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IMPACT OF BIOGAS AS PREDISPOSING FACTORS UPON BRONCHIAL ASTHMA (BA) AND CHRONIC OBSTRUCTIVE PULMONARY DISORDER (COPD) AMONG HOUSEWIVES

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Keywords:

Bronchial asthma (BA), Chronic obstructive pulmonary disorder (COPD), Predisposing factors, Prolonged kitchen stay, Dietary pattern

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ABSTRACT: This study aimed to assess the prevalence of the modifiable risk factors like prolonged kitchen stay, dietary pattern, cooking methods in outpatient (Housewives) bronchial asthma (BA) and chronic obstructive pulmonary disorder (COPD). This prospective observational study was carried out in Pulmonary Medicine Department in a Multispecialty Tertiary Care Hospital in Kerala, India. A total of 126 [BA (72) and COPD (54)] patients enrolled into the study as per global initiative for lung diseases (GOLD) standards. Hemoglobin concentration was measured by Sahli's method. Predisposing factors for bronchial asthma (BA) and chronic obstructive pulmonary disorder (COPD) were monitored from the patient's ecology. The univariate analysis showed a significant association between smoke exposure in kitchen and incidence of COPD and BA ($P<0.05$). The multivariate analysis showed the results demonstrated that risk for COPD group was significantly higher compared with BA group ($P<0.05$). Independent sample't' test showed significant more time where BA patients stayed in the kitchen ($P<0.05$). The group that exposed to kitchen smoke more than 500 min per day was four times higher ($P<0.05$) than that in other groups with kitchen exposure less than 200 min. The study had found positive associations with potentially predisposing modifiable risk factors with BA and COPD female patients. The exposure to kitchen smoke was related to the intensity of diseases; might be common in the rural and urban population. The study results lead to the importance of providing health-related education on kitchen smoke, biomass with the existence of diseases.

INTRODUCTION: Bronchial asthma (BA) and chronic obstructive pulmonary disease (COPD) is a prevalent disease condition which is caused due to respiratory air-flow limitation and characterized by airway inflammation. This disease develops with dyspnoea and oxygenation impairment thus contributing great burden to patients [1].

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In recent years, mortality due to COPD has been elevating rapidly in women than that in men.As per the World Health Organization (WHO) report, this mortality would be the third cause by 2020. [2, 3]

In women, household smoke is considered as the one of a predisposing factor for COPD and BA. Source of smoke are mainly from biomass wood; traditionally used for cooking and exposure to indoor pollutants, dust, fumes in the kitchen, *etc*. doubles the risk of respiratory air-flow limitation. The most important are particles, carbon monoxide, nitrous oxides, sulfur oxides, formaldehyde, and polycyclic organic matter, including carcinogens

such as benzopyrene, which can penetrate deeply into the lungs and appear to have the greatest potential for respiratory air-flow limitation [4, 5, 6]. The risk of kitchen smoke has similar hazard index to tobacco smoke. Hence, non-smoking women working in the kitchen in a polluted atmosphere is equally risk bearer as smoking men; the clinical correlations are also to be diagnostically carried out. Ideally while shifting to smokeless fuels like liquefied petroleum gas (LGP) and fumeless stoves may reduce the risks of air pollution. Perhaps for the execution of effective combustion, three ingredients are required that includes fuel, ignition, and air. Without any one of these three ingredients, combustion will not occur properly; incomplete combustion of LPG results in liberation of carbon dioxide (CO_2), carbon monoxide (CO), moisture (H_2O) and heat. Those families who stay among in high altitude and accommodated in an apartment may be under the risk of airflow limitation due to improper combustion [7, 8, 9, 10, 11, 12]. Dietary pattern and consumption of fruits remarkably reduced airflow limitation risk upon BA and COPD.

Even in cases where pharmacological treatment failed to manage the symptoms progression, fruits and dietary remedies showed significant positive changes. The traditional diet had anti-inflammatory effects in respiratory disorders as several studies showed, but reversal to western diet is associated with persistent BA and COPD symptoms [13, 14, 15, 16.] The present study concentrated on the prevalence of modifiable risk factors like prolonged kitchen stay, dietary pattern and cooking methods in outpatient BA patients and COPD patients.

