UNIVERSITI PUTRA MALAYSIA

EFFECT OF FOOTREST ON MUSCLE ACTIVITIES DURING PROLONGED STANDING AMONG WORKERS IN SELECTED FACTORIES IN MALAYSIA

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By

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

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October 2019

Chairman : Karmegam Karuppiah, PhD
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Prolonged standing has been identified as one of the risk factors which associated with occupational injuries. The workers tend to suffer from Musculoskeletal Disorders (MSDs) after a chronic exposure of prolonged standing while performing their task. Such disorders can cause performance decrement and high rate of absenteeism among the workers. Therefore, ergonomic intervention such as footrest could be used, in order to reduce the muscle activity among workers. The main objective for this study is to determine the effect of footrest on muscle activity during prolonged standing activity. A total of 74 workers chosen from the Assembly Line from selected factory were divided into control (without footrest) and experimental (with footrest) group. The response rate obtained was 100% for this research. The respondents were required to perform the given task while standing for two hours continuously. The perceived exertion rating in both groups was evaluated (for every 15 minutes) by using Borg's Scale CR-10 Questionnaire. Meanwhile, surface electromyography (sEMG) was used to monitor the muscle activity (right and left of the lower leg around calf area) specifically at tibialis and gastrocnemius muscles in both control and experimental groups throughout the experimental durations. The average of perceived exertion rating indicated by control group (0.07) was higher than experimental group (0.04) throughout the 2 hours session of prolonged standing for neck/head, shoulder, upper back, hands, lower back, buttocks, thighs, knees, calves and feet. However, these rating did not exceed more than 5. The results of statistical analysis has shown that perceived exertion rating on the lower body regions (lower back, knees, calves and feet) was significantly ($p<0.05$) more affected by prolonged standing compared to the upper body regions (neck/head, shoulder, upper back and hands) during the two hours period for both groups. The average of reduction of surface electromyography (sEMG) levels for both right and left tibilais anterior muscles and gastrocnemius posterior muscles respectively were 0.02 in experimental group when compared to the control group.

There were statistically significant differences in the sEMG levels between control and experimental groups for both in the right and left studied muscles at the 60th minute within the experimental session. There was reduction of perceived exertion rating when assessed by using Borg's Scale CR-10 and level of surface electromyography in experimental group than the control group. The intervention of footrest provides internal mechanism which reduces the muscle activity on body parts. This concluded that it was significant to state that footrest is success ergonomics' intervention in terms of minimizing muscle activity in a prolonged standing work posture.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

KESAN PENGGUNAAN TEMPAT MELETAKKAN KAKI TERHADAP AKTIVITI-AKTIVITI OTOT DALAM KALANGAN PEKERJA DI KILANG TERPILIH DI MALAYSIA

Oleh

ADRIANA BINTI ABDUL AZIZ

Oktober 2019

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Berdiri dalam tempoh masa yang panjang telah dikenal pasti sebagai salah satu faktor risiko yang berkaitan dengan kecederaan berkaitan dalam pekerjaan. Para pekerja cenderung mengalami masalah *Musculoskeletal disorders (MSD)* selepas pendedahan kronik berdiri bagi tempoh yang panjang ketika melakukan tugas mereka. Gangguan seperti itu boleh menyebabkan penurunan prestasi dan kadar ketidakhadiran yang tinggi dalam kalangan pekerja. Oleh itu, intervensi ergonomik seperti tempat meletakkan kaki boleh digunakan untuk mengurangkan aktiviti otot dalam kalangan pekerja. Objektif utama kajian ini adalah untuk menentukan kesan tempat meletakkan kaki terhadap aktiviti otot semasa aktiviti berdiri yang berpanjangan. Seramai 74 orang pekerja dipilih di bahagian pemasangan dari kilang yang terpilih telah dibahagikan kepada kumpulan kawalan (tanpa tempat meletakkan kaki) dan eksperimen (dengan tempat meletakkan kaki). Kadar respon yang diperolehi adalah100% bagi kajian yang dilakukan. Responden dikehendaki untuk melakukan tugas yang diberikan dalam keadaan berdiri selama dua jam berterusan. Kadar ketegangan otot yang dirasai bagi kedua-dua kumpulan telah dinilai (setiap 15 minit) dengan menggunakan Skala Borg CR-10. Selain itu, elektromilografi permukaan (sEMG) turut digunakan untuk memantau aktiviti otot (disekitar kawasan betis kaki kanan dan kiri) khususnya pada otot *gastrocnemius* dan *tibialis* terhadap kedua-dua kumpulan iaitu kawalan dan eksperimen sepanjang tempoh eksperimen. Purata kadar ketegangan otot yang dirasai yang ditunjukkan oleh kumpulan kawalan (0.07) adalah lebih tinggi daripada kumpulan eksperimen (0.04) sepanjang sesi dua jam berdiri secara berterusan terhadap anggota iaitu leher/kepala, bahu, belakang (atas), tangan, belakang (bawah), punggung, paha, lutut, betis dan kaki. Walau bagaimanapun, kesemua kadar adalah tidak melebihi daripada 5. Hasil analisis statistik menunjukkan bahawa ketidakselesaan anggota badan di bahagian pinggang serta ke bawah (bahagian belakang (bawah), lutut, betis dan kaki) adalah signifikan ($p<0.05$) terjejas disebabkan oleh posisi berdiri yang berpanjangan berbanding

dengan bahagian anggota badan pinggang dan ke atas (leher/kepala, bahu, bahagian atas belakang dan tangan) selama tempoh dua jam bagi kedua-dua kumpulan. Purata pengurangan kadar permukaan elektromilografi *(sEMG)* untuk kedua-dua otot *tibilais* (terletak di bahagian hadapan betis kaki) dan otot *gastrocnemius* (terletak di bahagian belakang betis kaki) masing-masing adalah 0.02 dalam kumpulan eksperimen berbanding dengan kumpulan kawalan. Terdapat perbezaan yang signifikan secara statistik bagi tahap elektromilografi di antara kumpulan kawalan dan eksperimen terhadap kedua-dua otot yang dikaji di kaki kanan dan kiri pada minit ke-60 dalam sesi eksperimen. Terdapat pengurangan kadar ketegangan otot apabila dinilai menggunakan Skala Borg CR-10 serta tahap elektromilografi permukaan (sEMG) dalam kumpulan eksperimen berbanding dengan kumpulan kawalan. Intervensi penggunaan tempat meletakkan kaki mampu menjadi suatu mekanisme untuk mengurangkan aktivit otot pada bahagian anggota badan. Hal ini dapat disimpulkan bahawa tempat meletakkan kaki merupakan suatu kejayaan intervensi ergonomik untuk meminimumkan aktivit otot dalam posisi kerja berdiri yang berpanjangan.

