International Journal of Occupational Safety and Health

ISSN: 2091-0878 (Online) ISSN: 2738-9707 (Print)

Original Article

The effect of noise reduction on work-related stress: A quasi-experimental study on weaving workers exposed to high levels of noise

Setyawan H[1]

[1]Department of Occupational Health and Safety, Vocational School, Universitas Sebelas Maret, Surakarta, Indonesia

Corresponding author:
Haris Setyawan,
Assistant Professor,
Department of Occupational Health and Safety, Vocational School, Universitas Sebelas Maret, Surakarta, Indonesia
Tel.: +62 0271 662622
E-mail: haris.setyawank3@staff.uns.ac.id
ORCID ID: https://orcid.org/0000-0002-1765-126X

Date of submission: 05.06.2003
Date of acceptance: 03.06.2024
Date of publication: 01.07.2024

Conflicts of interest: None
Supporting agencies: None
DOI:https://doi.org/10.3126/ijosh.v14i3.54624

ABSTRACT

Introduction: The textile industry is one industry in the world with a high risk of noise exposure in its production process. The operation of weaving machines generates high levels of noise, which can cause various adverse effects on workers' health, one of the major non-auditory effects is work-related stress. Since 1975, one of the largest textile companies in Solo, Central Java Indonesia, has been struggling with high noise levels, particularly in the weaving production room.

Methods: This study aims to determine the effect of reducing noise exposure on work-related stress by installing sound-absorbing materials made from coconut fiber. The study was carried out in 2 phases. The first phase measured noise intensity and work-related stress before the intervention. The second phase was carried out for 12 measurements daily after installing sound-absorbing material made from coconut fiber.

Results: Installing sound-absorbing material made from the coconut fiber on the second to the thirteenth day positively reduced the average noise intensity and work-related stress score compared to the first day before the intervention.

Conclusion: The study showed a significant difference in the average noise intensity and work-related stress before and after installing the sound-absorbing materials on 13 days of measurement.

Keywords: Occupational Noise, Stress, Textiles, Workplace

Introduction

Industrial development with increasingly advanced materials and equipment will increase risks to worker safety. Identifying and controlling relevant hazard factors is necessary to prevent accidents and occupational diseases.[1] The textile industry is one industry in the world with a high risk of noise exposure in its production process.[2] One of the classic problems in the textile industry is the noise hazard from weaving machine operations. The operation of these machines generates noise intensity that exceeds the threshold value and causes various adverse effects on workers' health, both auditory and non-auditory effects.[3]

Exposure to high levels of noise can interfere with non-auditory functions, including work-related stress. Noise intensity can be considered a stressor, which causes disturbances in the sympathetic and parasympathetic systems, giving rise to psychological, physiological, and behavioral symptoms.[4,5] To describe the physiological symptoms of stress, especially in disorders of the balance of human autonomic nervous activity, an indicator is used in the form of the Heart Rate Variability indicator, which has been found in modern stress detection devices.[6,7]

The National Institute for Occupational Safety and Health (NIOSH) recommends a limit of 85 dB of

noise exposure for eight hours per day in the workplace.[8] According to the Indonesian Minister of Manpower Regulation No. 5 of 2018, the maximum noise level for an 8-hour workday and 40-hour workweek is 85 dB.[9,10] However, many textile industries experience difficulty in controlling noise below the recommended limits.[11,12] The negative effect of noise has spawned several studies on noise control in the workplace. One of the studies to control workplace noise is installing sound-absorbing materials from natural and synthetic fiber materials.[13] Coconut fiber is one of the best natural sound-absorbing materials compared to commercially available synthetic fiber.[14] The availability of coconut fiber in tropical countries is abundant, and some places are considered waste. This waste is naturally available and inexpensive, can be used as an environmentally friendly sound-absorbing material, and supports international programs in environmental preservation.[15,16]

The prevalence of work-related stress among textile workers varies in developing countries, from 25% in India, 27.5% in Thailand, 21.3% in Iran, and 28% in Congo.[17] The prevalence of stress among textile weaving workers in Indonesia varies in each city, starting from 56.6-69.6%.[18,19] IT Co. Ltd., for the sake of confidentiality these initials are given, one of the largest textile companies in Solo, Central Java, since 1975, has not been able to overcome the problem of the high noise intensity, especially in the weaving room.[20] Previous studies were limited to analyzing the relationship between noise and its impact on health without taking remedial steps so that noise can be reduced to a level close to safe limits based Indonesian standard of 85 dB. This research aims to determine the effect of reducing noise exposure on work-related stress resulting from installing sound-absorbing materials from coconut fiber.

