

Noise Effect of Gamelan Jegog to the Risk of Hearing Loss among Jegog Players in Sangkaragung Village, Negara, Jembrana

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Jegog is a traditional Balinese music from the region of Jembrana. It consists of several sets of instruments made of big size bamboo tubes. When being played together, the instrument produce high intensity noise. This study examine the effect of this noise to the risk of hearing loss among the players. This study was conducted in the village of Sangkaragung, Negara, Jembrana. This study used a cross sectional method, being conducted in May-June 2016. The target population is all players of Jegog. The reachable target is Jegog players in the village of Sangkaragung. The sample group is the Jegog Players, who are residents of the Sangkaragung village those have been exposed to the noise of Jegog. The control group is Sangkaragung villagers who are not Jegog players and those have not been exposed to the noise of Jegog. Samples were chosen by total random sampling, while controls were taken by simple random sampling according to predetermined inclusion and exclusion rules. Jegog produces noise in the range of 86 – 105 dB. The players have been exposed to the Jegog noise for an average of 2 hours per day or 10 hours per week. Among the 37 players in the sample group, there were 13 (35.1%) players found to have noise induced hearing loss seen in their audiogram. In the control group consisting of 37 villagers, there were only 2 (5.4%) persons found to have noise induced hearing loss. This resulted in a 7 adjusted prevalence ratio, which means that Jegog players have risk of having noise induced hearing loss 7 times higher than the control group. Statistic test gives a confidence interval 95%(1.6-31.1) with $p = 0.011$ ($p < 5$). Statistically, there is a significant correlation between the noise of Jegog with the hearing loss among the players.

Keywords: Jegog noise, Noise induced hearing loss, Audiometry.

Musicians may be at risk of hearing loss due to noise. According to Halevi and Yaakobi in his study of 42 musicians pop, rock and jazz most of the musicians have hearing loss in the form of decreased hearing function and symptoms of tinnitus and hiperacusis.^{1,2,3} Tantana in his research on 166 students of art faculty in Denpasar, gained 39.20% experienced hearing loss due to Gamelan Balinese noise.⁴ In study performed by Wiastiti in

his research, 70% of Gamelan Barong Dance in Batubulan Village experienced decreased hearing function due to noise.⁵

Jegog is a traditional Balinese music from the region of Jembrana. It consists of several sets of instruments made of big size bamboo tubes. When being played together, the instrument produce low pitch but high intensity noise.⁶ Jegog player in Sangkaragung Village, Negara, Jembrana is at

risk for hearing loss due to noise. From the result of preliminary survey that has been done, the noise level of Jegog is high enough. It's reach 105 dB with frequency of 52-1240 Hz, length of the show is about 2 hours per day or 10 hours per week, and the average performance is 5 times a week.

Hearing impairment due to noise is irreversible. Even surgery and treatment can not be performed, it makes a hearing conservation program, especially early diagnosis before hearing loss becomes very important.

There has been a lot of research done on the hearing loss of musicians, especially orchestra, pop, rock and jazz, but the research of the noisy effects on Jegog player is still very limited. This study examine the effect of Jegog noise to the risk of hearing loss among the players.

METHODS

Research Design

This study is an observational analytic research using cross sectional design by taking primary data from the sample group and control group which is residents of the Sangkaragung village

Sample Research

The sample of this study is divided into two groups. The sample group is the Jegog Players, who are residents of the Sangkaragung village those have been exposed to the noise of Jegog. The control group is Sangkaragung villagers who are not Jegog players and those have not been exposed to the noise of Jegog. Samples were chosen by total random sampling, while controls were taken by simple random sampling according to predetermined inclusion and exclusion rules. In this study the total sample examined as many as 74 people, consist of 37 people Jegog player and 37 controls.

Data Collection Method

Data was taken from anamnesis, clinical examination of ENT, and tympanometric examination to the samples.

Data processing

Data analysis in this research consists of descriptive, bivariate, and multivariate analysis. The statistical test which is used is Chi Square (X^2), followed by multivariate analysis by using

poisson regression test. The results are presented in the form of tables and narratives.

RESULTS

Based on table 1, the mean age of Jegog player is 38.0 ± 8.4 years and the mean age of control is 39.5 ± 9.2 years. All subjects in this study are male. Length of work is grouped into groups with a working period of 10-15 years and more than 15 years. Sample obtained were as much as 18 people (48.7%) with length of work 10-15 years and 19 people (51.3%) with a length of work more than 15 years.

Based on table 2, we obtained that the prevalence of noise induced hearing loss in the group of Jegog player as many as 13 people (35.1%), while in the control group as much as 2 people (5.4%)

Based on table 3, as much as 26 people (70,3%) Jegog player have a normal hearing threshold in right ear while 28 people (75,7%) people in left ear. Most of Jegog player had light degrees of deafness which was 10 people (27.0%) in the right ear and 8 people (21.6%) in the left ear. 1 person had moderate degree of hearing loss (2.7%) in the right and left ear. No moderate severe, severe, and very severe degree was found among Jegog player. The hearing threshold value of Jegog Palyer can be seen in Table 3.

