

# NOISE EXPOSURE IN TWO TEXTILE PLANTS IN SUDAN

*Alshebli A. Ahmed*

Faculty of Public and Environmental Health,  
U of K, Khartoum, Sudan

*Mohammed A. Awadalkarim*

Faculty of Medicine, U of K, Khartoum, Sudan

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## Abstract

**Background:** Noise is a major health threat in occupations where the level exceeds the permissible limit (85 decibel), The degree of negative effects of noise depends on its intensity, spectrum of frequency nature, duration of exposure and individual sensibility. **Objectives:** To assess the noise in work environment at textile factories **Materials and Methods:** This cross-sectional study was conducted at two textile factories in Khartoum – Sudan in 2013. The study included all workers in the two factories (n=198). Data was collected through questionnaire to obtain data about noise level perceived and variables such as work section. Noise levels (dBA) were measured by sound level meter and octave band analyzer **Results:** Workers in weaving sections of both factories and preparing section in Alsbagoon factory were exposed to average levels of noise above 85 dBA. Octave band analysis of the noise in Alhodhood and Alsbagoon factories in weaving, preparing and quality control sections shows high noise level in 1000Hz, 2000Hz, 4000 Hz and 6000 Hz **Conclusion:** Based on the findings of this study, it was demonstrated that worker are exposed to excessively high noise levels.

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**Keywords:** Noise, Textile, Exposure, Sudan, Weaving

## Introduction

The word noise comes from the Latin (nausea) and is defined as unwanted sound (LuAnn et al, 2002). The threshold limit value has been set and allowed by the International Standards Organization (ISO), EEC and other developed countries. NIOSH estimates that there is an excess risk of 8% for a 25 dB average hearing loss at 1, 2, 3 and 4 kHz at an occupational  $L_{A2000hn}$  of 85 dBA and 25% excess risk at a level of 90 dBA recommended by National Institute for Occupational Safety and Health. (1998).The World

Health Organization reported that 16% of disabling hearing loss in adults is attributable to occupational noise exposure (OisSaeng et al, 2013). The association between noise and noise-induced hearing loss (NIHL) has been known since the 18th century. NIHL remains among the 10 leading occupational diseases (LuAnn et al, 2002). Low frequency noise is common as background noise in urban environments and as emission from many artificial sources (Siu and Johnsston, 2000). Most national and international occupational and environmental health agencies use the LEQ (Noah et al, 2005). workers are at risk of hearing loss if they are exposed, without hearing protection, to more than 85 decibels averaged over an eight-hour day (Patel et al, 2002). Occupational hearing loss resulting from exposure to high noise level depends not only on exposure time but also on the frequency, intensity and type of noise (continuous or impact) (Ahmed et al, 2001).

### Materials and methods

The study included 198 workers in two factories. Measurements of sound level at all sites were done by using a Burel and Kjaer type 2203 (Integrating), Sound Level Meter of class -I accuracy, sensitive to sound pressure between 20 and 20000 Hz. The range and sensitivity of the instrument is 32-140 dB with accuracy  $\pm 5\%$ , fitted with windscreen to limit the effect of wind on the measurement. Also noise mapping was carried out during regular working conditions to determine current noise exposure (dBA) in various parts of the two factories. Frequency characteristics of sound were analyzed with an octave band filter using Bruel and Kjaer meter type 1613. Measurements were taken during the usual business hours at 8:00 am and 3:00 pm, when the factories were in production. Care was taken so that the measurements were made with the minimum interference with normal working patterns as possible and none of the measurements was influenced by external noise, such as aircraft or road traffic noise. A comprehensive questionnaire with both open and closed ended questions was used to collect demographic data.

### Results

Table (1): Noise measurements in Alhodhood factory - Sudan – 2013.

