

Adverse Effect of Industrial Pollution on the Reproductive Outcome of Couples Living in and Around Bollaram and Patancheru Industrial Area

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Abstract – The effects of prolonged exposure to industrial pollutants and their spread in the environment results in development of diseases. Industrial pollutants can kill animals and plants, imbalance ecosystems and degrade man's quality of life. Factory workers and people living near the areas with uncontrolled industrial pollution are especially vulnerable to health problems. Bollaram and Patancheru is one of the most important industrial areas in Hyderabad city of Telangana state. The present research aims to provide a further understanding about the adverse effects of industrial pollution on the reproductive outcome in couples who are living in and around this industrial area. Reproductive performance of 350 couples of this industrial area and 350 couples living away from the industrial area was studied. The frequencies of abortions, congenital malformations, still births, premature births and neonatal deaths were estimated. The analysis of the data showed an increase in the frequency of abortions, neonatal deaths, still births, congenital malformations, premature births and a decrease in the live births in the couples of industrial area compared to controls. The fertility rate of couples living in industrial areas also decreased in the controls in comparison in couples of industrial area. The adverse reproductive outcome of couples might be due to undue exposure to the industrial pollution. In order to reduce the effects of the Industrial pollution on man, the industries should take necessary action to treat industrial waste or gases before they are let in to the environment.

Keywords: Industrial Pollution, Reproductive outcome, Neonatal deaths, congenital malformations

I. INTRODUCTION

During the last 50 years of independence, India has undergone rapid industrialization and developments. In developing as well as underdeveloped countries, industrial effluents are released directly or indirectly into air, soil and natural water resources, mostly without proper treatment, thus posing a serious threat to the environment and it has a negative impact on human lives and health.

Effects of chemical exposure on reproductive system of women has become a major concern in scientific community and this has become serious public issue regarding the adverse reproductive effects of environmental exposures occurring via three major pathways: contact with ambient air, soil, and drinking water (1), (2). Those who live near polluted sites may be exposed to chemicals released into the air as well as through surface or groundwater pollution, or by direct contact with contaminated soil. Indeed, these toxicants originating from contaminated sites including heavy metals, and volatile and other organic compounds have been reported to affect reproductive outcome (2). In 2008, WHO stated that "reproductive and sexual ill-health accounts for 20% of the global burden of ill-health for women, and 14% for men (3). The ambient air pollution showed adverse effect on reproductive outcome such as spontaneous abortions, fetal growth, preterm delivery and infant mortality, as per the epidemiological investigations of Glinianaia et al., 2004 (4)

Occupational exposure to chemical or biological agents may be harmful to workers reproductive health and might inflict damage to the male and female reproductive system of the workers (5) or evoke adverse effects on their sexual function and fertility alterations, diminished libido and potency, menstrual disorders, premature menopause, delayed menarche, ovarian dysfunction, impairment of semen quality (6) and reduced male and female fertility (7). Congenital anomalies are part of a

spectrum of adverse pregnancy outcomes that may be associated with exposure to environmental pollution. This spectrum also includes fetal death, including early spontaneous abortions, low birth weight associated with prematurity or intrauterine growth retardation, and neurodevelopmental effects that can only be detected in later infancy and childhood (8) Below the age group of 5 years, around 3.3 million of children die due to severe birth defects and every year around 300,000 newborns die due to birth defects within the first 28 days of life (9), (10), (11).

Reproductive toxic compounds have potential to alter either the development of the reproductive organs during the embryonic stages or diminish growth of the reproductive organs directly or indirectly such that ultimately the reproductive fertility of the individual is altered. Chemical pollution causes parturition, early pregnancy loss, neonatal deformities and death. The maternal proximity to pollutants may also cause contamination of their breast milk (12) Exposure later in pregnancy will decrease the birth weight and affect the growth of the brain and is more likely to reduce the duration of gestation. A minor level of exposure may cause birth defects, whereas a high dose may cause miscarriage or infertility (13).

Maternal residential proximity to industrial emissions was associated with increased risk of adverse pregnancy outcomes (14), chromosomal anomalies (15), and low birth weight (21) in numerous residents. Population monitoring for health effects of environmental pollutants is a critical problem especially in the case of mixed, low level chemical exposures. Many studies have reported adverse pregnancy outcome in off-springs associated with a maternal residence near incinerators (16), but very few studies have examined the effects in people living near industrial facilities (17). Since it is not possible to control the background exposure conditions, it is difficult to recognize the contaminants responsible for the observed effects in residents.

