

The Impact of Wood, Cigarette and Marijuana Smoke on the Reproductive Health of Tandoor Occupants

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Abstract

The objective of this study was to determine the effects of wood, cigarette and marijuana smoke on the reproductive health of tandoor occupants. A total of 100 male individuals were selected (50 control and 50 tandoor occupants). A standard questionnaire was designed regarding their age, economic status, marital status, fuel type, exposure time (per day), use of mask, addiction and reproductive health. Morning blood samples of 5 mL of the size were taken from all participants. Serums were obtained and analyzed for total serum testosterone concentration. Bio-check (USA) kit was used according to the manufacturer protocol and procedures for testosterone analysis. In control group the mean \pm SEM of total serum testosterone was 671.9 ± 20.02 ng/dl where as in tandoor occupants it was 542.7 ± 16.40 ng/dl. There was a significant reduction ($P^{****} < 0.0001$) in total serum testosterone concentration in tandoor occupants as compared to control group. Reproductive health problems like, low libido, erection problems, infertility, decreased frequency for shaving and absent morning and nocturnal erection were common in tandoor occupants as compared to control group.

Wood, cigarette and marijuana smoke negatively affects testosterone concentration and lowers it significantly. This reduced testosterone concentration then produces ill effects like low libido, erection problems, infertility and absent morning and nocturnal erection.

Keywords: Libido, Infertility, Nocturnal

1. Introduction

Tandoor is a cylindrical clay oven used for cooking and baking in Bangladesh, Burma, Afghanistan, Iran, Turkey, India and Pakistan. The heat for a Tandoor is generated by a charcoal or wood fire, burning within the Tandoor itself, thus exposing the food to live-fire. Tandoor is used for cooking certain types of food such as, Tandoori chicken, chicken tikka and bread varieties like Tandoori Roti and Naan in the above countries (Ghulam *et al.*, 2014).

The burning woods add toxic particulate matters (PM) into the air. Wood smoke in addition to particulate matter also emits dioxin, volatile organic compounds (VOCs), nitrogen oxides (NO_x) and carbon monoxide (CO). VOCs may be either nauseating, noxious, and/or cancer causing. Polycyclic aromatic hydrocarbons (PAHs) include carcinogens such as benzopyrene, is also present in wood smoke. The chemical composition and total amounts of toxicants depend on how the wood is burned. It mostly depends upon the appliances used for wood burning. Lesser amount of toxicant is produced using high energy efficient wood burning appliances. Wood smoke PM contains wood tars, gases, dust, and ashes. The size of the particulate matter in air is lesser than 2.5 micron (Minnesota Pollution Control Agency, 2011).

Wood smoke exposure can cause cardiovascular events, coronary artery diseases, cerebro-vascular diseases, venous thrombo-embolism (Fraanchini, 2011) chronic obstructive pulmonary diseases (COPD) (Riddervold *et al.*, 2011). During cooking PM concentration increases in kitchen, thus causing acute respiratory infection in children and lung cancer in women (Perez *et al.*, 2010).

Like wood smoke diesel exhaust is also the important cause of air pollution and contains complex mixture of vapor-phase compounds and particulate matters. Smoke particles consist of carbon cores that adsorb many organic compounds including polycyclic aromatic hydrocarbons, heterocyclic organic compounds, quinines, aldehydes, and aliphatic hydrocarbons (Schuetzle *et al.*, 1981; Schuetzle, 1983; Li *et al.*, 2000). These particles also contain substances having anti-androgenic, anti-estrogenic and estrogenic properties. The sperm production is severely reduced in adult rats due to decreased number of sertoli cells, when exposed to smoke particles during fetal life (Takeda *et al.*, 2004). Smoke particles are discharged into the atmosphere enters our body via skin, lungs or the intestinal tract and affect reproductive functions (Yoshida *et al.*, 1999; Yoshida *et al.*, 2002; Tsukue *et al.*, 2004; Oberdörster *et al.*, 2005_a; Oberdörster *et al.*, 2005_b; Yoshida *et al.*, 2006; Ono *et al.*, 2007). In developing mice it has been shown that exposure to diesel exhaust causes degeneration of leydig cells, increase the number of damaged seminiferous tubules, and reduce daily sperm production (DSP) (Yoshida *et al.*, 1999).

Cigarette smoking affects badly adrenal, thyroidal, pituitary, pancreatic, testicular and ovarian functions (Stárka *et al.*, 2005). Cigarette smoke disrupts fertility in both sexes, lowering testosterone level and negatively shift spermiogram parameters in male (Trummer *et al.*, 2002). Cigarette smoking also causes erectile dysfunction in male (Natali *et al.*, 2005; Corona *et al.*, 2005).

