

ORIGINAL ARTICLE

Correlation Between Posture of Job and Musculoskeletal Disorders Complains Among Emergency Departement Nurses in General Hospital Distric of Tangerang City

Siti Novy Romlah¹, Dewi Fitriani², Diah Susanti², Suganthi Lokonathan³, Nisha Nambiar³, Fana Devasa¹

¹ Faculty of Midwifery, Widya Dharma Husada Tangerang School of Health Science, Indonesia

² Faculty of Nursing, Widya Dharma Husada Tangerang School of Health Science, Indonesia

³ Faculty of Nursing, Lincoln University College, No. 2, Jalan Stadium, S7/15, 47301 Petaling Jaya, Selangor, Malaysia

ABSTRACT

Introduction: Based on World Health Organization (WHO) incidence of musculoskeletal diseases is estimated to reach 60.4% of all occupational illness. Research conducted in the UK and Hongkong on nurses reported lower stage pain of 38% and 39% and some neck pain 34% and 31% respectively. Musculoskeletal disorders are basically complaints of pain in parts of our body that include muscles, joints, ligaments, skeletons, and nerves. Work posture is one of the factors that influence the increase in musculoskeletal disorders. The objective of the research is to identify correlation between posture at job with musculoskeletal disorders complaints in the emergency department among nurses. **Methods:** The Method of the research was a quantitative research using cross sectional methods with Spearman Rho correlation statistic test and the sampling method used total sampling. The sample size in this study was 40 nurses in the Emergency Department. Data collection was conducted by using Nordic Body Maps questionnaire to assess Musculoskeletal Disorder and posture of job assessment was carried out by Rapid Entire Body Assessment (REBA). **Results:** The results from this study showed that half of respondents (50%) were 26-30 years old, more than half (67%) of respondents are male, more than half (60%) have very high risks due to posture of job, and more than half (55%) had heavy complaints. **Conclusion:** There was a correlation between job posture with musculoskeletal disorders.

Keywords: Musculoskeletal Disorders, Nordic Body Maps, Work Posture

Corresponding Author:

Siti Novy Romlah, M.Epid.

Email: sitinovyromlah@wdh.ac.id

Tel: +6221-74716128

INTRODUCTION

Development of health is an effort that is implemented by Indonesia to increase the awareness, willingness, and the ability to promote healthy life for everyone. This is an infestation for human resource development which is productive for social and economic development. The success of health development is largely brought about by the continuity in program implementation and sector efforts, as well as the continuity with efforts that have been carried out by the previous period (1).

Occupational health and safety is an important part of employment. Therefore, the Health Law No. 36 (2) was established to regulate the provision of health and safety for every individual, including the workers. As a result, many health problems that occur due to lack of labor unawareness leads to potential hazards in the work

environment including hospitals. Potential occupational hazards can be biological, chemical, physical, and ergonomic threats.

The results of the occupational health report in Indonesia in 2013 showed the prevalence rate of musculoskeletal disorders based on existing symptoms to be 24.7%. Global prevalence of Musculoskeletal Disorders (MSDs) is 8.4% recorded in 2014 and also found to increase in Disability Adjusted Life Years (DALY) from 20.6 million in 1990 to 30.9 million in 2010 (3).

The occupational health reports in 26 provinces in Indonesia in 2013 showed the numbers of common diseases detected in workers were about 2,998,766 cases, and the number of cases of illness related to work amounted to 428,844 cases. The relatively low number of work-related cases does not reflect the actual situation, but rather it remains undetected and undiagnosed. So, the problem of MSDs among workers, especially among physical labour naturally received special attention because MSDs causes loss of working hours due to injury almost in every type of industry (4).

Musculoskeletal disorders as an occupational health problem, often causes major disability among workers. The musculoskeletal disorders have become one of the main reasons of absence from work for the workers. As a result for that institutions suffers loss for their employer with respect to time and materials. Research on nurses in Cambodia showed that 95% of workers complain of symptoms of musculoskeletal disorders like pain, especially in the neck, shoulders, and back (5).