This study is expected to be a breakthrough and a different way of overcoming the classic problem of noise that exceeds the standards required in the textile industry, which previously only focused on using personal protective equipment as a practical solution. Still, it can disturb comfort during work.[21,22] This research is an answer to the assumption from the company regarding the installation of sound-absorbing material which requires a very high cost.[23] This study proposes innovative and cost-effective methods to address the issue of high noise intensity in weaving factories. The solution involves utilizing natural available inexpensive fiber as sound-absorbing materials, which can considerably reduce work-related stress on weaving workers. This noise problem has been unresolved in the company since 1975 until this study was conducted.

Methods

The quasi-experimental study with a time series design was conducted among all the female weaving workers at IT Co., Ltd. Ethical approvals were obtained from The Research Ethics Committee. All the participants signed the informed consent form before participating in this study. To calculate the minimum sample size, we use the minimum sample formula which is as follows:[24]

$$n_1 = n_2 = Y \left\{ 2 \left(\frac{[Z_\alpha + Z_\beta]\, s}{x_1 - x_2} \right)^2 \right\}$$

$$Y = \left[\frac{1 + (H-1)\, p}{H} - \frac{Gp^2}{1 + (G-1)\, p} \right]$$

n_1 = Sample size for weaving worker participants in the noise intensity measurement

n_2 = Sample size for weaving worker participants in work-related stress measurement

α = Type 1 error, the value is the researcher's judgment or determination (α=5%)

Z_α = Standard value of α obtained from the z value of the normal curve ($Z\alpha$=1.64)

B = Type 2 error, the value is the researcher's judgment or determination (β=20%)

Z_β = Standard value of β obtained from the z value of the normal curve (Zβ=0.84)

S = Combined standard deviation between groups at the point of interest whose value comes from literature or previous research (s= 5.22+3.58 = 8.8)

$x_1 - x_2$ = Minimum mean difference in points of interest that are considered meaningful between group one and group two, the value of which is the researcher's judgment or determination based on logical and ethical provisions (12.58 – 9.58 = 3)

Y = Correction factor due to repeated measurements

G = Number of measurements before randomization, the number of which is determined by the researcher (set 1 time, G=1)

H = Number of measurements after randomization, the number of which is determined by the researcher (set 3 times, H=3)

P = Intra-class correlation which is the

correlation between measurements whose value is determined by the researcher

According to the calculation formula provided, the sample size for the study was determined to be 47 female workers in the weaving section of IT Co. Ltd., Surakarta, Indonesia, who meet the inclusion and exclusion criteria. These criteria include being willing to be a respondent for 13 days of data collection, being a permanent worker in the weaving section, operating a weaving machine 8 hours/day, not experiencing illness during data collection, having a working period of more than two years, and having a salary above the regional minimum wage.

Previous studies on stress interventions have only used one pre-test and one post-test, which is insufficient to describe the day-to-day trend of decreasing stress caused by interventions to reduce noise. This research provides an overview of decreasing work-related stress which could also be attributed to the trend of lowering noise intensity. This research measured exposure to noise intensity and work-related stress during 13 days of data collection in August 2021. This study was carried out in 2 phases. The first phase measured noise intensity and work-related stress before the intervention on day 1 (pre). The second phase involved 12 days of measuring noise intensity after installing coconut fiber sound-absorbing material in the weaving room, starting from day 2 (post) until day 13 (post).