Department	Noise level in dBA						
	Leq(dBA)	Max p	Min L	Max L	Lepd	SEL	SPL
Weaving	88.0 $\pm$ 6.5	104.2 $\pm$ 2.1	86.9 $\pm$ 2.2	89.2 $\pm$ 5.6	87.5 $\pm$ 2.2	98.3 $\pm$ 2.3	88.9 $\pm$ 2.7
Administration	58.4 $\pm$ 8.1	83.61 $\pm$ 6.7	54.1 $\pm$ 8.5	64.3 $\pm$ 7.8	58.1 $\pm$ 8.2	68.7 $\pm$ 8.1	59.4 $\pm$ 9.7
Preparing	63.1 $\pm$ 4.6	90.5 $\pm$ 6.4	60.0 $\pm$ 3.8	70.5 $\pm$ 6.7	62.8 $\pm$ 4.6	73.7 $\pm$ 4.6	64.3 $\pm$ 5.0
Printing	77.0 $\pm$ 2.6	94.6 $\pm$ 3.1	75.8 $\pm$ 2.6	80.0 $\pm$ 3.3	77.6 $\pm$ 3.5	87.35 $\pm$ 2.7	77.8 $\pm$ 2.8
Quality control	79.6 $\pm$ 1.49	97.5 $\pm$ 1.1	78.3 $\pm$ 1.5	82.7 $\pm$ 1.9	79.3 $\pm$ 1.5	90.1 $\pm$ 1.4	80.4 $\pm$ 1.7

Table (2): Noise measurements in Alsbagoon factory - Sudan – 2013.

Department	Noise level in dBA						
	Leq(dBA)	Max p	Min L	Max L	Lepd	SEL	SPL
Weaving	86.1±6.4	102.2±2.9	85.3±3.1	87.3±4.0	85.8±3.2	91.0±3.3	87.0±3.0
Administration	63.6±3.5	92.34±5.5	57.4±3.5	74.4±6.7	63.9±4.1	75.0±3.9	61.8±2.8
Preparing	93.2±1.1	108.2±1.4	92.6±1.2	94.2±1.2	92.9±1.1	103.6±1.2	93.8±1.7
Printing	71.4±2.9	90.9±1.7	70.4±2.6	73.2±2.5	71.1±2.8	82.4±3.7	73.8±2.7
Quality control	74.37±1.7	93.24±3.0	73.18±3.0	76.3±3.5	74.1±3.9	85.1±3.7	76.5±4.1

Figure (1): Octave band analyzer measurements in Alhodhood factory Sudan – 2013.

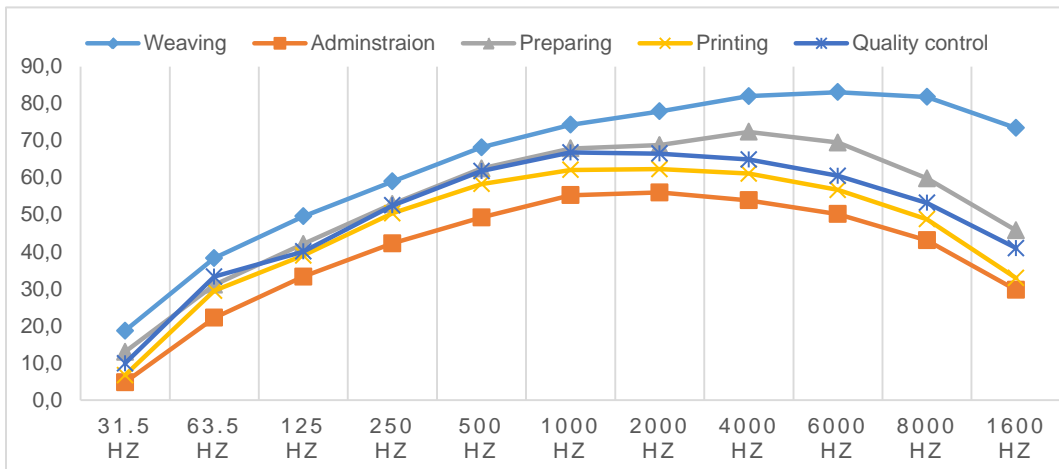


Figure (2): Octave band analyzer measurements in Alhodhood factory Sudan – 2013.

