

Research Article

Hazardous effect of Agricultural occupation on male fertility in central India

S.K Sadawarthe¹, **Rekha S. Jiwane**^{*2}, Jyotsna Gumashta¹, Naveen Bankey³

¹Professor in physiology, Peoples College of Medical Sciences & Research Center (PCMS & RC), Bhopal

²Associate Professor in Physiology, Peoples College of Medical Sciences & Research Center (PCMS & RC), Bhopal

³Junior resident in Physiology, Peoples College of Medical Sciences & Research Center (PCMS & RC), Bhopal

***Correspondence Info:**

Dr. Rekha S. Jiwane

Associate Professor in Physiology,

Peoples College of Medical Sciences & Research Center, Bhopal, India.

E-mail: piyurekha@gmail.com

Abstract

Sustained Exposure to pesticides can leads to deterioration of sperm concentration, morphology and impaired motility which may result in infertility. That's why present study was planned to investigate the semen quality among farmers exposed to pesticides. Fifty five male partners in between age group of 20 to 40 years of infertile couple attending infertility laboratory exposed with pesticides and other agricultural chemicals were included in this study .We divide infertile couples into two groups first group-Group I who had less than 5 years of exposure to pesticides and another group Group II of more than 5 to10 years of exposure to pesticides. All semen samples were analyzed within one hours of collection in accordance with the World Health Organization guidelines. The semen samples were processed for various parameters SMI and TFSC these parameters were calculated with the help of the instrument called SQA-IIB. The TFSC and SMI taken into account all the parameters of semen analysis and integrate them into a single, objective and more informative numerical value, which reflects the comprehensive overall status of the semen sample and its fertilization potential.

Total functional sperm concentration (TFSC) of sperm was better with group I than group II (p<0.01.) The difference was statistically significant (p>0.05). Sperm Motility Index (SMI) score is better in group I than group II (p<0.05). The difference was statistically significant (p>0.05).

Keywords: Infertility, Pesticides, TFSC and SMI

1. Introduction

The problem of the lack of offspring is a phenomenon concerning an approximately 15% of married couples. In half of the cases the causative factor is the male. Males are exposed to the effect of various environmental factors, which may decrease their reproductive capabilities. A decrease in male fertility is a phenomenon which occurs within years, which may suggest that one of the reasons for the decrease in semen parameters is the effect of the development of techniques in the surrounding environment, stress as well as increase in environmental pollution in industrial countries in recent decades. A hazardous effect on male fertility may be manifested by a decrease in the amount of sperm count, disorders in their motility, as well as their morphology¹. Pesticides have been proposed as one of the major cause for this decline. A pesticide is "any substance or mixture of substances intended for preventing, destroying or controlling any pest, including vectors of human or animal disease, unwanted species of plants or animals which may be administered to animals for the control of insects, arachnids or other pests in or on their bodies"². Over 700 active ingredients are in use worldwide as pesticides, each

with distinct chemical and toxicological properties³. Pesticides contaminate the environment; the soil and agricultural produced food as result human beings are exposed to pesticides through food, water, air, via tainted breast milk. Over 25% of fruits, vegetables, and cereals are known to contain detectable residues of at least two pesticides and more than 300 different pesticides are known to contaminate food products⁴. There has been rising concern in many developed countries about the adverse effects of pesticides on human reproduction, ranging from female and male sub fertility to abortion, stillbirths, birth defects and malformations. They may cause reproductive toxicity with direct damage to the structure of the cells or as a result of biotransformation into metabolites, or interference with processes necessary for the natural homeostasis and equilibrium.^{5,6}

Ethylene dibromide (EDB) is a component of some pesticide decreases sperm count, motility and morphology of normal sperm cells⁷. Vinclozolin possesses anti-androgenic properties and a study has reported increased follicle-stimulating hormone level among exposed workers⁸.

Carbaryl is a widely used insecticide but human studies among exposed workers have shown inconsistent results^{9,10}.