Data was collected for measurements for one day prior to the instillation of sound absorbing material to 12 days post instillation while employees were operating the weaving machine. Each participant operates two weaving machines, with 4 points measuring noise intensity in their work area. The first point is in front of the first machine, the second is in front of the second machine, the third is behind the first machine, and the fourth is behind the second machine. Each measurement point is taken, recording noise intensity for 60 seconds, then calculating Leq of environmental noise intensity for each worker according to SNI 7231-2009 with a reference time of 8 hours working and 1 hour resting. Similar recording were noted on all the days of measurement.

Sound-absorbing material was made from coconut fiber; the fiber is extracted using a machine that decomposes coconut coir and then compressed for an hour. The dimensions are 30 cm long, 30 cm wide, and 3 cm thick. The surface is flat and fibrous to maximize the surface area for sound absorption. This sound-absorbing substance has a latex blend to boost its heat, water, and humidity resilience.

Noise intensity measurement using sound level meter EXTECH 407750 with units of measurement decibels (dB). The measure of work-related stress using Mi Band 5 Fitness Tracker with stress scores ranging from 1 to 100. Stress can be categorized into four criteria based on the total score, including mild (1-25), moderate (26-50), severe (51-75), and very severe (76-100). Pre- and post-series data were analyzed using the Friedman test with SPSS 23.

Results

The study was conducted in IT Co. Ltd., especially in the weaving section. Total of 13 measurements were taken, one pre intervention and 12 post intervention during the morning shift. Table 1 shows the noise intensity measurement pre- and post-intervention.

Table 1: Friedman's test of noise intensity before and after installation of sound-absorbing material in the weaving section

Measurement Day	Noise Intensity (dB)					
	Mean	SD	Min	Max	Sig.(p)	N
1(pre)	103.58	2.20	100.60	108.60	<0.001	47
2(post)	92.46	1.52	90.10	95.80		
3(post)	92.47	1.53	89.50	96.00		
4(post)	92.41	1.59	89.60	95.90		
5(post)	93.70	1.79	89.90	97.40		
6(post)	93.37	1.79	90.00	97.70		
7(post)	93.58	1.57	90.20	96.20		
8(post)	93.18	1.97	87.80	96.10		
9(post)	92.36	1.24	90.00	95.40		
10(post)	92.29	1.30	89.50	95.60		
11(post)	92.38	1.28	90.00	95.30		

12(post)	92.48	1.45	89.90	95.90
13(post)	92.43	1.63	89.80	96.20

Table 2: Friedman's test of work-related stress before and after installation of sound-absorbing material in the weaving section

Measurement Day	Work-related stress					
	Mean	SD	Min	Max	Sig.(p)	N
1(pre)	72.83	17.00	41	99	0.022	47
2(post)	65.81	14.60	28	98		
3(post)	65.28	11.97	30	84		
4(post)	64.62	11.04	40	89		
5(post)	67.06	12.81	40	88		
6(post)	67.21	12.25	39	89		
7(post)	65.21	13.42	40	89		
8(post)	63.49	12.96	39	86		
9(post)	68.72	12.67	37	90		
10(post)	64.57	11.44	47	93		
11(post)	65.45	14.36	39	89		
12(post)	65.85	11.04	48	92		
13(post)	65.79	13.39	44	95		

