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Exposure of Pregnant Women to Indoor Air Pollution: A Study from nine low and middle income countries

Muhammad Masood Kadir[1], **Elizabeth M. McClure**[2], **Shivaprasad S. Goudar**[3], **Ana L. Garces**[4], **Janet Moore**[2], **Marie Onyamboko**[5], **Christine Kaseba**[6], **Fernando Althabe**[7], **Eduardo E. Castilla**[8], **Salvio Freire**[9], **Sailajanandan Parida**[10], **Sarah Saleem**[1], **Linda L. Wright**[11], **Robert L. Goldenberg**[12], and **the Global Network Tobacco Study Group**[*]

[1]Department of Community Health Sciences, Aga Khan University, Pakistan

[2]Research Triangle Institute, Durham, NC

[3]Jawaharlal Nehru Medical College Belgaum, India

[4]San Carlos University, Guatemala City, Guatemala

[5]Kinshasa School of Public Health, University of Kinshasa, Democratic Republic of the Congo

[6]University Teaching Hospital, Lusaka, Zambia

[7]Institute of Clinical Effectiveness and Health Policy, Buenos Aires, Argentina

[8]Estudio Colaborativo Latinoamericano de Malformaciones Congenitas, Rio de Janeiro, Brazil

[9]Federal University of Pernambuco, Recife, Brazil

[10]S.C.B. Medical College, Orissa, India

[11]National Institute of Child Health and Human Development, Bethesda, MD

[12]Drexel University College of Medicine, Philadelphia, PA

Abstract

Objective—We studied exposure to solid fuel smoke and second-hand tobacco smoke among pregnant women in south Asia, Africa and Latin America.

Design—Prospective cross-sectional survey.

Setting—Antenatal clinics in Argentina, Brazil, Ecuador, Guatemala, Uruguay, Democratic Republic of Congo, Zambia, India and Pakistan.

Sample—A total of 7961 pregnant women in ten sites in nine countries were interviewed between October 2004 and September 2005.

Corresponding Author: Elizabeth M. McClure, Department of Statistics and Epidemiology, Research Triangle Institute, 3040 Cornwallis Drive, Durham, NC 27709, mcclure@rti.org, phone: 919-316-3773.

[*]**Global Network Tobacco Study Group:** Argentina - Fernando Althabe and Jose M. Belizan, (Institute for Clinical Effectiveness and Health Policy); Democratic Republic of Congo - Antoinette Tshefu (Kinshasa School of Public Health); Guatemala - Ana Garces, (San Carlos University); India - Sailajanandan Parida, (Sriramchandra Bhanja Medical College), Shivaprasad S. Goudar and Bhalchandra S. Kodkany, (Jawaharlal Nehru Medical College); Pakistan - Omrana Pasha (Aga Khan University); Zambia - Elwyn Chomba (University of Zambia); U.S.- Jeffrey Murray (University of Iowa); Waldemar A. Carlo, (University of Alabama at Birmingham); Nancy Krebs and Michael Hambidge, (University of Colorado); Robert L. Goldenberg, (Drexel University); Pinaki Panigrahi, (University of Maryland Baltimore); Richard J. Derman, (University of Missouri, Kansas City); Carl Bose, (University of North Carolina at Chapel Hill); Pierre Buekens, (Tulane School of Public Health and Tropical Medicine); Joseph Spinnato (University of Cincinnati); Linda L. Wright (*Eunice Kennedy Shriver* National Institute of Child Health and Human Development); Elizabeth M. McClure, Norman Goco, Janet Moore, Jutta Thornberry, and Ty Hartwell (Research Triangle Institute).

Methods—A standardized questionnaire on exposure to indoor air pollution (IAP) and to secondhand smoke was administered to pregnant women during antenatal care.

Main Outcome Measures—Exposure to IAP and second-hand tobacco smoke.