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This thesis was submitted to the Senate of the Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

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This is to confirm that:

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Name of Member of Supervisory Committee: Dr. Velu Perumal,

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LIST OF ABBREVIATIONS

BMI	Body Mass Index
EMG	Electromyography
DOSH	Department of Occupational Safety and Health
MSD	Musculoskeletal disorders
sEMG	Surface Electromyography
SENIAM	Standards for surface electromyography: The European project Surface EMG for non-invasive assessment of muscles
SOCSO	Social Security Organization of Malaysia
SPSS	Statistical Package Service and Solution
VAS	Visual Analogue Scale

CHAPTER 1

INTRODUCTION

1.1 Background of Study

Manufacturing industry is one of important contributors to Malaysia‟s economy (Halim, Omar, Saman & Othman, 2012). Based on Department of Statistics Malaysia, the sales growth of manufacturing industry is 10.8 %, rising to 67.8 billion in 2018 as compared to 61.2 billion in 2017. Thus, a total number of employees engaged in the manufacturing industry in January 2018 also has been increasing about 2.5 % as compared to 1, 044, 346 workers in January 2017 (Department of Statistics Malaysia, 2018). In manufacturing industrial workplaces, prolonged standing has been identified as one of the risk factors which associated with occupational injuries (Ganesan, Lee & Aruin, 2015). Many workers are required to stand for a long time period (over 30 minutes to several hours) in performing their task without sit or walk during work shift (Lee, Baker, Coenen & Straker, 2018; Waters & Dick, 2015). Based on Guidelines of Occupational Safety and Health for Standing at Work by the Department of Occupational Safety and Health Malaysia (DOSH) defined standing workstation as performance of task in a relatively stationary standing position and without much leg movement by the worker. In this position, the body is held upright by the big muscles of the trunk and lower limbs (DOSH, 2002).

Previous researches revealed that industrial workers, especially those working in assembly production lines, are the most widely group of workers exposed to prolonged standing (Witana et al., 2009; Halim and Omar, 2011; Nunes, 2006). In Malaysia, this has been proven because manufacturing industries are the major production lines that produce a high volume capacity product within 24 working hours. Most of the industries working hours are 8 hours in a day and it can go up to 12 hours or even more.

Hence, occupational related to prolonged standing has become rising issue and concern in the aspect of ergonomics. Several studies conducted found out that the development of musculoskeletal disorders (MSDs) is the result of chronic health effects associated with prolonged standing including lower back pain, lower extremity discomfort and varicose (Lee et al., 2018; Nelson-Wong, Gregory & Callaghan, 2008). Meanwhile, the acute health effects caused by prolonged standing at work are sore feet, swelling of the legs, general muscular fatigue and stiffness in the neck and/or shoulders (Waters & Dick, 2015). This occurred due to static loading by muscles and ligaments; compression experienced by soft tissue in the joints and venous pooling in leg area. If there is not enough time for recovery between the muscles and soft tissues in the joint, fatigue would develop and cause pain (Ahmad & Kim, 2018).

Furthermore, Nunes (2006) stated that development of MSDs give significant impact on worker absence from work, low productivity which causes premature retirement and social-economic costs. According to UK Labour Force Survey, MSDs is the main reason for 30% of sick leave (United States Bureau of Labour Statistics, 2008). Decrement of performance is one of the effects of prolonged standing (Werner, Gell, Hartigan, Wiggerman & Keyserling, 2010). The injuries and body pains suffered by the workers can affect them from working effectively (Lin, Chen, & Cho, 2012). This situation wills eventually results in a larger expenditure needed for the consultancy and medication costs (Waters & Dick, 2015). The employers also need to spend on new recruitment for replacement of injured workers in terms of competency training (Halim et al. 2012).

Therefore, the ergonomics interventions such as anti-fatigue mat, footrest, foot massage and shoe insoles are necessary in order to overcome and reduce the issue (Garcia & Vieira, 2011; Waters & Dick, 2015). Some shoe insoles, particularly customized orthotics, provide biomechanical realignment, reduce shearing forces and alter sensorimotor control (Hughes, Nelson, Matz & Lloyd, 2011). Orlando and King (2004) found that the manufacturing workers indicated a preference for mats and insoles over hard floor surfaces to reduce pain and fatigue in various body regions, although these were not statistically significant between the surfaces studied. Footrest and treatment of massage onto also had shown an immediate decrease in electromyography reading, feeling of muscular tension and pain intensity in a few studies (Buttagat et al. 2016; Field, Hernandez-Reif, Diego & Fraser, 2007).

1.2 Problem Statement

Several physiological mechanisms have been proposed to explain the development of adverse health effects experienced by individuals engaging with prolonged standing activities. The accumulation of the metabolic wastes causes the muscles becoming hypersensitive and prone to nociceptive activation, thus eventually result in muscle fatigue (Lee et al. 2018). During prolonged standing, the postural muscles and ligaments undergoes static loading which causes the compression of tissue in the joints and venous pooling in the leg areas which leads to the cause of fatigue (Freitas et al., 2005; Ganesan et al. 2015). Postural muscles keep the body from falling over while standing or walking. Musculoskeletal disorder (MSD) has been thought to be due to the result of inflammation caused by pooling of blood in the lower limbs secondary to reduced circulation and venous return and gravity assisted blood backflow (Hughes et al., 2011; Lin et al., 2012).

Apart from that, Social Security Organisation (SOCSO) reported that the number of accidents which related to musculoskeletal disorders (MSD) has increased from 14 cases in 2006 to 449 cases in 2012 (SOCSO, 2018). In 2018, SOCSO also stated that RM 1.94 million has been spent on compensation for MSDs cases (SOCSO, 2018). In terms of the company profit, the decreased in worker‟s productivity, worker‟s compensation and health treatment costs will be disadvantageous to the company (Halim et al. 2012).

