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INDUSTRIAL NOISE EXPOSURE AND WORK-RELATED STRESS AS PREDICTORS OF AUDITORY PERFORMANCE AND PSYCHOLOGICAL WELL-BEING OF INDUSTRIAL WORKERS IN IBADAN, OYO STATE, NIGERIA

Abayomi Comfort FASOLA
Audiology and Speech Pathology Unit, Department of Special Education, University of Ibadan, Ibadan, Nigeria
ORCID: https://orcid.org/0000-0001-9421-0057
fasholaabayomi1311@gmail.com

Ayo OSISANYA
Dr., Audiology and Speech Pathology Unit, Department of Special Education, University of Ibadan, Ibadan, Nigeria
ORCID: https://orcid.org/0000-0001-6901-0977
ayoosisanya@gmail.com

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Abstract

Noise is a health-threatening phenomenon, which often affects health, safety, and efficiency of people at workplace, home, and socio-educational gatherings. Therefore, exposure to this noise and work-related stress has been observed to have deleterious effect on the auditory performance and psychological wellbeing of industrial workers. The study investigated the influence of industrial noise and work-related stress on the auditory performance and psychological well-being of factory workers in Ibadan. The study adopted a survey research design, and purposively sampled 304 industrial workers through the use of a self-developed questionnaire titled 'Influence of Industrial Noise Exposure and Work-Related Scale', with a reliability coefficient of 0.76. Afterwards, all the participants were audiologically examined via Pure-Tone Audiometric Assessment (PTA). Data generated were analysed using frequency counts, percentage, mean and Pearson's Product Moment Correlation (PPMC). 206 (67.8%) participants who were audiologically tested presented with different types and patterns of hearing loss, as 130 (47.0%) of the participants had high frequency hearing loss in the right ear, while 150(54.6%) had same in the left ear. Also, 90 (33.0%) of the participants had mild hearing loss in the right ear, while 80 (29.0%) had same in the left ear. 188 (61.8%) of the participants reported difficulty in hearing when someone speaks in a whisper or at a very low voice. 216 (71.1%) of the participants claimed that they frequently change their phone from one ear to another when receiving calls via mobile phone. 181 (59.5%) of the participants admitted that they hear better in one ear than the other. Further findings revealed that 179 (58.9%) of the participants do have difficulty hearing as well as understanding their fellow co-workers, clients or customers whenever engaging in conversation. 163 (53.6%) of the participants agreed that they always tune up to high volume when using mobile phone, TV or Radio. Consequently, reduced auditory performance and poor psychological wellbeing have been found to be associated with industrial noise exposure and work-related stress among industrial workers in Ibadan. Therefore, the study recommends periodic audiological evaluation, appropriate use of hearing protective devices, regular public awareness on effects of work-related stress on quality of life as well as the psychological well-being. Government should ensure that industrial firms adhere strictly to health and safety policies, hearing conservation protocols, and regular medical check-ups. Working hours at various industrial firms should be reduced to allow for adequate rest and off-duty relaxation as well as physical exercise to prevent unnecessary fatigue, reduced auditory performance and poor psychological well-being.

Keywords: Auditory performance, factory workers, hearing loss and conservation, industrial noise exposure, psychological well-being, work-related stress.

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INTRODUCTION

Hearing is the ability to hear; the main ability to recognize, perceive, understand and discriminate sounds accurately. Hearing is one of the five senses of human beings, which helps by attaching meaning to sounds for better speech understanding and discrimination. Hearing makes human beings stay alert in case of impending danger or for recreational purposes, such as listening to music or localizing verbal information and messages around. Thus, hearing, which is the ability to hear is critical to understanding the world around us (ASHA, 2016; Marconi, 2016). Hearing plays an essential role in communication, speech and language development and learning. Hearing is the ability, through effective auditory organs, to detect vibrating elements within the environment and transmitting same via the auditory nerves to the brain for interpretation. To this end, hearing is described as the ability to perceive sounds by detecting vibrations through the sense of hearing, while at the same time giving the received vibrations proper interpretation towards establishing the required speech-sound understanding and discrimination needed for effective human communication and other related psycho-social functions (Osisanya, 2014).