Chlordecone is an insecticide with estrogenic activity. Chronically exposed workers have been found to have decreased sperm motility but no effect on fertility was observed^{11,12}.

Many pesticides, such as DDT and chlordecone, are persistent in the environment and/or bioaccumulate in the food chain. As many possess endocrine-disrupting abilities, their adverse effects on human reproduction may have far-reaching consequences.¹³ Most are no longer used in the developed world but some are still widely used in less developed countries, often without proper safety precautions.

A few recent studies indicate that persistent organochlorine pollutants including polychlorinated biphenyls interfere with sperm motility and sperm DNA integrity at exposure levels that are encountered in populations with high body burdens related to marine diet and environmental contamination.¹⁴

2. Materials And Methods

The present study was conducted at the Infertility laboratory of department of physiology, Sawagram Medical College, Wardha India after obtaining permission from Institutional Ethical committee. Fifty five male partners of infertile couple in between age group of 20 to 40 years attending infertility laboratory exposed with pesticides and other agricultural chemicals for at least 1 year but not more than 10 years were included in the study after obtaining written informed consent. We divide infertile couples into two groups first group-Group I who had less than 5 years of exposure to pesticides and another group Group II of more than 5 years of exposure to pesticides. Azoospermics and all the subjects having any other conditions that can affect testicular function amounting to reduced sperm parameters were excluded from the study. After general and systemic examination a symptom based questionnaires regarding history of pesticides exposure and other potential risk factor among formers were asked.

The semen samples were delivered by masturbation after preferably three days of abstinence. All samples were analyzed within one hours of collection in accordance with the World Health Organization guidelines¹⁵. The semen samples were processed for various parameters SMI and TFSC these parameters were calculated with the help of the instrument called SQA-IIB. The TFSC and SMI take into account all the parameters of semen analysis and integrate them into a single, objective and more informative numerical value, which reflects the comprehensive overall status of the semen sample and its fertilization potential.¹⁶

TFSC was graded on a scale 0 - 13 millions and SMI was graded on an arbitrary scale of 0 - 160. All the data of each subject were noted down for further analysis. The data analysis was done using appropriate statistical tests by SPSS version 17 statistical package.

3. Observation and Results

Appearance of the semen was normal in all the subjects. The mean seminal volume was 2.63 ± 0.490 ml in exposed group I and 2.00 ± 0.00 ml in exposed group II.

Table No. 1 shows the TFSC of sperm was better with group I than group II ($p < 0.01$). The difference was statistically significant ($p > 0.05$).

In Table No. 2 SMI score is better in group I than group II ($p < 0.05$). The difference was statistically significant ($p > 0.05$).

Table No. 1: (Total functional sperm concentration)TFSC

Exposure period	No of patients	Mean+ SD	P Value	Result
Group I	25	3.472+3.478	0.0317	Significant
Group II	30	1.823+1.973		

Table No. 2: SMI%

Exposure period	No of patients	Mean+ SD	P Value	Result
Group I	25	56.40+30.838	0.06	Significant
Group II	30	31.60+18.525		

4. Discussion

Pesticides are known to affect the general health .Laboratory studies have confirmed the adverse low dose effect of paraquat, endosulphan, methyl parathion and malathion on the male reproductive system of rodent models.^{17,18} The present study provides sufficient evidence concerning that there is a strong relation between exposure of pesticides and male semen quality.All parameters of semen analysis showed significant difference between the exposure more than 5years and exposure less then 5 years.Some studies have shown definate relationship with exposure of Pesticides including DDT,Organophosphorus and mixtures of herbicides, fungicides and insecticides and decline in sperm count, motility, morpholgy.^{19,20}

In the present study TFSC of the groupII is less as compare to group I.As TFSC grade the overall sperm quality objectively. The careful examination of semen parameters reveals that the TFSC value is an integrative form of three main parameters viz.Total concentration, motility and normal percentage of sperm morphologies.

