International Journal of Applied Science and Engineering Review

IJASER

ISSN: 2582-6271

Vol. 3, Issue.6, Nov-Dec 2022, page no. 131-141

To cite this article: Pertiwi Andarani, Wiwik Budiawan and Yella Apriliana Sa'diyah (2022). NOISE-INDUCED WORK STRESS DURING A TRAIN OPERATION, International Journal of Applied Science and Engineering Review (IJASER) 3 (6): 131-141

NOISE-INDUCED WORK STRESS DURING A TRAIN OPERATION

Pertiwi Andarani[1]*, Wiwik Budiawan[2], Yella Apriliana Sa'diyah[1]

[1]Department of Environmental Engineering, Faculty of Engineering, Diponegoro University, Jl Prof Sudarto, Tembalang, Semarang 50275, Indonesia

[2]Department of Industrial Engineering, Faculty of Engineering, Diponegoro University, Jl Prof Sudarto, Tembalang, Semarang 50275, Indonesia

DOI: http://dx.doi.org/10.52267/IJASER.2022.3607

ABSTRACT

Train is a transportation that produces a high level of noise. Cabin crew as a person who work on the train will always be exposed to noise and have a greater chance to get work stress due to noise that will affect his work so that it can endanger passengers and the occurrence of train accidents. This study's objective is to determine the impact of noise level toward work stress of cabin crew KA Kaligung Loco CC 201 DAOP IV Semarang. Noise level was measured using Noise Dosimeter and work stress was measured using DASS 21. The relationship between variables was analyzed using SPSS program with chi square method. Respondents were taken 30 cabin crew of KA Kaligung Loco CC 201 and as a comparison were taken 30 workers of Station Pocol as control variables. The result shown that there is a correlation between the increase in work stress level with noise (sig ,000). Based on noise sampling with case control methode for 3 days at KA Kaligung Loco CC 201 produces a noise value above the threshold 87 dBA during 4 hours 47 minutes that is 88 dBA, 93 dBA and 90 dBA. Station's noise level as control is 74,78 dBA and this is result in under the threshold 85 dBA during 8 hours. While the average increase on cabin crew's work stress reached 3,6 point. Whereas, Station Poncol's workers have decrease work stress level until 3,3 point, From 30 cabin crew there were 26 respondents experienced an increase in work stress level, 3 respondents experienced a decrease in work stress level and 1 respondent had a constant stress level.

KEYWORDS: noise, work stress, train, cabin personnel

International Journal of Applied Science and Engineering Review

IJASER

ISSN: 2582-6271

Vol. 3, Issue.6, Nov-Dec 2022, page no. 131-141

1. INTRODUCTION

As a means of mass transportation on land, trains are a means of transportation that are in great demand by the public because they can travel near and far distances in a fairly fast and comfortable time to ride. However, noise generated by the train has a negative impact on PT KAI's workforce. One of the many negative impacts caused by noise is work stress. Work stress is all stimuli or actions from the human body both from outside and from within the body itself. Stress can cause a variety of adverse effects ranging from declining health to suffering from a disease [1].

With these considerations, the noise generated by the train is very necessary to be managed so as not to cause a negative impact on the workforce, especially train cabin personnel who are always exposed to noise and have a greater chance of experiencing work stress due to noise which will affect their work performance so that it can be dangerous. passengers and train accidents.

In this study, the selected location is the driver's cabin with the object of the train cabin personnel. The study was conducted to determine the level of train noise and the effect of noise levels on work stress on cabin personnel of the Kaligung Locomotive CC 201 round trip route Semarang-Tegal at DAOP IV Semarang Poncol. Noise level was measured using Noise Dosimeter and work stress level was measured using DASS 21 questionnaire.

2. METHODS

The research was conducted using an observational analytic method with a case control approach. The case control approach is an approach to help determine whether exposure is related to research results. Noise sampling was carried out during the Semarang-Tegal and Tegal-Semarang route of Kaligung KA Locomotive CC 201 which was taken by cabin personnel on the train for 3 consecutive days, namely from July 07, 2017 – July 09, 2017. While sampling the level of work stress was carried out at Semarang Poncol Station on Jalan Imam Bonjol before and after cabin personnel departed the train from July 10, 2017 – July 24, 2017. Sampling of noise and work stress on Poncol Station workers was carried out on August 2, 2017.