Hearing is a complex, and multi-process sensory-auditory function and ultimately occurs when the brain receives and interprets sounds from the environment (Bagai, Thavendiranathan, & Deksky, 2006; Adesokan & Osisanya, 2019). This, however, necessitates adequate and accurate reception of sound signals as the auditory sense serves as a window to the world, allowing access to essential information that underpins daily functioning. Hearing is the key to communication, and a means for social interaction, because it is a main tool for the smooth and efficient communication among human beings. As one sensory domain, hearing is critical to an individual's ability to communicate, interact with others, perceive dangers and feel connected to the environment (Dalton, 2003; Kochkin & Rogin, 2000). Hearing accompanies human beings throughout life; it shapes and influences every part of humans' world. Hearing enables human beings to communicate with others, enjoy social interaction as well as to benefit maximally from the humans' world, even with the use of natural auditory processing system Osisanya, Adeniyi, and Florain (2017). Our hearing is used for the entire twenty-four hours that makes up a day, because the auditory system keeps functioning even when we fall asleep. Hearing is the ability to perceive sounds, and the human ear plays an important role in hearing, for it is the main sensory organ of the human ear, which performs the first processing of sounds, while at the same time houses all the sensory receptors required for hearing (Boundless, 2016). The human ear can be broken down into the outer ear, middle ear and inner ear. These three divisions have specialized functions that work together to allow humans to hear. The human ear is an extraordinary sound-detecting organ of all the organs of the body (Bakare, 2013). Human beings also have the ability to access and determine where sounds originate from, which is an auditory function commonly called sound localization. It is the ability of the auditory system to localize and process the received sound signal perfectly, and process starts with the determination of where a sound originates, although this is dependent on the hearing ability of each ear, and the exact quality of sound involved (Boundless, 2016).

Human ear is a very delicate and highly sophisticated structure, as such it is particularly susceptible to damage which can lead to hearing loss over time or immediately, depending on the nature of damage (Deaf Hear, 2016; Fada & Osisanya, 2017). Hearing loss occurs, for some reasons, when sound is not properly transmitted from the external ear through the middle ear and inner ear to the brain where it is expected to be interpreted towards establishing proper speech understanding and discrimination of the sound received. There are a number of causative or risk factors responsible for hearing loss in humans, ranging from presbycusis (Age-related hearing loss), exposure to noise, use of toxic drugs, and other prenatal, peri-natal and post-natal causes. Whence, any of this occurs there is possibility of having hearing loss in the affected ear. Consequently, the emergent hearing loss would lead to loss of ability to recognize or perceive, understand and discriminate sounds perfectly.

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Hearing loss can be congenital or acquired as a result of excessive exposure to noise, ototoxic drugs such as certain types of chemotherapies and antibiotics, industrial chemicals, presbycusis which is related to ageing and nutritional deficiencies. Hearing loss has significant implications for an individual's ability to participate at work or other social activities as well as increasing the risk of an individual misinterpreting what is perceived. Put differently, hearing loss has negative impact on an individual's work-life, because it makes participation in the work environment challenging, especially if the work entails continuous verbal communication, using the phone or communicating with clients and other personnel (Boulton, 2013; Ross, 2011; Fada & Osisanya, 2017). Although, there are adaptations that can be made to facilitate continued work in such a situation, for example, such an individual might be redeployed or assisted via the recommendations of hearing conservation guidelines, and where this is not done, people with hearing loss will earn less than those without hearing loss and are more likely to be unemployed and experience work discrimination (Kochkin, 2010; Bowe, McMahon, Chang, & Louvi, 2005).

Hearing loss is classified as "conductive" or "sensorineural" and even mixed depending on the site of the problem. Conductive hearing loss occurs when there is a blockage in the outer or middle ear and can often be corrected surgically or through strict adherence to hearing conservation protocols, while sensorineural hearing loss describes a condition in which the problem lies in the cochlea (inner ear) or in the nerve pathways to the brain and this condition is always a permanent problem, as well required aural rehabilitation. Mixed hearing loss occurs when a person suffers from both conductive and sensorineural problems. Hearing loss can be of different degrees, ranging from mild to profound or total deafness. The categories are based on the results of audiological evaluations. Thus, Okuoyibo (2006) explained hearing loss as a generic condition that reduces the hearing acuity of an individual and makes it impossible for him to perceive and interpret auditory signals. While, IDEA (2004) expressed that hearing loss is an impairment in hearing, whether permanent or fluctuating that adversely affects a child's educational performance. According to Waleed, Al-Kandari and Hasan (2015), hearing loss is categorised as being mild, moderate, severe or profound loss, which includes deafness and hard of hearing. It is identified by the decibel (dB) loss; a mild loss is ranged between 25-40dB, moderate is 41-55dB, moderate-tosevere is 56-70dB, severe is 71-90dB, and profound is 91^{+}dB. Thus, an individual with a mild hearing loss has difficulty hearing soft sounds that is a bit far away, while a moderate hearing loss can lead to misunderstanding of conversational speech if the speaker is more than 5 feet away to the recipient, especially in a noisy environment (or where there is a lot of people) such as a public place or classroom setting. For someone with a moderate-to- severe hearing loss, the speaker must be loud to be understood and any group discussion will be hard to understand. For the severe loss, the speaker should be no further than one foot away. A profound loss may result in absolute silence or only loud sounds may be heard, such as a chain saw or jet. With this level of loss, the person is dependent on visual clues and even cues.