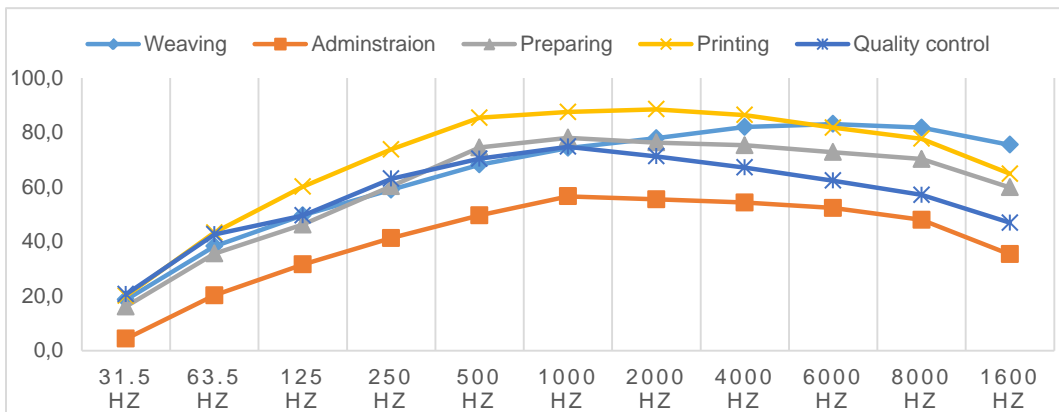


Figure (3): The perceived noise levels in the work environment according to questionnaire respondents employed at Alhodhood and Alsbagoon textile factories – 2013 (n=181).

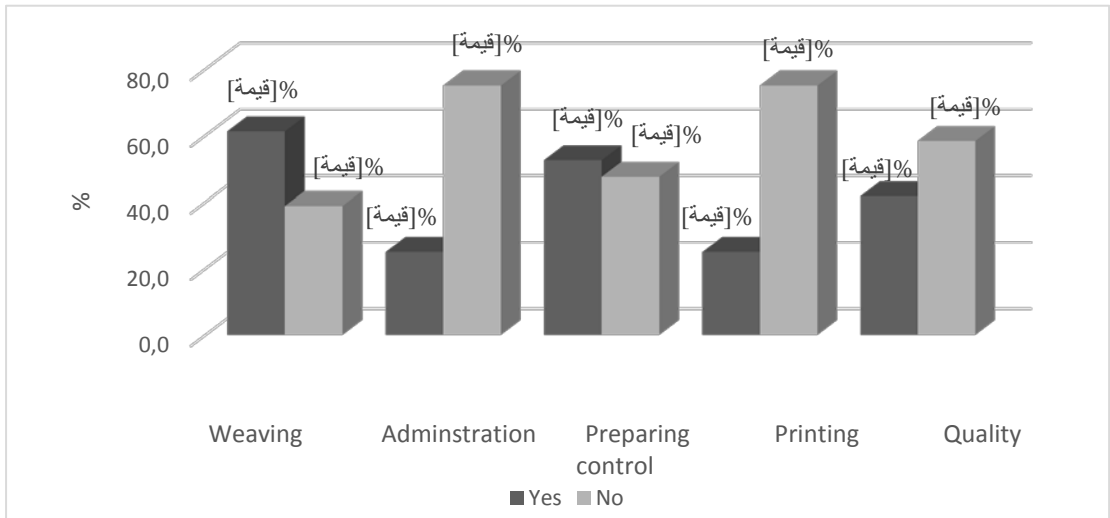
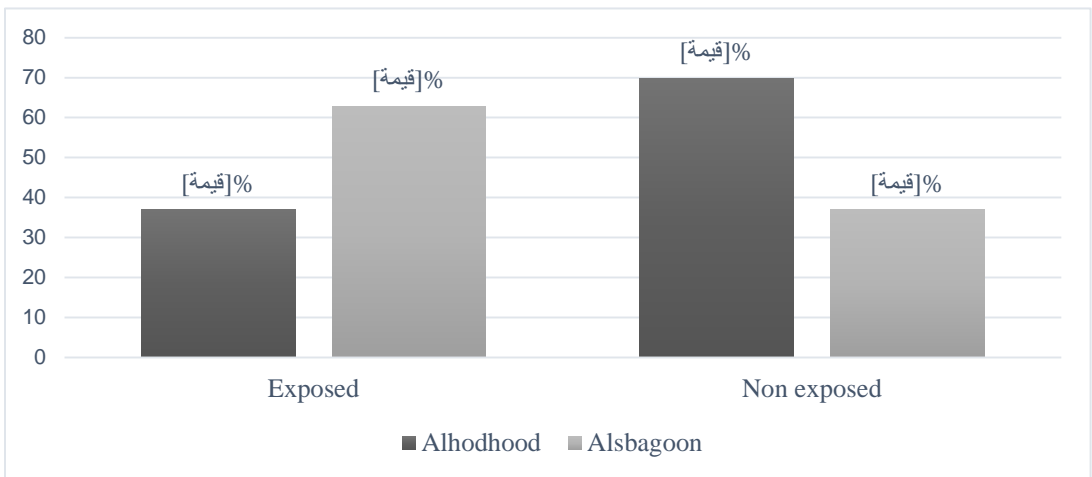