Objective: This study aimed to assess the prevalence of the modifiable risk factors like prolonged kitchen stay, dietary pattern, cooking methods in outpatient (Housewives) bronchial asthma (BA) and chronic obstructive pulmonary disorder (COPD) patients.

MATERIALS AND METHODS:

Study Design: This was a prospective observational study, carried out with Institutional Ethics Committee (IEC) Approval (Reference no. 34/17/IEC/JMMC&RI) in respiratory medicine department in a multispecialty tertiary care hospital in Kerala, India. A total 126 [BA (72) and COPD (54)] patients with age 18-70 were enrolled into the study, forced expiratory volume in one second (FEV1) <50%, The FVC, FEV1 and FEV/FVC (%) values were measured before and after usage of salbutamol. All the detected values were used for further statistical analysis. FEV1/FVC ratio ≤0.70 were enrolled in this study. Patients with chronic cardiac, hepatic, renal, haematological malignancy, endocrine, neurological psychiatric diseases, (as determined by history, physical examination and screening investigations) pregnant and lactating mother, bronchiectasis, fibrosis, TB or significant co-morbidity that might affect lung function, (*e.g.* poorly controlled heart failure, atrial fibrillation or ischaemic heart disease) regular oxygen or nebulised bronchodilator therapy, respiratory infection, hospitalized within 6 weeks prior to visit and steroidal therapy were excluded from the study [17, 18, 19, 20]. The socio-demographic parameters were assessed. Hemoglobin concentration was measured by Sahli's method [10, 21].

Analysis and Interpretation: The statistical analysis was performed with use of SPSS version 20 (SPSS Inc., Chicago, IL, USA). The analysis was carried out by comparing the average values ± standard deviation (SD), univariate-multivariate regression analysis, odds ratio (OR) and statistical method independent't' test was used, and significant level was set at $P<0.05$. The BA and COPD prevalence were calculated as the ratio of the number of COPD patients to the number of all participants. Age group, body mass index (BMI), household smoke, kitchen cooking methods were treated as categorical variables.

RESULTS:

Basic Characteristics: A total of 126 patients were enrolled in this study. Among 72 BA patients, 24 (33.33%) people aged 70-80 years, 23 (31.94%) aged 60-69 years, 12 (16.67%) aged 50-59 years, 10 (13.89%) aged 40-49 years, 2 (2.78%) aged 18-29 years and 1 (1.39%) aged 30-39 years. Among 54 COPD patients, 22 (40.74%) people aged 70-80 years, 14 (25.93%) aged 60-69 years, 11 (20.37%) aged 50-59 years and 7 (12.96%) aged 40-49 years. The basic characteristics of BA and COPD patients were shown in **Table 1**.

The distribution of elderly patients was significantly higher in both groups especially in COPD patients (33.33%) than in the BA group

(4.74%). In the number of cases, the rural and semi-urban population were high in both groups.

Risk Factors Analysis: Ageing was a risk factor among COPD patients. The study results demonstrated that the incidence of COPD risk factors as the age increases was significantly higher compared with the younger population as shown in **Table 1**. The BMI values were other indicators of impacts of body weight in COPD, where some obese patients were comparatively higher (n-30, 55.56%) than in BA group (n-8, 11.11%). Pre-obesity was also prevalent in both BA group (n-52, 72.22%) and COPD group (n-22, 40.74%).

Univariate Analysis: Diet was considered as the population attributable risk factor in COPD and chronic BA patients with age >40 years. The strength of evidence was found to be not significant in the present study where some predominantly vegetarians were higher (n-41, 56.94% in BA and n-41, 75.93% in COPD) than predominantly non-vegetarians (n-29, 40.28% in BA and n-13, 24.07% in COPD. The patients exposed to a different mode of cooking were similar in both BA (n-31, 43.06%) and COPD (n-31, 57.41%). The household smoke exposure was again assessed by calculating the percentages of use of wood stove as well as gas stove at home **Table 1**.