Posture of job are unnatural for example, constant standing, squat down, bent down, lift, and hauling for an extended period. These can cause inconvenience and pain in several parts of body. Early fatigue in workers can also cause illness due to work and work accidents resulting in disability and even death. The Rapid Entire Body Assessment (REBA) method is one of the tools used to measure posture of job. It is useful to calculate the level of risk that can occur and can also cause Musculoskeletal Disorders (MSDs) (6).

Unergonomic postures of job are very vulnerable towards experiencing MSDs. Based on the results of the research, non ergonomic postures of job with complaint at the neck amounting to 81%, complaint of back pain was 7%. Other studies also describe similar complaints of the body position on the incidence of MSDs (7).

Nurses and medical staff improve health conditions of patients, but in carrying out these activities, nurses often does not pay attention to the things that are important factor of risk due to work. Occupational Safety and Health Administration in 2004 (8) explained that the illness or injury that occurs in working place expose nurses to the adverse conditions of employee while doing the job. Musculoskeletal complaints are the complaint mostly reported due to workplace problems.

Based on World Health Organization (WHO) the incidence of occurrence of musculoskeletal disorders is a most prevalent disease and the cause of up to 60.4% of all occupational diseases. Musculoskeletal disorder complaints may occur at any time during the performance of activities of job by the nurses (9). Based on observations of the current pilot project shows that nurses lift and move the patient in a procedure that is less suited and recommended. This is due to the fact that they did not have time, nurses are unaware of the right posture of job during work, and because of adverse work pressure in the emergency department. So, they have to do the job fast even if they get injured in the process. Thus, the objective of this study was to look at the correlation between posture of job with musculoskeletal disorders complains of emergency department nurses in General Hospital District of Tangerang City Indonesia.

MATERIALS AND METHODS

The researchers used analytic design by cross sectional

method, where the approach, observation and collection of the data is done at one time, and the research subject is only observed once and the measurement is carried out on a characteristic of subject variable during the examination (10).

The type of research used in this study is quantitative analytical observation with cross sectional study approach. This research was conducted with interview methods, observations, and measurements of posture of job of worker where independent and dependent variables were observed at the same time. This method is intended to explain the relationship between the independent variable (postures of job) with the dependent variable (musculoskeletal disorders complain). Postures of Job was assessed using Rapid Entire Body Assessment (REBA) (Figure 1) while Nordic Body Maps questionnaire was used to assess Musculoskeletal Disorder (Figure 2).

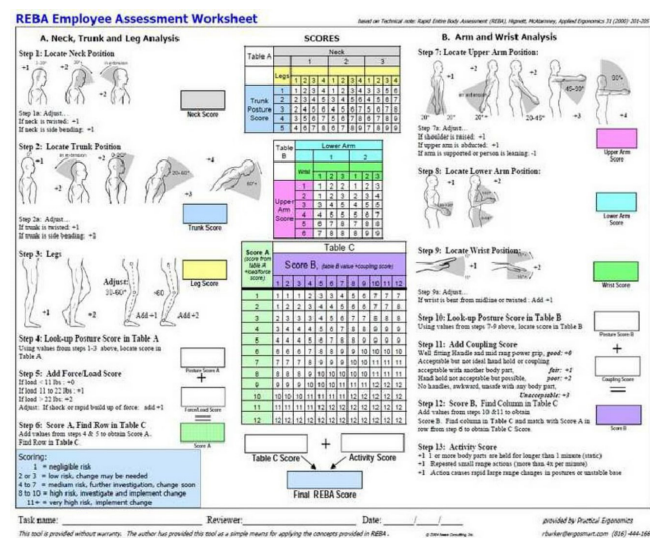


Figure 1: REBA Employee Assessment Worksheet

The study was conducted in General Hospital of Tangerang City Indonesia. The time of the study was between January - May 2019. In this study data collection was carried out between 22-25 May 2019. This study samples are hospital nurses as many as 40 respondents in the Emergency Department. Ethical approval for this study was obtained from the Widya Dharma Husada Ethics Committee (Ref No: KE/125/01/2019) .