Various solutions have been recommended in the literature to reduce the adverse health effects caused by prolonged standing. The Guidelines on Occupational Safety and Health for Standing at Work (2002) suggested in using intervention such as the footrest in order to prevent such exposure (DOSH, 2002). Nevertheless, research related with footrest and its ability to create a more active posture during prolonged standing has not received much attention (Karimi, Moghimbeigi, Motamedzade & Roshanaei, 2016). Footrest is one of the most strategic considerations for intervention because it could delays onset of muscle pain and eventually decreases the cost of treatment in work setting (Lee et al., 2018).

There is still limited number of studies regarding the association of the whole body muscle activity (upper and lower body regions) with ergonomic interventions especially regarding on the availability of footrest among industrial workers which are required to stand for a long period of time performing work activities in Malaysia. Therefore, the main aim of this study is to determine the effect of footrest on muscle activity due to prolonged standing in upright position by using both the subjective and objective assessments among selected workers.

1.3 Study Justification

Standing is a working position where the workers are reaching material, handling product and pushing and pulling loads can cause adverse health issues. Studies found that prolonged standing leads to various health problems such as lower extremity fatigue, pain, swelling, venous blood pooling, low- back pain, and whole-body fatigue (King, 2002; Lin et al., 2012; Reid et al., 2010).

Moreover, if the task is impossible to be done in sitting position, they need to stand throughout their working hours (Halim et al. 2012). Reid et al. (2010), reviewed on several studies and guidelines stated that standing more than 2 hours can affect the hip while more than 3 hours can affect the overall lower extremity. Those who stand in long period of time have significantly greater discomfort of body parts than those who sit most of the day (Drury, Hsiao, Joseph, Joshi, Lapp & Pennathur, 2008).

Based on previous study done by Sartika and Dawal (2011), installing a footrest under the standing workstation allowed the workers to change their posture and resulted in relieving pain and fatigue by putting one leg on the footrest. The body weight will be automatically shifted to the leg which is on the floor while the other leg which is on footrest will relax and the posture of body will remain erect (Reid et al., 2010). However, currently the researchers do not have sufficient information to conclude the effectiveness of using footrest as the intervention to reducing muscle activity in the real working environment.

A new approach, such as providing the footrest can be explored as another solution to the health issues experienced by workers. Buttagat et al. (2016) found that the lower back region had shown a decrease in EMG reading by using footrest. This

study is crucial to be carried out so that the adverse health effects in a prolonged standing posture on the workers can be minimized at an early stage. The result of this study could provide useful information to workers on how to manage their standing body posture. Together with the results obtained, appropriate actions could be done. If there is sufficient data and research to prove that the footrest treatment can be used as an intervention, then accessibility for footrest in standing work posture can be proposed and implemented. Hence, this research looks to explore footrest as part of solutions in decreasing muscle activity and muscle tension during prolonged standing among industrial workers.

1.4 Conceptual Framework

Prolonged standing has been identified to be the main risk factor among the industrial workers especially among the assembly line workers. Based on Zander, King and Ezenwa (2004), assembly workers are more required to stand in one area for long periods of time. Several ergonomics intervention have been proposed based on evidence from the previous study in order to reduce the health risk of workers during prolong standing including anti-fatigue mats, shoe insoles, foot massage and footrest (Ahmad & Kim, 2018; Choi & Waletz, 2010; King, 2002).

This research was a pre-post experimental study with the main aim to determine the effect of footrest on muscle activity for both the upper and lower body regions due to prolonged standing. There were a control group which stand on floor without intervention of footrest while for the experimental group, they used intervention designed of footrest throughout prolonged standing of two hours session. Footrest waas placed on the floor to allow the workers to place one of their legs on it in order to relieve pain and muscle fatigue (Sartika & Dawal, 2016).

There were also some biological factors affected the muscle activity in a standing posture such as an individual‟s age , Body Mass Index (BMI) and sleeping hours per day. The measurement for muscle activity were subjectively and objectively assessed by using the Borg's Scale questionnaire (Messing, & Kilbom, 2001) and the readings from surface Electromyography (sEMG) (Halim et al., 2012) respectively among selected respondents. The conceptual framework in this research was shown in **Figure 1.1**.

