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A STUDY OF VARIOUS MORBIDITIES IN RELATION WITH BIOMASS FUELS USED IN RURAL INDIA

Community Medicine

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ABSTRACT

OBJECTIVES:
To assess various morbidities and its relation with the duration of exposure in women using biomass fuel.
MATERIALS AND METHOD:
Community based study which included 994 subjects. Personal information along with clinical examination was collected. Exposure Index and Peak Expiratory Flow Rate were calculated.
RESULTS:
Among 994 subjects, 72.9% subjects were using biomass fuel, 12.1% were using LPG. Morbidities like respiratory illnesses, cataract, excessive eye watering, pallor and cyanosis were significantly associated with the type of fuel used and duration of exposure.
CONCLUSION:
Majority of women in rural area use biomass as the main source of fuel for domestic purposes and are more prone to suffer with different morbidities.

KEYWORDS

Biomass fuel, various morbidities, exposure index.

INTRODUCTION:
Air pollution has become a major concern in India in recent years both because it is now clear that large parts of the Indian urban population are exposed to some of the highest pollutant levels in the world and also because new studies around the world on the health effects of air pollution have increased confidence in estimates of the risks posed by air pollution exposures.[1]

In India, out of 0.2 billion people using fuel for cooking; 49% use firewood; 8.9% cow dung cake; 1.5% coal, lignite, or charcoal; 2.9% kerosene; 28.6% liquefied petroleum gas (LPG); 0.1% electricity; 0.4% biogas; and 0.5% any other means.[2]

It was found that though the overall proportion of households with SFU has declined from 62% in 1980 to 41% in 2010 globally, total number of people exposed has largely remained unchanged (2.8 billion) due to population growth.[3] It is believed that the toxins from biomass fuel smoke are absorbed systematically and accumulate in lens resulting in its opacity.[4]

There is now evidence linking an increased risk of respiratory tract infections, exacerbations of inflammatory lung conditions, cardiac events, stroke, eye disease, tuberculosis (TB), cancer and hospital admissions with air pollution levels.[5] Keeping this situation in mind, present study was planned to assess various morbidities and its relation with the duration of exposure in women using biomass fuel.

MATERIALS AND METHOD:
A Community Based Cross-Sectional Descriptive study conducted in rural area of Beed district. Total of 994 subjects were studied including all the women aged above 15 years involved in cooking, non-smokers and non-pregnant women and who were regular resident of area. A house to house survey was done and predesigned structured questionnaire was used to record personal information along with general examination. Weight, height and blood pressure recording was done using standard procedures. Exposure Index was calculated for all subjects by multiplying the average number of hours spent in cooking per day and total number of years spent in cooking.[6] Measurement of Peak Expiratory Flow Rate (PEFR) was carried out with Wright's Peak Flow Meter for all subjects. Three readings of PEFR were taken and highest of three readings was considered as a representative value. Expected PEFR was separately calculated for each subject depending on age and height.

Expected PEFR[6] = 3.310H – 1.865A – 81.0, where H = height (cm), A = age (years).

RESULTS:
Out of 994 subjects, 725 (72.9%) subjects were using only biomass fuel and 120 (12.1%) subjects were using only LPG for domestic purposes. None of the subjects were using kerosene as the only fuel, while, 149 (15.0%) were using combination of fuels.

Table 1: Distribution of Subjects according to Symptoms during cooking with Type of Fuel Used:

	Symptoms during cooking	Type of Fuel						Total		P value
		Biomass		LPG		Mixed				
		No	%	No	%	No	%	No	%	
1.	Dyspnoea	274	27.6	20	2.0	25	2.5	319	32.1	P<0.001
2.	Cough	382	38.4	40	4.0	56	5.6	478	48.0	P<0.001
3.	Blurring of Vision	510	51.3	60	6.0	65	6.5	635	63.8	P<0.001
4.	Watering of Eyes	685	68.9	80	8.0	149	15.0	914	91.9	P<0.001
5.	Rhinitis	529	53.2	60	6.0	127	12.8	716	72.0	P<0.001
6.	Headache	379	38.1	40	4.0	37	3.7	456	45.8	P<0.001

(Chi square test)

Almost all the subjects complained of watering of eyes during cooking (92%) mainly biomass users. Very few subjects using LPG or mixed fuel complained of these symptoms. The occurrence of all the symptoms was significantly higher among the subjects using biomass fuel and was statistically significant (p<0.001).