Need For the Study on People of Patancheru and Bollaram industrial area

The current study was carried out in residents of Patancheru-Bollaram industrial area to assess the risk of reproductive performance. The Patancheru-Bollaram industrial Estate is one of the main industrial hub in Hyderabad. This industrial Estate was established in 1975 in Medak district of Telangana state from Hyderabad. It is one of the most industrially polluted area having a huge number of industries manufacturing pharmaceutical drugs, bulk drugs, paints, pesticides, steel, plastics, textiles, leather and rubber. Here industries discharge lot of illegal toxic effluents and substances from various sources and contaminate the air, soil and water. The influence is such that a pungent and acrid odor is released in this area. This region depends on ground water for sustenance and is supported by seasonal streams like the NakkaVagu and IskaVagu. Current reports suggest that both groundwater of the area and the surface water in NakkaVagu are seriously polluted due to domestic sewage, industrial effluents and also due to partially treated effluents from the common effluent treatment plant (CETP) of this region. As per the study of CPCB, the Patancheru –Bollaram industrial area is treated as critically polluted, very few studies were carried out on the health hazards in people living in this industrial area. Thus in the current study an attempt is made to understand the reproductive outcome in the residents of this area.

II. RELATED WORK

Sandra et al (1992) “Risk of Congenital Malformations Associated with Proximity to Hazardous Waste Sites” results indicated that maternal proximity to hazardous waste sites may carry a small additional risk of bearing children with congenital malformations. Higher malformation rates were associated with both a higher exposure risk.

T J B Dummer et al., (2003) “Adverse pregnancy outcomes around incinerators and Crematoriums in Cumbria, north west England, 1956–93”, studied the risk of spina bifida, heart defects, stillbirth, and anencephalus in relation to proximity to incinerators and crematoriums in particular because of the increased use of incineration as a method of waste disposal.

III. MATERIALS AND METHODS

Study area

The present study was conducted in the residents of Patancheru-Bollaram industrial area, Hyderabad, Telangana state to evaluate the reproductive outcome in couples of the industrial area.

Study population

350 couples living in and around Patancheru –Bollaram industrial area were enrolled for the study (exposed group). For comparison, 350 couples belonging to the same age group and socioeconomic status and who were not occupationally exposed to chemical compounds and living away from the industrial area were selected (control group). This study was approved by the institutional ethics committee. Information on the, age, sex, socioeconomic status, nativity, hygienic conditions, surrounding environment, type of drinking water, family history, occupation (nature of work, duration of stay), habits (smoking

& nonsmoking), family history (marital status), general health and reproductive history (number of live children, abortions, still births, neonatal deaths, premature births, congenital malformations) and medical history (occurrence of chronic diseases, recent medication information etc.). The participants were informed about the objectives of the investigation and written consent was obtained from each person. Information on the weight, height, diet, literacy was also collected from the subjects from both the groups and entered in a questionnaire specially prepared for this purpose.

The following inclusion and exclusion criteria were followed for the selection of subjects in both the study and control groups.

- Inclusion:** 1. Residents with a minimum stay of 1 year
2. Residents not occupationally exposed to physical or biological agents
- Exclusion:** 1. Residents with less than one year stay
2. Industrial workers
3. Couples moved to the industrial area after conceiving elsewhere.

Statistical analysis

The differences in the demographic data and frequencies of reproductive parameters between the study and control groups were analysed for significance using chi-square test and t-test.

IV. RESULTS AND DISCUSSION

The demographic characteristics of the couples of the residents of industrial area and non industrial area are shown in **Table 1**.

The mean age of the residents of the industrial area was 32.3 yrs. as against 35.2 yrs. of the residents of the non-industrial area. Nearly 52% of the residents of the industrial area were obese having BMI ≥ 25 Kg/m² while only 41.71% were obese in control group (non industrial area group). The results also showed a higher prevalence of underweights (5.14 %) in industrial residents than in people who were living in non industrial area (2.57%). The Mean weight of industrial residents was 67 kg and that of control subjects was 62 kg. 42.57% industrial residents had a normal weight and 55.71% of control subjects have normal weights. 94.85% were non-vegetarians among study subjects as against 84.85% in the controls. 69.42% were literates and 30.57% were illiterates among the residents of industrial area while 83.14% literates, 16.85% illiterates were observed in non industrial area. 22.85% smokers were observed in industrial residents and 7.14% smokers were observed among the residents of non industrial area group.