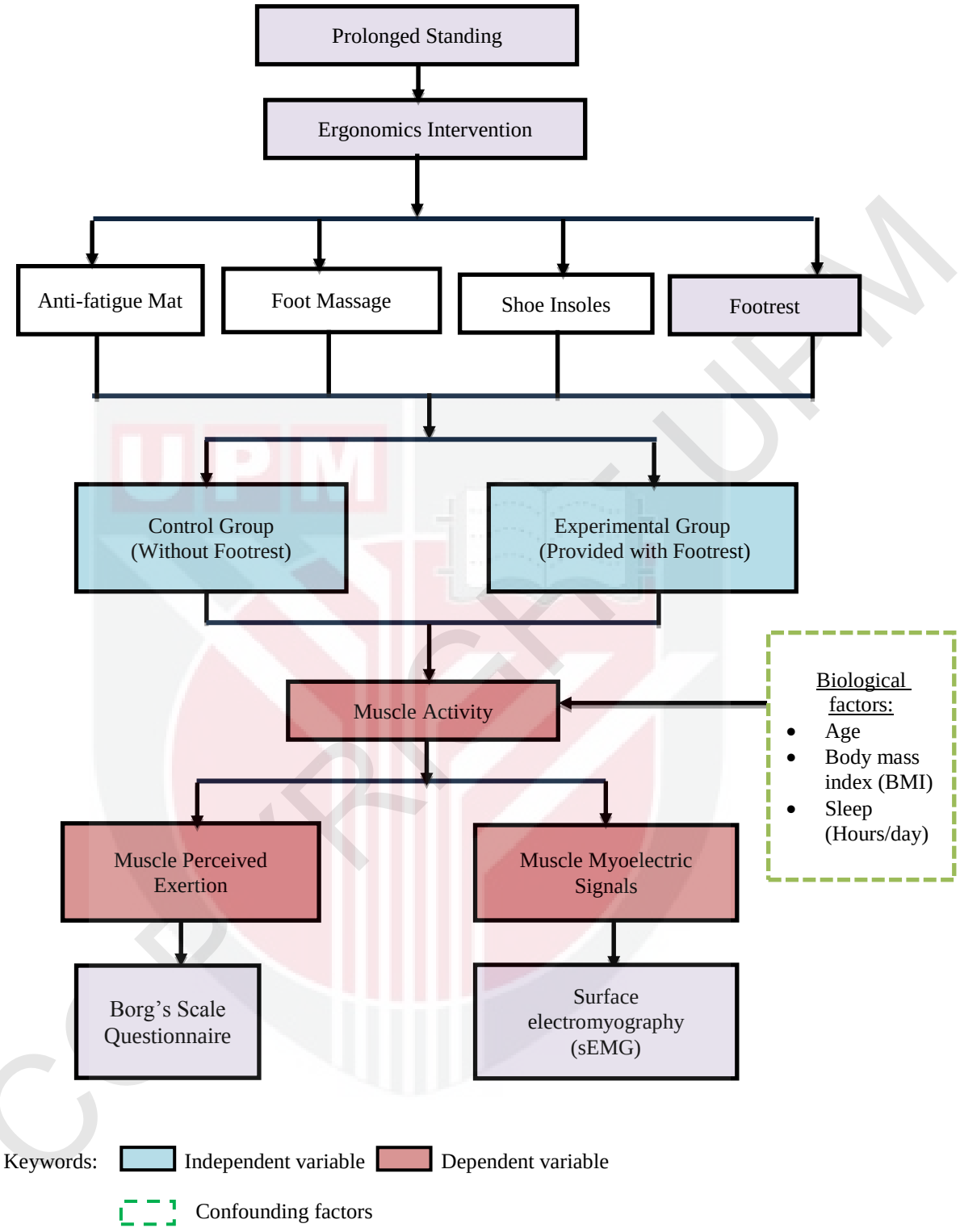

Figure 1.1 : Conceptual framework of the study

1.5 Study Objectives

1.5.1 General objective

To determine the effect of footrest on muscle activity during prolonged standing activity in an upright position.

1.5.2 Specific objectives

i. To determine data distribution of perceived exertion rating between control and experimental groups.
ii. To compare difference of perceived exertion rating between control and experimental groups.
iii. To determine data distribution of surface electromyography (sEMG) levels between control and experimental groups.
iv. To compare difference of surface electromyography (sEMG) levels (between control and experimental groups.

1.5.3 Hypothesis

i. There will be reduction of perceived exertion rating between experimental and control groups.
ii. There will be significant differences of perceived exertion rating between experimental and control groups.
iii. There will be reduction of surface electromyography levels between experimental and control groups.
iv. There will be significant differences of electromyography levels between experimental and control groups.

REFERENCES

Ahmad, I., & Kim, J. Y. (2018). Assessment of Whole Body and Local Muscle Fatigue Using Electromyography and a Perceived Exertion Scale for Squat Lifting. *International Journal of Environmental Research and Public Health*, *15*(4), 784.

Andayasari, L. (2009). Musculoskeletal Disorders in Dental Practices and Prevention Efforts. *Media Litbang Kesehatan*, *22*(2), 70-76.

Andersen, J. H., Haahr, J. P., & Frost, P. (2007). Risk factors for more severe regional musculoskeletal symptoms: A two- year prospective study of a general working population. *Arthritis & Rheumatism*, *56*(4), 1355-1364.

Anderson, S. P., & Oakman, J. (2016). Allied Health Professionals and Work-Related Musculoskeletal Disorders: A Systematic Review. *Safety and Health at Work*. doi:10.1016/j.shaw.2016.04.001

Ardalan, S., Joshua, C., Danaee, M., Alizadeh, R., Sangelaji, B., Kargarfard, M., Nakhosin, A., Shamsul T. (2018). Borg CR-10 Scale as a New Approach to Monitoring Office Exercise Training. *Work*, 60. doi:10.3233/WOR-182762.

Awosan, K. J., Yikawe, S. S., Oche, O. M., & Oboirien, M. (2017). Prevalence, perception and correlates of low back pain among healthcare workers in tertiary health institutions in Sokoto, Nigeria. *Ghana medical journal*, *51*(4), 164–174.

Aziz, R. A., Adeyemi, A. J., Kadir, A. Z., Rohani, J. M., & Rani, M. R. (2015). Effect of Working Posture on Back Pain Occurrence among Electronic Workers in Malaysia. *Procedia Manufacturing*, 2, 296-300. doi:10.1016/j.promfg.2015.07.052

Baker, R., Coenen, P., Howie, E., Williamson, A., & Straker, L. (2018). The short term musculoskeletal and cognitive effects of prolonged sitting during office computer work. *International journal of environmental research and public health*, *15*(8), 1678.

Balasubramanian, V., Adalarasu, K., & Regulapati, R. (2009). Comparing dynamic and stationary standing postures in an assembly task. *International Journal of Industrial Ergonomics*, *39*(5), 649-654.

Banks, S. (2007). Behavioral and physiological consequences of sleep restriction. *Journal of clinical sleep medicine*, *3*(5), 519-528.

Barghout, N. H., Al-Habashneh, R., & Al-Omiri, M. K. (2011). Risk factors and prevalence of musculoskeletal disorders among Jordanian dentists. *Jordan Medical Journal*, *171*(779), 1-20.

Berrigan, F., Simoneau, M., Tremblay, A. (2006). Influence of obesity on accurate and rapid arm movement performed from a standing posture. *Int J Obes., 30*, 1750–1757.

Boon, A. J., Oney- Marlow, T. M., Murthy, N. S., Harper, C. M., McNamara, T. R., & Smith, J. (2011). Accuracy of electromyography needle placement in cadavers: Non- guided vs. ultrasound guided. *Muscle & nerve, 44*(1), 45-49.

Borg, G. (1970). Perceived exertion as an indicator of somatic stress. *Scandinavian Journal of Rehabilitation Medicine, 2*, 92–98.

