

ORIGINAL ARTICLE

The Relationship between Carrying Load and the Occurrence of Kyphosis in Porter

Hubungan Beban Angkut Terhadap Kejadian Kifosis Pada Buruh Panggul

Tiffany Gita Yunilia Sari¹, Nuryani Sidarta²✉

¹ Medical Undergraduate Program, Faculty of Medicine, Universitas Trisakti, Jakarta, Indonesia

² Anatomy Department, Faculty of Medicine, Universitas Trisakti, Jakarta, Indonesia

✉ nuryani_sidarta@trisakti.ac.id

 <https://doi.org/10.18051/JBiomedKes.2022.v5.192-202>

ABSTRACT

Background

Occupational diseases that are often found in the porter (transport worker) are related with the changes in the structure of the spine. Work load, length and duration of work are factors that affect the spine curve. This study aims to see whether there is a relationship between those factors with the incidence of kyphosis among the workers.

Methods

The study used an observational study with a *cross-sectional* design that included 51 male workers aged 15-65 years in Sumbawa Regency. Sample selection is done *in consecutive random sampling*. Workers who had conditions such as a history of spinal surgery, spinal fractures, spinal tumors, spinal infections and osteoporosis were not included in the study. The curve of thoracic kyphosis is measured by *flexible ruler*. The calculation of the degree uses a standard and predetermined kyphosis index formula. Data on carrying loads, duration of work per day and length of work is obtained from the results of questions and answers with workers. The Fisher test was used as a statistical analysis with a p value <0.05.

Results

In this study, 60.8% of the porter had worked for more than 10 years and most had a carrying load of > 40 kg with the duration of work more than 8 hours per day. Measurements of the curvature of the vertebrae found that 35 people (68.6%) had normal curves followed by 16 people (31.3%) had kyphosis. Statistical test results with *Fisher* test found a significant relationship between carry load (p=0.003), duration of work (p=0.047) and working period (p=0.037) with kyphosis.

Conclusions

There is a significant relationship between the load of transport and the incidence of kyphosis in transport workers. The length of work per day and working period also have a significant influence on the efficacy of kyphosis.

Keywords: Work load; work duration; working period; kyphosis; *Flexicurve method*

ABSTRAK

Latar Belakang

Penyakit akibat kerja yang sering ditemukan pada buruh angkut adalah penyakit yang lebih disebabkan oleh perubahan pada struktur tulang belakang. Beban angkut, durasi dan lama kerja merupakan faktor-faktor yang berpengaruh pada perubahan kelengkungan tulang belakang. Penelitian ini bertujuan untuk melihat ada tidaknya hubungan antara faktor-faktor tersebut dengan kejadian kifosis pada para buruh angkut.

Metode

Penelitian menggunakan studi observasional dengan desain *cross-sectional* yang mengikutsertakan 51 buruh panggul laki-laki berusia 15-65 tahun di Kabupaten Sumbawa. Pemilihan sampel dilakukan secara *consecutive random sampling*. Pekerja yang memiliki kondisi seperti riwayat operasi tulang belakang, fraktur tulang belakang, tumor spinal, infeksi tulang belakang dan osteoporosis tidak diikutsertakan dalam penelitian ini. Kurva kifosis torakal diukur dengan *flexible ruler*. Perhitungan derajat kelengkungan menggunakan rumus indeks kifosis yang baku dan telah ditetapkan. Data tentang beban angkut, durasi kerja per hari serta lama bekerja didapatkan dari hasil tanya jawab dengan para pekerja. Analisis statistik menggunakan uji Fisher dengan nilai kemaknaan $p < 0.05$.

Hasil

Pada penelitian ini didapatkan 60.8% buruh angkut telah bekerja lebih dari 10 tahun dan sebagian besar memanggul beban angkut > 40 kg per harinya dengan jam kerja lebih dari 8 jam per hari. Pengukuran lengkung vertebra mendapatkan 35 orang (68,6%) memiliki kurva normal, 16 orang (31,3%) memiliki kifosis. Hasil uji statistik dengan uji Fisher didapatkan hubungan yang bermakna antara beban angkut ($p=0.003$), durasi kerja ($p=0.047$) serta lama kerja ($p=0.037$) terhadap kifosis.