In humans as well as in animals models low plasma testosterone, abnormal spermatogenesis and decreased weight of accessory sex organs have been reported in males using marijuana or methadone (Azizi *et al.*, 1973; kolodny *et al.*, 1974; Cicero *et al.*, 1975; Huang *et al.*, 1978). Unlike methadone marijuana acts both directly and indirectly decreasing plasma testosterone levels (Symons *et al.*, 1976; Smith *et al.*, 1978).

Tandoor occupants are exposed to a heavy wood smoke for years. Particulate matter and other gases accumulate in their shops due to lack of proper exhaust system. In addition to wood smoke exposure they are also addicted to cigarette and marijuana. The present study is designed to determine the effects of wood, cigarette and marijuana smoke on testosterone level and their resulting consequences in tandoor occupants.

2. Materials and Methods

2.1 Informed Consent

Before starting the study informed consent was obtained from all the participants. Enough information was given to them about the purpose of the study. They were also assured that the collected information's will be used only for scientific purposes.

2.2 Study Area

This study was conducted in district Lower Dir, Khyber pakhtunkhwa, Pakistan.

2.3 Questionnaire

A standard questionnaire was designed. Questions about their age, marital status, economic

conditions, type of fuel used, exposure time to wood smoke, addictions, use of mask and reproductive problems were asked for every participant.

2.4 Participants

A total of 100 male individuals were selected. Two groups were made. Control and exposed. Each group contains 50 participants. Control peoples were selected randomly from the same area. The age of both group participants ranges from 25 to 55 years and was divided into four age groups i.e. 25-34, 35-44, 45-49 and 50-55.

2.5 Blood Sampling

A morning 5 mL blood samples were taken from the brachial vein of all participants aseptically. Blood samples were collected in vacutainer tube containing no preservatives or additives. To prevent contamination of samples from smoke, collection tube and catheter site were covered. All the blood samples were centrifuged at 3200 rpm for 15 minutes at 4 °C. Serums were obtained and for latter analysis were stored at – 20 °C.

2.6 Exclusion Criteria

Participants with a history of tuberculosis, pneumonia, renal problems, hepatic problems, heart problems and individuals using medications were excluded from the study.

2.7 Assay

Testosterone enzyme immunoassay test kit, Bio-check (USA) was used for the determination of total serum testosterone level according to the manufacturer protocol and procedures.

2.8 Statistics

Software graph pad prism, *version 6.03* (Graph Pad Software Inc., San Diego, CA, USA) was used for data analysis. All data were presented as mean \pm SEM. Unpaired t test was used for the comparison of both groups. $P < 0.05$ indicated the significant difference.

3. Results

3.1 History

History of both control and exposed group are summarized in Table 1.

Table 1. History of control and Tandoor occupants

Age Group (Years)	No.	Economic status	Marital Status	Fuel type	Exposure Time (per day)	Addiction (%)	Mask	Reproductive health status
Exposed 25-34	15	Poor	03 single 12 married	Wood	≥9 hrs.	02 Snuff 13 C* + M*	No	05 low libido 06 LSF*
35-44	20	Poor	05 single 15 married	Wood	≥9 hrs.	04 Snuff 16 C* + M*	No	05 EP* 03 low libido 02 infertility 05 AME*
45-49	10	Poor	00 single 10 married	Wood	≥9 hrs.	02 Snuff 08 C* + M*	No	03 infertility 04 low libido 03 AME*
50-55	5	Poor	00 single 05 married	Wood	≥9 hrs.	01 Snuff 02 C* + M*	No	01 infertility 04 low libido
Control 25-34	15	Poor	05 single 10 married	No	00	02 Snuff	No	00
35-44	20	Poor	07 single 13 married	No	00	03 Snuff	No	00
45-49	10	Poor	00 single 10 married	No	00	03 Snuff	No	01 infertility
50-55	5	Poor	00 single 05 married	No	00	00 Snuff	No	01 EP*

C* = Cigarette, M* = Marijuana, LSF* = Low Shaving Frequency, EP* = Erection Problems, AME* = Absent Morning Erection.

3.2 Total Serum Testosterone Analysis in Control and Tandoor Occupants

Testosterone were analyzed both in control and tandoor occupants. Their results are summarized in Table 2. The results showed that testosterone level is significantly lower ($P^{****} < 0.0001$) in tandoor occupants as compared to control group.