Borg, G. (1982). *A category scale with ratio properties for intermodal and interindividual comparisons. In: Geissler HG, Petzold P, ed. Psychophysical judgment and the process of perception*. Berlin: VEB Deutscher Verlag der Wissenschaften,.

Borg, G. (1998). *Borg's perceived exertion and pain scales*. Human kinetics.

Brooks, C. P., Woodruff, L. D., Wright, L. L. and Donatelli, R. (2005). The immediate effects of manual massage on power-grip performance after maximal exercise in healthy adults. *Journal of Alternative & Complementary Medicine: Research on Paradigm, Practice, and Policy, 11*(6): 1093-1101.

Buttagat, V., Taepa, N., Suwannived, N., & Rattanachan N. (2016). Effects of scapular stabilization exercise on pain related parameters in patients with scapulocostal syndrome: a randomized controlled trial. . *Journal of Bodywork and Movement Therapies, 20*, 115-122.

Callaghan, J. P., & McGill S.M., (2001). Low back joint loading and kinematics during standing and unsupported sitting. *Ergonomics, 44*(3), 280-294.

Canadian Center of Occupational Health and Safety (CCHOS) (2014). Working in A standing position, 2018.

Chiodo, A., Goodmurphy, C., & Haig, A. (2005). Cadaveric study of methods for subscapularis muscle needle insertion. American journal of physical medicine & rehabilitation, 84(9), 662-665.

Choi, S. D., & Woletz, T. (2010). Do stretching programs prevent work-related musculoskeletal disorders. *Journal of Safety, Health and Environmental Research*, *6*(3), 1-19.

Cifrek, M., Medved, V., Tonković, S., & Ostojić, S. (2009). Surface EMG based muscle fatigue evaluation in biomechanics. *Clinical Biomechanics, 24(*4): 327-340. doi:10.1016/j.clinbiomech.2009.01.010

Coren, S., Ward, L. M., & Enns, J. T. (2004). *Sensation and perception*. Hoboken, NJ: John Wiley & Sons.

Daube, J. R. & Rubin, D. I. (2009). Needle electromyography. *Muscle Nerve, 39,* 244-270.

David, G. C. (2005). In depth Review: Assessment Of Exposure to Risk Factors for Work-related Musculoskeletal Disorders. *Occupational Medicine,* 55: 190-199. doi: 10.1093/occmed/kqi082

de Looze, M. P., Kuijt-Evers, L. F., & van Dieen, J. H. (2003). Sitting comfort and discomfort and the relationships with objective measures. *Ergonomics, 46*(10), 985- 997. doi:10.1080/0014013031000121977

Department of Occupational Safety and Health, Ministry of Human Resources, Malaysia. (2002).

Guidelines on occupational safety and health for standing at work.

Drury, C. G., Hsiao, Y. L., Joseph, C., Joshi, S., Lapp, J., & Pennathur, P. R. (2008). Posture and performance: sitting vs. standing for security screening. *Ergonomics, 51*(3), 290-307.

Dworkin, R. H., Turk, D. C., Farrar, J. T., Haythornthwaite, J. A., Jensen, M. P., Katz, N. P., & Carr,B. (2005). Core outcome measures for chronic pain clinical trials: IMMPACT recommendations. *Pain, 113*(1), 9-19.

El Falou, W., Duchene, J., Grabisch, M., Hewson, D., Langeron, Y., & Lino, F. (2003). Evaluation of driver discomfort during long-duration car driving. *Applied ergonomics, 34*(3), 249-255.

Eston, R. (2012).Use of rating of perceived exertion in sports. *Int J Sports Physiol Perform, 7,* 175-182. European Agency for Safety and Health at Work. (2010). OSH in Figures: Work-related musculoskeletal disorders in EU - Facts and Figures. Luxembourg, Publications Office of the European Union.

Fellowes. Back and Foot Support. Office Suites™ Microban® Adjustable Footrest. (2012). Retrieved on May7, 2018 http://www.fellowes.com.my/office_suites%E2%84%A2_microban%C2%AE_adjustable_footres t.html

Fewster, K. M., Gallagher, K. M., & Callaghan, J. P. (2017). The effect of standing interventions on acute low-back postures and muscle activation patterns. *Applied Ergonomics, 58,* 281-286.

Field, T., Hernandez-Reif, M., Diego, M., & Fraser, M. (2007). Lower back pain and sleep disturbance are reduced following massage therapy. *Journal of Bodywork and Movement Therapies*, *11*(2), 141-145.

Freitas, S. M., Wieczorek, S. A., Marchetti, P. H. and Duarte, M. (2005). Age-related changes in human postural control of prolonged standing. *Gait & posture, 22*(4), 322-330.

Furtado, F., Gonçalves, B. D., Abranches, I. L., Abrantes, A. F., & Forner-Cordero, A. (2016). Chronic Low Quality Sleep Impairs Postural Control in Healthy Adults. *PloS one, 11*(10)

Gallagher, K.M., & Callaghan, J.P. (2016). Standing on a declining surface reduces transient prolonged standing induced low back pain development. *Applied Ergonomics, 56*, 76-83.

Ganesan, M., Lee, Y. J., & Aruin, A. S. (2015). The Effect of Footrest on Standing Postural Control.

Motor Control, 19(3), 207–222. https://doi.org/10.1123/mc.2013-0017

Garcia, M. C., & Vieira, T. M. M. (2011). Surface electromyography: Why, when and how to use it. *Revista andaluza de medicina del deporte, 4*(1), 17-28.

Gawthrop, P., Loram, I., Lakie, M., & Gollee, H. (2011). Intermittent control: a computational theory of human control. *Biological cybernetics, 104*(1-2), 31-51.

Goonetilleke, R. S., & Feizhou, S. (2001). A methodology to determine the optimum seat depth. *International Journal of Industrial Ergonomics*, *27*(4), 207-217.

Grant, S., Aitchison, T., Henderson, E., Christie, J., Zare, S., Mc Murray, J., & Dargie, H. (1999). A comparison of the reproducibility and the sensitivity to change of visual analogue scales, Borg scales, and Likert scales in normal subjects during submaximal exercise. *Chest, 116*(5), 1208- 1217.