The number of samples taken were 30 respondents from cabin personnel and 30 respondents from station workers. With the criteria of a minimum age of 18 years, working period of more than 1 year, and no history of high blood pressure, diarrhea, asthma, headaches, back and neck pain.

2.1 Respondents characteristics

The average age of respondents who work as cabin personnel is 31 years old and at most 26 years old, which is 6 people. Have a maximum age of 46 years and a minimum of 23 years. The average tenure of

ISSN: 2582-6271

Vol. 3, Issue.6, Nov-Dec 2022, page no. 131-141

respondents who work as cabin personnel is 7.5 years and the most have worked for 6 years, which is 7 people with the longest working period of 23 years and the fastest 4 years.

Meanwhile, the average respondent who works at the station is 30 years old with a minimum age of 18 years and a maximum of 52 years. The average working period of respondents who work at the station is 6 years and the most have worked for 2 years with the longest working period of 21 years and the fastest 1 year.

2.2 Noise measurement

The tools and materials needed in the research "Analysis of the Relationship Between Noise Levels and Work Stress Against Cabin Personnel of the PT KAI (Persero) DAOP IV Semarang Short Distance Train" include:

1. Lutron DS-2013SD Noise Dosimeter
2. DASS 21 Questionnaire
3. Stationery

Sampling of noise sources is done by direct observation of the locomotive that produces the sound and where the sound comes from. Measurements using a Sound Level Meter as well as interviews with locomotive workers as a source of information about parts of the train that have the potential to produce noise.

Sampling of the noise level was carried out in the train cabin of the Semarang-Tegal route by placing a Noise Dosimeter in the driver's cabin. Where the Noise Dosimeter will be placed in the driver's cabin for a period of time as long as the train is running.

Sampling of the level of work stress is done before and after the respondent does the job. Respondents who were selected according to the criteria of age, years of service, and medical history were asked to fill out the DASS 21 questionnaire that had been provided according to the conditions experienced.

2.3 Noise dose

Before knowing the dose of noise received by cabin personnel, the exposure time to the noise level must first be calculated using the following formula:

International Journal of Applied Science and Engineering Review

IJASER

ISSN: 2582-6271

Vol. 3, Issue.6, Nov-Dec 2022, page no. 131-141

$$T = \frac{16}{2^{(L-82)/3}} \quad (1)$$

and the noise dose can be calculated using the following formula:

$$D = 100\frac{C}{T} \quad (2)$$

where, T is the exposure time, and L is the noise level, D is noise dose.

3. RESULTS AND DISCUSSION

Based on the equation (1), it can be seen that Tmax and the noise dose received by cabin personnel for a duration of exposure for 4 hours 47 minutes, the results of Tmax on the first day can be known which is 240 minutes or 4 hours. While Tmax on the second day is 76 minutes or 1.3 hours and Tmax on the third day is 151 minutes or 2.5 hours. The total exposure time on the journey from Semarang Poncol Station to Tegal Station and vice versa according to the departure and arrival schedule is 4 hours 47 minutes or 287 minutes. So, it can be concluded if Tmax on the first, second, and third day exceeds the maximum allowed time.

Meanwhile, the dose of noise received by cabin personnel on the first day with a noise of 88 dBA is 120%. On the second day cabin personnel received a noise dose of 380% with a noise level of 93 dBA. And on the third day the cabin personnel received a noise dose of 190% with a noise level of 90 dBA. Figure 1 is a diagram illustrating the statistics on the noise level received by cabin personnel due to train noise.

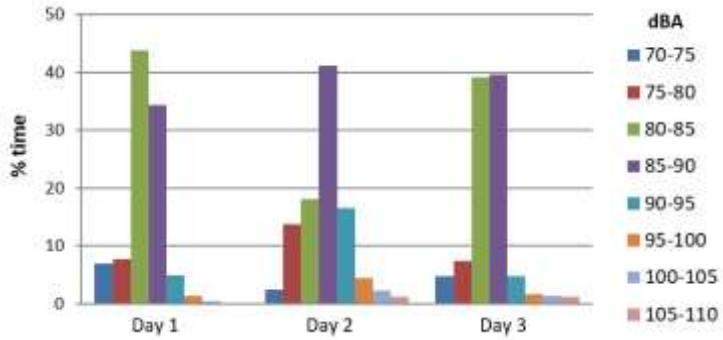

Figure 1. Noise level received by cabin personnel

From Figure 1, it can be seen that on the first day 43.9% of the noise during the machinist service contributed 80-85 dBA while 1.4% of the noise along the journey from Semarang Poncol Station to Tegal Station and vice versa was 95-100 dBA. 34.5% of travel time is from the 85-90 dBA range. 6.9% of travel time is noise with a level of 70–75 dBA. On the second day 41.2% of travel time was contributed by a