Table 2 Total serum testosterone concentration in control and Tandoor occupants

CI* = confidence interval

Parameters	Control Mean ± SEM	Tandoor occupants Mean ± SEM	95% C.I.*	P value
Total serum testosterone	671.9 ± 20.02 (ngdl)	542.7 ± 16.40 (ng/dl)	-180.6 to -77.88	< 0.0001

4. Discussion

Tandoor occupants are exposed to wood smoke, automobile emission as well as they also smoke cigarette. Most of them are also addicted to marijuana. The present study focuses on the reproductive health of these peoples.

Leydig cells take up smoke particles and have shown cytotoxicity in cultured cells in vitro (Don Porto Carero *et al.*, 2001; Renwick *et al.*, 2001; Hussain *et al.*, 2005). Particulate matters

and related organic compounds produce inflammatory responses in lungs, endothelial cells and alveolar macrophages (Hirano *et al.*, 2003). These particulate matters causes repressions of the StAR (Steriodogenic Acute Regulatory protein) expression, thus affects the production of steroid hormone productions from leydig cells. This also causes Leydig cell degeneration, increase the number of damaged seminiferous tubules, and reduce daily sperm production (; Yoshida *et al.*, 1999; Diemer *et al.*, 2003; Murugesan *et al.*, 2007). This has been reported that various factors like AP-1, C/EBP β , GATA4, and DAX-1 are responsible for the regulation of StAR gene expression. The induction of StAR in Leydig cells by nanoparticles may be associated with these factors. (Jana *et al.*, 2008; Silverman *et al.*, 2006; Manna *et al.*, 2004). In rats particulates matters triggers the suppressions of several genes which are crucial for gonadogenesis. This also reduces expression of genes which encode enzymes that are responsible for androgenesis. Diesel particulate matters also contain polycyclic aromatic hydrocarbons that stimulate Ah receptors. It also contains substances that have anti-androgenic, anti-estrogenic and estrogenic activity. In rats exposure to heavy smoke during fetal life, reduces the expression of Ad4BP/SF-1 mRNA that ultimately affect gonadal development. Such rats have low daily sperm production due to insufficient number of sertoli cells (Takeda *et al.*, 2004).

In rats this has been found that penile erection is badly affected by cigarette smoke. Cigarette smoke also reduces plasma testosterone level and the activity of nitric oxide synthase in corpus cavernosum, ultimately leading to erectile dysfunction (Zhan *et al.*, 2009). In an experiment 12 rats were exposed to cigarette smoke generated by a machine and 12 were exposed to room air. Before and after plasma testosterone, Luteinizing Hormone (LH) and Follicle Stimulating Hormone (FSH) were measured by Elisa. Testes were also examined histologically. It was found that plasma testosterone reduces significantly in cigarette smoke exposed rats as compared to control. No significant changes were found for LH and FSH in both groups. However in histological examination of testes, fewer leydig cells and degeneration of the remaining cells were observed (Yardimci *et al.*, 1997). Cigarette smoking reduces testosterone concentration (Alexandersen *et al.*, 1996). Cigarette smoke contains nicotine that like cocaine stimulates mesolimbic dopamine system which increases extracellular dopamine concentration (Corrigall *et al.*, 1992; Di Chiara, 2000; Watkins *et al.*, 2000). This increase in dopamine suppresses reproduction by regulating the secretion of Gonadotropin Releasing Hormone (GnRH) negatively (Murphy *et al.*, 1998; Mello and Mendelson, 2002).

Marijuana and its constituent delta-9-tetrahydrocannabinol (D-9-THC) affect the reproduction negatively by decreasing the level of testosterone (Okey and Truant 1975; Nashas, 1984). There are several evidences which confirm that marujana regulate the estrogen positively but androgen negatively. Different effects of marijuana suggest that different constituent affect the hormonal profile in a different way (Chakravarty *et al.*, 1975; Dixit *et al.*, 1975; Chakravarty *et al.*, 1976; Solomon *et al.*, 1976; Solomon and Cocchia, 1977; Solomon *et al.*, 1977).

5. Conclusions

Chronic exposure to wood smoke, cigarette and marijuana, negatively regulate testosterone level. Low testosterone level then leads to ill effects such as infertility, low libido, erection

problems, decreased frequency for shaving and absent morning and nocturnal erection. Tandoor occupants are advised to use mask during working hours, improve exhaust system and if possible replaced the wood by gas. Further studies are needed to analyze the effects of individual gases on reproductive system.

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