Table 2: Distribution of subjects according to Various Morbidity in relation with Type of Fuel used:

S. No	Various Morbidities	Biomass Fuel		LPG		Mixed Fuel		Subjects (N=994)	
		No.	%	No.	%	No.	%	No.	%
1.	Ocular System								
	Blurring of vision	510	51.3	60	6.0	65	6.6	635	63.9
	Watering of eyes	685	68.9	80	8.0	149	15.0	914	91.9

	Cataract	113	11.3	4	0.4	22	2.2	139	13.9
2.	Ear								
	Diminished hearing	98	9.9	12	1.2	15	1.5	125	12.6
3.	Respiratory System								
	Decreased air entry	184	18.5	12	1.2	23	2.3	219	22.0
	Crepitation	247	24.8	40	4.0	52	5.2	339	34.0
	Wheeze	18	1.8	1	0.1	1	0.1	20	2.0
4.	Cardiovascular System								
	Palpitation	20	2.0	16	1.6	25	2.5	61	6.1
	Murmurs	40	4.0	3	0.3	7	0.7	50	5.0
5.	Central Nervous System								
	Hemiparasis	9	0.9	2	0.2	5	0.5	16	1.6
6.	Gastrointestinal System								
	Dyspepsia	41	4.1	3	0.3	12	1.2	56	5.6
	Epigastric pain	50	5.0	7	0.7	15	1.5	72	7.2
	Constipation	33	3.3	3	0.3	4	0.4	40	4.0
7.	Urogenital System								
	Burning Micturition	20	2.0	20	2.0	40	4.0	80	8.0
	Urinary Incontinence	12	1.2	2	0.2	6	0.6	20	2.0
8.	Locomotor System								
	Backache	31	3.1	20	2.0	9	0.9	60	6.0
	Arthritis	351	35.3	34	3.4	45	4.5	430	43.2
9.	General								
	Pallor	356	35.8	60	6.0	57	5.7	473	47.5
	Edema	31	3.1	3	0.3	9	0.9	43	4.3
	Icterus	9	0.9	3	0.3	8	0.8	20	2.0
	Clubbing	10	1.0	2	0.2	6	0.6	18	1.8
	Cyanosis	58	5.8	5	0.5	21	2.1	84	8.4
	Lymphadenopathy	16	1.6	6	0.6	7	0.7	19	1.9

In the above table, 139 (14%) subjects had unilateral or bilateral Cataract, majority 117 (11.8%) in biomass fuel users. Statistically significant association seen between occurrence of cataract and type of fuel used for cooking predominance in biomass fuel users (p=0.001).

In respiratory system, decreased air entry was seen in 219 (22.0%) subjects. Deceased entry was mainly seen in biomass fuel users i.e. 184 (18.5%) which was statistically significant (p<0.001). In auscultation, crepitations were heard in 339 (34.1%) subjects with predominance in biomass fuel users i.e. 247 (24.8%). Arthritis was the second most common morbidity seen in almost half of subjects i.e. 430 (43.3%) with majority belonged to biomass fuel user group.

Pallor was seen in 473 (47.6%) subjects, cyanosis in 84 (8.5%) subjects, Statistical association was seen between pallor and fuel type (p<0.05). Cyanosis was observed in 84 (8.5%) subjects where; 58 (5.8%) were using biomass fuel which was statistically significant (p<0.05).