Kesimpulan

Terdapat hubungan yang signifikan antara beban angkut dengan kejadian kifosis pada buruh angkut. Durasi kerja per hari serta lama kerja juga memiliki hubungan yang signifikan terhadap kifosis.

Kata Kunci: Beban angkut; durasi kerja; lama kerja; kifosis; *Flexicurve method*

INTRODUCTION

The International Labor Organization (ILO) has established the protection of workers from various occupational risks as a major concern. This is done to increase the productivity of small to medium-sized companies by increasing respect for workers' rights so that goals in occupational safety and health can be achieved.¹ Industrial development in Indonesia is currently taking place rapidly, both in the formal business sector industry as well as the informal business sector.² The Central Bureau of Statistics (BPS) on Indonesia's Employment Situation in 2018 says that as many as 73.98 million people (58.22 per cent) work in the informal sector with worker welfare standards usually still lacking due to low wages with workload and excessive working time.³ It is often found that employers do not pay attention to occupational safety and health (K3) principles, causing workers to be more at risk of experiencing work-related health problems.⁴ The 2017 Indonesian Employment Report by the ILO reported that one-third of the total number of workers (35.5%) are transport workers, with the majority being male.⁵ In carrying out their work, hauliers rely heavily on their physical abilities to transport and unload goods and often put them in a bent position. Carrying heavy loads causes workers to experience fatigue easily and also musculoskeletal complaints such as muscle disorders and changes in spinal curvature in the form of kyphosis.⁶

Kyphosis is a condition in which there is a change in the curvature of the vertebrae forward in a manner with an angle of convex curvature of the thoracic spine exceeding 40° .⁷ This condition can be caused by loads that do not follow the recommended maximum weight on the torso each time the vertebrae are transported in a standing or walking position.⁸ The prevalence and incidence of kyphosis are more common in men of childbearing age and are more susceptible to women after the age of 40 years.⁹ Research on the normal range of thoracic kyphosis is $20-40^\circ$ and is considered hyperkyphosis if it exceeds 45° . With increasing age, the curvature of the angle of kyphosis begins to rise above 40° , causing age-related hyperkyphosis.¹⁰ The prevalence of hyperkyphosis in the age group over 60 years ranges from 20% to 40%.¹¹ Research by Malepe Maple and friends in South Africa in student groups found cases of kyphosis by 34%.¹² This shows the factors that influence because of age, but other factors can also affect changes in the vertebral arch. Research conducted by Noviani at Pasar Johar Semarang on female porters in 2015 concluded that there was a relationship between work duration, length of work, workload, bending position, frequency of transport, and bone density on postural kyphosis.¹³ This is also in line with the results of research from Henok and friends in Ethiopia which also concluded the same relationship.¹⁴ Research by Bora and friends, who conducted research on workers in Ambon in 2011, concluded that changes in spinal structure depend on the weight of the load being transported, and it is said that the load below 25 kg is said to have no significant effect on the curvature of the spine.¹⁵ Research conducted by Babatunde Adegoku in Nigeria concluded that there was no significant relationship between carrying heavy loads on the head and spinal deformities in porters.¹⁶

The explanation above attracted researchers' attention to examining the factors influencing the incidence of kyphosis in transport workers. The standard examination generally used to assess the angle of curvature of the vertebrae is an X-Ray examination. However, this radiological examination has limitations such as high costs, longer time and consideration of radiation exposure.¹⁷ Apart from radiological examinations, other methods can be used to measure the angle of kyphosis, namely the Flexicurve method. This method uses a measuring tool in the form of a flexible rule or flexible ruler 40-60 cm long, which can follow the contours of the spine. This measurement method is simple, fast, and inexpensive, with reasonably high validity ($ICC=0.97$).^{18,19} The factors to be assessed in this study are the transport workers' load, duration and working time. These three factors will be associated with the incidence of kyphosis in porters.