SMI is an arbitrary number generated by the instrument to define the overall sperm quality. SMI measures the number of motile sperms and multiplies them with their forward speed .In both groups SMI value is less but it is more decline in more exposure groupII as compared to less exposure group I.

One of the study in Malaysia evaluated that formers in Sabah state provide the strong evidence that pesticide exposure is associated with reduced semen quality –reduced semen volume ,abnormal pH ,decreased sperm concentration, reduced sperm motility ,reduced sperm morphology ,and abnormal WBC count .²¹

In a longitudinal follow-up study, done by [Recio-Vega R](#) et al.they show the effect of organophosphate pesticides (OP) at three occupational exposure levels on semen quality. In addition, the study examined the association between OP urinary levels and sperm parameters in exposed and unexposed workers. A total of 139 semen samples from 52 volunteers were assessed. Urinary OP levels were measured by gas-liquid chromatography. The results revealed that the poorest semen quality was found among the subjects with the highest OP exposure and the highest urinary OP levels.²²

Slutsky et al. in his report which represents the largest cohort of DBCP(Dibromochloroprpane) exposed workers, found that after a median exposure of three years, 64.3% of these men overall, and 90.1% of men studied from the Philippines, had oligospermia or azoospermia .²³

The study by Whorton et al. (1977), Potashniket al. (1978), Lipshultz et al. (1980) and Egnatz et al. (1980) had the same results of a significant association between exposure to pesticides and semen quality.^{24, 25, 26, 27} Some of the studies are not in association with our study.

Magnusdottir et al. (2005) concluded that poor semen quality is associated with sedentary work and obesity but not with plasma levels of fourteen organochlorine pesticides including DDT and metabolites.²⁸

Weiss et al. 2006 evaluating exposure, in Germany and in Tanzania, to a mixture of PCBs and pesticides, including DDT, found these pesticides had no impact on sperm quality. However high serum concentrations of DDT-DDE were associated with lower pregnancy rates in Germany.²⁹

Study by Larsen et; Härkönenet al., 1999 showed little or no association between pesticide exposure and semen quality.^{30, 31}

Pesticides may act as endocrine disruptors and alter the hormonal homeostasis in both males and females and lead to subfertility.³² Pesticides might have the ability to interrupt male fertility at several different sites in the reproductive pathway and by one or more mechanisms, Thus, they can interfere with the hypothalamo-pituitary axis that regulates,

through the production of the gonadotropins FSH and LH, the function of Sertoli and Leydig cells, impairing spermatogenesis and Steroidogenesis.³³

Paraquat and most of the organophosphates pesticides induce reactive oxygen species. The mechanism of action of pesticides involves the formation of the free radicals by reduction of the ion and the subsequent auto-oxidation to yield the original ion. During the auto oxidation of the paraquat free radicals to the ion :OH²,H²O²,&O² are formed .Each of these by-products is potentially phytotoxic .However recent researches suggests that the hydroxyl radical is responsible for paraquat induced lipid per oxidation and related phytotoxic symptoms .Lipid degradation induced by paraquat causes cell death. Secondly Seminiferous tubules sloughing and atrophy were confirmed in the experimental rodent models on exposed to paraquat and methyl parathion and further Gonadal hormones level may be involved in the possible mechanism of decline in semen quality .^{17,18}

These result suggested that the pesticides exposure really does have an adverse effect on the various parameters of seminal fluids of the farmer who are at the greater risk of having abnormal semen parameters .Our results also suggest poor semen parameters of the farmers working in fields and dealing with pesticides and insecticides for longer duration as compared to farmers whose duration of exposure is less.

This study is a valuable tool for predicting the possible semen quality status of men engaged in agriculture with pesticide use as most of the areas in central Maharashtra is classified as agricultural zone so in future depth research in relation between semen quality and exposure to pesticides should be recommended and farmers are strictly advised to stop extensive use of pesticides.

5. Conclusion:

Pesticides can produce adverse impacts on TFSC and SMI which might be responsible for infertility.

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