International Journal of Applied Science and Engineering Review

IJASER

ISSN: 2582-6271

Vol. 3, Issue.6, Nov-Dec 2022, page no. 131-141

noise level of 85-90 dBA, 18.1% was 80-85 dBA, 1.2% time was 105-110 dBA. And on the third day 40.1% of the time was noise with a level of 85-90 dBA, 39.6% of the time was noise with a level of 80-85 dBA, 100-105 dBA and 105-110 dBA each accounted for 1.3%, 1.2% of the time. Meanwhile, the driver noise level diagram can be seen in Figure 2.

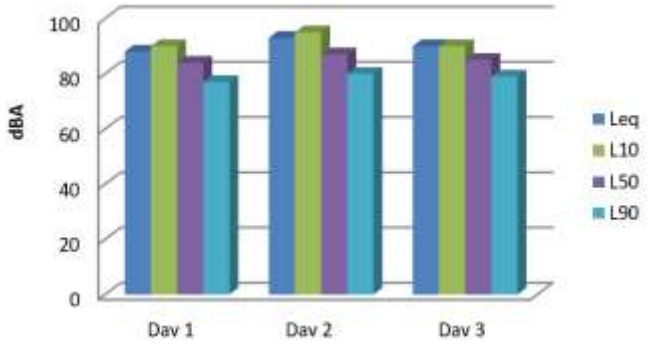

Figure 2. Noise level statistics on cabin personnel

The diagram above illustrates the L10 value which is greater than the Leq value on the first and second days while the value is the same as the Leq value on the third day. The L50 value on the first, second, and third day was at a level below Leq as well as the L90 value. L10 is usually called the initial noise level. Meanwhile, L50 describes the average noise level during the measurement and L90 is the residual noise level.

As a control, noise level measurements were carried out at the train station to determine whether the noise level at the train station was below the noise threshold value for 8 hours of work, namely 85 dBA or above 85 dBA. Measurements were carried out for 8 hours on the morning shift, from 6.30 to 14.30. After measurement, it was obtained that Leq was 74.78 dBA, L10 was 78.5 dBA, L50 was 67.2 dBA and L90 was 56.1 dBA. The following is Figure 3 that illustrates station noise level statistics.

International Journal of Applied Science and Engineering Review

IJASER

ISSN: 2582-6271

Vol. 3, Issue.6, Nov-Dec 2022, page no. 131-141

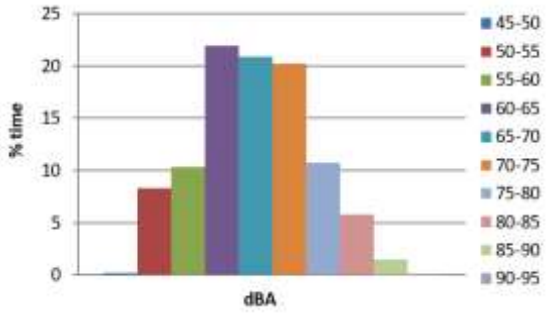

Figure 2. Noise level statistics by station personnel

In this study, the results obtained that the noise level of the Kaligung CC 201 train on weekends is higher than during weekdays. This is because on weekends, cabin personnel play the flute more than on weekdays. On weekends, the road passed by cabin personnel tends to be more crowded than on weekdays, so cabin personnel must sound the flute at train crossings with a more frequent frequency. This is evidenced from the noise data and noise level statistics for 3 days where on those 3 days the noise level that appears the most is in the range of 84 dBA to 87 dBA but from those three days on weekends the noise level reaches 100 dBA the most often occurs. Based on sampling, the flute sound reaches 100 dBA. This will affect the average value of the noise heard by cabin personnel.