Hearing loss generally occurs over a range of frequencies and may be described by the term(s) such as high frequency, low frequency loss or flat depending on the pattern of hearing loss recorded. However, apart from the three conventional types of hearing loss aforementioned, there are other classifications of hearing loss based on the causes of the loss such as the presbycusis; which is a kind of hearing loss caused by old age and is also referred to as a psychogenic hearing loss, caused by emotional and psychological factors. Other types include Noise-Induced Hearing Loss (henceforth, referred to as NIHL) which is caused by the exposure to noise (sound) particularly those exceeding 85dB. NIHL can be caused by a one-time exposure to an "impulse" sound, such as exposure to loud sounds over an extended period (National Institute on Deafness and Other Communication Disorders, 2014). It should be noted that most humans are prone to NIHL owing to exposure to noise from industrial firms, traffic, airplanes, recreation centres and concerts. Noise has been observed as an environmental pollutant ravaging the human environment due to improved human environment and activities, as well as technological advancement

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(Osisanya, 1998; Osisanya, Oyewumi, & Sumonu, 2014). For instance, in Brazil, NIHL is one of the major health problems of workers, and it ranks second among the most frequent diseases of this present age. This occupational disease has been defined as a gradual decrease in hearing acuity resulting from continuous exposure to high sound pressure levels, causing injury to the middle ear and the inner hair cells of the organ of corti. NIHL is an important public health priority because as population lives longer and industrialization spreads, NIHL adds substantially to the global burden of disability. In many countries, excessive noise is the biggest occupational hazard as 16.0% of the disabling hearing loss in adults worldwide is attributed to occupational noise, ranging from 7 to 21.0% in various sub-regions (Subroto & Dhatrak, 2008).

However, it is quite unfortunate that industrial workers with NIHL may not benefit sufficiently from the information or communication experience in the factories or industries, in the sense that they lack the ability to correctly pick, comprehend and appropriately locate the source(s) of sounds. This might lead to frustration, accident, occupational health problems and psychological imbalances. Apart from these, hearing loss, especially NIHL is the most common complication associated with exposure to industrial noise. Noise pollution is one of the major health challenges, and it has deleterious effect on the auditory system and psychological well-being of industrial workers if necessary, safety guidelines and tips are not adhered to strictly. While examining the source of noise pollution in the industry to project the preventive strategies in order to determine the appropriate hearing conservation protocols that will suit the nature of industrial noise and noise pollution in such factories examined, Burns and Faukner (2002) identified sources of noise pollution as machines such as automobiles, trucks and aircraft, construction equipment, farm machines and industrial machines which are dangerously loud for the auditory systems. Similarly, Shukla (2003) identified engine ships, super tankers, offshore oil exploration and drilling as high producing noise sources. With the identification of the sources of noise pollution in the industry, it is pivotal to consider mechanism(s) to prevent occurrence of further NIHL among the industrial workers. Thus, preventing hearing loss among the factory workers who are at risk of NIHL and the attendant physiological as well as psychological problems (Szeszenia, Dabrowska, & Wilezynska, 2013) requires the assessment of the factory workers in a bid to determine the prevalence of hearing loss and the magnitude of work-related stress among the workers of the industrial firms, and also to determine the relationship between work-related stress and psychological well-being. Therefore, this study was undertaken to investigate the predictive influence of industrial noise exposure and work-related stress on auditory performance and psychological well-being of industrial workers in Ibadan, Oyo State, Nigeri**a.**

Purpose of the Research

This study was conducted to:

1. investigate the influence of industrial noise and work-related stress on the auditory performance of the industrial workers.
2. investigate the influence of industrial noise and work-related stress on the psychological wellbeing of industrial workers.
3. determine the prevalence of hearing loss among the factory workers.
4. find out the relationship between industrial noise exposure and auditory performance.
5. find out the relationship between work-related stress and auditory performance.
6. find out the relationship between industrial noise exposure and psychological well-being **7.** find out the relationship between work-related stress and psychological well-being.

