

**THE EFFECT OF NOISE POLLUTION ON PHYSICAL AND MENTAL HEALTH OF  
PREGNANT WOMEN IN EKITI STATE, NIGERIA****Owoseni Joseph Sina<sup>\*1</sup>, Ibikunle Michael Ayodele<sup>2</sup> and Ijabadeniyi Olasupo Augustine<sup>2</sup>**<sup>1</sup>Department of Sociology, Ekiti State University, Ado-Ekiti, Ekiti State, Nigeria.<sup>2</sup>Department of Social Justice, College of Social and Management Sciences, Afe Babalola University, Ado Ekiti, Ekiti State, Nigeria.**\*Corresponding Author: Owoseni Joseph Sina**

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**ABSTRACT**

Noise is ubiquitous in our environment. High intensities of noise have been associated with numerous health effects in adults, including noise-induced hearing loss and high blood pressure. Exposure to high levels of noise can have beneficial harmful effects on the pregnant woman, developing fetus and preterm infant. Therefore, this study assessed the effect of noise pollution on physical and mental health of pregnant women in Ekiti State, Nigeria. One hundred pregnant women and health workers were interviewed on the effect of noise pollution on physical and mental health of pregnant women. Findings showed that knowledge on the causes, effect and prevention of noise in pregnant women was acceptable among the respondents. Thirty four (34%) of the respondents agreed that elevated workplace or environmental noise can cause hearing impairment. Conclusively, despite reasonable knowledge on excessive noise and its effect on pregnant women and the foetus, there is a need to improve availability of information. Policy makers should enforce policies that make the manufacturers of equipment to reduce their noise output.

**KEYWORD:** Pollution, Noise, Mental Health, Pregnancy, Ekiti, Nigeria.**BACKGROUND TO THE STUDY**

Noise is one of the physical environmental factors affecting our health in today's world. Noise is generally defined as the unpleasant sounds which disturb the human being physically and physiologically and cause environmental pollution by destroying environmental properties.

A majority of women of child-bearing age in the industrialized part of the world are occupationally active today. According to Organisation for Economic Co-operation and Development (2014) about 73.7% of women of working age were employed. This leads to a high number of pregnancies potentially exposed to various occupational hazards. In Sweden, 15% of employed women report exposure to noise during at least ¼ of the working day, so loud that they could not have a normal conversation (Arbetsmiljöverket - the Swedish Work Environment Authority, 2012).

Noise is ubiquitous in our environment. High intensities of noise have been associated with numerous health effects in adults, including noise-induced hearing loss and high blood pressure. Noise is undesirable sound. The loudness of sound is measured in decibels (dB), a logarithmic scale.

Many pregnant women are exposed to noise in the workplace which may damage fetuses and newborns. Reducing noise levels can improve the physiologic stability of sick neonates and therefore enlarge the potential for infant brain development. The human cochlea and peripheral sensory end organs complete their normal development by 24 weeks of gestation.

The hearing threshold (the intensity at which one perceives sound) at 27 to 29 weeks of gestation is approximately 40 dB and decreases to a nearly adult level of 13.5 dB by 42 weeks of gestation, indicating continuing postnatal maturation of these pathways. Thus, exposure of the foetus and newborn to noise occurs during the normal development and maturation of the sense of hearing.

Sound is well transmitted into the uterine environment. One to 4 seconds of 100 to 130 dB of 1220- to 15 000-Hz sound is used as a stimulus to document the well-being of the foetus. In one study, 12 children with high-frequency hearing loss tested at 4 to 10 years of age were more likely to have been born to women who were exposed consistently to occupational noise in the range of 85 to 95 dB during pregnancy (Yao, Jakobsson, Nyman, Rabaeus, Till and Westgren, 2000).

A Chinese study found that self-reported exposure to noise during the first trimester of pregnancy was associated with the congenital anomalies. A slight increase in reports on birth certificates of observable birth defects (excluding polydactyly) was noted in one study of black women exposed to airport noise (Zhang, Cai, and Lee, 2002).

Exposure of adults to excessive noise results in noise-induced hearing loss that shows a clear dose response relationship between its incidence and the intensity of exposure and also leads to noise-induced stimulation of the autonomic nervous system, which reportedly results in high blood pressure and cardiovascular disease. It is possible to classify the effects of noise on ears in three groups: acoustic trauma, temporary hearing losses and permanent hearing loss (Gerhardt, Abrams, and Oliver, 2000).