RESULTS

According to table I half (50%) of respondents were 26-30 years old, almost half (27.5%) were 21-25 years old and a small portion (22.5%) were 31-35 years old. More than half (67%) of respondents are male, because most of those serving in the emergency room are male nurses, according to the results of interviews with nurses at the emergency department at the Tangerang district hospital. Male nurses are much needed physically for heavy nursing tasks.

Anda diminta untuk menilai apa yang anda rasakan pada bagian tubuh yang ditunjukkan pada gambar. Apakah bagian tubuh yang sudah diberikan nomor tersebut tidak terasa sakit (pilih A), sedikit sakit (pilih B), sakit (pilih C) dan sangat sakit (pilih D). Pilih dengan memberikan tanda √ pada kolom huruf pilihan anda.

No.	Lokasi	Tingkat Kesakitan				Peta Bagian Tubuh
		A	B	C	D	
0	Sakit / kaku pada leher atas					
1	Sakit pada leher bawah					
2	Sakit pada bahu kiri					
3	Sakit pada bahu kanan					
4	Sakit pada lengan atas kiri					
5	Sakit pada punggung					
6	Sakit pada lengan atas kanan					
7	Sakit pada pinggang					
8	Sakit pada pantat (buttock)					
9	Sakit pada pantat (bottom)					
10	Sakit pada siku kiri					
11	Sakit pada siku kanan					
12	Sakit pada lengan bawah kiri					
13	Sakit pada lengan bawah kanan					
14	Sakit pada pergelangan tangan kiri					
15	Sakit pada pergelangan tangan kanan					
16	Sakit pada tangan kiri					
17	Sakit pada tangan kanan					
18	Sakit pada paha kiri					
19	Sakit pada paha kanan					
20	Sakit pada lutut kiri					
21	Sakit pada lutut kanan					
22	Sakit pada betis kiri					
23	Sakit pada betis kanan					
24	Sakit pada pergelangan kaki kiri					
25	Sakit pada pergelangan kaki kanan					
26	Sakit pada kaki kiri					
27	Sakit pada kaki kanan					

Reference : Hartoto, 2013

Figure 2: Nordic Body Map Questionnaire

Table I: Characteristics Respondents by Age and Gender in the Emergency Department Nurses in General Hospital District of Tangerang City (n = 40)

Variables	Frequency (n)	Percentage (%)
Age (Years)		
21-25	11	27.5
26-30	18	50.0
31-35	9	22.5
Gender		
Male	23	57.5
Female	17	42.5

According to table II, the frequency distribution on nurses postures of job from 40 respondents, it can be seen that more than half (60%) have very high risks and almost half (40%) have high risks. As for the frequency distribution based on musculoskeletal disorders complains from 40 respondents, it is known that more than half (55%) had heavy complaints, almost half (27.5%) had medium complaints and a small proportion (17.5%) had minor complaints (Table II).

The correlation between posture of job with musculoskeletal disorders complains, based on table III the result of the Spearman Rho test showed a significant p-value of 0.001, the test decision is H_0 rejected or H_a accepted means that there is a correlation between posture of job with musculoskeletal disorders complains in Emergency Department of Nurses in General Hospital District of Tangerang City Indonesia. The correlation value of 0.527 meaning there is a very strong correlation between the posture of job and complaint of musculoskeletal disorders.

Table II: Characteristics Respondents by Postures of Job and Musculoskeletal Disorders Complains in the Emergency Department Nurses in General Hospital District of Tangerang City (n = 40)

Variables	Frequency (f)	Percentage (%)
Posture of Job		
High risk	16	40.0
Very high risk	24	60.0
Musculoskeletal Disorders		
Minor complaint	7	17.5
Medium complaint	11	27.5
Heavy complaint	22	55.0

Table III: Cross Tabulation Between Posture of Job with Musculoskeletal Disorders Complains in the Emergency Department Nurses in General Hospital District of Tangerang City (n = 40)

Variabel	Mean	SD	Spearman's Rho Test Correlation	p value
Posture of Job	3.60	0.496	0.527	0.001
Musculoskeletal Disorders	3.25	0.630		

DISCUSSION

According to The Republic of Indonesia's Ministry (11) age is a unit of time that measures the time of a creature from living until dead. For example, the age of a human being is said to be 15 years from the time he was born until the time of age is calculated.

