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A comparative study of spirometry between priests who were exposed to smoke from fire rituals and normal individuals

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Abstract:

Introduction:In India, fire rituals (Homa) are commonly performed during religious functions.Some amount of smoke is generated during this ritual. Prolonged exposure to the smoke may lead to lung function abnormalities. However, there is a scarcity of literature on this aspect.

Aims and objectives:To find the spirometricabnormalities if any, in a group of priests who were exposed to smoke during fire ritual, in comparison with normal healthy volunteers
Materials and methods:This was a cross-sectional case control study with 57 cases and 57 controls. Priests who regularly performed fire rituals, at least 3-4 times per month for more than five years were cases. All casesand controls in thisstudy were male respondents. Controls wereage-matched normal, healthy adults without any history of exposure to the fire ritual. In both groups, those with pre-existing lung diseases and smokers were

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excluded. FEV1, FVC, FEV1/ FVC Ratio, PEFR, Forced expiratory flow 25 - 75 % were analysed.

Results: Out of 57 cases, 3 cases had obstructive pattern, 11 had restrictive pattern and majority (43) had normal spirometry values. Among control group, 9 had mild restriction. 48 have normal spirometric values, none showed obstructive abnormality.Data was analysed using Independent student T testin Microsoft Office Excel 2007.When each of these spirometry parameters were compared between two groups, the mean difference of FEV-1, FVC, FEV-1/FVC and FEF 25-75 were not statistically significant.

Conclusion: Exposure to smoke generated from fire rituals did not show any lung function abnormality in thisstudy.

Keywords: Fire Rituals, Smoke Generated, Exposure to Smoke, Spirometry, Priests

Short Running Title:Comparative Study of Spirometry in Priests

1. INTRODUCTION

Exposure to indoor and outdoor air pollution leads to the development of COPD in a significant number of people in India who are lifelong nonsmokers. Exposure to smoke from combustion of solid or biomass fuels, exposure to volatile gases, fumes and dusts, occupational exposures to dusts, industrial and traffic exhausts may lead to the development of COPD[1].

Homa is a religious offering by the Hindu community. *Homa* in this study is referred to as a fire ritual. In India, fire rituals are commonly performed during religious functions. This fire ritual involves a priest and a host.Fire ritual includes lighting of fire on a rectangular *HomaKunda*prepared using bricks or plantain stem and then offering of various substances (known as *dravyas*) with chanting of mantras[2]. These substances include milk and milk products, cakes made up of grain,cereal powder, boiled rice, and stem or leaves of certain plants (known as *samidhas*)[2].Priestsoffer these substances into fire and this is supposed to cleanse the environment. Some amount of smoke is generated during the ritual. Most often, the priest is exposed at least for more than one hour to the burning fire and the smoke during each ritual.

Most of the literature shows that various substances offered to the fire during ritual has beneficial effects on human mind and body as well as to the environment[3-7]. However,prolonged exposure to the fire and smoke over years may lead to COPD in the priests. There is a scarcity of data whether these fire rituals lead to any deleterious effect to the lungs. Hence,the researchers of this studywould like tofind out the spirometric abnormalities if there is any amongpriests who are exposed to smoke during fire ritualas compared to normal healthy volunteers.

2. MATERIAL AND METHOD

This was a cross-sectional,case-control study with 57 cases and 57 controls done after taking institutional Ethical Committee clearance. Priests who were performing fire rituals regularlyat least 3-4 times per month for more than fiveyears were taken as cases. Controls were normal healthy adults without any history of exposure to the fire ritual. Casesandcontrolswere matched with age andsex.In both groups, those with history of smoking, history of pulmonary tuberculosis, past history of any lung disease, pre-

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existingbronchial asthma, chest wall abnormalities, and neuromuscular diseases were excluded.

Addresses of all priests in Mangalore, city were collected from the local association of priests.Details regarding duration of occupation as a priest andfrequency of fire ritual conducted per monthwerecollected. They were examined for any respiratory disease and spirometry conducted. All the tests were conductedthroughhome visitation or at their respective workplaces where detailed history and physical examination were conductedfollowed by spirometry. On the first visit, informed consent was taken froma respondent who satisfy the inclusion criteria,appointment was taken for spirometry. During the second visit, spirometry was conductedas a planned procedure.

