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# Reproductive performance in wives of steel industrial workers

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***Abstract***

***Background:*** *Many factors such as exposure to physical and chemical agents, life style, smoking, and alcoholism habit may affect our reproductive health and ability to produce healthy children. We may be exposed to these factors at work, at home, or in the community, where they can cause reproductive or developmental problems such as infertility, miscarriage, birth defects, low birth weight, abnormal growth and development and childhood cancer. This study aims to investigate the reproductive outcome in spouses of the steel industry workers. Many studies have been carried out on health problems, cytogenetic damage but no studies have been carried out in spouses of workers exposed to steel dust. Hence a detailed study has been taken up to understand the hazards on reproductive system of male steel industrial workers, using reproductive performance as a parameter.*

***Methods:*** *The study population consisted of 260 steel industry workers and 255 control subjects who belonged to the same age group and socio economic status for the reproductive performance. The information on reproductive history including the number of pregnancies, live births, abortions, still births, neonatal deaths, premature births, malformations etc. were analyzed. The study was approved by the Institutional Ethics Committee of the Centre and written informed consent was obtained from all the participants of the study. The results were analyzed statistically using the appropriate t-test to find the significance for the differences in the reproductive outcome, between the two groups.*

***Results****: A significant increase in the frequency of spontaneous abortions (3.86% vs 1.30%)), premature births (3.40% vs 1.08%), neonatal deaths (2.27% vs 0.65%), malformations (1.81% vs 0.43%), still births (1.13 vs 0.21%), was observed in the spouses of the steel industrial workers compared to the control group.*

***Conclusion:*** *The findings of this study indicated adverse reproductive outcome in the spouses of steel industrial workers. This might be due to the undue exposure to steel dust at work place. Appropriate precautionary measures have to be taken to prevent or minimize the exposure of the workers to steel dust.*

***Keywords:*** *Spontaneous Abortion, Reproductive Dysfunction, Occupational Exposure, Birth defects.*

## Introduction

A person spends, on an average, one-third of his life at his workplace and therefore the environment in which he works can be a major factor in determining health. Men are forced to work anywhere under the influence of economic gain, to earn and meet the financial needs of the family .Therefore male reproductive health that faces various risks during his working life should be considered as a pain factor. The emitted material coming from steel industry contains heavy metals such as nickel, chromium, iron, manganese, cobalt, tungsten, molybdenum and vanadium etc. and hence workers exposed to steel dust are at high risk for health and reproductive problems.

Human exposure to heavy metals has risen dramatically in the last 50 years in the use of heavy metals in steel industries. In this aspect many international and national studies, related to reproductive performance have been carried out in industrial workers. Many studies have shown a decrease in semen quality which has increased the focus on male reproductive health. Studies have shown that heavy metals like lead (Pb), cadmium (Cd), and mercury (Hg) have toxic effects on reproductive outcome and are also associated with miscarriages (Gerhard, *etal.,* 1998).

Semen abnormalities correlated with the number of years of exposure to chromium Cr (VI) (Elbetieha, *et al*; 1997).Hong lif *et al.,* (2001) observed occupational exposure to Cr (VI) reduced sperm counts and sperm motility in electroplating workers. Long exposure to some of the metals has been documented to cause disruption in the fetal developmental process and pregnancy outcome (Kumar 2011). Astrid Sigel *et al*.,(2011) showed adverse effects of metals on male fertility that include altered genetic material of sperm, altered spermatogenesis, pregnancy loss, genetic diseases in offspring. Nordberg *et al*., (2005) reported adverse male

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reproductive functions that include size of testis, semen quality, seminal vesicles, reproductive endocrine function, impotency, and fertility. Welding fumes typically include many agents with potential reproductive toxicity, e.g. hexavalent chromium, nickel, cadmium, manganese, and carbon monoxide which have been reported to cause an increased risk of infertility and reduced semen quality among male welders. However, the studies have shown that spouses of stainless steel welders have an increased risk of spontaneous abortions (Hjollund, *et al*., 2000). Here we report cross-sectional data concerning the reproductive performance in spouses of steel industry workers who are occupationally exposed to steel dust.

## Materials and methods

260 spouses of steel industry workers and 255 spouses of normal subjects who belonged to the same age group and socio- economic status were studied for the reproductive performance.

