RESPIRATORY SYMPTOM AND ILLNESS PREVALENCE IN MOTHERS, IN RELATION TO BIOMASS COOKING FUEL USE IN MANDALAY, MYANMAR

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ABSTRACT: A cross-sectional study was conducted with the purpose of ascertaining the association between biomass cooking fuel use and prevalence of respiratory symptoms and illnesses in mothers in Mandalay, Myanmar. To the best of our knowledge, this is the first study that directly assesses respiratory effects of biomass fuel use in Myanmar. The study was conducted in 425 households, using a standardized, interviewer-administered questionnaire. All households had at least one child under 5 years old. Prevalences of respiratory symptoms and illnesses in these children's mothers (or female guardians) were measured and assessed in relation to biomass fuel use. Specific outcomes were cough with or without cold, phlegm with or without cold, wheeze, shortness of breath when hurrying on level ground, cold with cough in past 12 months, and doctor-diagnosed asthma. In addition to biomass fuel use, other independent variables were included such as other cooking-related variables, household environmental characteristics, and socio-demographic characteristics, totally 19 independent variables. Associations of categorical and continuous variables with respiratory outcome prevalences were measured by using chi-square tests and logistic regression, respectively. Each independent variable was assessed separately (bivariate analysis). More than half of the households (64.2%) used biomass fuel as their main cooking fuel. Prevalence of respiratory problems in mothers were statistically significantly associated with biomass fuel use ($p<0.05$). Mothers who use biomass fuel as their main cooking fuel had 3.2 times more chance to get cough, 3.9 times more occur to have phlegm, 7.3 times more experience to have wheeze, 10.6 times more chance to suffer from shortness of breath, 4.4 times more chance to have cold with cough in past 12 months and 7.2 times more opportunity to acquire asthma than who don't use. Therefore, this study strongly suggested that biomass fuel use is a risk factor for human respiratory health. It is likely that reduction of household biomass fuel use would improve respiratory health in Mandalay, Myanmar.

Keywords: respiratory symptom, respiratory, prevalence, biomass fuel, Mandalay, Myanmar

INTRODUCTION

Although our world has been developed with modern technologies, almost half of the world's population still uses traditional biomass and coal stoves causing about 2 million deaths annually, including over 1 million deaths from chronic obstructive pulmonary disease and almost another million deaths from pneumonia in children under the age of 5. More than one-third of the annual deaths from chronic lung disease worldwide and nearly 3% of lung cancer deaths are due to indoor air pollution from biomass and coal stoves, and most of this burden is born by poor women in developing countries. Lung cancer deaths of about 36,000 people every year are also due to indoor air pollution from coal stove [1]. In terms of disability adjusted life years lost (DALYs), indoor smoke from solid fuels ranks eighth globally and in terms of mortality it ranks eleventh [2].

People in Mandalay, Myanmar, a developing country in South East Asia, tra-ditionally use open fires for indoor cooking commonly found in the household. By the year 2002 in Myanmar according to WHO estimates, ALRI deaths attributable to solid fuel use (<5 year) was 11,590 and COPD deaths attributable to solid fuel use (30 years) was 3,070. Total deaths and total DALYs attributable to solid fuel use were 14,700 and 469,200 respectively, and the percentage of national burden of disease attributable to solid fuel use was 3.2% [3]. One study in Myanmar migrant workers in Thailand observed that the households' education status, ventilation of the house, ventilation during cooking, smoking habit of household members, and usage of incense and mosquito coils were positively associated with cough with or without cold (OR = 1.84, 95% CI = 1.02 - 3.33, p = 0.045), phlegm with

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Table 1 Unadjusted association between household environmental characteristics and prevalences of cough, phlegm and wheeze in mother