Research Questions

1. What is the prevalence of hearing loss among the factory workers?

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2. What is the prevalence of those who are present with hearing loss due to continuous exposure to industrial noise?

Hypothesis

Ho_1: There is no significant relationship between industrial noise and auditory performance among factory workers in Ibadan.

Ho_2: There is no significant relationship between work-related stress and auditory performance among factory workers in Ibadan.

Ho_3: There is no significant relationship between industrial noise and psychological well-being among factory workers in Ibadan.

Ho_4: There is no significant relationship between work-related stress and psychological wellbeing among factory workers in Ibadan.

METHOD

This study adopted the survey research design of correlational type to investigate the predictive influence of industrial noise exposure and work-related stress on auditory performance and psychological well-being of factory workers in Ibadan, Oyo State, Nigeria.

The population of the study comprised all industrial workers in Ibadan, Oyo State, Nigeria, while three hundred and four (304) industrial workers were purposively selected as participants in the study. The participants were selected from four (4) purposively selected industries within Ibadan Metropolis.

Instruments used for data collection were:

A. Influence of Industrial Noise and Work-Related Stress Scale (r=0.76).
B. Sound Level Meter - To determine the noise level in each of the industrial factories.
C. Otoscope - To evaluate the status of the ear tissue.
D. Audiogrammes - For recording of auditory performance.
E. Audiometer: Maico ST 20 - To determine the participants' hearing threshold.

In an attempt to carry out this study in the selected factories, permission of the officers in-charge of Human Resources Unit of each of the factories was sought. In the commencement of the study, a digital sound level meter (Bentech: GM-13507) was employed by the researchers to measure the degree of noise the workers in each factory were exposed to. Thereafter, the researchers explained the purpose of the study to the intended participants, and each of them was given a questionnaire to fill. After filling the questionnaire, the participants were audiologically examined to determine their hearing threshold and patterns of hearing loss. Thus, they were subjected to otoscopic examination towards checking the nature of the ear canals down to the tympanic membrane. Afterwards, Pure-Tone Audiometric assessment (PTA) was conducted individually on them at the noise-free complex (healthcare centre). With the nature of PTA, Air conduction and Bone conduction tests were the only audiological evaluation conducted on them, having complied strictly with the rules of Pure-Tone Audiometric assessment. Maico ST20, which has been calibrated to British Standards, International Standards Organisation, American National Standards Institute specification and biologically evaluated for efficiency and reliable outcome was employed to conduct the Pure-Tone Audiometry. Data collected via the administration of the questionnaire were subjected to frequency counts, percentages, Pearson's Product Moment Correlation (PPMC), Multiple regression analysis (MRA); while the Pure-Tone Audiometric results were subjected to frequency counts and percentages.

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Results Demographic analysis of the participants

Table 1. Frequency distribution of respondents by gender

Gender	Frequency	Percentage (%)
Male	185	60.9
Female	119	39.1
Total	304	100.0

The results in Table 1 show that the male participants were 185 (60.9%), while the female participants were 119(39.1%). This indicates that there were more male participants than female participants, meaning that there were more male factory workers than their female counterparts.

Table 2. Frequency distribution of respondents by age

Age group	Frequency	Percentage (%)
21 to 25 years	33	10.9
26 to 30 years	86	28.3
31 to 35 years	50	16.4
36 to 40 years	47	15.5
41 to 45 years	44	14.5
46 to 50 years	19	6.3
50 years and above	25	8.2
Total	304	100.0%

The results in Table 2 reveal that the majority of the workers were in the age group of 26-30 years. In fact, the group accounted for 28.3% (86) of the participants, followed by those in the age group of 31-35 years with 16.4% (50) and closely followed by those in age groups of 36-40 years and 40-45 years, with 15.5% (47) and 14.5% (44) respectively. While those in age group of 21-25 years were 33 in number accounting for 10.9% of the participants, and those above 50 years of age were 25 (8.2%) in number as against 19 (6.3%) in the age group of 46-50 years, which is the least in the categories of the participants.

Answering the research questions

RQ_1: What is the prevalence of hearing loss among workers?