One of the work units in a hospital that is very important is the Emergency Department. Emergency department is the first destination for patient who are in an emergency situation. The workload of emergency room nurses is quite heavy because in general, patients who are rushed to the emergency need to get health service as quickly and accurately as possible.

Nurses who are in charge of the emergency room must be on standby for 24 hours to handle patients whose level of survival is unpredictable. In addition, the responsibilities of the emergency room nurse are quite large because it involves the safety of one's life. Always they have to rush to the emergency room and they are ready for each type of medical action that must be given to patients who are affected by many type of medical injury (12).

According to research data nurses in the emergency department of the Tangerang district hospital in 2019, were young men who had to work quickly and readily in handling emergency patients, and their handling/action requires speed in dealing with critical patients. As young people are still productive to take action in the emergency room that requires physical labor and workload, as well as speed and readiness that is needed in the emergency room.

The nurses in the Emergency Department is confronted

by patients who arrive unconsciously and they cannot explain their complaints and requirements, so nurses are always prepared for the needs and treatments of those patients. The aforementioned matters constitute a situation that causes a variety of work, and therefore there is need for a lot of energy and physical strength, male nurses are needed in the emergency room due to the work intensity and need of physical labor (13).

Physically strong male nurses are needed in physical care tasks which was evident from the results of interviews with nurses as heavy work can be performed by male nurses, jobs that are harder for female nurses, can be carried out by male nurses (14).

According to the researchers the data shows that nurses at the Regional Hospital of Tangerang City in 2019 were dominated by male nurses due to the rapid assignment in the emergency room for activities such as moving patients from a wheelchair to bed quickly. The emergency room is the first place where many patients come with critical conditions and who need rapid treatment. So, the Emergency Department have a high demand for male nurses to provide physical energy.

Postures of job are a determining factor in analyzing the effectiveness of the essence of a job. If the posture of job carried out by the worker is good and ergonomic then the posture of job by the worker will be good. However, if the worker's posture during job is not ergonomic then the worker will get exhausted (15).

One of the research result showed that (16) the relationship of non-ergonomic postures of job and the characteristics of respondents with musculoskeletal disorders (MSDs). The results of this study showed there was a relationship with non-ergonomic posture of job with $p=0.000$. So it can be concluded that there was a relationship.

These results are consistent with another research by Rahman showed that the majority (81.8%) work posture among informal sector concrete workers was at a moderate level of risk that required more inspection and changing work conditions (17). Here it was found that the body parts of workers who felt the most MSDs complaints is 88.6% on the back and the severity of complaints that were felt most at moderate complaints is 61.4%. Chi-square test results with an error rate of 5% showed a work posture relationship ($p= 0.000$).

Nuryaningtyas et al. study among welding workers showed data was obtained by measurement, observation using The Rapid Entire Body Assessment (REBA) and filling the Nordic Body Map (NBM) questionnaire and relationship analysis using the Spearman test(18). As many as 68.6% of workers have a moderate musculoskeletal risk. According to the study the body position of the worker has a significant correlation with

musculoskeletal complaints. There is a correlation with $p =0.005$, so that it can be concluded that there is a relationship.

According to researchers the data shows that the majority of respondents have non-ergonomic postures of job, this is because respondents do not pay attention to ergonomic postures of job at work, because nurses are required to be quick in handling patients, causing them to rush, and cause postures of job that are not right and exceed the limits of ability, and become one of the many causes of Musculoskeletal Disorders. The lack of concern for occupational diseases will be experienced later by the nurses.