Spirotech spirometer which is a hand-held, portable instrument was used for spirometry. Alltests were done by a single-trained technician. The test was carried out with the subject in a comfortable sitting position. The flow, volume/timed graphs wereaccomplished according to the criteria suggested by American Thoracic Society. Instruction was given toa subject to (1) take a deep breath until s/hefeels his/her lungs full;and (2) blow outthrough mouth piece sealing the lips tightly around the mouthpiece,as forcibly and as fast and as long as possible until his maximum capacity. The bestof the three acceptable curves was selected as the recording for the study. Forced Vital Capacity (FVC),Forced Expiratory Volume in first one second (FEV1), FEV1 / FVC Ratio, Peak Expiratory Flow Rate (PEFR), and Forced Expiratory Flow FEF 25 - 75 % were recorded for analysis. These parameters were compiled,reported, and analysed between the two groups.Data were entered into theMicrosoft Office Excel 2007 and Independent student t-testwas applied for the variables under the study.Significant level was P-value less than 0.05.

3. RESULTS

Table No. 1. Age Distribution Among Cases and Controls

Age Group in Years	*Cases (n=57)*	*Controls (n=57)*
20-29	15	08
30-39	15	10
40-49	16	18
50-59	07	16
60-69	04	04
70-79	00	01

Of the 114 subjects who participated in the study, 57 were cases and 57 were controls.Sinceall the cases in thisstudy were males, only male respondents wereincludedin the control group.Boththe groups had people of age group between 20-79 yrs. Majority were in the age group of 20-50. Matching for age was done in the population of the study (Table1).

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Table No. 2. Number of Fire Rituals Performed in a Month by the Cases

Number of Fire Rituals in a Month	*Cases*
3 - 5	02
6-10	30
11-15	17
16-20	03
21-25	03
26-30	02

Majority of the cases performed around sixto tenfire rituals every month. More than 25% of case population performed around 11 to 15 fire rituals in a month (Table 2).

Table No. 3. Number of Years of Fire Rituals Performed by the Cases

Number of Years of FireRituals	*Cases*
0-5	06
6-10	20
11-15	11
16-20	07
21-25	05
26-30	07
31-35	00
36-40	01

Majority of the cases were performing the fire rituals for 6-10 years,and only one case has been performing fire rituals regularly since 36 years (Table 3).

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Table No. 4. Comparison of SpirometryAbnormality Among Study Population

Groups	Obstructive Pattern	Restrictive Pattern	Normal
Case (n=57)	3	11	43
Control (n=57)	0	9	48

Out of 57 cases, there are only two cases who had respiratory symptoms. One of them had cough with scanty expectoration since one week and another had dry cough for few days. None of these two caseshad any other respiratory complaints. None of the cases had developed any chronic respiratory symptoms after they initiated fire rituals.

Out of 57 cases, only three subjects had obstructive pattern and 11 had restrictive pattern and rest (43 subjects) showed normal results. Only one out of three cases with obstruction had severe obstruction, the other two had mild obstruction. In the control group, nine subjects had restrictive disease; none showed obstructive abnormalityand 48 had normal spirometric values(Table 4).

Table 5. Statistical Analysis of PFT Values Among Groups and PValue

SpirometryValues	Cases (n=57) Mean ± SD	Controls (n=57) Mean ± SD	P VALUE
FEV-1	90.386 ± 14.2638	86.474 ± 9.4512	0.87
FVC	89.088 ± 17.1196	85.947 ± 9.5402	0.230
FEV-1/FVC	106.947 ± 15.1203	104.333 ± 8.8688	0.263
FEF25-75	81.246 ± 23.8479	81.228 ± 22.6716	0.997

The values are expressed as mean ± standard deviation. On comparison, the difference between the mean of FEV-1, FVC, FEV-1/FVC, and FEF 25-75 did not show any statistical significance. (Table 5). The above results show that there is no significant spirometric abnormality noted in case compared to control groups.

4. DISCUSSION

Fire rituals are routinely performed by priests in Hinducommunitiesin India. During these fire rituals, smoke is generated. Priests who perform these fire rituals are exposed to this smoke. Prolonged exposure to this smoke may lead to development of COPD or deterioration of lung function. Lung function abnormalities can be detected by spirometry.

Indoor pollution is an important cause for COPD. Fuels likeanimal dung, wood, coal, and crop residues when burned in poorly functioning stovesor open fires, may lead to severe air pollution[8].Studies show thatbiomass fuel used for cooking and heating in poorly ventilated houses cause high degreeof indoor pollution whichis a major risk factor for COPD[9,10].Trupinetal.(2005), Matheson et al.(2005) and Hnizdo et al.(2004) stated that occupational exposure to organic and inorganic dusts and chemical agents and fumes are also