Blood pressure increases, heart beat accelerations, appearance of muscle reflexes, sleeping disorders may be considered among the other physiological effects. The psychological effects of noise are more common compared to the psychological ones and they can be seen in the forms of annoyance, stress, anger and concentration disorders as well as difficulties in resting and perception (Yao, 2000).

### **The problem**

Noise is ubiquitous in our environment. High intensities of noise have been associated with numerous health effects in adults, including noise-induced hearing loss and high blood pressure.

Exposure of pregnant workers to high noise levels at work can affect the unborn child. 'Prolonged exposure to loud noise may lead to increased blood pressure and tiredness. Experimental evidence suggests that prolonged exposure of the unborn child to loud noise during pregnancy may have an effect on later hearing and that low frequencies have a greater potential for causing harm (European Agency for Safety and Health at Work, 2013). It is imperative to create awareness for paediatricians, nurses and pregnant women with information on the potential health effects of noise on the pregnant women and the foetus. This research therefore aims to study the effect of noise pollution on physical and mental health of pregnant women in Ekiti State.

### **OBJECTIVES OF THE STUDY**

The main objective of this study is to study the effect of noise pollution on pregnant women and the foetus. This study will also

- i. Examine the causes of noise pollution in Ekiti State.
- ii. Examine the effects of noise pollution on physical and mental health of pregnant women.

iii. To ascertain if health workers have enough knowledge on the risks associated with excess noise in pregnant women.

iv. To investigate the measures put in place to control noise pollution.

### **METHOD**

#### **Research Design**

This research employed a descriptive survey design in which the researcher used a sample drawn from the population to have an insight to the problem under investigation and uses the research findings to make generalization about the topic: The Effect of Noise Pollution on Physical and Mental Health of Pregnant Women in Ekiti State.

#### **Population of the study**

The population for this research were 50 pregnant women and 50 health workers in selected in Ekiti State.

#### **Sample and sampling techniques**

The study adopted a purposive sampling technique in arriving at the sample size. Random sampling was used to select 50 pregnant women and 50 health workers in Ekiti State for the research.

#### **Research Instruments**

The research instrument was a questionnaire which consists of two parts. Section A consisted of demographic variables like age, qualification, occupation etc while section B was a structured questionnaire used to assess the level of knowledge among staff nurses and the pregnant women regarding effect of noise on physical, physiological and mental health of pregnant women.

#### **Administration of instruments**

The data were collected by the researcher herself by using structure closed ended questionnaires. Formal permission was obtained from the concerned authority of selected hospitals, to conduct the study. Informed consent was taken from the respondents before the questionnaire was administered unto them.

#### **Method of data analysis**

The collected data were organized, tabulated and analysed by using descriptive statistics using percentage distribution.

#### **Ethical consideration**

Ethical approval was sought and obtained from Ekiti State University Teaching Hospital Ethical Committee. Consent form was also given to the pregnant women and health workers who participated in the study. Only eligible and consenting pregnant women and health care workers were used after due explanation of the purpose, objectives, benefits and risks of the study.

## DATA ANALYSIS, INTERPRETATION AND DISCUSSION OF FINDINGS

Table 1: Socio Demographic factors.

Variables		Number N= 100	Percentages (%)
Age	18-30	62	62%
	31-40	18	18%
	41-50	16	16%
	50 and above	4	4%
Education of respondents	Primary and below	9	9%
	Secondary	29	29%
	Tertiary & above	62	62%
Religion of respondents	Christianity	72	72%
	Islam	24	24%
	Traditional	4	4%
Marital Status of respondents	Single	16	16%
	Married	75	75%
	Divorce	9	9%
Occupation of respondents	Civil Servant	53	53%
	Self-employed	18	18%
	Factory Worker	19	19%
	Not employed	10	10%
Income of respondents	Less than 30,000	38	38%
	31,000- 50,000	47	47%
	51,000 – 100,000	14	14%
	Above 100,000	1	1%
Ethnic group	Yoruba	78	78%
	Igbo	17	17%
	Hausa	1	1%
	Others	4	4%

**Fieldwork, 2017:** The total number of respondents interviewed was 100. They were interviewed on demographic characteristics (their age, education, marital status, occupation, and income levels). The minimum age of the respondents was 18 years while the maximum age was 50 years.