Musculoskeletal disorders are complaints on the parts of the skeletal muscles that are felt by someone ranging from complaints that start with very mild to very painful. If the muscle receives a static load repeatedly and for a long time, it can cause pain in the form of damage to the joints, ligaments and the tendons. These complaints or injuries are usually termed as musculoskeletal disorders (MSDs) (19).

Maysyarah et al. studied based on musculoskeletal complaints in nurses at Muhammadiyah's Hospital in Delanggu Indonesia used the method of analytic research design with cross sectional survey(20). The measurement of patient was done using RULA and measurement of the musculoskeletal disorders was done by Nordic Body Map (NBM). Analysis using chi-square obtained $p = 0.048$, so it can be concluded that there is a relationship.

Putri S E found that there is a relationship between lifting of patients with complaints of musculoskeletal disorders (MSDs) in nurses (21). The results showed that the length of service is the most dominant variable and it influences the complaints of musculoskeletal disorders. So it can be concluded that there is a relationship.

According to researchers the available data shows that are majority of respondents complains of musculoskeletal disorders, due to frequent forced movements, non ergonomic body postures, repetitive movements, including lifting heavy patient burdens, bending postures, bending, turning, standing for too long, and maintaining a statistic body position. The asymmetrical, heavy, and moving characteristics of the patient's body without coordination make handling the patient difficult for the nurse's body. Besides the insufficient space in the room force the nurse to make a bad posture. The conditions of health facilities in Indonesia which is heterogeneous with different workloads, that results in the development of risks of MSDs for nurses in hospitals.

The results of this study on emergency nurses with a total of 40 respondents, shows a significant p-value 0.001 that means there is a very strong relationship between postures

of job with complaints of musculoskeletal disorders. Unusual postures of job can cause musculoskeletal disorders in every nursing individual.

Musculoskeletal disorders (MSDs) are the abnormalities that are caused by injuries or damage to the system of musculoskeletal due to repeated trauma that cannot be cured completely and cause of pain. An anomalous posture is a deviation from body movements or limbs carried out by workers while doing work repeatedly for a relatively long time. Anomalous posture movement is one of the risk factors for disruption, disease, or injury to the musculoskeletal system which never cured but rather is an accumulation of small and large collisions continuously which relatively take long period of time (22).

The results of another research indicate that there is a very strong relationship where the value of $r = 0.803$ and significant p value = 0.001 between posture of job with musculoskeletal complaints. From these results it is known that the average value of the work posture is in the medium risk category. While the average value of musculoskeletal complaints in the high risk category (24).

This study is in line with research of Wajdi et al. regarding the risk of occupational type of complaints of musculoskeletal disorders in nurses in hospital (25). In this study the percentage of respondents experiencing physical complaints were mostly by nurses with neck pain (69%), upper back (59%), and shoulder (58%). Then the level of effort to do light to very heavy work was measured on a scale of 1-4 with the following results: lifting patients (mean = 2.6, SD = 0.8), moving patients (mean = 2.2, SD = 0.9), clean the room (mean = 1.9, SD = 0.6), walk (mean = 1.9, SD = 0.6), sit (mean = 1.8, SD = 0.5), put on clothes (mean = 1.75, SD = 0.081). Spearman's correlation measurement showed that there was significant correlation with the work of bathing patients ($S = 0.208$, Sig. 2-tailed = 0.008) there was an upper back complaint ($p < 0.01$). While too much walking ($S = 0.617$, Sig. 2-tailed = 0.034) is significant for neck complaints ($p < 0.05$), so it can be concluded that there is a relationship.

This study is also in line with Arfiyanti's research (26). This research method uses analytic surveys with a method by cross sectional method. The population of this study were all workers in the enforcement department as many as 28 respondents. The results showed that there was a strong enough relationship $r = 0.439$ and significant with a p value of 0.019 between posture of job with musculoskeletal complaints. There is a strong enough relationship $r = 0.512$ and significant with $p = 0.005$ between musculoskeletal complaints with productivity. From these results it is known that the average value of the work posture is in the low category or there is no need for any corrective action. Whereas the average

productivity value is more than 9 respondents and less than the average is 19 respondents.