Table 3i. Prevalence of hearing loss among the factory workers

Items	Number	Percentage
Participants without hearing loss	98	32.2%
Participants with hearing loss	206	67.8%
Total	304	100

The result in Table 3i shows that 98 (32.2%) participants were found without any type of hearing loss, while 206 (67.8%) participants presented with hearing loss. This result reveals further that 206 of the sampled factory workers were with unidentified hearing loss. Thus, many of the factory workers have developed different types and nature of auditory disabling conditions, which would have negative impact on their daily interpersonal interaction, productivity at work and overall psychological well-being, if the reduced auditory sensitivity is not rehabilitated early.

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Table 3ii. Different patterns of hearing loss of participants based on audiometric report

Pattern of hearing loss	Right ear	%	Left ear	%
	Frequency	Percentage	Frequency	Percentage
Normal	55	20	45	16.4
Mild	90	33	80	29
High Frequency hearing loss	130	47	150	54.6
Total	275	100	275	100

Table 3ii shows the different patterns of hearing loss observed among the sampled factory workers based on the audiometric performance of each of the hearing systems of the factory workers. Therefore, out of 275 workers audiometrically tested only 55 participants had normal auditory acuity on their right ear, while 45 participants had normal hearing acuity at the left ear. 90 of the participants had mild hearing loss at the right ear as against 80 with left ear mild hearing loss. Also, 130 of the participants had high frequency hearing loss at their right ear, while 150 of the participants had high frequency at the left ear. The finding implies that 220 (80.0%) out of 275 right ears examined had different types of hearing loss, while 230 (83.6%) at 275 left ears examined had different forms of hearing loss. The finding also indicates that there is no significant difference in the auditory performance at both the right and left ears of the participants.

Table 3iii. Prevalence of hearing loss

S/N	Item Description	Yes (%)	No (%)	Mean	Rank
1	Do you have difficulty hearing when someone speaks in a whisper or at a very low voice	188(61.8)	116(38.2)	1.62	2
2	I tune up to high volume when using mobile phone, TV or Radio	163(53.6)	141(46.4)	1.54	5
3	When people talk to me, I require for repetition or clarification	143(47.0)	161(53.0)	1.47	8
4	I cannot hear people well when outside my place of work	159(52.3)	145(47.7)	1.52	6
5	Has anyone ever told you that you are speaking too loudly when talking to him/her at your place of work or elsewhere	156(51.3)	148(48.7)	1.51	7
6	Most times when receiving calls via mobile phone, I frequently change the phone from one ear to another	216(71.1)	88(28.9)	1.71	1
7	I hear better in one ear than other	181(59.5)	123(40.5)	1.60	3
8	Do you have difficulty hearing/ understanding co-workers, clients or customers	179(58.9)	125(41.1)	1.59	4
9	Does your hearing performance cause you to feel frustrated when talking to members of your family	130(42.8)	174(57.2)	1.43	10
10	Do your family members feel uncomfortable talking to you from a far distance or behind you	135(44.4)	169(55.6)	1.44	9
	Grand mean			**1.54**	

The results in Table 3iii explain additional information about the prevalence of hearing loss among the sampled factory workers. Thus, the results show that 216; 71.1% of the participants expressed that they frequently change their phone from one ear to another most times when receiving calls. 188 (61.8%) of the participants agreed to the construct that they have difficulty hearing clearly whenever someone speaks in a whisper or at a very low voice, but 181(59.5%) claimed hearing better in one ear than the other one. On the other hand, 179 (58.9%) expressed that they have difficulty hearing or understanding their co-workers and customers whenever they are in a conversation. Also, 163 (53.5%) agreed that they always tune up to high volume whenever they are using mobile phone, as well as when viewing

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television or listening to Radio set, while 14 (46.4%) of the participants disagreed with this construct based on the mean value of χ = 1.54. 159 (52.3%) of the participants agreed that they cannot hear (understand clearly) people very well whenever they are outside of their places of work or at any other place apart from their places of work. Although, 148(48.7%) of the participants claimed that there is no one who has told them that they are speaking too high or loudly. On the other hand, 161(53.0%) of the participants disagree with the construct that they require clarification or do ask the speaker(s) to repeat whatever they are saying, but 143 (47.1%) agreed with the construct, based on the mean value of χ = 1.47, that they require repetition and clarification whenever people are talking to them. With the mean value of χ = 1.44, 135 (44.4%) claimed that their family members always find it difficult and uncomfortable taking with them from a distance or behind them, as against 174 (57.2%) of the participants who reported that their family member find it easy and convenient to communicate with them. In a nutshell, the findings in Table 3iii have shown that hidden (unidentified) hearing loss was common among the sampled factory workers in Ibadan, Oyo State, Nigeria, and there is urgent need to compel all the factories in the city of Ibadan, and Oyo State in general to adhere strictly to the hearing conservation protocols, and health and safety rules.