Table – 1. Demographic data for the couples of Residents of industrial and non-industrial areas

S.No.	Parameter	Residents of industrial area	Residents of non industrial area	P-Value
1	Age (Years)			
	Mean + SD	32.3+10.00	35.2+12.00	0.020*
2	Height (cm)			
	Mean + SD	158.29+8.00	160.09+7.00	0.017*
3	Weight (Kg)			
	Mean + SD	67.0+11.00	62+9.99	0.01**
4	BMI (Kg/m ²)			
	Under weight (<18.5)	18 (5.14 %)	9(2.57)	0.140
	Normal (18.5-24.9)	149 (42.57%)	195(55.71)	
Obese (>25)	183 (52.28%)	146(41.71)		
5.	Veg	22 (6.28 %)	53(15.14)	0.01**
	Non-Veg	328(94.85%)	297(84.85)	
6.	Literates	243 (69.42%)	291(83.14)	0.01**
	Illiterates	107(30.57%)	59(16.85)	
7.	Duration of Exposure (Years)			
	Range	1 -30 years		
8.	Smokers	80 (22.85)	25(7.14)	0.01**
	Non-smokers	150(77.14)	325(92.85)	

***p<0.05 significant **P<0.01 highly significant**

Reproductive performance of the 350 couples who were living in and around the industrial area and for comparison equal number of 350 couples who were living away from industrial area and not exposed to industrial pollutants (Control group) was studied and the results on the outcome of the reproductive performance of couples living in industrial area and non-industrial area are shown in **Table-2 and Figure -1**

Table – 2 Reproductive outcome of the couples living in and around the Bollarum and Patancheru industrial area.

Group	Number of couples	Infertile couples	Fertile couples	Number of pregnancies	Number of live births	Number of abortions	Number of still births	Number of neonatal deaths	Number of congenital defects	Number of premature births
Non-Industrial Residents	350	45 (12.85)	305 (87.14)	542	509 (93.91)	25 (4.61)	0 (0.00)	8 (1.47)	0 (0.00)	0 (0.00)
Industrial Residents	350	115 (32.85)	235 (67.14)	360	273 (75.83)	50 (13.88)	12 (3.33)	25 (6.94)	10 (2.77)	11 (3.05)
X ² P Value		0.01 **	0.01 **		0.03*	0.01 **	0.01 **	0.01 **	0.01**	0.01**

***p<0.05 significant **P<0.01 highly significant**

There was a significant increase in the frequency of abortions (13.88%) and neonatal deaths (6.94 %) in the couples of the industrial area, when compared to the frequency of abortions (4.61%) and neonatal deaths (1.47%) recorded in the couples from the non-industrial area. There was a significant decrease in the frequency of live births (73.83%) in the study group when compared to the controls (93.91%). Frequency of stillbirths (3.33%) and premature births (3.05%) was significantly high in the offspring of the couples from the industrial area workers when compared to the data from the controls (0.0%). In Control group 12.85 % were found to be infertile couples whereas in the study group 32.85% were found to be infertile indicating a high percentage of infertility amongst the study subjects. The statistical analysis of the results showed that the increase in infertility rate, abortions, neonatal deaths, still births, premature births in the study group was significant compared to the control group.

