SUBJECTIVE ANALYSIS OF NOISE LEVELS AND ITS POSSIBLE EFFECTS ON WORKERS AND THEIR ENVIRONMENT IN IKOT UDUAK TIMBER MARKET, CALABAR, CROSS RIVER STATE, NIGERIA

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ABSTRACT: This research measures the social and attitudinal responses to noise by the workers and the business populace in Ikot Uduak timber market, in Calabar, Cross River State, Nigeria. This social survey and attitudinal response to the industrial noise were determined by means of questionnaires. The subjective results showed that over 200 respondents out of 320 responses work for 8 hours and above in a day, which represents 63 percent of the results obtained. 205 of 270 respondents representing 76 percent of the respondents, work for 6 days per week while 155 of 270, which is 57 percent of the respondents, have worked for over 10 years now. From this, and also from the data already gotten from objective analysis of the noise levels in the market, the Occupational Safety and Health Act (OSHA) permissible level of 90dBA for 8-hour day and 5 days a week has been exceeded and this could lead to noise related ailments. The subjective assessment also showed that 98 percent of the respondents agitated that the noise should be controlled.

Key words: Timber market, Social survey, Attitudinal response, Subjective results, Objective analysis, Questionnaire, Noise related ailments.

1. INTRODUCTION:

Noise has been defined as unpredictable sound, especially loud ones, which upset people or make it hard for them to hear 'desired' sound (EPA, 2009). In industries generally, noise is one of the most undesired and unavoidable by-products of modern mechanical operations and a prolonged exposure to it of 85dB (which is the threshold for dangerous levels of noise, based on the stipulations of the Academy of Pediatrics and the National Campaign for Hearing and Health) and above, can lead to hearing impairments, hypertension, ischemic heart diseases, annoyance, and sleep disturbance (Field, 1993).

Noise quantification is very difficult due to the subjective contents involved. Annoyance, for example, as an effect of noise is extremely difficult to quantify, since the decibel level that can cause annoyance to one person may not have the same effect on another person within the same environment or community. In this research work, emphasis was on the whole residents or community, rather than on individuals or small groups.

The machines available in the timber market were identified through a field survey. They are (with their machine code): Band saw (IUM1), Table saw (IUM2), Plainer (IUM3), Spindle/Curving machine (IUM4) and the Drilling machine (IUM5). The subjective assessments of the noise were carried out through the use of questionnaires distributed to respondents around each of the machines listed above. The respondents were asked to respond on how he or she is affected by the closest machine.

2. MATERIALS AND METHODS:

This research was carried out with three hundred and fifty (350) copies of a self-study questionnaire which has twenty-eight items. (See appendix 1). The questionnaires were distributed to workers who operate the machines at the designated locations in the timber market as well as the business men and women who are directly influenced by the noise from the machines, and it was tailored towards obtaining information about the effects of the timber market noise on the workers and their environment. The questionnaire was designed to have five degrees of response as summarized below:

i	Very High (VH)	=	5 points
ii	High (H)	=	4 points
iii	Moderate (M)	=	3 points
iv	Low (L)	=	2 points
v	Very Low (VL)	=	1 point

The questionnaires were distributed to respondents from ages 20 years to 55 years and above. Out of a total of three hundred and fifty (350) copies that were distributed, the valid responses received were three hundred and twenty-five (325), representing 93 percent.

The assessment questionnaire was sub-divided into three major sections; A, B and C. Questions 1 to 4 in section A provides information on easy sorting. Question 5 to 13 in section B was the demographic information section. In this section, respondents answered questions about age, marital status, sex, area of residence, number of years of residence in that area, and educational qualification, if any. Section C contains questions 15 to 28 which was based on general feeling on the effect of woodworking noise such as communication disruption, annoyance rating, likeness rating, who should control noise, and the effects like sleeplessness, headache, hearing loss, fatigue, and adaptation, as the case may be.