Ergonomic or unnatural work postures can lead to MSDs complaints. The worse the posture increase the risk of MSDs. Routine supervision on activities that are at risk of injury must be conducted, routine activities that are at risk of injury must be held and regular sports must be held once a week (24).

According to the researchers the available data shows that most of the respondents have unergonomic posture of job which causes complaints of musculoskeletal disorders in nurses. Due to lack of concern of work-related disease the nurses experienced above injuries. As they always pay attention to patient's comfort they do not have time to pay attention to an ergonomic work posture. Not only for the above reason, due to frequent forced movements, postures that are not ergonomic, repetitive movements, including lifting a heavy patient, also causes of complaints of musculoskeletal disorders among nurses.

CONCLUSION

In conclusion it can be said that the relationship of posture of job with musculoskeletal disorders complaints in nurses in the Emergency Department, as many as 22 nurses lead to very severe MSDs, 11 nurses had moderate MSDs and 7 nurses had mild MSDs. The results with a p -value $0.01 < 0.05$. So, there is a correlation between posture of job with musculoskeletal disorders in nurses at Emergency Department of General Hospital District of Tangerang City, Indonesia.

ACKNOWLEDGMENTS

All authors are very thankful to Chairman of Widya Dharma Husada Foundation and for technical help from Tangerang District Hospital authority for giving permission and support

REFERENCES

1. Mansyur, Muchtarudin. One People Workers Death Every 15 Seconds Because Accidents. Ministry of Health Republic of Indonesia. 2014.
2. Ministry of Health of The Republic of Indonesia, The Law of the Republic of Indonesia, No. 36/2009 about Health. 2009.
3. Saftarina F, Mayasari D, Octaviani D. Analysis of work posture Using Rapid Entire Body Assessment (REBA) as the risk factor of work related musculoskeletal Disorders in Inter-provincial Bus Drivers. 2017.
4. Jannah. Musculoskeletal Disorders Risk Analysis (MSDs) in Cashier, Grocery and Receiving Giant Hypermarket Workers Division Thesis Faculty of Medicine and Health Sciences. Syarif Hidayatullah