The majority of the respondents 62 (62%) were aged between 18 and 30 years, 18 respondents (18%) were aged between 31 - 40 years, 16 respondents (16%) were aged between 41 – 50 years and only 4 respondents were aged between 50 years and above. On education of the respondents, 61 (61%) of the respondents had tertiary education, 30 (30%) had secondary education, 9 (9%) had primary education. This shows that many pregnant women in Ekiti did acquire formal education. 74 (74%)

of the respondents were Christians, 22 (22%) were Muslims, while 4 (4%) were traditionalist.

Seventy Three of the respondents were married, 18 (18%) were single, 9 (9%) were divorced. Most of the women were civil servants 53 (53%), 31 (31%) were self-employed, while 19 (19%) factory workers. Thirty Eight percent of the respondents earn less than 30,000 Naira, 47% earn between 31,000 to 50,000 Naira while 14% earned between 51,000-100,000 Naira. Only one of the respondents earned above 100,000 Naira. Seventy eight percent of the respondents are from Yoruba ethnic group, 17% were Igbo, 1 was Hausa and 4 are from other tribes. This finding was expected because the study was conducted in the Yoruba speaking community. The proportion of the Yoruba women attending antenatal and postnatal was higher compared to other ethnic groups.

Table 2: Causes of noise pollution

Variable	Strongly Agree	Agree	Undecided	Strongly Disagree	Disagree
Automobiles are a major source of noise pollution	38 (38%)	26 (26%)	7 (7%)	14 (14%)	15 (15%)
Elevated workplace or environmental noise can cause hearing impairment	34 (34%)	28 (28%)	9 (9%)	14 (14%)	15 (15%)
Many pregnant women are exposed to noise in the workplace	29 (29%)	22 (22%)	8 (8%)	18 (18%)	23 (23%)
Heavy Machineries are a major cause of workplace noise	26 (26%)	31 (31%)	10 (10%)	15 (15%)	18 (18%)

**Fieldwork, 2017:** Table 2 shows that 38 (38%) of the respondents strongly agreed that automobiles are a major source of noise pollution, 26 (26%) agreed while 7 (7%) were undecided. Fifteen (15%) of the respondents disagreed and 14 (14%) of the respondents also strongly disagreed that Automobiles are a major source of noise pollution.

Thirty four (34%) of the respondents strongly agreed that elevated workplace or environmental noise can cause hearing impairment, while 28 (28%) agreed and 9 (9%) were undecided. Fifteen (15%) of the respondents disagreed, and 14 (14%) strongly disagreed that Elevated workplace or environmental noise can cause hearing impairment.

Twenty Nine (29%) of the respondents strongly agreed that Many pregnant women are exposed to noise in the workplace, while 22 (22%) agreed. Eight (8%) of the respondents were undecided. Twenty Three (23%) of the respondents disagreed, and 18 (18%) strongly disagreed that Many pregnant women are exposed to noise in the workplace. Question 4 shows that 26 (26%) of the respondents strongly agreed that Heavy Machineries are a major cause of workplace noise, while 31 (31%) agreed. Ten were undecided, 18 (18%) of the respondents disagreed and 15 (15%) strongly disagreed that Heavy Machineries are a major cause of workplace noise.