Characteristics	Cough			Phlegm			Wheeze		
	Prevalence (%)	χ^2	*p-value*	Prevalence (%)	χ^2	*p-value*	Prevalence (%)	χ^2	*p-value*
Cooking-related characteristics									
Biomass main fuel		154.53	<0.001		114.81	<0.001		101.63	<0.001
No	27.0			18.4			7.9		
Yes	86.8			72.5			57.9		
Usually cook indoors		1.09	0.298		10.26	0.001		1.78	0.182
No	60.0			35.7			32.9		
Yes	66.5			56.6			41.4		
Meals cooked per week		9.07	0.011		16.10	<0.001		22.98	<0.001
10 or less	65.1			39.7			31.7		
11 to 15	72.6			69.7			52.6		
16 or more	57.6			46.5			29.1		
Smokiness during cooking		167.56	<0.001		145.45	<0.001		113.71	<0.001
No	29.7			18.3			9.7		
Yes	90.4			77.6			61.2		
Eye irritation caused by smokiness during cooking		82.11	<0.001		102.72	<0.001		78.86	<0.001
No	49.2			34.2			23.7		
Yes	92.5			84.9			67.3		
Other household environmental characteristics									
Burn mosquito repellent		31.21	<0.001		8.99	0.003		0.39	0.535
No	57.5			48.7			40.9		
Yes	86.3			65.0			37.6		
Burn incense		22.15	<0.001		7.89	0.005		0.31	0.577
No	58.2			48.6			39.1		
Yes	81.7			63.4			42.0		
Wooden house		114.46	<0.001		65.96	<0.001		55.66	<0.001
No	34.7			28.7			18.0		
Yes	85.3			69.0			54.3		
2 storied house		18.33	<0.001		7.23	0.007		9.43	0.002
No	79.4			62.4			50.4		
Yes	58.5			48.6			34.9		

or without colds (OR = 2.02, 95% CI = 1.28-3.19, p = 0.003) and wheeze with or without colds (OR = 2.47, 95% CI = 1.52 - 4.00, p < 0.001) [4].

The aim of this study was to investigate the association between socio-demographic characteristics, biomass fuel usage, household environmental characteristics, and respiratory symptom and illness prevalence in mothers in Mandalay, Myanmar. This research may serve as a working principle for future prevention and control measures upon health hazards due to biomass fuel usage and research findings may help to increase the general public's awareness of indoor air pollution due to biomass fuel.

MATERIALS AND METHODS

A quantitative, cross-sectional study was conducted in Chan Aye Thar Zan Township of Mandalay City, Mandalay Region, Myanmar. The study included 425 households, selected by multi-stage sampling from the Mandalay population. All households had at least one child under 5 years old. In each household, the mother (or female guardian) was interviewed, using a standardized, pre-tested questionnaire. This queried cooking fuel use, cooking habits, other household environmental factors, socio-demographic characteristics, and prevalences of respiratory symptoms and illnesses. This report focuses only on prevalences in the mothers or female guardians. Majority of respondents about >95% were children's mothers and the rest were female guardians (grandmothers or aunt of the children). Descriptive statistic was used to describe the socio-demographic characteristics, household environmental characteristics and prevalence of respiratory symptom and illness in mother. Bivariate analysis by using chi-square tests for categorical independent variables such as biomass main fuel, usually cooks indoors, meals cooked per week, smoky during cooking, eyes irritation caused by

Table 2 Unadjusted association between household environmental characteristics and prevalences of shortness of breath, cold and asthma in mother

Characteristics	Shortness of breath			Cold			Asthma		
	Prevalence (%)	χ^2	*p-value*	Prevalence (%)	χ^2	*p-value*	Prevalence (%)	χ^2	*p-value*
Cooking-related characteristics									
Biomass main fuel		39.81	<0.001		132.32	<0.001		22.32	<0.001
No	2.6			17.1			2.6		
Yes	27.5			75.1			18.7		
Usually cook indoors		5.56	0.018		6.96	0.008		12.46	<0.001
No	8.6			40.0			0		
Yes	20.6			57.2			15.5		
Meals cooked per week		1.92	0.384		11.40	0.003		14.69	0.001
10 or less	12.7			42.9			0		
11 to 15	20.5			63.2			18.4		
16 or more	18.6			48.8			11.6		
Smokiness during cooking		52.25	<0.001		141.51	<0.001		36.76	<0.001
No	2.3			20.0			1.1		
Yes	30.0			78.4			21.2		
Eye irritation caused by smokiness during cooking		25.11	<0.001		120.65	<0.001		37.20	<0.001
No	11.3			33.8			5.3		
Yes	30.8			88.7			25.8		
Other household environmental characteristics									
Burn mosquito repellent		1.41	0.235		3.36	0.067		2.47	0.116
No	17.2			51.6			11.4		
Yes	22.2			61.5			17.1		
Burn incense		0.19	0.656		0.35	0.555		0.85	0.355
No	18.0			53.4			13.9		
Yes	19.8			56.5			10.7		
Wooden house		11.09	0.001		59.76	<0.001		16.22	<0.001
No	10.8			31.1			4.8		
Yes	23.6			69.4			18.2		
2 storied house		6.72	0.010		11.45	0.001		0.01	0.940
No	25.5			66.0			12.8		
Yes	15.1			48.6			13.0		