TABLE 1: DEMOGRAPHIC CHARACTERISTICS OF THE STUDY POPULATION

Parameters	Bronchial asthma (n-72)		COPD (n-54)	
	Number	%	Number	%
		Age		
18-29	2	2.78	0	0
30-39	1	1.39	0	0
40-49	10	13.89	7	12.96
50-59	12	16.67	11	20.37
60-69	23	31.94	14	25.93
70-80	24	33.33	22	40.74
		BMI		
<18.5 kg/cm^2	0	0.00	0	0.00
18.5 -24.9 kg/cm^2	12	16.67	2	3.70
25-29 kg/cm^2	52	72.22	22	40.74
>30 kg/cm^2	8	11.11	30	55.56
		Residence		
Urban	12	16.67	4	7.41
Semi urban	29	40.28	15	27.78
Rural	31	43.06	35	64.81
		Mode of cooking		
Wood stove	17	23.61	4	7.41
Gas stove	24	33.33	19	35.19
Both wood and gas	31	43.06	31	57.41
		Dietary pattern		
Predominantly Veg	41	56.94	41	75.93
Predominantly Non-Veg	29	40.28	13	24.07
Pure Veg	2	2.78	0	0
Pure Non-Veg	0	0	0	0

TABLE 2: FRUITS AND FAST FOOD CONSUMPTION OF STUDY POPULATION

Fruits consumption	Bronchial asthma (n-72)		COPD (n-54)	
	n	%	n	%
Occasional	52	72.22	31	57.41
Daily	19	26.39	19	35.19
Never	1	1.39	4	7.41
		Time of consumption		
Day time	53	73.61	32	59.26
Night time	19	26.39	22	40.74
		Fast food consumption		
Occasional	72	100.00	49	90.74
Daily	0	0.00	0	0.00
Never	0	0.00	5	9.26

The univariate analysis showed a significant association between smoke exposure in kitchen and incidence of COPD or BA (p<0.05). Another risk factor demonstrated in BMI where normal BMI patients were less in COPD than in BA group. The diet variables had shown significant changes as shown in **Table 2**. Daily fruit consumers were lesser in BA group (n-19, 26.39%) and in COPD group (n-19, 35.19%) compared to occasional fruit consumers in BA patients (n-52, 72.22%) but lesser in COPD patients (n-31, 57.41%).

Multivariate Analysis: The multivariate analysis showed the risk of household smoke exposure and consumption of fruits and its detoxifying effects were not truly established here; the results demonstrated that risk for COPD group was significantly higher compared with BA group (P<0.05). The risk in the group that stayed more than 500 minutes per day was four times higher (P<0.05) than that in other groups with kitchen exposure less than 200 min **Table 3**.

TABLE 3: UNIVARIATE ANALYSIS OF THE STUDY POPULATION

Parameters		Stay at the kitchen (h/day)	Stay at outdoor (h/day)	Outdoor other than kitchen (h/day)	Wood stove	Gas stove	Both Wood and Gas
Bronchial Asthma (n-72)	Duration of exposure (min)	312.63± 80.2	167.37± 58.58	960.12± 120.42	11.97± 1.92	12.65± 1.02	12.27± 1.22
	RC	4.91	2.71	12.4	1.01	0.92	0.84
	OR	24.94	12.01	57.11	2.12	2.82	5.84
	p value	0.002*	0.041*	0.0001*	0.032*	0.54	0.21
	95% CI	43.12-57.01	31.13-43.22	52.32-59.94	4.82-9.14	2.01-5.12	9.42-14.01
COPD (n-54)	Duration of exposure (min)	123.53± 55.68	1534.37± 220.46	283.16± 50.1	14.5± 0.11	10.8± 0.94	12.9± 0.12
	RC	9.33	59.79	29.04	9.71	21.12	3.04
	OR	4.93	21.42	10.61	5.13	2.19	1.87
	p value	0.0001*	0.042*	0.54	0.0001*	0.014*	0.0002*
	95% CI	32.05-41.22	59.32-74.13	24.12-41.02	11.91-15.73	14.12-24.11	1.05-4.82