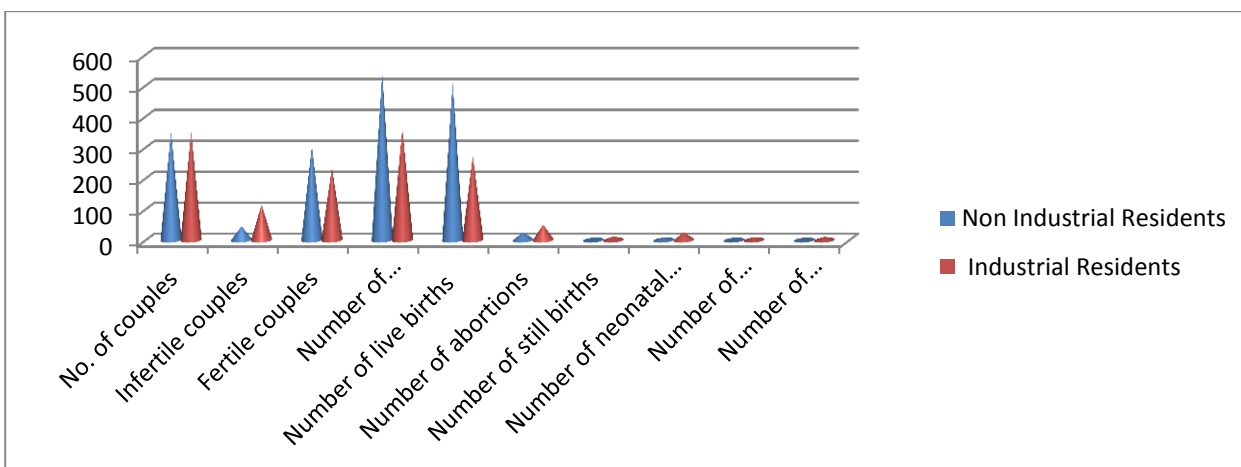


Figure – 1 Reproductive performance of couples who are living in and around Patancheru and Bollarum industrial areas

The effect of environmental pollutants on human health is one of the major concerns presently in environmental health. Scientific investigations are now focusing on identifying and understanding the role of environmental pollutants in the development of birth outcomes that result from in utero exposure to environmental pollutants. Both animal and human epidemiological studies showed that air pollutants cause defects during gametogenesis leading to a drop in reproductive abilities in exposed people. Air quality has an impact on overall health as well as on the reproductive function, so increased consciousness of environmental protection concerns is needed amongst the general public and the authorities (7).

In the present study an increase in abortions, neonatal deaths, still births, premature births, congenital malformations have been observed in women living in industrial area. These adverse effects might be due to exposure of women to industrial pollutants before or during pregnancy. Extensive studies have been carried out on the ill effects of air pollution from all over the globe and the results have shown reduced live births and increased still births. In the present study a decrease in the fertility was also recorded in the residents of the industrial area (Table 2).

Our results are in agreement with that of (18) and (19) who also found higher frequency of abortions in a population living near a landfill site. Our results are also in agreement with that of (16) who also found higher frequency of neonatal deaths in relation to proximity at birth to incinerators and crematoriums.

The results are also in agreement with studies carried out in populations living near special waste landfill sites by (20),(21) also observed abnormal still births. In population living near industrial sites (22) showed abnormal congenital anomalies associated with residential proximity to polluted sites. The abnormal reproductive outcome in the residents might be due to exposure to the industrial pollutants in this area. The results further suggest that reproductive performance may be considered as suitable biomarker to delineate the genotoxic effects of industrial pollution in the risk populations. Shirangi et al., (2011) (23) in his recent review presented evidence for strong association between pesticides near the houses and adverse reproductive outcome. Mariana Tavares Guimaraes et al., (2011) (24) carried out a study on the reproductive outcome in metropolitan cities of Santos and Sao Vicente estuary located very close to industrial areas in Brazil and the results have shown a reduced number of pregnancies in the contaminated areas. However no significant increase in the spontaneous abortions and low birth weight was observed. Earlier studies carried out have clearly shown health problems, genetic and cytogenetic damage in agricultural and industrial workers occupationally exposed to various chemicals in India has increased over the past 5 decades. Studies on the adverse effects in people living in and around industries are however very scanty. In recent years a number of authors have reviewed the evidence on the relation between prenatal exposure to air pollutants and reproductive outcomes (25),(26),(27),(28),(29),(30),(31),(32), in these reviews several outcomes have been related to exposure to air pollution during pregnancy, including low birth weight, reduced birth size, fetal growth retardation, pre-term birth, stillbirth, congenital malformations, and infant mortality. Few studies carried out on people living near to industrial dumps and in children playing close industrial waste indicated certain health problems (2),(33), (22). Further studies are needed to understand the genetic and cytogenetic damage in people residing in industrial areas.

V. CONCLUSION

In the present study, the frequencies of abortions, malformations, still births, premature births and neonatal deaths in couples living in the Industrial and Non Industrial areas were estimated. The analysis of the data showed a significant increase in the frequency of abortions, neonatal deaths, still births and a decrease in fertility and live births observed in couples from the industrial area when compared with controls. The adverse reproductive outcome of couples might be due to undue exposure to pollutants from nearby industries. Industrial pollutants or effluents should be properly treated by the management of the industries before disposal to protect environment and people's health. Government agencies should consider these conclusions in establishing rules and regulations for enforcement of appropriate procedures to reduce pollution from industries.

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