smokiness during cooking, burn mosquito repellent, burn incense, wooden house, 2 storied house, mother's education, mother's occupation, mother smokes, father's education, father daily paid worker, father dusty job, father smokes and monthly income and binary logistic regression for continuous independent variables such as age and total number of people in the household used to find out associations of these independent variables with the dependent variables. Each independent variable was assessed separately. This study was approved by Ethics Review Committee of Chulalongkorn University, Bangkok, Thailand.

RESULTS

Households using biomass fuel (wood or charcoal) as the main cooking fuel were 64.2%, and those using cleaner fuels such as gas or electricity were 35.8%. 83.5% of households cooked mainly indoors. Number of meals cooked per week in the home was categorized into 3 groups, 10 or less, 11 to 15 and 16 or more and their prevalences were 14.8%, 44.7% and 40.5%, respectively. Over 99% of respondents reported opening doors and windows during cooking. Overall, 58.8% of households had smokiness during cooking and 37.4% of respondents suffered eye irritation due to smokiness during cooking. Only 27.5% of households burned smoke- producing mosquito repellent and 30.8% of them burned incense. Most of the respondents lived in wooden houses. Two storied houses were nearly double of one storied houses, 66.8% and 33.2% respectively.

About 43.8% of mothers have primary education or less. Among the mother's occupations, housewife was the most common occupation and it was about 51.8%. Very few mothers (5.2%) smoked. Around 43.5% of the households had monthly income between 100,000 and 149,999 Kyats (between 123 USD and 184 USD), 27.3% of them had less than 100,000 Kyats (123 USD) and 29.2% had above

Table 3 Unadjusted association between socio-demographic characteristics and prevalences of cough, phlegm and wheeze in mothers

Characteristics	Cough			Phlegm			Wheeze		
	Prevalence (%)	χ^2	***p-value***	**Prevalence (%)**	χ^2	***p-value***	**Prevalence (%)**	χ^2	***p-value***
Mother's education		52.76	<0.001		28.18	<0.001		47.69	<0.001
>Primary education	50.6			41.8			25.5		
≤Primary education	80.4			67.7			58.6		
Mother's occupation		23.89	<0.001		11.87	0.003		27.99	<0.001
Daily paid worker	76.4			60.0			58.2		
Housewife	68.7			56.4			38.6		
Others	45.3			37.9			22.1		
Mother smokes		6.74	0.009		7.52	0.006		5.55	0.019
No	63.8			51.9			38.4		
Yes	90.9			81.8			63.6		
Father's education		77.42	<0.001		43.17	<0.001		35.77	<0.001
>Primary education	48.2			39.7			27.9		
≤Primary education	89.3			71.9			56.7		
Father daily paid worker		49.77	<0.001		22.76	<0.001		49.22	<0.001
No	49.8			42.1			24.0		
Yes	82.4			65.2			57.4		
Father dusty job		15.25	<0.001		9.28	0.002		6.34	0.012
No	63.1			51.3			38.4		
Yes	100			81.5			63.0		
Father smokes		21.69	<0.001		9.26	0.002		25.31	<0.001
No	55.7			46.4			29.1		
Yes	77.4			61.3			53.2		
Income		21.22	<0.001		6.19	0.014		5.55	0.018
≥100,000 Kyats	58.9			49.5			36.6		
<100,000 Kyats	82.8			62.9			49.1		

Table 4 Unadjusted association between socio-demographic characteristics and prevalences of shortness of breath, cold and diagnosed asthma in mother