METHODS

This research was conducted at the Bulog warehouse in Sumbawa Besar district, NTB and was carried out from April 2021 to June 2021. This research was an observational analytic study with a cross-sectional study design. The sampling technique used in this study was consecutive sampling with inclusion criteria, namely working as hip labourers at the Bulog warehouse in Sumbawa Besar district, male, with an age range of 15-65 years. In addition, workers with a history of diseases such as a history of spinal surgery, spinal fractures and trauma, spinal tumors, and infections of the spine were not included in this study because they were considered to be able to cause changes in the vertebral arch.

The data examined in this study were primary data obtained directly by filling out questionnaires, recording workload and duration, and measuring the vertebral curve directly by the researcher. The data collected through the questionnaire is sociodemographic. The inspectors also

recorded the hours worked per day and the loads carried by the workers per day. The data was taken for seven days and then averaged to calculate the average working hours and daily load. The thoracic kyphosis curve was measured using a 60 cm long flexible ruler. The measurement method employs the subject standing upright by releasing footwear, adjusting one end of the flexible ruler on the cervical spinous process 7, then slowly attaching the ruler according to the contours of the



respondent's back up to lumbar 5. Place the ruler on paper and then draw the curve formed. (Image 1). The measurement results were then matched with the kyphosis index normal assessment table (Figure 2). The data obtained will be statistically performed using Fisher's test with a significance value of $p < 0.005$.

Figure 1. Kyphosis angle measurement with flexicurve¹⁸

<u>Index of Kyphosis*</u> = (TW/TL)x100		
Age	Female	Male
20-24	7.0 ± 2.0	8.5 ± 2.0
25-29	8.5 ± 2.5	8.0 ± 2.5
30-34	7.0 ± 1.0	8.0 ± 2.5
35-39	7.5 ± 2.0	8.2 ± 1.5
40-44	7.0 ± 1.5	8.5 ± 2.5
45-49	7.0 ± 2.0	8.5 ± 2.5
50-54	9.0 ± 3.0	7.5 ± 2.0
55-59	9.5 ± 2.5	8.5 ± 3.0
60-64	11.0 ± 2.0	10.0 ± 3.0
65-69	12.0 ± 2.5	11.0 ± 3.0
70-74	12.5 ± 3.0	11.5 ± 2.5
75-79	13.5 ± 4.0	12.0 ± 4.0
80 +	15.0 ± 6.0	12.0 ± 4.0

Figure 2. Kyphosis Index²⁰

RESULTS

This research involved 51 workers who worked at the Bulog warehouse in Sumbawa Besar. Table 1 shows the age range of the workers in this study was from 15 to 60 years, with the most age being the 36–45 year age group, namely 17 people (33.3%). Of the 51 workers who participated in this study, it was found that around 31 people (60.8) had worked for ≥ 10 years. Most of these workers (76.5%) work for ≥ 8 hours, with most (84.3%) carrying loads of ≥ 40 kg per day. Of the 51 hip workers in this warehouse, 35 (68.6%) had normal curves, and 16 people (31.3%) had thoracic kyphosis.

The following study result shows the significant relationship between workload, length of work and duration of work with the incidence of kyphosis. Table 2 displays the results of the statistical analysis test between the variables. A higher incidence of kyphosis in the group of workers who have worked more than ten years with a working duration of more than 8 hours per day and carrying loads of more than 40 kg. Of the workers who worked for less than ten years, only one person (5%) had kyphosis. The Fisher's Test analysis results on the relationship between carrying a load and the incidence of kyphosis with $p = 0.003$ concluded that there was a significant relationship between the weight of the carrying load and the incidence of kyphosis in hip workers. The same thing can be seen from the duration of working hours where in the group of workers who work less than 8 hours per day, only one person (8.3%) has kyphosis. Fisher's test showed a significant relationship with $p = 0.047$.