*P<0.05, Chi-Square test, RC-Regression coefficient, OR- Odds ratio, SD- Standard deviation, CI-confidence interval

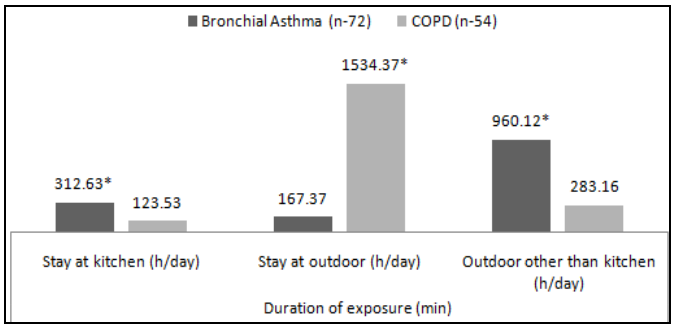

FIG. 1: KITCHEN STAY OF THE STUDY POPULATION. Values expressed as average, *P<0.05, independent sample‘t’ test.

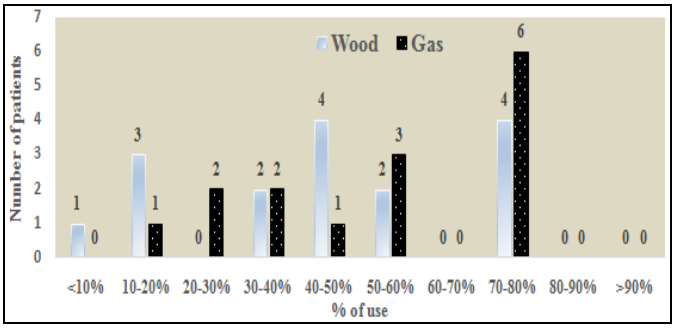

FIG. 2: THE PERCENTAGE USE OF WOOD AND GAS IN BA PATIENTS. Value expressed as number.

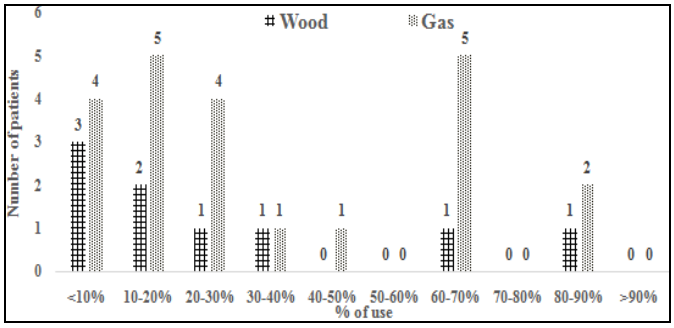

FIG. 3: THE PERCENTAGE USE OF WOOD AND GAS IN COPD PATIENTS. Value expressed as number, *P<0.05, independent sample‘t’ test.

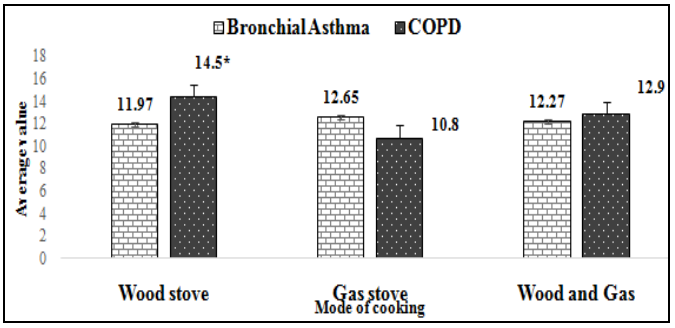

FIG. 4: HAEMOGLOBIN CONCENTRATION AGAINST KITCHEN STAY. Values expressed as average, *P<0.05, independent sample‘t’ test.