Characteristics	Shortness of breath			Cold			Diagnosed asthma		
	Prevalence (%)	χ^2	***p-value***	**Prevalence (%)**	χ^2	***p-value***	**Prevalence (%)**	χ^2	***p-value***
Mother's education		37.69	<0.001		46.94	<0.001		24.32	<0.001
>Primary education	8.4			39.7			5.9		
≤Primary education	31.7			73.1			22.0		
Mother's occupation		27.84	<0.001		19.19	<0.001		2.17	0.339
Daily paid worker	34.5			65.5			16.4		
Housewife	15.5			56.8			12.7		
Others	7.4			35.8			9.5		
Mother smokes		11.58	0.001		7.19	0.007		4.60	0.032
No	16.7			52.6			11.7		
Yes	45.5			81.8			27.3		
Father's education		16.18	<0.001		54.07	<0.001		34.20	<0.001
>Primary education	12.1			39.3			4.9		
≤Primary education	27.5			75.3			24.2		
Father daily paid worker		42.37	<0.001		58.15	<0.001		20.36	<0.001
No	6.8			36.7			5.9		
Yes	31.4			73.5			20.6		
Father dusty job		6.49	0.011		16.99	<0.001		2.20	0.138
No	17.3			51.8			12.3		
Yes	37.0			92.6			22.2		
Father smokes		37.19	<0.001		14.40	<0.001		30.03	<0.001
No	8.4			46.0			5.1		
Yes	31.7			64.5			23.1		
Income		12.12	<0.001		17.16	<0.001		0.11	0.743
≥100,000 Kyats	14.6			48.2			13.3		
<100,000 Kyats	29.3			70.7			12.1		

Table 5 Unadjusted association between continuous independent variables and prevalences of respiratory symptoms and illness in mother

Characteristics	Odds ratio	95% CI		*p-value*
		Lower	Upper	
Cough				
Age	1.08	1.038	1.115	<0.001
Total number of people in the house	0.86	0.781	0.937	0.001
Phlegm				
Age	1.06	1.022	1.090	0.001
Total number of people in the house	0.91	0.830	0.989	0.027
Wheeze				
Age	1.09	1.049	1.122	<0.001
Total number of people in the house	1.04	0.957	1.138	0.334
Shortness of breath				
Age	1.14	1.089	1.184	<0.001
Total number of people in the house	0.98	0.876	1.094	0.708
Cold				
Age	1.06	1.025	1.094	0.001
Total number of people in the house	0.89	0.811	0.968	0.007
Diagnosed asthma				
Age	1.10	1.051	1.147	0.001
Total number of people in the house	1.11	0.986	1.245	0.084

150,000 Kyats (184 USD) respectively. There were 94.8% of households with 1 child under 5 and 5.2% with 2 or 3 such children.

Prevalence of cough with or without cold was 65.4% in the mothers. 53.2% of mothers had phlegm from the chest with or without cold. About 40% of mothers ever had wheezing and 18.6% of them had shortness of breath (SOB) when hurrying on level ground. Prevalence of cold with cough in past 12 months was 54.4%. Prevalence of diagnosed asthma ever was 12.9%.

Tables 1, 2, 3 and 4 show using chi-square tests to find out the association of each respiratory health outcome of mother with categorical independent variables. All prevalences were positively and statistically significantly associated with use of biomass cooking fuel. Unadjusted relative risks of biomass fuel use were high: 3.2 for cough, 3.9 for phlegm, 7.3 for wheeze, 10.6 for SOB, 4.4 for colds, and 7.2 for diagnosed asthma. Significant associations were observed for 21 of 24 possible comparisons for other cooking-related variables (87.5%). Corresponding percentages for other environmental and socio-demographic variables were 62.5% and 75.0%, respectively.

Table 5 presents mother's age was statistically significantly associated with all respiratory outcome prevalences but total number of people in the house was significantly associated only with prevalence of cough, phlegm and cold in past 12 months. ORs of age and number of people in the house were not large enough to say that there were strong association between these two continuous variables and respiratory outcomes of mothers.