Table 3: Distribution of subjects according to Various Morbidities in relation with Exposure Index (EI):

Sr. No	Type of Morbidity	Exposure Index (EI)				P value
		<30 No. (%)	31-60 No. (%)	61-90 No. (%)	>90 No. (%)	
1.	Ocular System					
	Blurring of vision	59 (197.1)	180 (18.1)	178 (17.9)	218 (21.9)	p<0.001*
	Watering of eyes	179 (18.0)	259 (26.1)	198 (19.9)	278 (28.0)	p<0.001*
	Cataract	20 (2.0)	19 (1.9)	38 (3.8)	62 (6.2)	p<0.001*
2.	Ear					
	Diminished hearing	1 (0.1)	19 (1.9)	4 (0.4)	76 (7.6)	p<0.001*
3.	Respiratory System					
	Decreased air entry	21 (2.1)	41 (4.1)	40 (4.0)	117 (11.8)	p<0.001*
	Crepitation	20 (2.0)	40 (4.0)	79 (7.9)	200 (20.1)	p<0.001*
	Wheeze	1 (0.1)	16 (1.6)	1 (0.1)	2 (0.2)	p<0.001*
4.	Cardiovascular System					
	Palpitation	6 (0.6)	10 (1.0)	6 (0.6)	40 (4.0)	p<0.001*
	Murmurs	2 (0.2)	6 (0.6)	12 (1.2)	30 (3.0)	p<0.001*
5.	Central Nervous System					
	Hemiparesis	1 (0.1)	2 (0.2)	2 (0.2)	11 (1.1)	p>0.05
6.	Gastrointestinal System (GIT)					
	Dyspepsia	1 (0.1)	20 (2.0)	17 (1.7)	18 (1.8)	p<0.001*
	Epigastric pain	17 (1.7)	17 (1.7)	14 (1.4)	24 (2.4)	p>0.05
	Constipation	1 (0.1)	15 (1.5)	14 (1.4)	10 (1.0)	p<0.05*
7.	Urogenital System					
	Burning Micturition	20 (2.0)	9 (0.9)	13 (1.3)	38 (3.8)	p<0.001*
	Urinary Incontinence	2 (0.2)	3 (0.3)	5 (0.5)	10 (1.0)	p<0.05*
8.	Locomotor System					
	Backache	3 (0.3)	17 (1.7)	19 (1.9)	21 (2.1)	p<0.001*
	Arthritis	20 (2.0)	119 (12.0)	92 (9.2)	199 (20.0)	p<0.001*
9.	General					
	Pallor	116 (11.7)	108 (10.8)	116 (11.7)	133 (13.4)	p<0.001*
	Pedal oedema	1 (0.1)	5 (0.5)	5 (0.5)	32 (3.2)	p<0.001*
	Icterus	7 (0.7)	4 (0.4)	5 (0.5)	4 (0.4)	p>0.05
	Clubbing	3 (0.3)	3 (0.3)	5 (0.5)	7 (0.7)	p>0.05
	Cyanosis	9 (0.9)	16 (1.6)	24 (2.4)	35 (3.5)	p<0.05*
	Lymphadenopathy	3 (0.3)	6 (0.6)	4 (0.4)	6 (0.6)	p>0.05

Occurrence of cataract and other ocular symptoms were seen more in subjects with EI more than 90 hours-years and were statistically significant (p<0.001). Similarly, decreased air entry, palpitation and crepitations were commonly present in subjects with EI more than 90 and were statistically significant (p<0.001).

Pallor was most commonly found in the subjects with EI more than 90 i.e. 133 (13.4%). Cyanosis was common in 24 (2.4%) subjects with EI of 61 to 90. Significant association was seen in EI of subjects with pallor, edema, and cyanosis (p<0.001).

DISCUSSION:

Present study shows higher percentages of women use biomass fuel (72.9%). Choice of fuel is mainly a matter of availability, affordability, and habit which includes domestic energy needs, sustainability of alternate source, cultural and economic aspects, etc. Similar findings were seen in study done by Saha A were 94.1% used biomass fuel and only LPG was used by 3.9% women.[7] Johnson P showed that 83.7% participants used biomass as their primary fuel in unimproved stoves as compared to only 16.3% using cleaner fuels such as kerosene and LPG.[8] Mishra V analyzed NFHS I data and reported that 93.1% rural population use biomass fuels for cooking while only 6.9% use cleaner fuels for cooking.[9]