Table 1. Distribution of Frequency Characteristics of respondents, Length of Work, duration of work and Carrying Load

Variable	N	%
Age		
17 – 25 (late adolescent)	4	7.8
26 – 35 (early adulthood)	9	17.6
36 – 45 (late adulthood)	17	33.3
46 – 55 (early elderly)	14	27.5
56 – 65 (late elderly)	7	13.7
Gender		
Male	51	100
Female	0	0
Length of working		
< 10 years	20	39.2
≥ 10 years	31	60.8
1 day work duration		
< 8 hours	12	23.5
≥ 8 hours	39	76.5
Carrying load		
< 40 kg	8	15.7
≥ 40 kg	43	84.3
The curvature of the thoracic vertebrae		
Normal	35	68.6
Kyphosis	16	31.3

Table 2. Relationship between carrying load, duration of work and years of service with kyphosis

Variable	The curvature of the thoracic vertebrae		p
	Normal	Kyphosis	
	n = 35	n = 16	
Length of work			
< 10 years	19 (95.0)	1 (5.0)	0.003 [†]
≥ 10 years	16 (51.6)	15 (48.4)	
1 day work duration			
< 8 hours	11 (91.7)	1 (8.3)	0.047 [†]
≥ 8 hours	24 (61.5)	15 (38.5)	
Carrying load			
< 40 kg	8 (100)	0 (0)	0.037 [†]
≥ 40 kg	27 (62.8)	16 (37.2)	

† Fisher test

No kyphosis was found in the group of workers who received a load of less than 40 kg. Different results were found in the group of workers who carried loads of more than 40 kg; it was found that 16 out of 27 workers had kyphosis. Results of analysis with Fisher's test showed a significant relationship with a value of $p < 0.005$.

DISCUSSION

This research was conducted at the Bulog Warehouse, Sumbawa Regency, NTB, where the pelvic laborers who work in this warehouse are responsible for carrying rice to be stored or removed from the warehouse. The youngest hip laborer who works in this warehouse is 19 years old, and the oldest is 68 years old. This study only involved workers with an age range of the research sample from 15 to 65 years. This warehouse's largest age group of hip workers is between 36 and 45. It is included in the late adult age group based on the age distribution category by the Indonesian Ministry of Health (2009).²¹ The second largest group is the 46 to 55-year age group, and only seven were found out of the total Fifty-one workers aged 56 years and over. The age factor contributes to changes in the vertebral arch, especially the kyphotic arch. As a person ages, the curvature of the kyphosis angle can also increase with more incidence in men of reproductive age.^{9,11} Apart from the age factor, other factors such as length of work and heavy loads on the back with a duration of work that are not in accordance with the recommendations are also factors that contribute to the incidence of kyphosis.^{7,13}

This study found that most workers had been in the profession as hip laborers for at least ten years. This condition can provide advantages and disadvantages for these workers. According to Tarwaka, the longer a person's working period, the ability and skills to do work will increase, based on experience carrying out work continuously.²² Thus, it is hoped that groups of workers who have worked for more than ten years have better work skills and reduce work risk. Another factor that must also be considered is the duration of work is directly proportional to the increased risk of interference with the body. This was concluded from the results of research conducted by Dhania and friends, where it was concluded that a person's work activities carried out in the long term, if carried out continuously, will result in disturbances in the body. Physical pressure within a certain time can result in reduced muscle performance, with symptoms of decreased movement.²³

This study found that in the group of workers who had worked for less than ten years, only one person (5%) had kyphosis. A very different condition was found in the group of workers who worked for more than ten years, where the percentage of workers with kyphosis increased to 48.4%. It was found that 15 out of 31 workers had kyphosis. The results of Fisher's test concluded that there was a significant relationship between the length of work and the incidence of kyphosis in hip workers at the Bulog Warehouse, Sumbawa ($p=0.003$). These results align with a study by Henok et al., who examined the incidence of kyphosis in a group of female pelvic laborers who worked for an average of > 10 years. This study found a significant relationship between the length of work and kyphosis.¹⁴ Lifting heavy loads for long periods can be one of the factors that cause disturbances in the body, and physical stress over a certain period can result in reduced muscle strength, as well as compression on the vertebrae. Can accelerate degeneration and flattening of the anterior intervertebral disc.^{9,23} Research by Adegoke et al. showed different results where it was concluded that there was no difference in bone deformity and body posture with the length of work. The difference in the results obtained in this study and that of Adegoke et al. could be due to differences in the research subjects, where the subjects in this study were professional supermarket hip workers with a working period of 2-15 years with a daily load of up to 100 kg.²⁴ Meanwhile, In this study, the average hip laborer has worked for a more extended period (2-32 years), with a total load of up to 125 kg per day. From the discussion above, the researchers

considered that the duration of work that has an impact on the vertebral arch is for more than ten years, continuously receiving loads on the back.