**Table. 3: Effects of Noise Pollution.**

Variable	Strongly Agree	Agree	Undecided	Strongly Disagree	Disagree
Noise exposure can induce hypertension in pregnant women	28 (28%)	31 (31%)	11 (11%)	17 (17%)	13 (13%)
Elevated noise levels can create stress and increase workplace accident rates	21 (21%)	26 (26%)	12 (12%)	19 (19%)	22 (22%)
Elevated noise levels can have negative impact on the foetus	27 (27%)	31 (31%)	11 (11%)	14 (14%)	17 (17%)
High noise levels in the hospital ward may have a damaging effect on newborns	28 (28%)	34 (34%)	9 (9%)	14 (14%)	15 (15%)
Women who were exposed consistently to occupational noise are at risk of giving birth to children with high-frequency hearing loss	33 (33%)	27 (27%)	10 (10%)	13 (13%)	17 (17%)
Exposure to noise during the first trimester of pregnancy can lead to congenital anomalies	25 (25%)	26 (26%)	9 (9%)	21 (21%)	19 (19%)
Women exposed to high noise are at increased risk of preterm delivery	19 (19%)	22 (22%)	9 (9%)	24 (24%)	26 (26%)
Decreased birth weight can be associated with noise exposure	18 (18%)	21 (21%)	13 (13%)	23 (23%)	25 (25%)
Noise levels in hospital wards are high enough to interfere with the work of health workers	25 (25%)	29 (29%)	9 (9%)	18 (18%)	19 (19%)
Noise disturbance during the night may increase total noise annoyance in pregnant mothers the next day	28 (28%)	24 (24%)	11 (11%)	18 (18%)	19 (19%)

**Fieldwork, 2017**

Table 3 shows that 28 (28%) of the respondents strongly agreed that noise exposure can induce hypertension in pregnant women, 31 (31%) agreed, while 11 (11%) were undecided. Thirteen (13%) of the respondents disagreed and 17 (17%) strongly disagreed that Noise exposure can induce hypertension in pregnant women. Also, 21 (21%) of the respondents strongly agreed that Elevated noise levels can create stress and increase workplace accident rates, while 26 (26%) agreed. Twelve (12%) were undecided, 22 (22%) of the respondents disagreed while 19 (19%) strongly disagreed that Elevated noise levels can create stress and increase workplace accident rates.

Twenty Seven (27%) of the respondents strongly agreed that elevated noise levels can have negative impact on the foetus, while 31 (31%) agreed. Eleven (11%) were undecided, 17 (17%) of the respondents disagreed, while 14 (14%) strongly disagreed that Elevated noise levels can have negative impact on the foetus.

Twenty Eight (28%) of the respondents strongly agreed that High noise levels in the hospital ward may have a damaging effect on newborns, 34 (34%) agreed, 9 (9%) were undecided. However, 15 (15%) disagreed and 14 (14%) strongly disagreed that High noise levels in the hospital ward may have a damaging effect on newborns.

It is shown that 33(33%) of the respondents strongly agreed that Women who were exposed consistently to occupational noise are at risk of giving birth to children with high-frequency hearing loss, 27 (27%) agreed. Ten (10%) were undecided, nonetheless 17 (17%) of the respondents disagreed and 13 (13%) strongly disagreed that Women who were exposed consistently to occupational noise are at risk of giving birth to children with high-frequency hearing loss.

Twenty Five (25%) of the respondents strongly that Exposure to noise during the first trimester of pregnancy can lead to congenital anomalies, 26 (26%) agreed. Nine (9%) were undecided, 19 (19%) of the respondents disagreed and 21 (21%) strongly disagreed that Exposure to noise during the first trimester of pregnancy can lead to congenital anomalies. Nineteen (19%) of the respondents strongly agreed that Women exposed to high noise are at increased risk of preterm delivery, 22 (22%) agreed, conversely 9 (9%) were undecided. Twenty Six (26%) of the respondents disagreed while 24 (24%) strongly disagreed that Women exposed to high noise are at increased risk of preterm delivery.

Eighteen (18%) of the respondents strongly agreed that decreased birth weight can be associated with noise exposure, 21 (21%) agreed, while 13 (13%) were undecided. Twenty Five (25%) disagreed, 23 (23%) of the respondents strongly disagreed that Decreased birth weight can be associated with noise exposure. Question 9 on table 2 shows that 25 (25%) of the respondents strongly agreed that Noise levels in hospital wards are high enough to interfere with the work of health workers, 29 (29%) agreed. Nine (9%) of the respondents were undecided, 19 (19%) disagreed, while 18 (18%) of the respondents strongly disagreed that Noise levels in hospital wards are high enough to interfere with the work of health workers. The last question on the above table shows that 28 (28%) of the respondents strongly agreed that Noise disturbance during the night may increase total noise annoyance in pregnant mothers the next day, 24 (24%) agreed, while 11 (11%) of the respondents were undecided. Nineteen (19%) disagreed that Noise disturbance during the night may increase total noise annoyance in pregnant mothers the next day, 18 (18%) of the respondents also strongly disagreed.