Gregory, D. E., & Callaghan J. P. (2008). Prolonged standing as a precursor for the development of low back discomfort: An investigation of possible mechanisms. *Gait & Posture, 28*(1), 86-92. doi:10.1016/j.gaitpost.2007.10.005

Guldemond, N. A., Leffers, P., Sanders, A. P., Emmen, H., Schaper, N. C., & Walenkamp, G. H. (2006). Casting methods and plantar pressure: effects of custom-made foot orthoses on dynamic plantar pressure distribution. *Journal of the American Podiatric Medical Association, 96*(1), 9-18.

Halim, I., & Omar, A. R. (2011). A review on health effects associated with prolonged standing in the industrial workplaces. *IJRRAS, 8*(1), 14-21.

Halim, I., Omar, A. R., Saman, A. M., & Othman, I. (2012). Assessment of muscle fatigue associated with prolonged standing in the workplace. *Safety and health at work, 3*(1), 31-42.

Handrigan, G., Corbeil, P., Simoneau, M., & Teasdale, N. (2010). Balance control is altered in obese individuals. *J Biomech, 43*(2), 383-384.

Hernandez-Reif, M., Field, T., Krasnegor, J. and Theakston, H. (2001). Lower back pain is reduced and range of motion increased after massage therapy.

International journal of neuroscience, *106*(3-4), 131-145.

Hjermstad, M. J., Gibbins, J., Haugen, D. F., Caraceni, A., Loge, J. H., Kaasa, S., & European Palliative Care Research Collaborative. (2008). Pain assessment tools in palliative care: an urgent need for consensus. *Palliative Medicine*, *22*(8), 895-903.

Hue, O., Simoneau, M., Marcotte, J., Berrigan, F., Doré, J., Marceau, P., Marceau, S., Tremblay, A., & Teasdale, N. (2007). Body weight is a Strong predictor of postural stability. *Gait & posture*, *26*, 32-38.

Hughes, N. L., Nelson, A., Matz, M. W., & Lloyd, J. (2011). AORN Ergonomic Tool 4: Solutions for Prolonged Standing in Perioperative Settings. *AORN Journal*, *93*(6), 767–774. https://doi.org/10.1016/j.aorn.2010.08.029

Injuries, illness, and fatalities of United States. Washington, DC: US Bureau of Labor Statistics. (2008). Retrieved October 11, 2018 from http://www.bls.gov/iif/oshcfoi1.htm.

Injuries, illness, and fatalities of United States. Washington, DC: US Bureau of Labor Statistics. (2011). Retrieved February 11, 2019 from http://www.bls.gov/iif/oshcfoi1.htm.

Intani, A. C. (2013). Relationship Workload with Stress on Elderly Farmers in the Tobacco Farmer Groups Sukowono Sub-District Jember District. Jember: Nursing science Program University of Jember.

Isa, H., & Omar, A. R. (2012). Prolonged Standing Strain Index (PSSI): A Proposed Method to Quantify Risk Levels of Standing Jobs in Industrial Workplaces. *Advanced Materials Research*, *433*, 497-506.

Jakobsen, M. D., Sundstrup, E., Persson, R., Andersen, C. H., & Andersen, L. L. (2014). Is Borg's perceived exertion scale a useful indicator of muscular and cardiovascular load in blue-collar workers with lifting tasks? A cross-sectional workplace study. *European journal of applied physiology*, *114*(2), 425–434.

Kanekar, N., & Aruin, A. S. (2014). Aging and balance control in response to external perturbations: role of anticipatory and compensatory postural mechanisms. *Age*, *36*(3), 9621.

Karimi, N., Moghimbeigi, A., Motamedzade, M., & Roshanaei, G. (2016). Evaluation of Related Risk Factors in Number of Musculoskeletal Disorders among Carpet Weavers in Iran. *Safety and Health at Work*, *7*(4), 322-325. doi:10.1016/j.shaw.2016.04.004

Karmegam, K., Salit, M. S., Ismail, M.Y., Ismail, N., & Tamrin, S. B. M. (2012). Evaluation of motorcyclist‟s discomfort during prolonged riding process with and without lumbar support. *Anais Da Academia Brasileira de Ciencias*, *84*(4), 1169-1188.

King, P. M. (2002). A comparison of the effects of floor mats and shoe in-soles on standing fatigue. *Applied Ergonomics, 33*(5), 477-484. doi:10.1016/s0003-6870(02)00027-3

Koleini, M. N., Shimomura, Y., Iwanaga, K., & Katsuura, T. (2009). Effects of strap support in a hand- held device on the muscular activity in female workers assessed by electromyography and subjective rating. *Ergonomics*, *52*(7), 848-859.

Konrad, F., Murad, M. S., Farnworth, L., & O"Brien, L. (2005). Psychometric Properties of Occupational Self-Assessment for Injured Workers with Musculoskeletal Disorders. *Procedia- Social and Behavioral Sciences, 42*, 507-517.

Kuijt-Evers, L. F., Bosch, T., Huysmans, M. A., de Looze, M. P., & Vink, P. (2007). Association between objective and subjective measurements of comfort and discomfort in hand tools. *Applied Ergonomics, 38*(5): 643-654. doi:10.1016/j.apergo.2006.05.004

Laposky, A. D., Van Cauter, E., & Diez-Roux, A. V. (2016). Reducing health disparities: the role of sleep deficiency and sleep disorders. *Sleep medicine, 18*, 3-6.

Lee, J. Y., Baker, R., Coenen, P., & Straker, L. (2018). Use of a footrest to reduce low back discomfort development due to prolonged standing. *Applied Ergonomics, 67*, 218–224. https://doi.org/10.1016/j.apergo.2017.09.009

Leis, A. A., & Trapani, V. C. (2000). Atlas of electromyography. Oxford University *Press*.

Lemeshow, S., Hosmer, D. W., Klar, J., Lwanga, S. K., & World Health Organization. (1990). Adequacy of sample size in health studies. Chichester: Wiley.

Li, W., Yu, S., Yang, H., Pei, H., & Zhao, C. (2017). Effects of long-duration sitting with limited space on discomfort, body flexibility, and surface pressure. *International Journal of Industrial Ergonomics, 58*, 12–24. https://doi.org/10.1016/j.ergon.2017.01.002

Lim, C. M., Jung, M. C., & Kong, Y. K. (2011). Evaluation of upper-limb body postures based on the effects of back and shoulder flexion angles on subjective discomfort ratings, heart rates and muscle activities. *Ergonomics, 54*(9), 849-857.