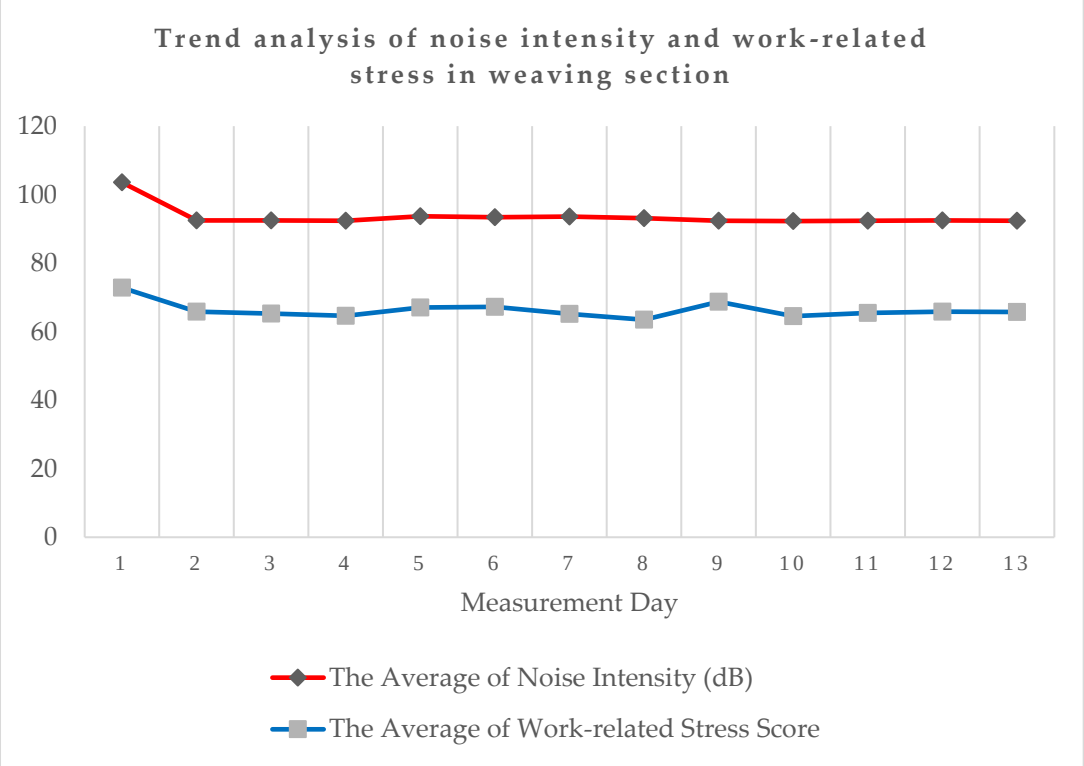

Figure 1: The Trend Analysis of Noise Intensity and Work-related Stress in Weaving Section IT Co. Ltd

Based on Table 2, on day one before the installation of sound-absorbing material, the average work-related stress score on day one pre-intervention, the work-related stress score reached 72.83; after the intervention, there was a significant decrease in work-related stress scores (p=0.022). The lowest average work-related stress was on day 8 (post), with the lowest average reduction of 9.34. Figure 1 shows the trend analysis of noise intensity and work-related stress for 13 days of measurement.

Based on Figure 1, the intervention of installing sound-absorbing material on the second to thirteenth day had a positive trend in reducing the average noise intensity and work-related stress score compared to the first day before the

intervention.

Discussion

Noise is an unwelcome sound that bothers workers in the workplace.[25] It can come from machinery, manufacturing processes, assembly lines, and building sites. At some levels, noise can harm people's physical and psychological well-being.[26] Due to the spinning and weaving processes, the textile sector can produce a high level of noise.[27] One of Surakarta's leading textile companies, IT Co. Ltd, has noise issues that affect the health of its employees.[28] The weaving room has a lot of noise, particularly with the weaving machine in operation.[29] As a result of sound waves reflecting off the floor and walls and creating echoes, which can magnify the original sound, the noise level in the space can increase.[30] Forming a constructive interference noise pattern by reflecting sound waves with a similar medium and frequency will raise the sound intensity level.[31] In an effort to minimize noise, sound-absorbing materials can be applied to the walls. It can absorb sound energy and turn it into heat, and the effect of sound reflecting through the wall can be lessened.[32]

The installation of sound-absorbing material from coconut fiber can reduce noise intensity, but it cannot lower noise levels to an acceptable level of 85 dB. The lowest average reduction of 11.29 dB was recorded on day 10 (post), with the lowest average noise level. Numerous studies have shown natural fiber as a valuable material for sound absorption.[33] As a result of the benefit of preserving ecologically friendly conditions and the risk of these materials being lower than synthetic fibers already marketed on the market, using natural fibers as an industrial sound absorption material is now a new research trend.[15,34] One of the natural fibers that have demonstrated its capacity to absorb sound at high frequencies in numerous experiments is coconut fiber.[15] Coconut fiber has a high lignin concentration (40.5–45.8%),[14] making it more robust, elastic, and denser than other natural fibers. As a result, it has a sound absorption coefficient that can reach 0.7 at high frequencies.[35]