In addition to determining the value of Leq, the values of L10, L50 and L90 are also determined from calculations through noise statistical histograms. According to Mansouri, et al. [2], L10 is the noise level that passes 10% of the measurement time. While L90 is a noise level that passes 90% of the measurement time and is usually considered as background noise. Meanwhile, L50 is the noise level that passes 50% of the reduction time and is usually considered as the initial noise level. In this study, noise was recorded on weekdays and weekends. From the data exposure, it can be seen that L90 or background noise on weekdays and weekends does not experience much difference, but there is a tendency for background noise on weekends to be higher than on weekdays. On weekdays the value of L90 reaches 77 dBA and on weekends the value of L90 reaches 78 dBA - 79 dBA. This indicates that traffic on weekends tends to be busier than weekdays.

The Leq value on weekdays is 88 dBA and the L10 value reaches 90 dBA. Meanwhile, the L50 value reaches 84 dBA and the L90 value reaches 90 dBA. The noise level heard by cabin personnel varies from 70.6 dBA to as high as 109.1 dBA. While the noise level most often heard by drivers is 84.7 dBA. In measuring noise for 3 days, from Friday to Sunday, the noise data represents the noise level of the weekend on Saturday. The Leq value at the weekend reached 93 dBA and the L10 value reached 95 dBA. Meanwhile, the L50 value reached 86 dBA and the L90 value on weekends reached 78 dBA. From the

International Journal of Applied Science and Engineering Review

IJASER

ISSN: 2582-6271

Vol. 3, Issue.6, Nov-Dec 2022, page no. 131-141

graph, it can be seen that the minimum noise level heard by cabin personnel is 70.7 dBA while the highest noise level heard by the driver is 109.9 dBA.

To measure the work stress level of cabin personnel and station workers, a stress measuring instrument in the form of a DASS 21 questionnaire was used. The DASS 21 questionnaire is an abbreviated version of DASS 42 which contains 21 questions. In DASS 21, it can be seen that the scale of depression, anxiety and stress that contributes to the respondent's stress level. The following table describes the stress level of respondents who work at noise levels above the threshold value and below the noise threshold value. Respondents who work with noise levels below the threshold value are station officers while respondents who work with noise levels above the threshold value are cabin personnel. Meanwhile, the stress level of respondents exposed to noise below the threshold value and above the noise threshold value before and after work can be seen in Table 2.

Table 1: Stress Levels and Noise TLV Comparison

	Stress Level			
	Normal		*Low*	
	Σ	*%*	*Σ*	*%*
≤ TLV	20	67	10	33
> TLV	28	93	2	7
Total	48	80%	12	20%

Table 2: Stress level comparison before and after work

Level	*Before*		*After*	
	> TLV	≤ TLV	> TLV	≤ TLV
Normal	28	20	28	24
Low	2	10	2	6

International Journal of Applied Science and Engineering Review

IJASER

ISSN: 2582-6271

Vol. 3, Issue.6, Nov-Dec 2022, page no. 131-141

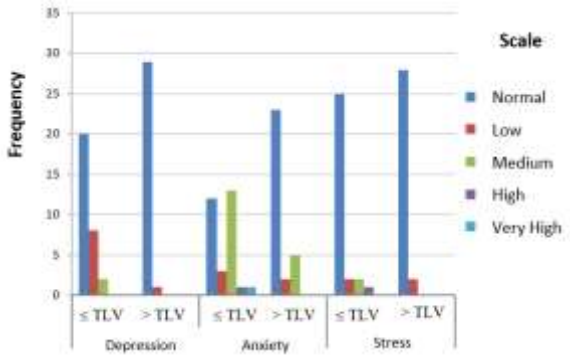

Figure 4. Comparison of TLV and frequency of depression, anxiety, and stress

Table 3. Stress Level Fluctuations

	Fluctuation of Stress LevelTingkat Stres					
	Increase		*Decrease*		*Stable*	
	Σ	%	Σ	%	Σ	%
≤ TLV	4	13	12	40	14	47
> TLV	26	87	3	10	1	3

If we compare the levels of depression, anxiety, and stress scale between respondents exposed to noise exceeding the threshold value and respondents exposed to noise below the threshold value, it can be seen in Figure 4. The following table 3 describes fluctuations in work stress levels that occur before and after working for cabin personnel and station officers. From table 4 above, it can be seen that respondents who work at noise levels above the noise threshold value tend to experience an increase in stress level values, although not significantly. Meanwhile, respondents who work at noise levels below the noise threshold value tend to have a constant stress value or decrease.