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underestimated potential risk factor for COPD [11-13].Balmes etAl. (When was this published?) observed that occupational exposures account for 10-20% of either symptoms or functional impairment consistent with COPD [14].A total of 114 people were included in our study. Out of these, 57 were cases and equal number of control population were included. Only two out of 57 cases in our study had reported respiratory symptoms. One of them had dry cough lasting only few days, and another had cough with scanty expectoration since three days with acute rhinitis. This indicates that both of them had only upper respiratory tract infection of a recent onset. None of the cases had reported any nasal irritation, itching, sneezing, nasal congestion, nasal block, nasal discharge, feeling of suffocation, itching or redness of eyes, or headache on performing fire ritual. None of them reported any breathlessness, cough, expectoration, hemoptysis, chest pain, or other lower respiratory tract symptoms on performing fire rituals. Absence of respiratory symptoms in any of the cases even after many years of exposure indicates that the smoke generated from these fire rituals is not an irritant to the respiratory tract. Smoke generated during fire rituals came from burning of substances like wood, ghee, plant twigs, leaves, bark of trees, and other plant-derived organic derivatives [15]. Probably, these substances on burning do not cause any deleterious effect on respiratory tract or lungs.

In various literatures, it has been shown that most of the ingredients used in these fire rituals lead tobeneficial effects on human body [16,17,18,19,20]. *Butea-monosperma*, a species of *Butea* native to tropical and sub-tropical parts of the Indian Subcontinent and Southeast Asia,has anti-inflammatory, anti-oxidant, anti-mycobacterial, anti-stress activity, anti-ulcer, and anti-fungal properties[16].*Calotropisgigantea*, also known as the crown flower, is used to treat various diseases like cold, cough, asthma, bronchitis, cholera, antifertility, as anti-venom for a snake bite, and liver disorders[17]. *Ficusreligiosa*, also knownas sacred fig, has anti-ulcer, antibacterial, antidiabetic, antifungal, anticonvulsant, immune-modulatory, antioxidant, hypoglycemic, hypolipidemic, anthelminthic, and wound healing properties [18]. *Inder Kumar Makhij*et al.(2010)reported *Ficusreligiosa*in addition to the above, has antidiabetic, anti-inflammatory activity, analgesic activity, anticonvulsant activity, anti-amnesic activity, anti-acetylcholinesterase activity, proteolyticactivity [19].Virmaniet al. (When was this published?)reported the medicinal values of *cynodondactylon*, which is also knownas Doob Grass,whichis used in the treatment of *leukoderma*, bronchitis, piles, asthma, tumors,enlarged spleen, epileptic seizures, hallucinations, fatigue, scabies, leprosy, and other skin diseases, dysentery, fever, laxatives, epistaxis,erysipelas, brain and heart tonic, aphrodisiac, alexipharmic, vomiting, expectorant, carminative, and influenza amongchildren, and for pain[20]. Above are the various herbs and plants used in fire ritual as ingredients which all have various medicinal properties.

None of the cases in our study developedany respiratory symptoms or any respiratory diseases like asthma orCOPD, after they started performing fire rituals. This may indicate that the smoke generated during these fire rituals is not harmful to the lungs and respiratory tract. Furthermore, as majority of the ingredients have medicinal properties, they may have positive health benefits on body.

To determine chronic effects of smoke exposure from fire rituals on pulmonary function, spirometry was performed and these were values compared with control group. Our study showed no statistically significant difference in FEV1, FVC, FEV-1/FVC, and FEF 25-75 % between cases and the control group. This may be due to medicinal properties of various ingredients used in the fire rituals, wherein the smoke generated does not harm the lungs.

Several studies show that prolonged inhalation of smoke produced from burning wood causes chronic bronchitis (Raj Pandey et al)[21], chronic interstitial lung disease, pulmonary hypertension, corpulmonale (Sandoval et al)[22], and weakened pulmonary immune

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mechanisms (Demarestet al., 1979; Ramageet al, in 1988)[23,24]. However,our study did not show any statistical significance in the pulmonary function parametersbetween both study groups. None of the cases had any history of recurrent respiratory infections.

Large et al. (When was this published?) conducted a study to look on the short term effects of exposure to smoke on lung functions of fire fighters [25]. Two indices FEF25-75 and FEV-1 showed statistical significance. A study conductedby Mondkar et al.(2010) showed that fire ritual reduced the microbial count in surrounding environment by91.4%[26]. The fumes generated during fire ritual are rich in formaldehyde and other substances which have inhibitory effect on microorganisms.

Many of the ingredients used in fire ritual have medicinal properties and beneficial effect on environment.The smoke generated may have positive health benefits which need to be studied.

Not many studies were conductedto look onthe impact of fire ritual on human health. Hence, it is important to find out the positive impact of these rituals on human respiratory system. Furthermore, studies are needed on the composition of smoke generated during fire rituals and the possible positive health effects.

5. CONCLUSION

Long term exposure to smoke generated from fire ritual does not cause any respiratory symptoms, lung disease, or pulmonary function abnormalities.On the contrary, it might have a positive impact on human and environmental health which needs to be studied.

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