachers from Primary and Secondary Schools in Hong Kong. *International Journal of Occupational Safety and Ergonomics*. 16(1): 23-39.
13. Erick, P. N., and Smith, D. R. 2011. A Systematic Review of Musculoskeletal Disorders among School Teachers. *BMC Musculoskeletal Disorders*. 12: 260.
14. Ezzatvar, Y., Calatayud, J., Andersen, L. L., & Casaña, J. (2020). Are moderate and vigorous leisure-time physical activity associated with musculoskeletal pain? A cross-sectional study among 981 physical therapists. *American Journal of Health Promotion*, 34(1), 67-70.
15. Erick, P. N., Smith, D. R. 2014. The Prevalence and Risk Factors for Musculoskeletal Disorders among School Teachers in Botswana. *Occupation Medicine and Health Affairs*. 2:178.
16. Grabara M. 2023. The association between physical activity and musculoskeletal disorders—a cross-sectional study of teachers. *PeerJ* 11:e14872 <https://doi.org/10.7717/peerj.14872>
17. Guo, H. R., Chang, Y. C., Yeh, W. Y., Chen, C. W. & Guo, Y. L. 2004. Prevalence of Musculoskeletal Disorder among Workers in Taiwan: A Nationwide Study. *Journal of Occupational Health*. 46(1): 26-36.
18. Harithasan, D., Singh, D. K. A, Abd Razak, N. A. B., and Baharom, N. B. 2022. Personal, Academic Stressors and Environmental Factors Contributing to Musculoskeletal Pain among Undergraduates Due to Online Learning: A Mixed Method Study with Data Integration. *International Journal of Environmental Research and Public Health*. 2022; 19(21):14513.
19. Haukka, E., Ojajarvi, A., Takala, E. P., Viikari-Juntura, E., and Leino-Arjas, P. 2012. Physical Workload, Leisure-Time Physical Activity, Obesity and Smoking as Predictors of Multisite Musculoskeletal Pain. A 2-Year Prospective Study of Kitchen Workers. *Occupational and Environmental Medicine*. 69(7): 485-492.
20. Horng, Y., Hsieh, S., Wu, H., Feng, C., and Lin, M. 2008. Work-related Musculoskeletal Disorders of the Workers in a Child Care Institution. *American Journal of Physical Medicine & Rehabilitation*. 36(1):15-21.
21. Kamada, M., Kitayuguchi, J., Lee, I. M., Hamano, T., Imamura, F., Inoue, S., Miyachi, M. and Shiwaku, K. 2014. Relationship between Physical Activity and Chronic Musculoskeletal Pain among Community-Dwelling Japanese Adults. *Journal of Epidemiology*. 24(6): 474-483.
22. Korkmaz, N. C., Cavlak, U., and Telci, E. A. 2011. Musculoskeletal Pain, Associated Risk Factors and Coping Strategies in School Teachers. *Scientific Research and Essays*. 6(3):649-657.
23. Mahmud, S. N. D., Nasri, N. M., Samsudin, M. A., and Halim, L. 2018. Science Teacher Education in Malaysia: Challenges and Way Forward. *Asia-Pacific Science Education*. 4: 8.
24. Meaza, H., Temesgen, M. H., Redae, G., Hailemariam, T. T., and Alamer, A. 2020. Prevalence of Musculoskeletal Pain among Academic Staff of Mekelle University, Ethiopia. *Clinical Medicine Insights: Arthritis and Musculoskeletal Disorders*. 13: 1179544120974671
25. Mokhtar, M. M., Md Deros, B., and Sukadarin, E. H. 2013. Evaluation of Musculoskeletal Disorders Prevalence during Oil Palm Fresh Fruit Bunches Harvesting Using RULA. In *Advanced Engineering Forum*, Trans Tech Publications, Ltd. 10: 110–115.
26. Moreira-Silva, I., Teixeira, P. M., Santos, R., Abreu, S., Moreira, C., and Mota, J. 2016. The Effects of Workplace Physical Activity Programs on Musculoskeletal Pain: a Systematic Review and Meta-Analysis. *Workplace Health & Safety*. 64(5): 210-222.
27. Muda, N., Samsudin, H. B., Majid, N., Ali, K. A. M., and Ismail, W. R. 2012. Students Perspective on Lecturer Characteristic for Effective Teaching. *Procedia-Social and Behavioral Sciences*. 59: 535-540.