Figure (4): Distribution of employees into exposed and non-exposed according to (SPL ≥ 85 dB) at Alhodhood and Alsbagoon factories - Sudan – 2013 (n=198).



The highest recorded sound pressure level SPL reading at Alhodhood factory was  $88.9 \pm 2.7$  dB and  $Leq$   $88.0 \pm 6.5$  measured at the weaving section. Max p ranged from  $83.61 \pm 6.5$  to  $104 \pm 2.1$ . The highest recorded sound pressure level reading at Alsbagoon factory was  $93.8 \pm 1.7$  dB and  $Leq$   $93.2 \pm 1.1$ , measured at the preparing section flowed by weaving recorded  $87.0 \pm 3.0$  which were more than permissible level. Max p ranged from 92.34 to  $108.2 \pm 1.4$  (Tables 1, 2). Figure (1) shows the octave band analysis of the noise in Alhodhood factory in weaving, preparing and quality control sections. There is high noise level in 1000Hz, 2000Hz, 4000 Hz and 6000

Hz. The high levels in this region can be a major reason of noise induced hearing loss. Figure (2) shows the octave band analysis of the noise in Alsbagoon factory in weaving, quality control and preparing sections. There is high noise level in 1000Hz, 2000Hz, 4000 Hz and 6000 Hz. The high levels in this region can be a major reason of noise induced hearing loss. Workers at Alhodhood and Alsbagoon perceived the level of noise in their work environment. Workers in weaving section 61.2% described the noise levels in their work environment as high, followed by preparing section 52.5%. There is about 37.1% workers are exposed in Alhodhood factory compare to 62.9% in Alsbagoon factory according to ( $SPL \geq 85$  dB) (Figure 3). Figure (4) illustrates distribution of workers into exposed and non-exposed according to ( $SPL \geq 85$  dB) at Alhodhood and Alsbagoon factories. There is about 37.1% workers are exposed in Alhodhood factory compare to 62.9% in Alsbagoon factory.