RQ_2: What is the prevalence of those who are presented with hearing loss due to continuous exposure to industrial noise?

Table 4. Hearing loss due to continuous exposure to industrial noise

S/N	Item Description	SD (%)	D (%)	A (%)	SA (%)	Mean	Rank
1	I get annoyed with high noise level at workplace	43(14.1)	80(26.3)	112(36.8)	69(22.7)	2.68	3
2	I do have a headache due to high level noise at workplace	44(14.5)	137(45.1	76(25.0)	47(15.5)	2.41	9
3	Noise in the factory causes interference in speech for me	41(13.5)	55(18.1)	141(46.4)	67(22.0)	2.77	1
4	The hazardous effects of noise in the factory affect my productivity	27(8.9)	171(56.3	78(25.7)	28(9.2)	2.35	10
5	Factory noise makes me have poor hearing	15(4.9)	114(37.5	124(40.8)	51(16.8)	2.69	2
6	Factory noise is injurious to my health	27(8.9)	124(40.8	92(30.3)	61(20.1)	2.62	4
7	I experience a headache due to exposure to high noise in the factory	11(3.6)	153(50.3	113(37.2)	27(8.9)	2.51	6
8	Factory noise sometimes constitutes distractions to me at work	18(5.9)	154(50.7	116(38.2)	16(5.3)	2.43	7
9	I find it difficult to interact with other employees at work due to high noise interference	29(9.5)	160(52.6	92(30.3)	23(7.6)	2.36	8
10	I hardly comprehend instruction from my supervisor due to high noise exposure	5(1.6)	158(52.0	120(39.5)	21(6.9)	2.52	5
	Grand mean					**2.53**	

Table 4 presents results on the prevalence of those who are present with hearing loss due to continuous exposure to industrial noise, and the findings show the level of exposure to industrial noise. 208 (68.4%) agreed that noise in the factory causes interference in speech for them, while 96 (31.6%) disagreed and supported the findings based on the mean value of χ = 2.77. 175 (57.6%) of participants agreed that factory noise makes them have poor hearing, while 129(42.4%) disagreed and this is supported with the mean value of χ = 2.69. Also, 181(59.3%) of the participants agreed that they get annoyed with high noise level at work place, while 123(40.7%) disagreed and this is based on the mean value of χ = 2.68. 153(50.4%) agreed that factory noise is injurious to their health, while 151(40.4%) disagreed totally that

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factory noise is not in any way injurious to their health. On the other hand, 163(53.6%) of the participants disagreed with the construct that they hardly comprehend instructions from their supervisors due to high noise exposure, while 141(46.4%) of them agreed with the mean value of $\chi = 2.52$ that they hardly comprehend the instructions given to them by their supervisors. Furthermore, 164(53.9%) disagreed that they experience a headache due to exposure to industrial noise in their workplaces, while 140(46.1%) of them agreed with mean value of $\chi = 2.51$ that they always experience headache due to the pressure of noise in their places of work. 172(56.6%) of the participants disagreed that factory noise sometimes constitutes distractions to them at work, while 132 (43.4%) agreed and supported with mean value of $\chi = 2.43$. 189(62.1%) disagreed that they find it difficult to interact with other employees at work due to high level of noise interference, while 115 (37.9%) agreed that they find it difficult to interact while at work due to noise interference. Although, 198(65.2%) of the participants disagreed that hazardous effect of noise in the factory always affects their productivity at work, while 106 (34.8%) agreed with the construct and this is based on the mean value of $\chi = 2.35$. This implies that there is evidence of hearing loss due to continuous exposure to industrial noise among the factory workers sampled. The findings are indicative of negative effect of continuous exposure to industrial noise on the auditory performance and psychological well-being of the factory workers sampled.

Testing the Hypotheses

Ho_1: There is no significant relationship between industrial noise and auditory performance among factory workers in Ibadan.