**Table. 4: Control of Noise Pollution.**

Statement	Strongly Agree	Agree	Undecided	Strongly Disagree	Disagree
Preganant women should avoid noisy workplaces	21 (21%)	26 (26%)	12 (12%)	19 (19%)	22 (22%)
Noise-induced hearing loss in infants who were exposed to excessive noise in the uterus or as a newborn should be carried out routinely	28 (28%)	32 (32%)	5 (5%)	16 (16%)	19 (19%)
Health workers should monitor sound levels in the Intensive Care Unit of Hospitals	26 (26%)	29 (29%)	11 (11%)	15 (15%)	19 (19%)

#### Fieldwork, 2017

Table 4 shows that Twenty One (21%) of the respondents strongly agreed that pregnant women should avoid noisy workplaces, 26 (26%) agreed, 12 (12%) were undecided. Twenty Two (22%) disagreed, while 19 (19%) strongly disagreed that Elevated noise levels can create stress and increase workplace accident rates. Twenty eight 28 (28%) of the respondents strongly agreed that Noise-induced hearing loss in infants who were exposed to excessive noise in the uterus or as a newborn should be carried out routinely, 32 (32%) agreed. Five (5%) were undecided, 19 (19%) of the respondents disagreed and 16 (16%) strongly disagreed that noise-induced hearing loss in infants who were exposed to excessive noise in the uterus or as a newborn should be carried out routinely. The last question shows that 26 (26%) of the respondents strongly that Health workers should monitor sound levels in the Intensive Care Unit of Hospitals, 29 (29%) agreed. Eleven (11%) were undecided, 19 (19%) disagreed, 16 (16%) of the respondents strongly disagreed that Health workers should monitor sound levels in the Intensive Care Unit of Hospitals.

#### DISCUSSION

Noise has attracted widespread attention as a significant environmental and occupational health concern. In addition to the more obvious effects on hearing, there has been increasing concern directed toward the non-auditory effects of chronic exposure to noise, including the potential for disturbing normal fetal development. The occurrence of adverse or mildly harmful reproductive outcomes among women living or working in noisy environments has been suggested and investigated for years. The source of most outdoor noise worldwide is mainly caused by machines and transportation systems, motor vehicles, aircraft, and trains. Outdoor noise is summarized by the word environmental noise.

This research finding shows that (38%) of the respondents strongly agreed that automobiles are a major source of noise pollution. A cursory observation of our environment shows that this is true. Horns, engine noise, sudden braking and the sound of heavy trucks are now a commonplace in our environment. This is not only



detrimental to the health of the pregnant women; it could also affect the foetus.

Thirty four (34%) of the respondents strongly agreed that elevated workplace or environmental noise can cause hearing impairment. Excessive noise levels over a long period of time can damage hearing. This may happen so gradually and painlessly that the deterioration may not be noticed until it becomes pronounced. Excessive noise in the workplace presents a risk of hearing damage and other health problems. The parts of the ear that process high frequency sounds are usually the first to be affected. The degree of hearing loss depends on the loudness of the noise and your level of exposure. Sudden explosive sounds, such as gunshots, can cause immediate damage (Better health Channel, 2005). Some people exposed to excessive noise develop tinnitus, which is described as a constant ringing sound. For most cases of noise-induced hearing loss, there is no cure. Hearing aids only amplify sounds and can't replace normal hearing.

Twenty eight (28%) of the respondents strongly agreed that noise exposure can induce hypertension in pregnant women. Noise pollution affects both health and behavior. This is in agreement with Hoffmann *et al.*, (2016) who asserted that unwanted sound (noise) can damage psychological health. Noise pollution can cause hypertension, high stress levels, tinnitus, hearing loss, sleep disturbances, and other harmful effects.

Twenty One (21%) of the respondents strongly agreed that pregnant women should avoid noisy workplaces. This is in accordance with Jenny *et al.*, (2016) who agreed that there exist considerable association between maternal occupational noise exposure > 85 dBA during pregnancy and hearing dysfunction among children was indicated. The association was more pronounced when restricting the study to full-time working mothers with < 20 days' leave of absence during pregnancy.