According to Muandar in Budiyanto [3], besides being able to cause temporary or permanent disturbances to our hearing devices, it can also be a source of stress that causes an increase in alertness and psychological imbalance of employees. Such conditions facilitate the occurrence of accidents. According to Ivancevich & Matterson in Budiyanto [3], argued that excessive noise (about 80 decibels) that is repeatedly heard, for a long period of time can cause stress. The psychological impact of excessive noise is to reduce the tolerance of employees to other stressors, and reduce work motivation.

According to Seňová and Antošová [4], long-term and high-level work stress can cause health effects, including stomach disease, heart disease, high blood pressure, tuberculosis, asthma, allergies, and immune

ISSN: 2582-6271

Vol. 3, Issue.6, Nov-Dec 2022, page no. 131-141

deficiencies. Mursali, et al. [5] mentioned that stress can affect health and cause many health problems including anxiety, arthritis, cancer, depression, heart disease, high blood pressure and insomnia. According to WHO [6], the causal chain scheme of the principle of reaction in noise epidemiological research is as follows: Sound → noise → stress → indicator risk factor (biological) → disease → death.

This mechanism works directly through synaptic nervous interactions and indirectly depends on sound responses through cognitive and emotional responses. So it can be concluded if the stress that appears does not necessarily cause disease but is an indirect influence on the onset of disease. Normal stress is faced regularly and is a natural part of life. As in situations: fatigue after doing a job, feeling the heart beat harder after activity. Normal stress is natural and important, because everyone experiences stress at some point. In fact, since the womb. While mild stress is a stressor faced regularly that can last a few minutes or hours. This stressor can cause symptoms, including often dry lips, difficulty breathing (often gasping for air), difficulty swallowing, feeling unsteady, feeling weak, sweating excessively when the temperature is not hot and not after activities, fear for no apparent reason, aware of heart rate although not after doing physical activity, tremors in the hands, and feeling very relieved when the situation ends.

According to Robbins [7], there are several factors that influence stress levels, including work environment factors which include physical work environment, and psychological work environment as well as individual factors including age, years of service, and health conditions. The stress level of station workers, which tends to be higher than cabin personnel, can be due to the psychological work environment experienced by station workers is higher than cabin personnel. These psychological work environment factors include excessive physical workload, limited time in completing tasks, unclear roles, or disputes between individuals and groups.

Based on the results of sampling the work stress experienced by cabin personnel, it can be seen that the average increase in work stress levels is 3.6 points. While the average increase in the level of work stress experienced by station workers is -3.3 points or there is a decrease in the average level of work stress. This is in line with research conducted by Ardiansyah [8] where in his research on the effect of noise intensity on blood pressure and work stress levels in IKPP pallet section workers there was an average increase in work stress of 5.33 units. Research conducted by Ljungberg [9] regarding stress, subjective experience and cognitive performance during exposure to noise and vibration also showed an increase in the respondent's stress level after being given vibration and noise stimulation which was marked by an increase in the hormone cortisol in the respondent's saliva sample.

According to Yildiz, et al. [10], uncontrolled noise is an activator of stress and various physiological mechanisms. It is considered that the release of stress hormones caused by noise is an important biological

ISSN: 2582-6271

Vol. 3, Issue.6, Nov-Dec 2022, page no. 131-141

mechanism. It has been shown in laboratory-scale studies with short-term noise involving human objects that noise affects the sympathetic and endocrine systems and causes a response to stress hormones. Walker, et al. [11] showed an insignificant increase in stress levels from cortisol and alpha amylase measurements in respondents who were given high-frequency noise stimulation. Meanwhile, according to Ryherd, et al. [12], stress can be influenced by sensory overload triggered by environmental factors such as noise levels. In addition, work stress comes from workplace conditions or environmental loads such as noise, work time and work schedule, level of responsibility, and speed in completing work. Ryherd, et al. [12] conducted a survey of 47 nurses in a neurologic intensive care unit and found that 91% of nurses felt that noise negatively affected their daily work environment. Many nurses reported experiencing symptoms of noise-induced stress such as irritation (66%), fatigue (66%), and headaches (40%). Research conducted by Nawawinetu [13] on rice mill workers in the Metatu Village area, Benjeng District found a relationship between noise and work stress based on symptoms of stress caused by noise such as physical symptoms including headaches and high blood pressure, as well as emotional symptoms including feelings of irritability. and easy to forget. According to Tarwaka [1], stress is a stimulus or action from the human body both from outside and from within the body itself which causes various kinds of adverse effects ranging from declining health to suffering from a disease. In relation to work, all the effects of stress will lead to a decrease in the performance, efficiency and productivity of the work concerned.