## Discussion

This study is conducted in Alhodhood and Alsbagoon textile factories to assess the noise in the work environment at two textile factories. Results of the noise measurement show that overall noise levels dBA Leq in Alhodhood included in this study ranged between  $58.4 \pm 8.1$  and  $88.0 \pm 6.5$  dBA. Noise levels dBA Leq in Alsbagoon ranged between  $63.6 \pm 3.5$  and  $93.2 \pm 1.1$ . Workers in weaving section of both factories and preparing section in Alsbagoon factory were exposed to average levels of noise above 85 dBA, the threshold limit value has been set and allowed by the International Standards Organization (ISO), EEC and other developed countries. The noise levels exceeded the 85 dB (A) criterion recommended by National Institute for Occupational Safety and Health. (1998). United Kingdom, Belgium, Italy, Canada, France and Denmark allow 90 dBA Leq. Japan, Sweden, Germany, Norway allow 85 dBA Leq. These limits are allowed for halving rates of 3 dBA and working schedules of 8 h/d. OSHA (USA) allows 90 dBA for 8 h/d with halving rate of 5 dBA (Bedi, 2006), as well as in some African countries, including Sudan (Yousif, 2006) and in some Asian countries including Vietnam (Nguyen et al, 1998). The results revealed that 61.2% of the workers in weaving section described the noise levels in their work environment as high, followed by preparing section 52.5%. This agrees with our noise measurements. The noise level  $88.0 \pm 6.5$  dBA in the weaving section in Alhodhood and noise level  $87.0 \pm 3.0$  were comparable to noise level in range of 88.4 - 104 dBA level measured in weaving sections of five renowned textile industries of Karachi in Pakistan (Ashraf et al, 2009), 102.5 dBA in Hong Kong (Yu & Wong, 2000). The average noise level in the weaving sections were  $101.3 \pm 2.7$  dBA and  $89.8 \pm 5.3$  dBA in Thailand (Charalistsakulchait et al, 1999), also in Ethiopia (Belachew &

Berhane, 1999) who reported that the highest noise level in area samples was observed in weaving section, with mean  $\pm$ SD of 99.5  $\pm$ 3.2dBA. Also (Păuncu, 2000) who reported that the noise levels range between 94 dBA and 116 dBA in a textile factory of Timisoara city i.e., they exceeded the Romanian limit of 90 dB. Also (Yildirim et al, 2007) who reported that workers exposed to high noise 105 dBA in a textile factory also (Bedi, 2006) who reported that workers in two factories in India exposed to high noise level ranged between 80 to 102 dBA. Daily duration of noise exposure was 8 hours for all workers in both factories. The daily noise exposure of workers in areas like weaving, quality control in both factories and preparing section in Alsbagoon exceeds the maximum exposure limit of 90 dBA, specified by occupational health Khartoum state Ministry and OSHA. The noise exposure in other work areas like administration section in both factories recorded less than 90d BA, but is quite higher than limits used for assessment of noise for community response. The findings of this study illustrate that about 37.1% workers are exposed in Alhodhood factory compared to 62.9% in Alsbagoon factory most (100.0%) of these did not used any form of hearing protection compared to study conducted in Saudi Arabia among the exposed group 75% (202 subjects) were exposed to a daily Leq above the permissible level of 85 dBA and most (100.0%) of these did not and had never used any form of hearing protection (Ahmed et al, 2001). As reported by Nguyen et al (1998) noise mapping in the weaving section showed that the noise levels exceeded the Vietnamese standard of 90 dBA by as much as 90 dBA in some areas (Păuncu, 2000) .The noise levels ranged between 94 and 116 dB (A), i.e., they exceeded the Romanian limit of 90 dB. Exposed to continuous broadband noise of the constant level of approx. 100 dBA (Sulkowski & Kowalska, 1986). The study revealed that the highest noise level in area samples was observed in weaving section, with mean  $\pm$ SD of 99.5  $\pm$  3.2dB (Belachew & Berhane, 1999) . Noise level was in range of 88.4-104 dBA (Ashraf et al, 2009). The finding of this study shows that octave band analysis of the noise in Alhodhood and Alsbagoon factories in weaving, preparing and quality control sections is high noise level in 1000Hz, 2000Hz, 4000 Hz and 6000 Hz. The high levels in this region can be a major reason of noise induced. Exposure to broadband, steady noise, or noise with an impulsive component, the first sign was a dip or notch in the audiogram maximal at 4 kHz with recovery at 6 and 8 kHz (McBride & Williams, 2001).

## **Conclusion**

Based on the findings of this study, it was demonstrated that workers are exposed to excessively high noise levels.

## **Acknowledgment**

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