Around 92% subjects complained of watering of eyes during cooking with higher occurrence in biomass fuel users. Also, 14% subjects had unilateral or bilateral Cataract, majority (11.8%) seen in biomass fuel users. Statistical association was seen between occurrence of ocular symptoms and cataract with type of fuel used with more frequency in biomass fuel users (p=0.001). Sukhsohale N stated that 38.2% subjects complained of eye irritation, followed by headache in 34.5%. Symptoms like eye irritation, headache, and diminution of vision were significantly higher in biomass users (P < 0.05).[6] Occurrence of cataract was higher in women using biomass fuel i.e. 9.1%, followed by mixed fuel users (7.8%) and was statistically significant (p<0.05). Subjects using LPG had relatively lower risk of cataract.[6] Pokhrel A revealed univariate OR of cataract cases using biomass was 3.39 (2.10–5.46) suggesting increased risk of cataract by indoor smoke exposure from solid-cooking-fuel combustion.[10]

In respiratory system, decreased air entry was seen in 22.0% subjects,

mainly in biomass fuel users (18.5%) which was statistically significant ($p<0.001$). Crepitations were heard in 34.1% subjects with predominance in biomass fuel users (24.8%). Similar findings shown by Dutt D. Overall prevalence of respiratory symptoms including breathlessness and cough was higher in biofuel users (23%) compared to LPG users (18%, $p<0.05$) or kerosene users (13%, $p>0.05$).[11] Kurmi OP reported that prevalence of breathlessness, wheeze, and chronic bronchitis symptoms were more common in biomass users compared to non- biomass fuel users ($p <0.001$).[12] Ellegard A explained the absorption and accumulation of toxins from fuel source that lead to oxidation in lens and occurrence of cataract. Various respiratory morbidities have significant association with type of fuel used for cooking ($p<0.05$) predominantly, biomass fuel users. Pollutants such as hydrocarbons cause irritant or inflammatory action on conjunctiva and lodge in mucous linings of respiratory tract leading to tissue damage.[13]

Pallor was seen in 47.6% subjects, in which 35.8% subjects were biomass fuel users, showing statistical association between anaemia and fuel type used ($p<0.05$). Findings of the present study differ with that of Sukhsohale N where higher proportion of anaemia was seen in women using LPG and no statistical association was found between occurrences of anaemia with type of fuel used.[6]

Cyanosis was observed in 8.5% subjects where 5.8% were using biomass fuel. Statistical association was seen between fuel type and occurrence of cyanosis. Underlying diseases which might lead to cyanosis are COPD, or any pulmonary system originated cardiac disease e.g. cor pulmonale, pulmonary oedema, etc. Particulate air pollution leads to rapid and significant increase in fibrinogen, plasma viscosity, platelet activation and release of endothelins.[14] Long-term prospective cohort studies show an association between levels of air pollution consisting of fine particulate matter ($PM_{2.5}$) and an elevated risk of death from all causes and from cardiovascular disease.[15,16]

Significant association was seen between EI and ocular morbidities ($p<0.001$) predominantly in subjects with EI more than 90. Pokhrel A gave an evidence of exposure-related trend in the risk of cataract with increasing duration of cooking.[10] Sukhsohale N observed the same results where 7 % of cataract cases had EI more or equal to 100 which was statistically significant ($p<0.001$).[6]

Decreased air entry, crepitations and wheezing were found to be statistically significant in the present study with EI of subjects, proportion being more in subjects with higher EI. Similar findings were seen in other studies.[8]

Out of 443 subjects with pallor, 13.4% subjects had EI more than 90 and statistically significant ($p<0.001$). Similarly Sukhsohale N showed statistical association between occurrence of anaemia with the EI where around 30 % subjects with anaemia had EI more than 100.[6] Due to lack of literature, it becomes difficult to comment on association between EI and other morbidities which came out to be statistically significant in the present study.

CONCLUSION:

Majority women in rural area use biomass fuel as the main source of fuel for cooking and other purposes. Risk of developing various respiratory morbidities, ocular morbidities, pallor, cyanosis, etc. is high in subjects using biomass fuel. Also, occurrence of such morbid conditions depends on longer duration of exposure and ill-ventilation.

RECOMMENDATIONS:

Intervention programme should include public awareness; change in pattern of fuel use; modification in stove design; improvement in ventilation; and multisectoral approach.

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