The results of this study also assessed the relationship between the number of hours worked per day and the incidence of kyphosis. The data shows that most workers (76.5%) work for ≥ 8 hours per day. On average, hip laborers work from 7 am to 4 pm. They are given a lunch break of 1 hour. The tasks performed during these working hours are to move and arrange sacks containing rice or sugar from the truck to the warehouse. The number of working hours can vary and depends on the number of goods that must be entered into the warehouse. The duration of work will increase in the months of food procurement, such as April to August. They will work a full day, especially during procurement or mop, in certain months during the main harvest, namely April to August. This research was conducted from April to June, which are months with high duration and work intensity. When compared between groups of workers who work for more than 8 hours per day and those who work less than 8 hours per day, it can be seen that the incidence of kyphosis increases three times in the group of workers who work longer working hours. Of the 39 workers who worked longer hours, 15 (38.5%) had kyphosis. Different things were found in the group of workers who worked less than 8 hours per day. Of the 12 workers in this group, only one person (8.3%) had kyphosis. Based on the results of Fisher's test analysis, it was found that the value of $p = 0.047$, which means that there is a significant relationship between the duration or hours of work in one day and the incidence of kyphosis in hip workers at the Bulog Warehouse, Sumbawa. This result is in line with the theory put forward by Ginting (2011) that working for prolonged periods can lead to fatigue, health problems, illness and work accidents.²⁶ In accordance with the theory above, according to the book by Prawirakusumah on Occupational Health, it is said the heavier the workload of a worker, it must be arranged so that the working time is shorter. This is done so that a worker can work without fatigue or experiencing distraction. Research by Noviani at Pasar Johar Semarang and research by Henok *et al.* in Ethiopia showed results that labor duration was significantly associated with kyphosis in hip labour.^{13,14}

Another variable assessed in this study is the relationship between weight and kyphosis. The weight of the load measured is the average weight transported per day. The hip laborers at the Sumbawa Bulog warehouse usually carry one sack of rice per load. The weight per sack can vary from 25 kg to 50 kg per sack. The researcher will record each load carried by the worker and then calculate the average load per day. Recording results show that almost as much as most hip workers lift weights ≥ 40 kg. This indicates that the importance of the load carried by most workers is not in accordance with the recommended weight of the lifting load set by the ILO (International Labor Organization) in 2013, where the maximum recommended lifting limit for each lift is 25 kg.¹ This study also looks for relationships between payload and kyphosis. A higher kyphosis rate was found in the group of workers who carried loads equal to 40 kg. The Fisher's test results found a significant relationship between the weight of a load of more than 40 kg and the incidence of kyphosis in workers in this warehouse, with a value of $p = 0.037$. Research by Bora and friends who tried to find a carrying load that could impact spinal abnormalities concluded that a carrying load of 25 kg was at risk of experiencing spinal cord injury.¹⁵ This is in line with the basic knowledge of biomechanics which shows that an increase in the kyphosis curve can be associated with high spinal bone loads.⁹ Research conducted by Novianti also states that there is a significant relationship between hip labor with a carrying load of > 20 kg.¹³ Research by Adegoke and friends also tried to

see the relationship between spinal deformity and carrying loads on workers in Nigeria and found that the incidence of spinal structural changes was higher in groups of workers who lifted more weight. This study states that a large carrying load in the head area causes degeneration of the intervertebral discs, which in turn causes changes in the vertebral arch. However, statistical tests did not show a significant relationship, so it cannot be concluded that the carrying load is related to changes in the spine. Furthermore, in this study, it was stated that the relationship between the two variables was meaningless because the average working period of these workers was still around two years; further studies were needed involving workers with a more extended working period.¹⁶

This study had several limitations in evaluating the exclusion criteria in this study which was only carried out using the interview method, and no direct medical examinations were carried out to ascertain whether other spinal conditions could affect vertebral curvature. In addition, this study used the Flexicure measurement method to measure vertebral curvature. Although this method has been assessed as having good validity and reliability, the standard measurement of vertebral curvature is by radiological examination.