The Friedman's test showed a significant decrease in noise intensity ($p<0.001$) and work-related stress scores ($p=0.022$) from day 1 to day 13. The installation of sound-absorbing material as part of engineering control, in the form of adjustments to environmental conditions, especially to reduce environmental stressors. In a previous study, noise can cause stress after continuous exposure for 3 hours. This exposure felt by workers will interfere with communication, psychological pressure, and assessment of external stimuli. If the adjustment or adaptation of workers is not going well, it will trigger stress.[36] These studies align with research in Turkey that reducing noise can reduce psychological disorders and stress for workers and visitors.[37]

Prolonged stressful conditions without corrective or countermeasures will increase the risk of various physiological and psychological disorders.[38] Pressure and stressors that individuals receive will be processed at the psychological level first; then, they will be processed physiologically. These physiological changes will disrupt homeostatic processes due to the cortisol hormone, causing the body to prepare or run to face threats.[39,40]

The secretion of cortisol hormones can cause an increase in blood pressure and decrease the body's immune. In addition, this condition also triggers the adrenocortical system to be activated, causing Corticotropin Releasing Factor (CRF) to be secreted into the pituitary gland, thus triggering the secretion of serotonin and melatonin. Serotonin secretion can affect changes in the feelings, behavior levels, and depression levels of an individual, while melatonin secretion can also cause sleep disturbances, awareness, and mood in individuals.[41]

Preventing accidents and work-related diseases in the workplace is very important and must be a priority for leaders and workers. Company management must provide efforts to prevent this from happening to its employees.[42–44]

Conclusions

Installing sound-absorbing material made from coconut fiber on the second to thirteenth day positively reduced the average noise intensity and work-related stress score compared to the first day before the intervention. The study also showed a significant difference in the average noise intensity and work-related stress before and after installing the sound-absorbing materials. Sound-absorbing materials from coconut fiber can be used as an alternative in overcoming noise problems and their effects on health at a lower cost and easier to install. This study has certain limitations, as it's only possible to install sound-absorbing materials on wall surfaces. The installation on floor and roof surfaces is not feasible as it may interfere with weaving operations. However, it's recommended to consider installing sound absorbers as engine covers in future studies, which could be an

additional control to reduce noise exposure to a safe limit of 85 dB.

Acknowledgments

The authors would like to acknowledge the funding for this study provided by the Chairperson of Research Institutions and Community Service at Universitas Sebelas Maret through the Penelitian Fundamental (PF-UNS) number 194.2/UN27.22/PT.01.03/2024.