Some of the ways to control noise pollution are as follows

- **Control at Receiver's End:** For people working in noisy installations, ear-protection aids like ear-plugs, ear-muffs, noise helmets, headphones etc. must be provided to reduce occupational exposure.

- **Suppression of Noise at Source:** This could be achieved by designing, fabricating and using quieter machines to replace the noisy ones.

Also, noise pollution can be reduced by proper lubrication and better maintenance of machines, installing noisy machines in sound proof chambers, covering noise-producing machine parts with sound-absorbing materials to check noise production.

From the above discussion, it is evident that noise is not merely a nuisance but is a serious environmental problem and a health hazard. Like all other pollutions,

noise pollution needs to be controlled by measures which will maintain the acceptable levels of noise pollution for human beings.

## CONCLUSION

This research supports the claim that occupational noise exposure during pregnancy has an effect on physical and mental health of pregnant women. Taken together with previous epidemiological and experimental studies as well as mechanistic data, the available data indicate that pregnant women should not be exposed to high levels of noise at work. Nonetheless, whether impulse noise affects health or causes physiologic alterations depends both on how long the duration is and on how frequently this noise occurs. If the noise exposure is not continuous but is intermittent, the period between noise episodes may provide adequate time to recover from temporal physiologic alterations. Only a very high level of impulse noise lasting a significant length of time can cause instant damage. In addition there is a need to further study the effects of intermediate levels of occupational noise, peak values, and leisure-time exposure, such as rock concerts. Although leisure-time activities are of much shorter duration, the exposure intensity may be very high.

## RECOMMENDATION

Providing safe prenatal and early neonatal care is not just the responsibility of the family and health care providers. It is also that of the policy makers within each health care system responsible for providing care during this vulnerable time in early development. The following recommendations are made to protect pregnant women and foetus from excess noise

1. Technology should be provided to and placed strategically to monitor and alert pregnant women when sound levels exceed established policies.
2. Use of sound attenuating devices, keeping staff away from bedsides during shift reports and other strategies is also recommended.
3. Where there is evidence to safely and effectively address the issue of elevated sound levels, it is the ethical obligation of those involved in their care to keep abreast of new and innovative ideas to address this dilemma.
4. Policies should be made to encourage manufacturers to reduce noise from manufacturing, medical and factory equipment.

## REFERENCES

1. Arbetsmiljöverket (2012). the Swedish Work Environment Authority.
2. Arbetsmiljön 2011 – the work environment 2011 (in swedish). Stockholm.
3. Babisch, W. The noise/stress concept, risk assessment and research needs. *Noise Health*, 2002; 4: 1–11.
4. Berglund, B. and Lindvall, T. Community Noise. *Archives of the Center for Sensory Research*. Stockholm, 2005; 2(1): 1-195.