Table 5. Showing the significant relationship between industrial noise and auditory performance among factory workers

Variable	Mean	Std. Dev.	N	r	P	Remark
Industrial noise	25.34	5.87	304	.377**	.005	Sig.
Auditory performance	15.42	3..36				

*Sig. at .05 level

The results in Table 5 show that there was a positive significant relationship between industrial noise and auditory performance (r = .377**, N= 304, p=.005<.05) among factory workers in Ibadan. This means that there was a significant difference in the mean value of industrial noise and auditory performance, and that continuous exposure to industrial noise brings about negative changes in the auditory performance of these workers who were constantly exposed to the industrial noise. Thus, the null hypothesis is rejected on the ground that there was a significant relationship between exposure to industrial noise and the auditory performance of the factory workers.

Ho_2: There is no significant relationship between work-related stress and auditory performance among factory workers in Ibadan.

Table 6. Showing the significant relationship between work-related stress and auditory performance among factory workers

Variable	Mean	Std. Dev.	N	r	P	Remark
Work-related stress	73.39	10.19	304	.510**	.003	Sig.
Auditory performance	15.42	3.36				

*Sig. at .05 level

Table 6 shows that there was a positive significant relationship between work-related stress and auditory performance (r = .510**, N= 304, p=0.003 < .05) among factory workers in Ibadan. There is a significant relationship between work-related stress and auditory performance among factory workers in Ibadan. The

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findings in table 6 have shown the significant relationship between work-related stress and auditory performance on the ground that there was significant difference between the mean score of work-related stress (73.39) and auditory performance (15.42). This finding suggests the rejection of the null hypothesis which states that there is no significant relationship between work-related stress and auditory performance among factory workers in Ibadan.

Ho_3: There is no significant relationship between industrial noise and psychological well-being among factory workers in Ibadan.

Table 7. Showing the significant relationship between industrial noise and psychological well-being among factory workers in Ibadan

Variable	Mean	Std. Dev.	N	r	P	Remark
Industrial noise	25.34	5.87	304	.109**	.006	Sig.
Psychological well-being	56.36	6.27				

*Sig. at .05 level

The findings in Table 7 above show that there was a positive significant relationship between industrial noise and psychological well-being (r = .109**, N= 304, p=.006<.05) among factory workers in Ibadan. The findings also reveal a strong relationship between industrial noise and psychological well-being, and that continued exposure to industrial noise could negatively affect the psychological wellbeing of those who are exposed to it on a regular basis. Furthermore, there was a significant difference between industrial noise (25.34) and psychological well-being (56.36), it could be concluded that industrial noise is capable causing negative psychological feelings. Thus, most factory workers sampled have developed negative psychological wellbeing due to continued exposure to unregulated industrial noise.

Ho_4: There is no significant relationship between work-related stress and psychological wellbeing among factory workers in Ibadan.

Table 8. Showing the significant relationship between work-related stress and psychological well-being among factory workers

Variable	Mean	Std. Dev.	N	r	P	Remark
Work-related stress	73.39	10.19	304	.419**	.000	Sig.
Psychological well-being	56.36	6.27				

*Sig. at .05 level

Table 8 reveals a positive significant relationship between work-related stress and psychological well-being (r = .419**, N= 304, p=.000<.05) among factory workers in Ibadan. This indicates that work-related stress has negative influence on the psychological well-being of the factory workers. With the significant difference in the mean of work related stress (73.39) and psychological wellbeing (56.36), it implies that the null hypothesis is rejected on the ground that there is significant relationship between the two constructs.

Discussion of Findings Prevalence of hearing loss among the factory workers

Based on the findings of this study, it has been confirmed that there were more male factory workers than their female counterparts, and the majority of the factory workers were between ages 26 and 45 years. And that majority of the factory workers had already developed high frequency hearing loss unknowingly. This finding was in line with the findings of Adesokan and Osisanya (2019). It is visible from the analysis in Table 3 that majority of the participants frequently change their phone from one ear to another when receiving calls via mobile phone and experiencing difficulty hearing when someone

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speaks in a whisper or at a very low voice. Also, it has been found that many of the participants hear better in one of the ears with attendant difficulty hearing and/ or understanding co-workers, clients or customers. Thus, they resulted in tuning up to high volume when using mobile phone, viewing television or listening to radio. Majority of the participants cannot hear people well when outside their places of work, and people do complain that they are speaking too loudly when talking to them at their places of work or elsewhere. This is in accordance with the submission of National Institute on Deafness and other Communication Disorders (NIDCD, 2007) that Noise-Induce Hearing Loss can be caused by a one-time exposure to an intense or impulse sound, such as noise explosion or continuous exposure to loud sounds over an extended period of time. This study therefore discovered that there is high prevalence of hearing loss among factory workers in Ibadan which was in tandem with earlier studies of Osisanya, Oyewumi and Summonu (2014), Fada and Osisanya (2017); and Adesokan and Osisanya (2019) that reported similar high prevalence of high frequency hearing loss among the factory workers as well as the commercial drivers in Ibadan metropolis.