Lin, Y. H., Chen, C. Y., & Cho, M. H. (2012). Influence of shoe/floor conditions on lower leg circumference and subjective discomfort during prolonged standing. *Applied Ergonomics, 43*, 965–970.

Ludwig, O., Kelm, J., & Fröhlich, M. (2016). The influence of insoles with a peroneal pressure point on the electromyographic activity of tibialis anterior

and peroneus longus during gait. *J Foot Ankle Res*, *9*, 33.

Marieb, E. N., & Hoehn, K. (2006). The Cardiovascular System: The Heart. *Human Anatomy & Physiology*, 658-691.

McNeil, C. J., & Rice, C. L. (2007). Fatigability is increased with age during velocity-dependent contractions of the dorsiflexors. J. Gerontol. *A Biol. Sci. Med. Sci.*, *62*(6), 624–629.

Mehrparvar, A. H., Heydari, M., Mirmohammadi, S. J., Mostaghaci, M., Davari, M. H., & Taheri, M. (2014). Ergonomic intervention, workplace exercises and musculoskeletal complaints: a comparative study. *Medical journal of the Islamic Republic of Iran*, *28*, 69.

Messing, K., & Kilbom, A. (2001). Standing and very slow walking: foot pain pressure threshold, subjective pain experience and work activity. *Applied Ergonomics, 32*, 81-90.

Messing, K., Tissot, F., & Stock, S. (2008). Distal lower-extremity pain and work postures in the Quebec population. *American Journal of Public Health, 98,* 705-713.

Mohan, G., Lee, Y., & Aruin, A. S. (2014). The effect of footrest on standing postural control. *Mot. Control*, *19*(3), 207-222.

Mohd Noor, S. N. A., Ahmad, I. N., Wahab, N. A., & Ma"arof, M. I. N. (2014). A Review of Studies Concerning Prolonged Standing Working Posture.*Advanced Engineering Forum*, *10* (December), 131–136. https://doi.org/10.4028/www.scientific.net/aef.10.131

Mohseni-Bandpei, M. A., Fakhri, M., Bargheri-Nesami, M., Ahmad-Shirvani, M., Khalilian, A. R., & Shayesteh-Azar, M. (2006). Occupational back pain in Iranian nurses: an epidemiological study. *British Journal of Nursing*, *15*(17), 914-917.

Motavalli, S., & Ahmad, F. (1993). Measurement of seating comfort. *Computers & Industrial Engineering*, *25*(4), 419-422.

Nelson-Wong, E., Gregory, D. E., Winter, D. A., & Callaghan, J. P. (2008). Gluteus medius muscle activation patterns as a predictor of low back pain during standing. *Clinical Biomechanics*, *23*(5), 545-553.

Nunes I. (2006). Work-Related Musculoskeletal Injuries–A Guide to Risk Assessment. *Portuegese Journal of Public Health, 10*, 58-73.

Nur, N. M., Dawal, S. Z. M., Dahari, M., & Sanusi, J. (2015). Muscle activity, time to fatigue, and maximum task duration at different levels of production standard time. *Journal of Physical Therapy Science*, *27*(7), 2323–2326.

Nurse, M. A., & Nigg, B. M. (2001). The effect of changes in foot sensation on plantar pressure and muscle activity. *Clinical Biomechanis, 16*, 719-727.

Nyland, L. J., & Grimmer, K. A. (2003). Is undergraduate physiotherapy study a risk factor for low back pain? A prevalence study of LBP in physiotherapy students. *BMC Musculoskeletal Disorders*, (4), 22. doi: 10.1186/1471-2474-4-22

O'Neill, J. M. (2008). Musculoskeletal ultrasound. *Springer*.

Orlando, A., & King, P. (2004). Relationship of demographic variables on perception of fatigue and discomfort following prolonged standing under various flooringconditions. *Journal of Occupational Rehabilitation, 14*(1), 63–76.

Partsch, H., Winiger, J., & Lun, B. (2004). Compression stockings reduce occupational leg swelling. *Dermatologic Surgery, 30*(5), 737-743.

Patel, M., Gomez, S., Berg, S., Almbladh, P., Lindblad, J., & Petersen, H. (2008). Effects of 24-h and 36-h sleep deprivation on human postural control and adaptation. *Experimental Brain Research, 185*, 165–73.

Pereira, Gleber, Souza, Douglas Martins de, Reichert, Felipe Fossati, & Smirmaul, Bruno Paula Caraça. (2014). Evolution of perceived exertion concepts and mechanisms: a literature review. *Revista Brasileira de Cineantropometria & Desempenho Humano, 16*(5), 579-587.

Perreault, N., Brisson, C., Dionne, C. E., Montreuil, S., & Punnett, L. (2008). Agreement between a self-administered questionnaire on musculoskeletal disorders of the neck-shoulder region and a physical examination. *BMC musculoskeletal disorders, 9*(1), 34.

Peterka, R. J. (2002). Sensorimotor integration in human postural control. *Journal of neurophysiology, 88*(3), 1097-1118.

Potvin, J.R., & Fuglevand, A.J. (2017). A motor-unit based model of muscle fatigue. *PloS Computational Biology*. doi: 10.1371/journal.pcbi.1005581.

Rath, R., & Wade, M. G. (2017). The Two Faces of Postural Control in Older Adults: Stability and Function. *EBioMedicine, 21*, 5–6.

Reid, C. M., Bush, P. M., Karwowski, W., & Durrani, S. K. (2010). Occupational postural activity and lower extremity discomfort: A review. *International Journal of Industrial Ergonomics, 40*, 247– 256.

Rezaeipour, M., & Apanasenko, G. L. (2018). Effects of Overweight and Obesity on Postural Stability of Aging Females. *Middle East J Rehabil Health Stud., 5*(4), e81617.

Sartika, S. J., & Dawal, S. Z. (2011). Investigating the physiological effects of standing, using a sit/stand stool and standing with a footrest during static tasks. *Australian Journal of Basic and Applied Sciences*, *5*(7), 516–522.