3. RESULTS AND DISCUSSION:

Tables 1, 2 and 3 show the hourly response of respondents to timber market noise, daily exposure to the noise and respondents' yearly exposure to the timber market noise. It can be observed from Table 1 that 200 out of 320 workers, which is about 63 percent of the respondents, work for 9 hours and above in a day, while Table 2 shows that 205 out of 270 workers, representing about 76 percent of the respondents, work for 6 days and above in a week. Fifty-seven percent of the respondents, that is, a total of 155 out of 270 respondents, have been exposed to the noise for more than ten years, as can be seen from Table 3.

It can be seen also from the clustered column chart of Fig. 1, that headache and irritation of the ear, represented by 107 and 132 respectively, out of a total of 321 respondents are the most common effects of noise as expressed by the respondents while the least is annoyance, represented by only 10 respondents. Fig. 2 is a line graph that shows the respondents' reaction to timber market

noise pollution control. A total of 285 respondents out of 291, representing 98 per cent, were of the opinion that timber market machines noise should be controlled.

TABLE 1

Hourly exposure of respondents to the timber market noise

Location code	Exposure time (Hours)				Total
	3-5	6-8	9-12	Above 12	
IUM1	10	25	55	0	90
IUM2	6	10	40	0	56
IUM3	5	30	50	0	85
IUM4	5	15	39	0	59
IUM5	4	10	16	0	30
Total	30	90	200	0	320

TABLE 2

Daily exposure of respondents to the timber market noise

Location code	Exposure time (Days)						Total
	2	3	4	5	6	7	
IUM1	0	0	0	15	40	0	55
IUM2	0	0	0	10	40	2	52
IUM3	0	0	0	20	50	0	70
IUM4	0	0	0	15	40	0	55
IUM5	0	0	0	5	30	3	38
Total	0	0	0	65	200	5	270

TABLE 3

Yearly exposure of respondents to the timber market noise

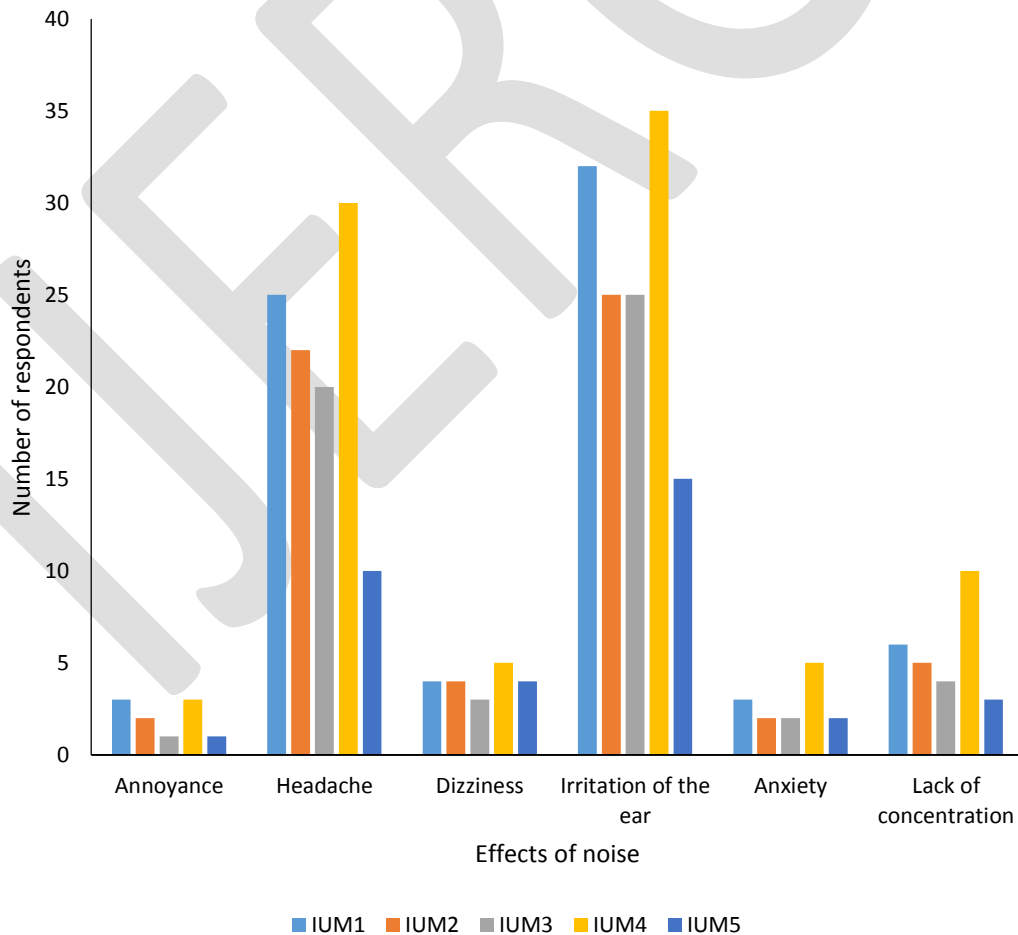| Location code	Exposure time (Years)						Total
	1-5	6-10	11-15	16-20	21-25	26-30	
IUM1	7	15	30	8	3	1	64
IUM2	5	25	15	7	1	1	54
IUM3	8	10	30	5	2	1	56
IUM4	10	20	25	3	2	1	61
IUM5	5	10	15	2	2	1	35
Total	35	80	115	25	10	5	270