References

1. Setyawan H, Nugraheni AM, Haryati S, Qadrijati I, Fajariani R, Wardani TL, et al. The correlation of fire knowledge toward disasters response and preparedness practice among hospital nurse Klaten Central Java, Indonesia. IOP Conf Ser Earth Environ Sci. 2021;724:1–6. Available from: https://doi.org/10.1088/1755-1315/724/1/012041
2. Chahyadhi B, Widjanarti MP, Ada' YR, Suratna FSN, Wijayanti R. Noise Intensity, Blood Pressure, and Pulse Rate in Textile Industry Workers. Placentum: Jurnal Ilmiah Kesehatan dan Aplikasinya. 2022;10(1):73–80. Available from: https://doi.org/10.20961/placentum.v10i1.53146
3. Basner M, Babisch W, Davis A, Brink M, Clark C, Janssen S, et al. Auditory and non-auditory effects of noise on health. The Lancet. 2014;383(9925):1325–32. Available from: https://doi.org/10.1016/S0140-6736(13)61613-X
4. Park SH, Lee PJ, Jeong JH. Effects of noise sensitivity on psychophysiological responses to building noise. Build Environ. 2018 May 15;136:302–11. Available from: https://doi.org/10.1016/j.buildenv.2018.03.061
5. Sumardiyono, Probandari A, Hartono, Wijayanti R. A Path Analysis: Study of Correlation between Noise Intensity and Quality of Life of Workers in Textile Industry. J Phys Conf Ser. 2019;1424(1):1-8. Available from: https://doi.org/10.1088/1742-6596/1424/1/012045
6. ChuDuc H, NguyenPhan K, NguyenViet D. A Review of Heart Rate Variability and its Applications. APCBEE Procedia. 2013;7:80–5. Available from: http://dx.doi.org/10.1016/j.apcbee.2013.08.016
7. Landsbergis PA, Dobson M, LaMontagne AD, Choi BK, Schnall P, Baker DB. Occupational stress. Occupational and Environmental Health. Oxford: Oxford Scholarship Online. 2017:325–344. Available from: https://doi.org/10.1093/oso/9780190662677.003.0017
8. Fink D. The recommended exposure limit for occupational noise needs to be revised downwards. Proceedings of Meetings on Acoustics. 2023;50(1):1–12. Available from: https://doi.org/10.1121/2.0001729
9. Sasmita A, Osmeiri B. Noise Mapping and Analysis of Maximum Exposure Time in Rubber Processing Industries. Journal of Industrial Hygiene and Occupational Health. 2021;6(1):35–48. Available from: https://doi.org/10.21111/jihoh.v6i1.6120
10. Giantara W, Tugiyono T, Setiawan A, Susanto GN. The Air Quality and Noise Study in Settlements and Metal Scrap Melting Factory. Jurnal Ilmiah Biologi Eksperimen dan Keanekaragaman Hayati. 2021;8(2):1–7. Available from: https://doi.org/10.23960/jbekh.v8i1.159
11. Parvin F, Islam S, Urmy Z, Ahmed S, Islam AS. A Study on the Solutions of Environment Pollutions and Worker's Health Problems Caused by Textile Manufacturing Operations. Biomed J Sci Tech Res. 2020;28(4):21831–44. Available from: https://doi.org/10.26717/bjstr.2020.28.004692
12. Setyawan H, Denny HM, Nurjazuli N, Dewi EK. Personal and Environmental Risk Factors of Work-Related Stress: A Cross-Sectional Study among Female Workers of a Textile Industry in Indonesia. Open Public Health J. 2022;15(1):10–5. Available from: https://doi.org/10.2174/18749445-v15-e2210190
13. Arenas JP, del Rey R, Alba J, Oltra R. Sound-absorption properties of materials made of esparto grass fibers. Sustainability. 2020;12(14):1–10. Available from: https://doi.org/10.3390/su12145533
14. Eriningsih R, Widodo M, Marlina R. Pembuatan dan Karakterisasi Peredam Suara dari Bahan Baku Serat Alam. Arena Tekstil. 2014;29(1):1–8. Available from: http://download.garuda.kemdikbud.go.id/article.php?article=416051&val=8401&title=PEMBUATAN%20DAN%20KARAKTERISASI%20PEREDAM%20SUARA%20DARI%20BAHAN%20BAKU%20SERAT%20ALAM
15. Pawestri AKR, Hasanah W, Murphy A. Studi Karakteristik Komposit Sabut Kelapa dan Serat Daun Nanas sebagai Peredam Bunyi. Jurnal Teknologi Bahan Alam. 2018;2(2):112–7. Available from: http://download.garuda.kemdikbud.go.id/article.php?article=775615&val=12666&title=STUDI%20KARAKTERISTIK%20KOMPOSIT%20SABUT%20KELAPA%20DAN%20SERAT%20DAUN%20NANAS%20SEBAGAI%20PEREDAM%20BUNYI
16. Zulkifli R, Zulkarnain, Nor MJM. Noise control using coconut coir fiber sound absorber with porous layer backing and perforated panel. Am J Appl Sci. 2010;7(2):260–4. Available from: https://doi.org/10.3844/ajassp.2010.260.264
17. Belete H, Ergetie T, Ali T, Biharnu S, Belete T. Work-Related Stress and Associated Factors

Among Textile Factory Employees in Northwest Ethiopia: A Cross-Sectional Study. Psychol Res Behav Manag. 2020;13:1071–8. Available from: https://doi.org/10.2147/PRBM.S282061