28. Murata, S., Doi, T., Sawa, R., Nakamura, R., Isa, T., Ebina, A., Kondo, Y., Tsuboi, Y., Torizawa, K., Fukuta, A., and Ono R. 2019. Association Between Objectively Measured Physical

- Activity and the Number of Chronic Musculoskeletal Pain Sites in Community-Dwelling Older Adults. *Pain Medicine*. 20(4):717-723.
29. Norashid, O. and Hamzah, M. O. 2014. Beban Tugas dan Motivasi Pengajaran Guru di Sekolah Menengah Daerah Ranau. *Jurnal Pemikir Pendidikan (Journal for Educational Thinkers)*. 5: 35 - 57.
 30. Ojukwu, C. P., Anyanwu, G. E., Eze, B., Chukwu, S. C., Onuchukwu, C. L., and Anekwu, E. M. 2018. Prevalence, Pattern and Correlates of Work-Related Musculoskeletal Disorders among School Teachers in Enugu, Nigeria. *International Journal of Occupational Safety and Ergonomics*.
 31. Pan, F., Byrne, K. S., Ramakrishnan, R., Ferreira, M., Dwyer, T., and Jones, G. 2019. Association Between Musculoskeletal Pain at Multiple Sites and Objectively Measured Physical Activity and Work Capacity: Results from UK Biobank Study. *Journal of Science and Medicine in Sport*. 22(4): 444-449.
 32. Pihl, E., Matsin, T. & Jurimae, T. 2002. Physical Activity, Musculoskeletal Disorders and Cardiovascular Risk Factors in Male Physical Education Teachers. *The Journal of Sports Medicine and Physical Fitness*. 42(4):466-471.
 33. Saat, N. Z. M., Hanawi, S. A., Farah, N. M., Hanafiah, H., & Zuha, A. A. (2022). Relationship between physical activity and musculoskeletal disorders among low income housewives in Kuala Lumpur: A cross sectional study. *Plos one*, 17(10), e0274305. Samsuddin, N. A., and Daruis, D. D. I. 2013. A Study of Musculoskeletal Disorders among Visual Display Terminal Workers. In *Advanced Engineering Forum*, Trans Tech Publications, Ltd. 10: 300–307.
 34. Seibt, R., Lutzkendorf, L., and Thinschmidt, M. 2005. Risk Factors and Resources of Work Ability in Teachers and Office Workers. *International Congress Series*. 1280: 310-315.
 35. Stergioulas, A., Filippou, D. K., Triga, A., Grigoriadis, E., and Shipkov, C. D. 2004. Low back pain in physical education teachers. *Folia Med (Plovdiv)*. 46(3):51-55.
 36. Samad, N. I. A., Abdullah, H., Moin, S., Tamrin, S. B. M., and Hashim, Z. 2010. Prevalence of Low Back Pain and its Risk Factors among School Teachers. *American Journal of Applied Sciences*. 7(5), 634-639.
 37. Shamsuddin, N., Koon, P. B., Syed Zakaria, S. Z., Noor, M. I., and Jamal, R. 2015. Reliability and Validity of Malay Language Version of International Physical Activity Questionnaire (IPAQ-M) among the Malaysian Cohort Participants. *International Journal of Public Health Research*. 5(2): 643–653.
 38. World Health Organization, T., 2010. *Global recommendations on physical activity for health*. World Health Organization.
 39. Yue, P., Liu, F., and Li, L. 2012. Neck/shoulder Pain and Low Back Pain among School Teachers in China, Prevalence and Risk Factors. *BMC Public Health*. 12: 789.
 40. Yhi, C., Saat, N.Z., and Fauzi, N.F. 2018. Knowledge, Attitude and Practice (Kap) on Daily Steps among University Employees. *Malaysian Journal of Public Health Medicine*. 77-91.
 41. Zamri, E. N., Moy, F. M., and Hoe, V. C. W. 2017. Association of Psychological Distress And Work Psychosocial Factors with Self-Reported Musculoskeletal Pain among Secondary School Teachers in Malaysia. *PLoS ONE* 12(2): e0172195.
 42. Zulkepli, Z., Saat, N. Z. M., Fauzi, N. F. M., Hanawi, S. A., and Zin, N. M. 2019. Relationship between Physical Activity Level and Cardiovascular Riskfactors Among Teachers. *Asian Journal of Epidemiology*. 12: 1-8.