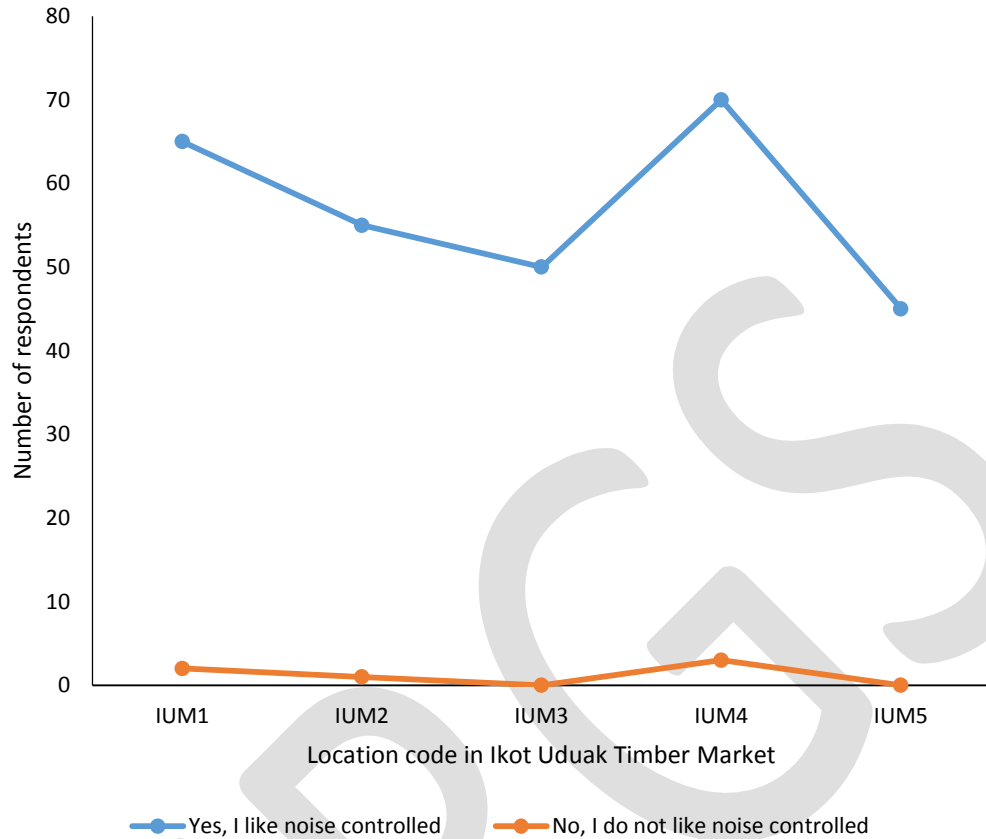FIG. 1: Respondents' reaction to the effects of noise