18. Andarini YD, Prasetya TAE. The Correlation Of Occupational Stress With Subjective Fatigue Women Workers In Weaving Loom Unit PT. X. Journal of Vocational Health Studies. 2017;1(1):18–22. Available from: https://doi.org/10.20473/jvhs.V1.I1.2017.18-22

19. Suryani AI, Muliawan P. Hubungan Beban Kerja Dengan Stres Kerja Pada Karyawan Garmen Di Kota Denpasar. Jurnal Penelitian dan Kajian Ilmiah Kesehatan. 2020;6(2):143–8. Available from: https://jurnal.poltekmfh.ac.id/index.php/JPKIK/article/view/137

20. Sumardiyono S. The Difference Blood Cortisol Level Betwen Male and Female on Workers Exposed by Continuous Noise. Journal of Vocational Health Studies. 2020;3(3):120–5. Available from: https://doi.org/10.20473/jvhs.V3.I3.2020.120-125

21. Tarwaka. Ergonomi Industri: Dasar Dasar Pengetahuan Ergonomi dan Aplikasi di Tempat kerja. 2nd Edition. Surakarta: Harapan Press, 2015. Available from: https://pustaka.sttcipasung.ac.id/index.php?p=show_detail&id=1869

22. Setyaningrum I, Suroto S, Widjasena B. Analisa Pengendalian Kebisingan Pada Penggerindaan Di Area Fabrikasi Perusahaan Pertambangan. Jurnal Kesehatan Masyarakat. 2014;2(4):267–75. Available from: https://ejournal3.undip.ac.id/index.php/jkm/article/view/6411

23. Amalia R, Jayanti S, Kurniawan B. Analisis Pengendalian Kebisingan Di Area Body Minibus Perusahaan Karoseri Tahun 2015. Jurnal Kesehatan Masyarakat. 2015;3(3):616–26. Available from: https://ejournal3.undip.ac.id/index.php/jkm/article/viewFile/12560/12190

24. Dahlan MS. Besar Sample dalam Penelitian Kedokteran dan Kesehatan. 3rd Edition. Jakarta: Epidemiologi Indonesia; 2010. Available from: http://103.44.149.34/elib/assets/buku/Besar_sampel_dan_cara_pengambilan_sampel.pdf

25. Fink D. A new definition of noise: Noise is unwanted and/or harmful sound. Noise is the new "secondhand smoke." Proceedings of Meetings on Acoustics. 2019;39(1):1-12. Available from: https://doi.org/10.1121/2.0001186

26. Kee HY, Fauzan NS, Widia M. Psychological impact of noise exposure among machine and non-machine operators in construction industry. IOP Conf Ser Mater Sci Eng. 2019;702(1):1–7. Available from: https://doi.org/10.1088/1757-899X/702/1/012055

27. Abbasi M, Yazdanirad S, Mehri A, Fallah Madvari R, Alizadeh A, Ghaljahi M, et al. Noise Exposure and Job Stress – a Structural Equation Model in Textile Industries. Archives of Acoustics. 2020;45(4):601–11. Available from: https://journals.pan.pl/dlibra/publication/135248/edition/118237/content

28. Setyawan H, Qodrijati I, Widjanarti MP, Rinawati S, Atmojo TB, Fajariani R, et al. The impact of hot work climate on textile industry productivity. IOP Conf Ser Earth Environ Sci. 2018;200:1-5. Available from: https://doi.org/10.1088/1755-1315/200/1/012053

29. Sumardiyono S, Wijayanti R, Hartono H, Sri Budiastuti MT. Pengaruh Kebisingan terhadap Tekanan Darah, dengan Stres Kerja sebagai Variabel Mediator. Jurnal Kesehatan Vokasional. 2020;5(2):124-31. Available from: https://www.researchgate.net/publication/341768363_Pengaruh_Kebisingan_terhadap_Tekanan_Darah_dengan_Stres_Kerja_sebagai_Variabel_Mediator

30. Nuradiati N, Wiyancoko D. Shelter Peredam Suara Untuk Penggunaan pada Area Taman Kota. Jurnal Tingkat Sarjana Senirupa dan Desain. 2014;3(1):1–5. Available from: https://www.neliti.com/publications/180273/shelter-peredam-suara-untuk-penggunaan-pada-area-taman-kota