Furthermore, the association between time of stay at the kitchen in BA and COPD were also assessed as shown in **Table 3** and **Fig. 1**. The length of stay at the kitchen was found to be higher in BA patients. The average time of stay at kitchen could be a new variable for analysis against the risk factors for COPD and BA. Independent sample‘t’ test showed significant more time where BA

patients stayed in the kitchen (P<0.05). COPD patients stayed out-door other than the kitchen for a longer time as they avoided use to kitchen smoke. By contrast, diet habits and further adjustment for kitchen smoke were the positive potential confounders that continued to show a strong association **Fig. 2** and **Fig. 3**. Furthermore, no significant correlation between education, the cross-ventilated kitchen was identified by either univariate or multivariate logistic regression analysis (P>0.05); suggesting that they were not potential risk factors for COPD progression. The Odds Ratio (OR) values were listed as shown in **Table 3** with confidence interval (CL) as well as a p-value. We found the women used a wood stove and gas stove had increased Hb concentration than others **Fig. 4**; the proportions of use of wood to LPG was not measured. The concentrations of carboxyhemoglobin and serum ferritin levels were not measured in our study.

DISCUSSION: We determined the prevalence of the modifiable risk factors like prolonged kitchen stay, dietary pattern, cooking methods in outpatient BA and COPD patients. Later we determined the association of Hb values and time of exposure in kitchen, indoor other than kitchen and outdoor. Since, BA and COPD are significant causes for death in rural and urban areas, the prevalence of risk factors is important to analyze. The results found a positive association of dietary pattern, fruits intake and kitchen exposure with BA and COPD.

The development of progressive, irreversible symptoms of COPD and reversible BA is already studied through previous years [7, 10]. It has been found similar to the result as discussed in WHO indoor air quality guidelines [12], that both biomass smoke exposure and cigarette smoke exposure, emphasizes the adverse effects of biomass smoke exposure on respiratory air-flow limitation to be as significant as cigarette smoke exposure. As per the epidemiological point of view, the prudent pattern of dietary loaded with non-vegetarian, least daily consumption of fruits could be associated with slowed propagation of BA severity and COPD with emphysema. The results suggested in Fernandes L *et al*., Johnson P *et* al., and Chakraborty D *et al*., supports the extended stay at kitchen presumably increased CO levels, but partially reversible binding with hemoglobin was expected in BA patients. Perhaps, the intensity of exposure to CO while cooking may differ with use of wood fire stove and LPG stove (depends upon the availability of air), the presence of cross ventilation and smoke cloud in the kitchen was not found anywhere. The smoke exposure might be from the neighbors; people douse the smoke stove as well as smokeless stove simultaneously [22], [23]. Our findings were brought to emphasize the importance of cross ventilation and enough exhaust precautions in the kitchen. The concentrations of carboxyhemoglobin and serum ferritin levels were not measured in our study. We did not include the fact of the presence of another smoker in every home since it was negligible to cause confounding being an observational prevalence study. We found the women used a wood stove and gas stove had increased Hb concentration than others; the proportions of use of wood to LPG was not measured. Obesity was another marker for COPD was measured more significant than BA patients; can still increase the risk for prognosis of COPD symptoms. Therefore, as per study result by Kumbhare S *et al*., women patients with a disparate elevated risk like environmental, household smoke can exacerbate greater portions of overlap syndrome; may direct us for further studies on correlated genotype-phenotype subjects in COPD[25].

CONCLUSION: The study has found a positive association with potentially predisposing modifiable risk factors like household kitchen biomass smoke and dietary pattern in both BA and COPD female patients. The exposure to kitchen smoke was related to the intensity of diseases; might be common in the rural and urban population. This may increase the burden of diseases, cause financial as well as social loss. The study results lead to the importance of providing health-related education on kitchen smoke, biomass with the existence of diseases severity and huge economic burden on our country. This awareness programs shall be extended to all healthcare and social workers to help the patients for earlier detection of disease and thereby provide a better quality of life to both BA and COPD patients.

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CONFLICT OF INTEREST: No conflict of interest.

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