Subjects for the present study were selected among the workers of the steel industry situated at Patancheru, Hyderabad, India. After informed consent was obtained, information on age, years of service, socio economic status, life style, income, occupational history, tobacco and alcohol use, health conditions, etc. and details on the reproductive history including fertility, number of pregnancies, live births, abortions, still births, neonatal deaths and congenital malformations in their offspring etc were collected following the criteria set by Danforth (1977). The results were analyzed statistically using the appropriate t-test to find the significance in the differences between the two groups for the reproductive parameters studied and the differences were found to be significant.

## Results

**Table1** Reproductive outcome of spouses of steel industry workers

| Parameter | Subjects (%) | Controls (%) | OR(95%CI) |
|---|---|---|---|
| No. Of couples | N= 260 | N= 255 | |
| Infertile couples | 30(11.53) | 12(4.70) | 2.6(1.26-5.60)* |
| Fertile couples | 230(88.46) | 243(95.29) | 0.37(0.17-0.79) |
| No. Of pregnancies | 440 | 460 | |
| Live children | 408(92.72) | 450(97.82) | 0.28(0.12-0.60)* |
| Abortions | 17(3.86) | 6(1.30) | 3.04(1.11-8.70)* |
| Premature birth | 15(3.40) | 5(1.08) | 3.21(1.08-10.1)* |
| Neonatal death | 10(2.27) | 3(0.65) | 3.54(0.89-16.3)* |
| Stillbirths | 5(1.13) | 1(0.21) | 5.27(0.60-119)* |
| Malformation | 8(1.81) | 2(0.43) | 4.24(0.83-29.0)* |

OR-Odds ratio, CI-95% Conf. interval, P value <0.05 *-Significant

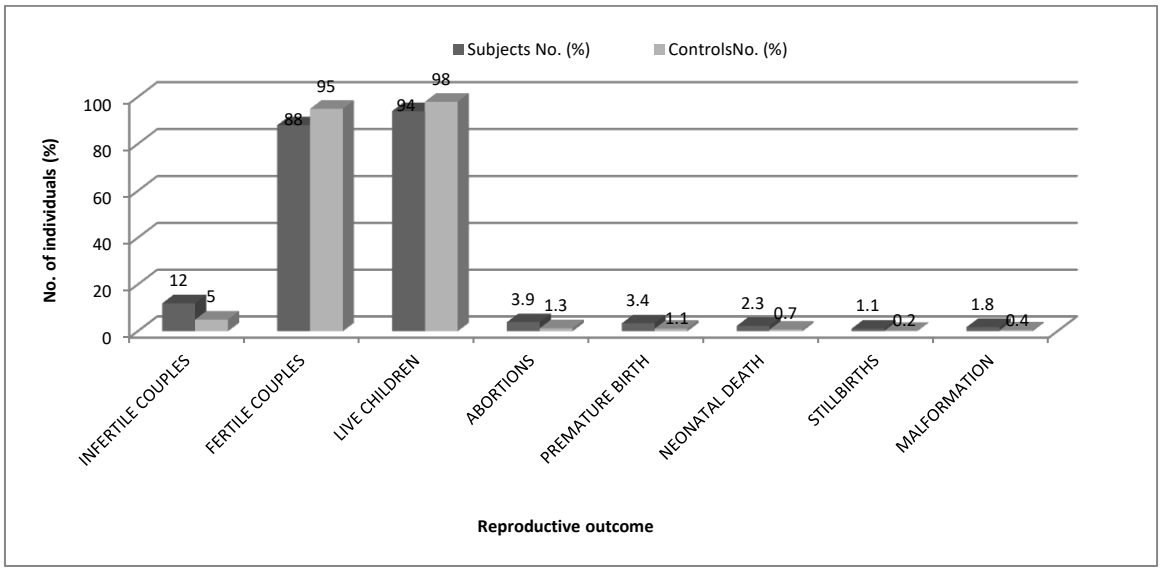


**Figure 1** Reproductive outcome of spouses of steel industry workers

The results on reproductive outcome of spouses of workers of steel industry and that of spouses of control subjects not exposed occupationally to any physical, biological and chemical agents are presented in Table 1.

260 couples in the study group and 255 couples in the control group were studied for the reproductive outcome. In the study group 11.53% were found to be infertile as against 4.70% in the control group ($p$<0.05). The results

further showed a significant increase in the percentage of abortions (3.86% vs 1.30 %), premature births (3.40 % vs 1.08%), neonatal deaths (2.27% vs 0.65%), still births (1.13% vs 0.21%) and malformation (1.81% vs 0.43%) and a significant decrease in the live births (93% vs 98%).

**Discussion**

Despite concern about the harmful effects of industrial and agricultural chemicals very little attention has been paid to generate data on reproductive performance of steel industry workers. The study presents evidence for impaired reproductive performance in spouses of steel industry workers.