31. Tambunan STB, Dhewiberta H. Kebisingan di Tempat Kerja. Yogyakarta: Penerbit Andi, 2005. Available from: https://lib.fkm.ui.ac.id/detail?id=73111&lokasi=lokal

32. Cobo P, Simon F. Multiple-Layer Microperforated Panels as Sound Absorbers in Buildings : A Review. Buildings. 2019;9(2):53. Available from: https://www.mdpi.com/2075-5309/9/2/53/htm

33. Sakthivel S, Kumar SS, Solomon E, Getahun G, Admassu Y, Bogale M, et al. Sound absorbing and insulating properties of natural fiber hybrid composites using sugarcane bagasse and bamboo charcoal. J Eng Fiber Fabr. 2021;16:1–10. Available from: https://doi.org/10.1177/15589250211044818

34. Yang T, Hu L, Xiong X, Petrů M, Noman MT, Mishra R, et al. Sound absorption properties of natural fibers: A review. Sustainability. 2020;12(20):8477. Available from: https://doi.org/10.3390/su12208477

35. Asdrubali F, Schiavoni S, Horoshenkov K V. A review of sustainable materials for acoustic applications. Building Acoustics. 2012;19(4):283–312. Available from: https://doi.org/10.1260/1351-010X.19.4.283

36. Tao Y, Chai Y, Kou L, Kwan MP. Understanding noise exposure, noise annoyance, and psychological stress: Incorporating individual mobility and the temporality of the exposure-effect relationship. Applied Geography. 2020;125:1–14. Available from:

https://doi.org/10.1016/j.apgeog.2020.102283

37. Kol E, Demircan A, Erdog A, Gencer Z, Eregin H. The Effectiveness of Measures Aimed at Noise Reduction in an Intensive Care Unit. Workplace Health Saf. 2015;63(12):539–45. Available from: https://doi.org/10.1177/2165079915607494
38. Dhakate MA, Domple VK, Joge US, Khakse GM, Hiwarkar PA. Assessment of job stress among non-teaching staff: A cross-sectional study at a teaching hospital, Central India. International Journal of Occupational Safety and Health. 2022;12(1):29–34. Available from: https://doi.org/10.3126/ijosh.v12i1.41036
39. Seaward BL. Managing stress: Principles and strategies for health and wellbeing. 5th edition. Colorado: Jones and Bartlett Publishers. 2006. Available from: https://samples.jblearning.com/0763740411/TOC_and_Preface_Seaward_Managing_Stress_5e.pdf
40. Bano S, Ambardar NR, Joshi AR. COVID-19 pandemic and perceived stress in Information Technology professionals. International Journal of Occupational Safety and Health. 2024;14(2):166–73. Available from: https://doi.org/10.3126/ijosh.v14i2.47140
41. Nathania A, Krisna Dinata IM, Adiartha Griadhi IP. Hubungan stres terhadap kelelahan pada mahasiswa Fakultas Kedokteran Universitas Udayana. Intisari Sains Medis. 2019;10(1):134–8. Available from: https://doi.org/10.15562/ism.v10i1.400
42. Setyawan H. The determinant of fire disaster mitigation (fire practices study in gas station operator Surakarta, Indonesia). IOP Conference Series: Earth and Environmental Science. Yogyakarta: IOP Publishing; 2020;423(012005):1-5. Available from: https://doi.org/10.1088/1755-1315/423/1/012005
43. Prasetio DB, Setyaningsih Y, Suhartono, Suroto. Identification of Subjective Fatigue Accompanied by Hypertension in Female Workers Making Tiles in Indonesia: A Cross-Sectional Survey. International Journal of Occupational Safety and Health. 2023;13(4):484–93. Available from: https://doi.org/10.3126/ijosh.v13i4.48940
44. Zhang S, Shi X, Wu C. Measuring the effects of external factor on leadership safety behavior: Case study of mine enterprises in China. Saf Sci. 2017;93:241–55. Available from: http://dx.doi.org/10.1016/j.ssci.2016.12.017