Based on table 4, there were 2 (5.4%) controls who had mild degrees of noise induced hearing loss in the right and left ear, while others had normal hearing threshold values.

Based on table 5, we obtained as much as 9 people (47.4%) Jegog player with length of work more than 15 years who suffered Noise Induced Hearing Loss, while 4 people (22.2%) in the working group 10-15 years who suffered Noise Induced Hearing Loss. Distribution of Jegog Gamelan player based on length of work and audiogram results can be seen in Table 5

Based on table 6, among the 37 players in the sample group, there were 13 (35.1%) players found to have noise induced hearing loss seen in their audiogram. In the control group consisting of 37 villagers, there were only 2 (5,4%) persons found to have noise induced hearing loss. Analysis variables obtained prevalence ratio (PR) = 6.5 (95%

CI: 1,5-28,8), which means that Jegog player have a risk of Noise Induced Hearing Loss 6.5 times higher than the control group. Result of statistical test with Chi Square Test got 95% confidence interval equal to 1,5-28,8 and p value = 0,014 (p <0,05), so that there is significant relation between noise of gamelan jegog to the risk of hearing loss among jegog players.

Based on table 7, we obtained that adjusted prevalence risk (APR) is 7. It means the Jegog player's risk for hearing loss due to noise is 7 times bigger than control group with 95% confidence interval equal to 1,6-31,1 and p value

= 0,011 (p <0,05). The relationship was statistically significant.

DISCUSSION

Jegog produces noise in the range of 86 – 105 dB. This noise is similar to the other studies on gamelan. In a study performed by Wiastiti Gamelan Barong Dance ranging from 95 to 106.3 dB.⁵ Other study by Tantana obtained the noise intensity on Gong Kebyar Gamelan ranged from 77-108 dB.⁴ High intensity of noise which exceed the noise threshold value that allowed can damage the hearing function.

Tabel 1. Characteristics of subjects by age, sex and length of work

Characteristic	Gamelan Jegog Player n=37		Control n= 37	
	n	(%)	n	(%)
Age (years old), mean ± SD	38,0 ± 8,4		39,5 ± 9,2	
Sex:				
Man	37	(100,0)	37	(100,0)
Length of work, mean ± SD	16,4±6,1			
10-15 years	18	(48,7)	0	0
>15 years	19	(51,3)	0	0

Table 2. The prevalence of hearing loss due to noise in the group of Jegog player and controls

Group	Noise Induced Hearing Loss (NIHL)		Normal	
	n	(%)	n	(%)
Jegog Player	13	(35,1)	24	(64,9)
Controls	2	(5,4)	35	(94,6)

In this study, the mean age of Jegog player is 38.0 ± 8.4 years and the mean age of control is 39.5 ± 9.2 years. All subjects in this study are male. Length of work is grouped into groups with a working period of 10-15 years and more than 15 years. Sample obtained were as much as 18 people (48.7%) with length of work 10-15 years and 19 people (51.3%) with a length of work more than 15 years.

Table 3. Hearing threshold value in Jegog player

Hearing threshold value (dB)	Criteria	Right ear		Left ear	
		N	(%)	n	(%)
0-25	Normal	26	(70,3)	28	(75,7)
26-40	Mild	10	(27,0)	8	(21,6)
41-55	Moderate	1	(2,7)	1	(2,7)
56-70	Moderate severe	0	(0,0)	0	(0,0)
71-90	Severe	0	(0,0)	0	(0,0)
>90	Very severe	0	(0,0)	0	(0,0)
Total		37	(100,0)	37	(100,0)

In this study we obtained that the prevalence of noise induced hearing loss in the group of Jegog player as many as 13 people (35.1%), while in the control group as many as 2 people (5.4%). This result is similar with the other study. According to Stormer et al, about 37.8% of rock musicians suffered hearing loss.⁷ Prevalence

of hearing loss among Jegog Player is smaller than on the gamelan musician Dance Barong whose instruments are mostly made of metal. In study performed by Wiastiti, prevalence of hearing loss due to noise Gamelan Barong Dance with ten years or more length of work without using ear protector is 70%.⁵ Beside the noise intensity, the

Table 4. Hearing threshold value in control group

Hearing threshold (dB)	Criteria	Right ear		Left earvalue	
		n	(%)	n	(%)
0-25	Normal	35	(94,6)	35	(94,6)
26-40	Mild	2	(5,4)	2	(5,4)
41-55	Moderate	0	(0,0)	0	(0,0)
56-70	Moderate severe	0	(0,0)	0	(0,0)
71-90	Severe	0	(0,0)	0	(0,0)
>90	Very severe	0	(0,0)	0	(0,0)
Total		37	(100,0)	37	(100,0)