Our results showed a significant increase in the frequency of abortions, stillbirths, neonatal deaths and decrease in fertility rate and a significant decrease in fertility rate and live births suggesting adverse reproductive outcome in spouses of the male steel industry workers as a result of occupational exposure to steel dust at work place. The results of this study sound an alarm about the reproductive outcome that has not received adequate attention so far. No studies have been carried out on reproductive outcome in steel industry. However similar studies have been carried out in some industrial workers. Baranski *et al*.,(1993), have shown that exposure of welding workers to agents like lead, manganese, and other welding operations including heat and noise cause an effect on male genital system, leading to sperm abnormalities, hyperestrogenism, impotence, infertility and increased spontaneous abortion rate in their wives of the exposed workers. Our results are in agreement with that of Sreedevi *et al*., (2000) who have shown an increased frequency of abortions and decreased infertility rate in traffic police due to exposure to- vehicular exhaust.

The steel dust contains nickel, chromium, iron, manganese, cobalt, tungsten, molybdenum and vanadium which are carcinogenic and mutagenic (Cornelia 2002). Thus the adverse effects might be due to exposure to complex mixtures of these heavy metals whose combined effect may be greater than the sum of their individual effects on reproductive health. The earlier studies carried out in the workers exposed to nickel, chromium, iron, manganese, lead showed adverse effects on both male and female reproductive systems.

Sunil Kumar (2004) showed occupational exposure to lead, nickel, iron and chromium was associated with reproductive dysfunction like abortion and reduction in fertility. Studies have shown effects on Semen quality of industrial workers occupationally exposed to chromium (Kumar *et al*., 2005). Piotr Rzymski *et al*., (2015) showed an increased risk of spontaneous abortions, pre-term deliveries, still births and hypotrophy in man exposed to heavy metals. Das (2009) showed an increase in the rate of spontaneous abortions among a group of 356 women who worked in a nickel hydrometallurgy refining plant. Inhorn *et al*., (2008) observed a decreased sperm count, cryptorchidism, hypospadias, miscarriages, endometriosis, impaired fertility and infertility in workers occupational exposure to heavy metals. Metals not only influence male reproductive health and fertility but also cause ill effects on the developing foetus (Agrawal *et al*., 2012). Sengupta (2012) summarized studies carried out on the effects of more than 20 metals and concluded that many metals have potential toxic effects on the male reproductive systems. Sengupta *et al*., (2013) also showed an altered sexual behavior, altered fertility and fertility problems in workers occupationally exposure to metals.
Studies carried out in animal models also showed evidence for adverse reproductive outcome in workers exposed to heavy metals. Elbetieha *et al*., (1997) have shown that fertility was significantly reduced in males exposed to the trivalent chromium compounds in experimental animal models. Kakela *et al*., (2008) conducted a study to determine the reproductive effects of nickel in both female and male Wistar rats in which one or both genders were exposed to nickel and they observed induced shrinkage of seminiferous tubules and decreased number of spermatogonia in the tubules. Aruldhas *et al*., (2004) reported Cr (VI) induced detrimental effects on fertility in experimental animal models. Das and Dasgupta (2009) also reported decreased sperm count, sperm motility in nickel treated rats.

Tina *et al*., (2000) have shown a reduced quantity and quality of semen in man exposed to welding metals. Kumar (2004) reported occupational exposure associated with reproductive dysfunction in males as well as in females. The problem of infertility has increased from 8 to 15% over the past two decades in industrialized countries (Dondero *et al.,* 1991,Runnebaum *et al.,*1997). All these studies suggest there is an increase in the environmental pollution as a result of industrialization and urbanization.

The ultimate aim and purpose of reproductive epidemiology is to promote, protect, and restore good health and reduce incidence of reproductive problems by understanding the risk factors in the steel industry workers. Many studies are based on workers exposed to a variety of metals that may be reproductive toxin. Their occupational exposure may also include such confounding exposures as heat, vibration, or noise. It is therefore difficult to attribute specific observed toxic effects in a workplace study to any single hazard, and difficult to define interactions that may increase or diminish the reproductive toxicity of a single metal. Both management and regulatory authority should take initiative to comply with occupational health regulations to control adverse reproductive health.

**Conclusions**

The result of study suggest adverse reproductive outcome in the spouses of steel industrial workers and this might be due to the undue exposure of male steel industrial

workers to steel dust at work place. Appropriate precautionary measures have to be taken to prevent or minimize the exposure of the workers to steel dust.

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