FIG. 2: Respondents' reaction to the timber market pollution control

In order to discover how the subjective responses obtained by making use of questionnaires as a study instrument are related to the objective responses got by the use of the sound level meter (from the work done by Okoro et al 2016, in the same market), the coefficient of correlation was deduced using the standard expression. Correlation coefficient is a rough calculation of the extent of the relationship that exists between two variants and this estimate is only valid when the sample is randomly drawn from the population. The numbers 5, 4, 3, 2 and 1 represent "very high", "high", "moderate", "low," and "very low" respectively, as shown on tables 5 and 6. The corresponding weighted ratings, as shown on table 4, are obtained by finding the product of the numbers and their corresponding frequency of responses. The ratio of the weighted ratings to their separate total responses for each location gives the overall average scale values for each machine (Molino, 1979). These general mean scale values for machines in the markets represent the overall industrial noise rating for that specific industry.

The objective responses determined by the use of the level meter, shown on table 4, represents the x-variants while the subjective responses are shown by the equivalent scale value as y - variants. Table 6 shows the correlation between objective and subjective responses in the market. The correlation coefficient is given by:

$$r = \frac{\{n\Sigma xy - \Sigma x\Sigma y\}}{\sqrt{\{[n\Sigma x^2 - (\Sigma x)^2][n\Sigma y^2 - (\Sigma y^2)]\}}} - - - - - - - - - - - - - - - - - 3.1$$

The correlation coefficient between objective and subjective measures was calculated 0.99. This shows that there is a good correlation between the objective measurements of the noise and the attitudinal responses of the workers to the noise. This is not unrelated to the fact that Ikot Uduak timber market is located in residential environment where residential buildings, hotels and churches are located. This situation had made the workers and the people around to react adversely to any increases in noise level. They are thus poorly adapted to the noise from the machines and as such could easily decipher any slight effect the noise had on them.

TABLE 4

Relationship between sound pressure level and the working condition of the machines

Machine code	Average sound level when there is no load (dBA)	Average sound level when loaded (dBA)
IUM1	98.0	100.5
IUM2	86.0	98.5
IUM3	96.0	98.2
IUM4	95.5	101.5
IUM5	82.5	90.5

Source: Okoro et al 2016

TABLE 5

Summary of respondents' timber market noise rating

Location code	Noise rating					Response per location (n)	Weighting rating (nx)	Average value per location (nx/n)=y
	Very high (5)	High (4)	Moderate (3)	Low (2)	Very low (1)			
IUM1	40	25	5	0	0	70	315	4.50
IUM2	35	15	10	0	0	60	265	4.42
IUM3	30	20	5	0	0	55	245	4.45
IUM4	50	23	7	0	0	80	363	4.54
IUM5	25	20	15	0	0	60	250	4.17

TABLE 6

Correlation between objective and subjective responses

S/N	Location code	Mean value, loaded -state, A-weighted SPL ±0.5 dBA (x_i)	Mean value per location (y_i)	x_iy_i	x_i^2	y_i^2	Correlation coefficient (r)
1	IUM1	100.5	4.50	452.25	10,100.25	20.25	0.99
2	IUM2	98.5	4.42	435.37	9,702.25	19.54	
3	IUM3	98.2	4.45	436.99	9,643.24	19.80	
4	IUM4	101.5	4.54	460.81	10,302.25	20.61	
5	IUM5	90.5	4.17	377.39	8,190.25	17.39	
Total		489.2	22.08	2,162.81	47,938.24	97.59	

4. SUMMARY/CONCLUSION:

Generally, the subjective results in the industry under survey show that over 200 respondents out of a total of 320 results received work for 8 hours and above in a day, and this represents 63 per cent of the results obtained. Two hundred and five out of 270, which is about 76 percent of the respondents work 6 days per week while a total of155 of 270 respondents representing 57 percent of the respondents have worked for 10 years and above. These values exceed the recommendation of the Occupational Safety and Health Act (OSHA) of 1970 which permits noise level of 90 (dBA) for a daily exposure time of 8 hours and 5 days per week. Hence, the workers exposed to such noise levels are assumed to have hearing impairment and other noise related ailments.

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