4. CONCLUSIONS

The source of the noise of the Kaligung KA Locomotive CC201 comes from the locomotive, including the sound of the flute reaching 110-123.4 dBA, the sound of the engine when stable reaching 86.4 dBA, braking sound reaching 71.2 dBA. Sampling the noise level of the Kaligung Locomotive CC 201 train for 3 days, from July 7, 2017 - July 09, 2017 shows the Leq value above the threshold value of 87 dBA, namely 88 dBA, 93 dBA, and 90 dBA, respectively. Sampling the work stress level of cabin personnel shows that there is an increase in the average stress level of 3.6 points where 26 cabin personnel experience an increase in the value of the work stress level where the stress level includes normal stress levels and mild stress levels so that based on the results of the chi square test there is a relationship between the increase in stress levels that occur in cabin personnel due to exposure to noise more than TLV.

REFERENCES

[1] Tarwaka, H.B. Solichul, L. Sudiajeng, Ergonomics for safety, health and productivity, UNIBA, Surakarta, 2004.

[2] N. Mansouri, M. Pourmahabadian, Road traffic noise in downtown area of Tehran, Iran, ITEE 2005 - 2nd Int. ICSC Symp. Inf. Technol. Environ. Eng. Proc. (2005) 665–675.

[3] T. Budiyanto, E.Y. Pratiwi, The Relationship between Noise and Work Mass on the Occurrence of Work Stress on Workers in the Weaving Section of Agung Saputra Tex Piyungan Bantul

ISSN: 2582-6271

Vol. 3, Issue.6, Nov-Dec 2022, page no. 131-141

Yogyakarta, J. Kesehat. Masy. (Journal Public Heal. 4 (2015) 126–135. https://doi.org/10.12928/kesmas.v4i2.2258.

[4] A. Seňová, M. Antošová, Work Stress as a Worldwide Problem in Present Time, Procedia - Soc. Behav. Sci. 109 (2014) 312–316. https://doi.org/https://doi.org/10.1016/j.sbspro.2013.12.463.

[5] A. Mursali, E. Basuki, S. Dharmono, Relationship between noise and job stress at a private thread spinning company, Univ Med. 28 (2009) 8–16.

[6] World Health Organization (WHO), Night noise guidelines for Europe, Denmark, 2009.

[7] S. Robbins, T. Judge, Essentials of Organizational Behavior, 14th editi, Pearson, New York, 2017.

[8] M.R. Ardiansyah, J. Salim, W. Susihono, Effect of Noise Intensity on Blood Pressure and Work Stress Level, J. Tek. Ind. Untirta. 1 (2013) 7–12. https://jurnal.untirta.ac.id/index.php/jti/article/view/110/72.

[9] J.K. Ljungberg, G. Neely, Stress, subjective experience and cognitive performance during exposure to noise and vibration, J. Environ. Psychol. 27 (2007) 44–54. https://doi.org/https://doi.org/10.1016/j.jenvp.2006.12.003.

[10] H.G. Baytan Yıldız, E. Özgencil, S. Çakar, F. Ökten, F. Tüzüner, Ortopedi ameliyathanesinde farklı iki ameliyat grubundaki gürültü düzeylerinin stres yanıt üzerine etkisinin karşılaştırılması, J. Clin. Anal. Med. 8 (2017) 116–121. https://doi.org/10.4328/JCAM.4752.

[11] E.D. Walker, A. Brammer, M.G. Cherniack, F. Laden, J.M. Cavallari, Cardiovascular and stress responses to short-term noise exposures—A panel study in healthy males, Environ. Res. 150 (2016) 391–397. https://doi.org/https://doi.org/10.1016/j.envres.2016.06.016.

[12] E. Ryherd, J. Ackerman, C. Zimring, S. Okcu, K.P. Waye, Noise pollution in Hospitals: Impacts on staff, J. Clin. Outcomes Manag. 19 (2012) 1–10.

[13] D.E. Nawawinetu, R. Adriyani, Stress due to work on workers who are exposed to noise, Indones. J. Public Heal. 4 (2007) 59–63.