Sartika, S. J., & Dawal, S. Z. (2016). Investigation of Lower Limb Fatigue on Two Standing Posture.

Jurnal Optimasi Sistem Industri, *11*(1), 208. https://doi.org/10.25077/josi.v11.n1.p208-213.2012 Silviyani, V. (2014). The Correlation between Position of Elderly Farmers Working with the Risk of

Low Back Pain in the Working Area of Puskesmas. *Nursing science Program University of Jember*.

Smith, J., Hurdle, M. F., Locketz, A. J., & Wisniewski, S. J. (2006). Ultrasound-guided piriformis injection: technique description and verification. *Archives of physical medicine and rehabilitation*, *87*(12), 1664-1667.

Smith, M. D., Kwan, C., Zhang, S., Wheeler, J., Sewell, T., & Johnston, V. (2019). The Influence of Using a Footstool during a Prolonged Standing Task on Low Back Pain in Office Workers. *International Journal Of Environmental Research and Public Health*, *16*(8), 1405. doi:10.3390/ijerph16081405

Social Security Organization (SOCSO). Annual Report 2014, https://www.perkeso.gov.my/images/laporan_tahunan/Laporan_Tahunan_2014

Søgaard, K., Sjøgaard, G., Finsen, L., Olsen, H. B., & Christensen, H. (2001). Motor unit activity during stereotyped finger tasks and computer mouse work. *Journal of Electromyography and Kinesiology*, (11), 197-206.

Son, J.I., Yi, C.H., Kwon, O.Y., Cynn, H.S., Lim, O.B., Baek, Y.J. & Jung, Y.J. (2017) Effects of footrest height on muscle fatigue, kinematics and kinetics during prolonged standing work. *Journal of Back and Musculoskeletal Rehabilitation*, *31*(2), 1-8.

Spielholz, P., Silverstein, M., Morgan, H., & Checkoway, K. J. (2001). Comparison of self-report, video of observation and direct measurement methods for upper extremity musculoskeletal disorder physical risk factors. *Ergonomics*, *44*(6), 588-613.

Stat Trek. (n.d.). Retrieved April 27, 2018, from https://stattrek.com/statistics/random-number- generator.aspx

Stoffregen, T. A. (2016). Functional control of stance in older adults. *Kinesiology Review*, *5*(1), 23-29.

Streiner, D. L., Norman, G. R., & Cairney, J. (2015). Health measurement scales: a practical guide to their development and use. Oxford University Press, USA

Tomei, F., Baccolo, T. P., Tomao, E., Palmi, S., & Rosati, M.V. (1999). Chronic venous disorders and occupation. *American Journal of Industrial Medicine,36,* 653-655.

Tüchsen, F., Krause, N., & Hannerz, H. (2000). Standing at work and varicose veins. *Scandinavian Journal of Work, Environment and Health, 26,* 414-420.

Van Laerhoven, H., van der Zaag-Loonen, H. J., & Derkx, B. H. (2004). A comparison of Likert scale and visual analogue scales as response options in children's questionnaires. *Acta paediatrica, 93*(6), 830-835.

Waters, T. R., & Dick, R. B. (2015). Evidence of health risks associated with prolonged standing at work and intervention effectiveness. *Rehabilitation Nursing, 40*(3), 148-165.

Watson, N. F., Badr, M. S., Belenky, G., & Bliwise, D. L. Buxton. OM, Buysee, D., & Tasali, E.(2015). Recommended amount of sleep for a healthy adult: A joint consensus statement of the American Academy of Sleep Medicine and Sleep Research Society. *Sleep, 38*(6), 843-844.

Werner, R. A., Gell, N., Hartigan, A., Wiggerman, N., & Keyserling, W. M. (2010). Risk factors for plantar fasciitis among assembly plant workers. *Physical medicine and rehabilitation, 2*(2), 110- 116.

Witana, C. P., Goonetilleke, R. S., Xiong, S. and Au, E. Y. (2009). Effects of surface characteristics on the plantar shape of feet and subjects‟ perceived sensations. *Applied Ergonomics, 40*(2), 267-279.

Yun, Y. X. (2012). Musculoskeletal Disorders Related to Work Are on The Rise. *The Star Online*. Retrieved June 11, 2018 from http://www.thestar.com.my/news/community/2012/12/03/musculoskeletal-disorders-related-to- work-are-on-the-rise/

Zander, J. E., King, P. M., & Ezenwa, B. N. (2004). Influence of flooring conditions on lower leg volume following prolonged standing. *International Journal of Industrial Ergonomics, 34*(4), 279-288.

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Adriana Binti Abdul Aziz was born on the 14th of February 1994 in Bukit Mertajam, Penang, Malaysia. She started getting her primary education in Sekolah Kebangsaan Tunku Abdul Malik, Kedah in the year of 2001. She went to Sekolah Menegah Kebagsaan Sultan Badlishah, Kedah, Malaysia in 2007. After a year, she transferred to the High School Bukit Metajam, Penang, Malaysia in 2008 for her secondary level of education. After that, in the year of 2012, she further her study at Penang Matriculation located in Kepala Batas, Penang before getting the admission into the Universiti Putra Malaysia (UPM), Serdang, Malaysia in 2013. In this university, she has taken Environmental and Occupational Health course where she bagged a Bachelor of Science in the respective course. After graduated in 2018, she furthers her study for Master Science (Occupational Safety and Health) in the Faculty of Medicine and Health Sciences. Her research interest was mainly related to the occupational health field.

LIST OF PUBLICATIONS

Adriana, A., Karmegam, K., Velu, P., Shamsul Bahri, M. T., Enoch, K., & Sivasnkar, S. (2019). Muscle Discomfort in Prolonged Standing among Industrial Workers. Malaysian Journal of Medicine and Health Sciences, 15(Suppl. 3), 90-92.

Adriana, A., Karmegam, K., Nurul Amanina, S., Velu, P., Enoch, K., & Shamsul Bahri, T. (2020). Footrest intervention: Association between prolonged standing and perceived exertion in the body parts among industrial workers using Borg's scale questionnaire. International Journal of Industrial Ergonomics, 76. doi:10.1016/j.ergon.2019.102898

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