5. Blanc, A.K.; Wardlaw, T. Monitoring low birth weight: An evaluation of international estimates and an updated estimation procedure. *Bull. WHO.* 2005; 83: 178–185.
6. Cowan, J.P. Educating the public on environmental and recreational noise exposure: 2004, pp. 14-20. In *Handbook of Environmental Acoustics*. New York.
7. European Agency for Safety and Health at Work (2013). *The impact of noise at work*. ISSN 1681-2123.
8. Gerhardt KJ, Abrams RM, Oliver CC. (2000). Sound environment of the fetal sheep. *Am J Obstet Gynecol.* 1990; 162: 282–287.
9. Gorai, A.K., Pal, A.K. Noise and its effect on human being-A review. *Journal of Environmental Science and Engineering.* 2006; 48: 253-260.
10. Gordana R., Helga E., L. and Anna L. H. Reproductive Outcomes Associated with Noise Exposure — A Systematic Review of the Literature. *Int. J. Environ. Res. Public Health,* 2014; 11: 7931-7952.
11. Hoffmann, Barbara; Moebus, Susanne; Stang, Andreas; Beck, Eva-Maria Dragano, Nico; Möhlenkamp, Stephan; Schmermund, Axel; Memmesheimer, Michael; Mann, Klaus (2006-11-01). "Residence close to high traffic and prevalence of coronary heart disease". *European Heart Journal.* 2006; 27(22): 2696–2702.
12. Hohmann. C., Grabenhenrich, L., de Kluizenaar, Y., Tischer, C., Heinrich, J., Chen, C., Thijs, C., Nieuwenhuijsen, M., Keil, T. Health effects of chronic noise exposure in pregnancy and childhood: A systematic review initiated by ENRIECO. *Int. J. Environ. Health,* 2013; 216: 217–229.
13. Jenny S., Maria A., Rosenhall, L. R., Marie L. and Gustavsson P. (2016). Maternal Occupational Exposure to Noise during Pregnancy and Hearing Dysfunction in Children: A Nationwide Prospective Cohort Study in Sweden.
14. Job, R.F.S. The influence of subjective reactions to noise on health effects of the noise. *Environment International,* 2006; 22(1): 93-104.
15. Juang D. F., Lee C. H., Yang T., Chang M. C., Noise pollution and its effects on medical care workers and patients in hospitals, *Int. J. Environ. Sci. Tech.,* 2010; 7(4): 705-716.
16. Khursheed A.W. and Y.K. Jaiswal, Assessment of noise pollution in Gwalior Madhya Pradesh, India, *Advan. Bio Res.,* 2010; 1(1): 54-60.
17. Lad R. J., Patil V. N. and Raut P. D. Study of noise pollution during Deepawali festival in Kolhapur City of Maharashtra, India, *Ind. Streams Res. J.,* 2011; 1(7): 82.
18. Meyer R.E, Aldrich, T.E., Easterly, C.E. Effects of noise and electromagnetic fields on reproductive outcomes. *Environ Health Perspect* 1989; 81: 193-200.
19. Nakamura, K.; Sheps, S.; Arck, P.C. Stress and reproductive failure: Past notions, present insights and future directions. *J. Assist. Reprod. Genet.* 2008; 25: 47–62.
20. Organisation for Economic Co-operation and Development (2014). Employment rate of working age population, sweden, women, 2014 q3, <http://data.Oecd.Org/emp/employment-rate.Htm#indicator-chart> date accessed 2015-02-13.
21. Peter, G. K., Rudy, J., Matetic., Adam, K., Smith., Susan, B., Bealko. Application of Prevention through Design for Hearing Loss in the Mining Industry. *Journal of Safe Research:* 2008; 39: 251-254.
22. Piccolo, A., Plutino, D., Cannistraro, G. Evaluation and analysis of the environmental noise of Messina, Italy. *Applied Acoustics:* 2005; 66: 447–465.
23. Prasher, D. Estimation of hearing damage from noise exposure, World Health Organisation and European Centre for Environment and Health Report on the Technicalmeeting of exposure–response relationships of noise on health, Bonn, Germany: 2003, pp. 17–19.
24. Richards D.S., Frentzen B., Gerhardt K.J. Sound levels in the human uterus. *Obstet Gynecol* 1992; 80: 186-90.
25. Rocha E.B., Frasson A. M., Ximenes F.A. Study of the hearing in children born from pregnant women exposed to occupational noise: Assessment by distortion product otoacoustic emissions. *Braz J Otorhinolaryngol,* 2007; 73: 359-369.
26. Savale P. A. (2014). Effect of Noise Pollution On Human Being: Its Prevention And Control *Journal of Environmental Research And Development,* April-June 2014; 8(4).
27. Subramani T., Kavitha M. and Sivaraj K.P. Modeling of traffic noise pollution, *Int. J. Engineer. Res. Appl. (IJERA),* 2012; 2(3): 3175-3182.
28. Suter, A.H. (2001). *Noise and Its Effects*. Prepared for the Consideration of the Administrative Conference of the United States.
29. Tometten, M.; Blois, S.; Kuhlmei, A.; Stretz, A.; Klapp, B.F.; Arck, P.C. Nerve growth factor translates stress response and subsequent murine abortion via adhesion molecule-dependent pathways. *Biol. Reprod.* 2006; 74: 674–683.
30. Yao Q.W., Jakobsson J., Nyman M., Rabaeus H, Till O, Westgren M. Fetal responses to different intensity levels of vibroacoustic stimulation. *Obstet Gynecol.* 2000; 75: 206–209.
31. Zhang J, Cai WW, Lee DJ. (2002). Occupational hazards and pregnancy outcomes. *Am J Ind Med.* 1992; 21: 397–408.