- State Islamic University Jakarta. 2008.
5. Van L, Chaiear N, Sumananont C, Kannarath C. Prevalence of musculoskeletal symptoms among garment workers in Kandal province, Cambodia. *Journal of occupational health*. 2016 Jan;58(1):107-17.
 6. Rahman A. Analysis of Work Posture with Complaints of Musculoskeletal Disorders (MSDs) in Informal Sector Concrete Workers in Samata Village, Somba Opu District, Gowa Regency 2017. Thesis. Faculty of Medicine and Health Sciences. Alauddin State Islamic University Makassar. 2017.
 7. Octrasisy M, Hendra. Musculoskeletal Disorders (MSDs) Complaints in the Manual Conference of Handling Services for National Conference on Applied Ergonomics Manual Handling Services. 2010.
 8. Occupational Safety and Health Administration. *Ergonomic*. United States Departement of Labor. 2004.
 9. Yasobant S, Rajkumar P. Work-related musculoskeletal disorders among health care professionals: A cross-sectional assessment of risk factors in a tertiary hospital, India. *Indian journal of occupational and environmental medicine*. 2014 May;18(2):75.
 10. Notoatmodjo, Soekidjo. *Health Research Methodology* Jakarta: Rineka Cipta. 2012
 11. Ministry of Health of the Republic of Indonesia. 2009.
 12. Tyagita. Analisa Beban Kerja Perawat UGD Menggunakan Masalah Bournout Inventory & Modifikasi Hear RS.X. 2015.
 13. Susanto H. Hubungan Persepsi Beban Kerja dengan Stres Kerja pada Perawat Igd dan ICU Eka Hospital Pekanbaru (Doctoral dissertation, Riau University). 2015.
 14. Rika, Nike. Relasasi Gender Dalam Tugas di RS Puri Husada Sleman Yogyakarta. Skripsi. Fakultas Ilmu Sosial Universitas Negeri Yogyakarta. 2012.
 15. Susihono W, Prasetyo W. Perbaikan postur kerja untuk mengurangi keluhan muskuloskeletal dengan pendekatan metode owas (Studi Kasus Di UD. Rizki Ragil Jaya–Kota Cilegon). *Spektrum Industri*. 2012 Apr 1;10(1).
 16. Putri VR, Tarwaka P. Hubungan Postur Kerja Tidak Ergonomis Dan Karakteristik Responden Dengan Musculoskeletal Disorders (MSDS) Pada Pekerja Furniture Di Cv Nova Furniture Boyolali (Doctoral dissertation, Universitas Muhammadiyah Surakarta). 2017
 17. Rahman A. Analisis Postur Kerja dan Faktor yang Berhubungan dengan Keluhan Musculoskeletal Disorder (MSDs) pada Pekerja Beton Sektor Informal di Kelurahan Samata Kecamatan Somba Opu Kabupaten Gowa Tahun 2017 (Doctoral dissertation, Universitas Islam Negeri Alauddin Makassar).
 18. Nuryaningtyas BM, Martiana T. Analisis Tingkat Risiko Muskuloskeletal Disorders (MSDs) dengan The Rapid Upper Limbs Assessment (RULA) dan Karakteristik Individu Terhadap Keluhan MSDs. *The Indonesian Journal of Occupational Safety and Health*. 2014 Jul;3(3):160-9.
 19. Fuady AR. Faktor-Faktor Yang Berhubungan dengan Keluhan Musculoskeletal Disorders (MSDs) pada Pengrajin Sepatu di Perkampungan Industri Kecil (PIK) Penggilingan Kecamatan Cakung Tahun 2013.
 20. Maysyaroh ND, Suwaji MK. Hubungan Patient Handling Dengan Kejadian Musculoskeletal Disorders Pada Perawat di RSU PKU Muhammadiyah Delanggu (Doctoral dissertation, Universitas Muhammadiyah Surakarta). 2016
 21. Putri SE. Hubungan Angkat Angkut Pasien Dengan Keluhan Musculoskeletal Disorders (Msd's) Pada Perawat Ruang Rawat Inap Rsud Teluk Kuantan Tahun 2018. *Photon: Jurnal Sain dan Kesehatan*. 2018 Oct 28;9(1):112-21.
 22. Hasrianti Y. Hubungan Postur Kerja Dengan Keluhan Musculoskeletal pada Pekerja di PT. Maruki International Indonesia Makassar. Universitas Hasanudin, Makasar: Skripsi Dipublikasikan. 2016.
 23. Bukhori E. Hubungan faktor risiko pekerjaan dengan terjadinya keluhan muskulokeletal disorders (MSDs) pada tukang angkut beban penambang emsa di kecamatan cilograng kabupaten lebak Banten tahun 2010.
 24. Erdiansyah M. Hubungan Tingkat Risiko Postur Kerja Berdasarkan Metode Rula Dengan Tingkat Risiko Keluhan Muskuloskeletal pada Pekerja Manual Handling di Pabrik Es Batu Pt. Sumber Tirta Surakarta (Doctoral dissertation, Universitas Muhammadiyah Surakarta).
 25. Wajdi F, Kusmasari W. Resiko Jenis Pekerjaan Terhadap Keluhan Muskuloskeletal Disorders Pada Perawat Rumah Sakit. *Prosiding Semnastek*. 2015 Nov 26.
 26. Arfiasari AD. Hubungan Postur Kerja Dengan Keluhan Muskuloskeletal Dan Produktivitas Kerja Pada Pekerja Bagian Pengepakan Di PT. Djitoe Indonesia Tobako (Doctoral dissertation, Universitas Muhammadiyah Surakarta).