Prevalence of those who are presented with hearing loss due to continuous exposure to industrial noise

Considering the findings of this study in relation to the above, 68.4% of the participants agreed that noise in the factory causes interference in speech for them, 59.3% of the participants agreed that they get annoyed with high level noise at workplace and 57.6% of the participants agreed that factory noise makes them to have poor hearing. In addition, 53% of the participants disagreed that they have a headache due to exposure to high noise in the factory. Therefore, the findings implied that the percentage of the participants that are present with hearing loss due to continuous exposure to industrial noise were more than those who are not present with hearing loss. According to studies on auditory performance of factory worker of small or medium companies by Kim, Min and Park (2009) the risk for reported accidents is more for factory workers. It is estimated that over 600 million people in the world are exposed to sounds higher than the acceptable standard in their working places (Kim et al, 2009; Shulka, 2003). Thus, those factory workers easily acquire hearing loss (especially noise induced hearing loss) due to continuous exposure to industrial noise, which was in accordance with the findings of past studies. In fact, the findings of this study supported the report of Bruce (2008) that frequent exposure to industrial noise always impairs factory workers and other employees' auditory performance as much as 40.0%. Therefore, the findings of this study were in support of the past studies on the same variables.

Relationships between the Independent Variables and the Dependent Variables

The findings revealed that there was significant relationship between the independent variables and dependent variables. The possible reason for this development could be as a result of the continuous exposure of the participants to industrial noise and work-related stress which have been negatively affecting their auditory performance and psychological well-being. Although, the noise produced by these industries varies according to their process, technology, size and nature of products, generative characteristics and complexity of their production, but the scientific evidence(s) available on noise pollution reports the consequences of noisy environment as hazardous and detrimental to human health considering the fact that when people are exposed to intense noise levels, some or all of the hair cells in the organ of corti would be damaged temporarily or permanently, and this is consistent with the study of Kim, et al (2009) which examined the auditory performance of factory workers of small or medium companies, and reported that accidents were common among the factory workers who were exposed to noise. Also, there is emergence of disorders along cognitive activities such as learning, memorizing, and other personal behaviours, followed by reduction in the efficiency of such individuals, especially in the area of intellectual activities (Muzet, 2007). Also, Goines and Hagler (2009) stated that auditory function of factory workers could make alterations in performance and social behaviours such as increasing the

rate of error, accidents, reducing concentration, memory, and the ability to solve problems, misuse of medicines, disappointment, and hopelessness.

Conclusion and Recommendations

Exposure to noise has been observed to have deleterious impact on the health of individuals working within the ravaging environment. In today's complex industrial society, noise exposure poses an increasingly serious threat to individuals hearing mechanisms. Majority of the industrial workers are unaware of the harmful effects of industrial noise to their auditory performance and psychological well-being. On the other hand, stress, due to work, is a growing concern in the current state of the economy, where employees increasingly experience varied negative conditions of overwork, job insecurity, low levels of job satisfaction and lack of autonomy. Workplace stress has been observed to have detrimental effects on the health and general well-being of the employees, as well as having negative impact on productivity at work and psychosocial life. Therefore, based on the findings of this study, it is necessary to recommend that periodic audiological assessment and evaluation should be encouraged so as to detect early if there are any change in their auditory performance. Also, the factory workers should cultivate positive attitude to following hearing conservation guideline at work, as well as practising positive healthy lifestyle both at work and outside the workplaces. They should not overwork themselves or work beyond their capacity. The factory workers should try to avoid unnecessary workload and work-related stressors. As well, every conflicting priority between work and home should be resolved early, and adequate time must be allocated for their personal rest and leisure (recreational activities). Lastly, every factory worker should endeavour to reduce their stress level regularly and cultivate the habit of eating healthy diets, enjoying regular exercise, while avoidance of alcohol and smoking is advised. The professional counselling of a career counsellor (or psychologist) and mental-health expert might also be necessary whenever there are feelings of work-related stress.

Ethics and Conflict of Interest

We declare and confirm that we have acted in accordance with ethical rules throughout the entire research. No potential conflict of interest was reported by the authors.

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