CONCLUSION

Based on the data obtained from this study, it was found that most workers had worked for more than ten years with minimum working hours of 8 hours or more and carrying loads of more than 40 kg. Spinal curvature measurements showed that one-third of workers (31.3%) had kyphosis. The statistical analysis test results showed a relationship between the length of work, working hours per day and hauling load with the incidence of kyphosis in hip workers. Referring to the results mentioned above, further research with a cohort research design involving a more significant number of respondents with a more diverse type of work is considered useful for following the development of kyphosis with carrying a load, duration and length of employment.

ACKNOWLEDGEMENT

Thank you to the Sumbawa BULOG Public Corporation for providing the opportunity to conduct research at the Sumbawa BULOG Warehouse and assist researchers in taking research samples.

AUTHORS CONTRIBUTION

TGY: Study concept and design, data collection, analysis and interpretation of results, preparation of manuscripts; NS: Concept and study design, analysis and interpretation of results, preparation of manuscripts, and corresponding author.

FUNDING

This research was carried out with the researcher's personal funds.

CONFLICT OF INTEREST

There is no conflict of interest between the authors.

REFERENCES

1. International Labour Organization (ILO). Keselamatan dan Kesehatan Kerja Sarana Untuk Produktivitas. 2013.
2. Ulfah N, Harwanti S, Nurcahyo PJ. Sikap kerja dan risiko musculoskeletal disorder pada pekerja laundry. Jurnal Kesehatan Masyarakat Nasional 2014;8(7): 313-8 DOI: <http://dx.doi.org/10.21109/kesmas.voio.371>
3. Badan Pusat Statistik (BPS) Keadaan Ketenagakerjaan Indonesia. Available at: https://www.bps.go.id/wp-content/uploads/2018/06/BPS_Berita-Resmi-Statistik_Keadaan-Ketenagakerjaan-Indonesia-Februari-2018.pdf. 2018
4. International Labour Organization (ILO). The Effects of Non-standard Forms of Employment on Worker Health and Safety: Michael Quinlan; International Labour Office, Inclusive Labour Markets, Labour Relations and Working Conditions Branch. Geneva: International Labour Organization. 2015.
5. International Labour Organization (ILO). Memanfaatkan Teknologi untuk Pertumbuhan dan Lapangan Kerja. Laporan Ketenagakerjaan Indonesia. 2017.
6. Tjahjuningtyas A. Faktor Yang Mempengaruhi Keluhan Musculoskeletal Disorders (MSDs) Pada Pekerja Informal. The Indonesian Journal of Occupational Safety and Health 2019;8(1):1-10 <https://doi.org/10.20473/ijosh.v8i1.2019.1-10>
7. Yaman O, Dalbayrak S. Kyphosis and Review of the Literature. Turkey. Neuro Spinal Academy 2014;24(4):455-65. DOI: 10.5137/1019-5149.JTN.8940-13.0
8. Infodatin Pusat Data Dan Informasi Kemenerian Kesehatan RI. Situasi Kesehatan Kerja. Tahun 2014.
9. Lewis JS, Valentine RE. Clinical measurement of the thoracic kyphosis. A study of the intra-rater reliability in subjects with and without shoulder pain. London. BMC Musculoskeletal Disorders 2010;11(39). DOI: [10.1186/1471-2474-11-39](https://doi.org/10.1186/1471-2474-11-39)
10. Qiang F, Mei W, Yanfeng Z, et al. The effect of a corrective functional exercise program on postural thoracic kyphosis in teenagers: a randomized controlled trial. Clin Rehabil 2018;32(1):48-56. doi: 10.1177/0269215517714591
11. Roghani T, Zavieh MK, Manshadi FD, et al. Age-Related Hyperkyphosis: Update Of Its Potential Causes And Clinical Impacts-Narrative Review. Aging Clin Exp Res.2017;29(4):567-77. DOI: [10.1007/s40520-016-0617-3](https://doi.org/10.1007/s40520-016-0617-3)
12. Maple MM, Goon DT, Anyanwu FC, et al. The Relationship Between Postural Deviations And Body Mass Index Among University Students. University of Venda, South Africa. Biomedical Research 2015;26(3):437-42.
13. Novianti H. Hubungan antara beban kerja dengan kejadian postural kifosis (postur membungkuk) pada pekerja buruh gendong wanita di Los Tengahan Pasar Johar Semarang. Jurnal Kesehatan Masyarakat 2015;3(1):375-84. DOI: <https://doi.org/10.14710/jkm.v3i1.11446>
14. Henok A. Prevalence of Musculoskeletal Pain and Factors Associated With Kyphosis Among Pedestrian Back-loading in Selected Towns of Bench Maji Zone. Ethiopia. Ethiopia Journal Health Dev 2017;31(2):103-9
15. Soleman A. Analisa beban kerja ditinjau dari faktor usia dengan pendekatan recommended weight limit (studi kasus mahasiswa unpatti poka). ARIKA 2011;05(2). 83-98
16. Adegoke BOA, Anyakudo RO, Odole AC. Spinal Deformities Among Professional Load Porters In A Nigerian Urban Market. J Environ Occup Health 2014;3(2):109-13. doi: [10.5455/jeos.20140328035014](https://doi.org/10.5455/jeos.20140328035014)
17. Yousefi M, Saeed S, Ilbiegi I, et al. Reliability of Body Landmark Analyzer (BLA) System For Measuring Hyperkyphosis and Hyperlordosis Abnormalities. Journal of Advanced Sport Technology 2020;4(1):20-9