DISCUSSION

In this study, about 64.2% of households used biomass fuel such as wood and charcoal as their main cooking fuel. The rest used gas or electricity and no one used dung and coal as their main cooking fuels. In 2002, according to WHO estimated data, it was found that more than 95% of households in Myanmar used solid fuels [3] and it seems to be declined using solid fuels in nowadays upon information on this study. None of the study area households used home heating, and none had chimneys. Only a few mothers (5.2%) smoked and this finding is consistent with the national prevalence data on adult tobacco use in south-east Asia (Indonesia, Malaysia, the Philippines, Thailand and Viet Nam) indicates that cigarette smoking in women is 3–18% [5]. It was seen that almost all of the respondents in this study were children's mothers (>95%). Prevalence of wheeze in mothers was much more than that of fathers as well as asthma preva-lence. In one of the studies in China showed that females had a significantly higher risk of asthma-like symptoms and asthma attacks than males after adjusting for age, smoking, county of residence and other exposures [6]. In 2002, the cross-sectional world health survey for global asthma prevalence in adults by WHO showed that the global prevalence of doctor diagnosed asthma was 4.3% [7]. Everyone who had phlegm with or

without cold had cough with or with-out cold. In this community-based survey, we also observed that prevalence of TB in mother was 3.3%. In Myanmar, the previous WHO estimated survey in 2009 for all TB cases including TB in children, extra-pulmonary TB and bacteriologically negative TB are taken into consideration, the TB prevalence (all cases) could be 600 or more per 100,000 population [8]. In 2010, 8.8 million people fell ill with TB and 1.4 million died from TB. The largest number of new TB cases occurred in Asia, accounting for 60% of new cases globally [9].

In this study, prevalences of mother's cough ($p<0.001$) and phlegm ($p<0.001$) were statistically associated with biomass cooking fuel and it is consistent with a study in rural Mexican women after adjusting for passive smoking and level of income, women cooking with biomass stoves had cough or phlegm most of the day than those women cooking with gas stoves (OR=2.3, 95%CI= 1.1-4.8) [10]. It was also observed that mother's asthma was significantly associated with main cooking fuel. However, several studies have reported no associations, biomass fuel use is associated with reduced risk, reflecting a possible protective effect in some studies. The use of an open fire was associated with a non-significantly reduced risk of asthma (OR=0.64, 95% CI=0.21–1.91) [11]. There was one of the studies which is similar with this study is that elderly men and women in India living in households using biomass fuels have a significantly higher prevalence of asthma than do those living in households using cleaner fuels (OR= 1.59; 95% CI= 1.30 to 1.94), after controlling potentially confounding factors such as age, tobacco smoking, education and living standard [12]. Father's smoke was also positively influenced on both mother's asthma and mother's shortness of breath in this study which could indicate that passive smoking was associated with asthma and shortness of breath. After controlling age, sex, body mass index (BMI) and study area in 8 areas in Switzerland, passive smoking was associated with an increased risk of dyspnoea (OR=1.45, 95% CI=1.20-1.76), and an increased risk of physician diagnosed asthma (OR=1.39, 95% CI=1.04-1.86) [13]. If exposure to passive smoking exceeded 5 hours daily, the risk for wheeze (OR=2.67, 95% CI=1.98–3.61) and physician-diagnosed asthma (OR=1.79, 95%CI=1.02–3.16) in women were increased [14].

This study did not use multiple regression in data analysis and that multiple regression would be needed to gain a clearer idea of the relative importance of the independent variables and to show biomass main fuel has more significant relation with respiratory health outcomes than other independent variables. Findings of this study suggested that there were more incidences of respiratory problems in mothers who use biomass fuel as their main cooking fuel than the mothers who don't use. The reason for these findings was women are in charge of cooking in most societies and they usually spend 3 to 7 hours per day near the stove for preparing food. Thus, 59% of indoor air pollution attributable death falls on women [15]. Regarding analytical part, cooking-related variables were frequently significantly associated with each other. This raises the possibility that p-values for some of these variables could change in multiple regression models. The current study also gathered information on respiratory symptom and illness prevalences and socio-demographic characteristics in fathers and under 5 children, in addition to mothers and female guardians. Thus, father's socio-demographic factors were put in analysis to find out the associations with mother's respiratory health outcomes. Results for fathers and children will be reported separately.

CONCLUSION

Utilization of biomass fuel is still high in Myanmar as one of the most important findings of this study and this study also explored that respiratory illnesses are more common in mothers who live in biomass fuel using households than in mothers those who don't live. Like we mentioned in results, this study revealed that cooking related variables have more percentage of significant associations with respiratory outcomes of mothers in compare with household environmental or socio-demographic characteristics. Future prevention of respiratory illnesses can consider upon controlling number of biomass fuel using households in Myanmar.

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