Table 5. Distribution of Jegog player based on length of work and audiogram results

Length of work (years)	Noise Induced Hearing Loss (NIHL)		Normal		Total	
	n	(%)	n	(%)	n	(%)
15-Oct	4	(22,2)	14	(77,8)	18	(48,6)
>15	9	(47,4)	10	(52,6)	19	(51,4)
Total	13		2		37	(100,0)

Table 6. Correlation between noise effect of gamelan jegog to the risk of hearing loss among Jegog players

Variabel	Category		PR	95%CI	p value
	Noise Induced	Normal			
Group:					
Jegog player	13 (35,1)	24 (64,9)	6,5	1,5-28,8	0,014
Control	2 (5,4)	35 (94,6)	ref.		

Table 7. Multivariate analysis between noise effect of gamelan Jegog to the risk of hearing loss among Jegog players

Variabel	Adjusted PR	95% CI	p value
Group:			
Jegog player	7,0	1,6-31,1	0,011
Control	ref.		
Age	1,0	1,0-1,1	0,188

noisy frequency also affects the degree of noise induced hearing loss. High frequency noise is said to cause more cochlear damage compared to low frequency noise.⁸ When compared to industrial noise, the hearing loss acquired after a long period of exposure to noise in musicians is smaller than the hearing loss in industrial noise. Other study performed by Khalid et al found as much as 93.8% workers had noise induce hearing loss in the steel industry.⁹

Hearing impairment due to noise is also associated with feedback from the central nervous system. The innervation of hair cells by efferent fibers has been known for a long time, but its function is still unknown. It has recently been revealed that there is an active feedback system that is thought to inhibit contractile activity from outside hair cells, thereby reducing the stimulus captured by deep hair cells. This mechanism also explains why exposure to pleasant sounds such as music causes less hearing loss than other noise exposure with the same intensity and duration¹⁰

In this study, as much as 26 people (70,3%) Jegog player have a normal hearing threshold in right ear while 28 people (75,7%) people in left ear. Most of Jegog player had mild degrees of deafness which was 10 people (27.0%) in the right ear and 8 people (21.6%) in the left ear. 1 person had moderate degree of hearing loss (2.7%) in the right and left ear. No moderate severe, severe, and very severe degree was found among Jegog player. There were 2 (5.4%) controls who had mild degrees of noise induced hearing loss in the right and left ear, while others had normal hearing threshold values.

We obtained as much as 9 people (47.4%) Jegog player with length of work more than 15 years who suffered noise induced hearing loss, while 4 people (22.2%) in the working group 10-15 years who suffered noise induced hearing loss. In study performed by Tantana found that the most influencing factor for hearing loss due to Gamelan Balinese noise is the exposure period which is more than 10 years.⁴ According to Wiastiti on Gamelan Musician Barong Dance got 70% of hearing impaired due to noise after working ten years or more.⁵ In long-term exposure to noise, the most severe hearing loss occurs in the first 10-15 years after exposure to noise. Then cochlear damage will continue slowly along with the longer exposure to noise.¹¹ In long-term exposure to noise (e⁹⁰ dB), some sensory cells are likely to degenerate within the Corti's organons every day. Damage to hair cells occurs gradually. The longer the exposure takes place, the more sensory cells are lost. Longer exposure or more intense noise causes more outer hair cells and deep hair cells disappear and loss of support cells such as outer and inner pillars¹²

In this study, there were 13 (35.1%) players found to have noise induced hearing loss

seen in their audiogram. In the control group consisting of 37 villagers, there were only 2 (5,4%) persons found to have noise induced hearing loss. This resulted in a 7 adjusted prevalence ratio, which means that Jegog players have risk of having noise induced hearing loss 7 times higher than the control group. Statistic test gives a confidence interval 95%(1.6-31.1) with $p= 0.011$ ($p<5$). Statistically, there is a significant correlation between the noise of Jegog with the hearing loss among the players. Compared with research on Gamelan Barong Dance by Wiastiti, the risk of hearing loss in this study is smaller where Gamelan Barong Dance have a risk 14 times greater than controls for decreased hearing function.⁵

CONCLUSIONS

Jegog produces noise in the range of 86 – 105 dB. The players have been exposed to the Jegog noise for an average of 2 hours per day or 10 hours per week. Among the 37 players in the sample group, there were 13 (35.1%) players found to have noise induced hearing loss seen in their audiogram. In the control group consisting of 37 villagers, there were only 2 (5,4%) persons found to have noise induced hearing loss. This resulted in a 7 adjusted prevalence ratio, which means that Jegog players have risk of having noise induced hearing loss 7 times higher than the control group. Statistic test gives a confidence interval 95%(1.6-31.1) with $p= 0.011$ ($p<5$). Statistically, there is a significant correlation between the noise of Jegog with the hearing loss among the players.

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