18. Barret E, Keeffe M, Sullivan K, et al. Is thoracic spine posture associated with shoulder pain, range of motion and function? A systematic review. *Man Ther.* 2016;26:38-46. doi: 10.1016/j.math.2016.07.008
19. Tizabi AA, Mahdavinejad R, Azizi A, et al. Correlation between height, weight, BMI with standing thoracic and lumbar curvature in growth ages. *World Journal of Sport Sciences* 2012;7(1):54-6. DOI: 10.5829/idosi.wjss.2012.7.1.64109
20. Lindsey CC. Protocol for Clinical Assessment: Kyphosis and Lordosis. Available at: geriatrictoolkit.missouri.edu/Flexicurve-spinal-measurement.doc. 2003
21. Santika IGPNA. Hubungan Indeks Massa Tubuh (IMT) Dan Umur Terhadap Daya Tahan Umum (Kardiovaskuler) Mahasiswa Putra Semester II Kelas A Fakultas Pendidikan Olahraga dan Kesehatan IKIP PGRI Bali Tahun 2014. *Jurnal Pendidikan Kesehatan Rekreasi* 2015;1:42-7
22. Tarwaka. *Ergonomi Industri: Dasar-Dasar Pengetahuan Ergonomi dan Aplikasi Ditempat Kerja*. 2nd ed. Surakarta:Harapan Press;2014.
23. Dhania DR. Pengaruh Stress Kerja, Beban Kerja Terhadap Kepuasan Kerja (Studi Pada Medical Representatif Di Kota Kudus). *Jurnal Psikologi Universitas Muria Kudus* 2010;1(1):15-23
24. Ginting S. Pengaruh Beban Kerja Dan Asupan Kalori Terhadap Status Gizi Pekerja Peternakan Ayam Broiler Di Desa Silebo-Lebo Kecamatan Kutalimbaru Kabupaten Deli Serdang Tahun 2011. Tesis, Jurusan Kesehatan Masyarakat, Universitas Sumatera Utara.
25. Prawirakusumah S, Soedirman. *Kesehatan Kerja Dalam Perspektif Hiperkes & Keselamatan Kerja*. Jakarta:Erlangga;2014.



This work is licensed under a Creative Commons Attribution Non-Commercial 4.0 International License