Results—South Asian pregnant women commonly reported use of wood (49.1%–89.7%), crop residue and animal dung for cooking and heating fuel. African pregnant women reported higher use of charcoal (85.4%–93.5%). Latin American pregnant women had greater use of petroleum gas. Among south Asian women, solid fuel use and cooking on an open flame inside the home were common. There was a significant association between solid fuel use and allowing smoking within the home at the Asian sites and in Zambia ($p<0.05$).

Conclusions—Pregnant women from low/middle income countries were commonly exposed to IAP secondary to use of solid fuels. Among these populations, exposure to second-hand tobacco smoke was also common. This combination of exposures likely increases the risk of poor pregnancy outcomes among the most vulnerable women. Our study highlights the importance of further research on the combined impact of IAP and second-hand tobacco smoke exposures on adverse maternal and perinatal outcomes.

Keywords

Pregnancy; indoor air pollution; second-hand tobacco smoke exposure; smoking

Introduction

Indoor air pollution (IAP) is an important risk factor for morbidity and mortality; it accounts for about 4% of the global burden of disease (1). Nearly two million people die each year from causes related to IAP (1,2). More than 90% of these deaths occur in low and middle income countries (LMICs), often in rural or peri-urban areas. IAP levels in LMICs are typically many times higher than developed world standards for ambient air quality (1,3,4). Since women and young children often spend considerable time indoors, mostly associated with food preparation and cooking, they are at greatest risk for exposures to IAP.

Globally, three billion people, about half the world's population, rely on solid fuel including wood, charcoal, crop residues, dung and coal as the main source of household energy (4–7). In many LMICs, solid fuel used for household activities such as cooking and heating is a major source of IAP. Solid fuels are often burned over an open fire or in an inefficient stove. The incomplete combustion of solid fuels in simple stoves releases a complex mixture of toxic chemicals, including formaldehyde, nitrogen dioxide, carbon monoxide, radon, ozone and polycyclic aromatic hydrocarbons and suspended particulate matter (1,8,9).

The association between IAP due to solid fuel use and acute lower respiratory tract infection and chronic obstructive lung disease has been clearly established (10–14). Coal smoke also has also been associated with lung cancer (15,16). IAP increases the risk of otitis media, asthma, tuberculosis, low birthweight, stillbirth and neonatal mortality (17–23).

Poor air quality also may be due to second-hand tobacco smoke. Second-hand tobacco smoke is associated with premature death and disease in children and in adults who do not smoke themselves. Maternal exposure to second-hand tobacco smoke during pregnancy has been found to cause a reduction in birth weight, and exposure of infants to second-hand smoke is causally linked to sudden infant death syndrome (SIDS) (19, 24–29). However, very few studies have explored the combined exposure of pregnant women to IAP secondary to solid fuel and secondhand tobacco smoke. We undertook a study to evaluate the extent of these exposures in pregnant women at 10 sites in nine LMICs.

Material and methods

As part of a larger study about tobacco use and exposure during pregnancy, a survey on type of fuel used for cooking and heating and location of the cooking site was administered to pregnant women in antenatal care clinics in Latin America, Africa and south Asia. Each site enrolled participants from representative community and/or hospital based antenatal clinics. The 10 study sites that participated in the survey included: (a) Latin America (Argentina, Brazil, Ecuador, Guatemala and Uruguay), (b) Africa (Democratic Republic of the Congo [DRC] and Zambia), and (c) south Asia (India – 2 sites, and Pakistan). The details of the methods and study population have been published previously (30). Data were collected between October 2004 and September 2005 by trained interviewers using a pre-tested questionnaire that included socioeconomic and demographic variables, fuel used for cooking and heating, location of the kitchen, open flame or stove use, the pregnant women's smoking of tobacco products, and individual and household second-hand tobacco smoke exposure. The interviewers read the questionnaires to the women and recorded the women's answers.

Research teams identified participants at antenatal care clinics, hospitals or health centers. Participant eligibility criteria include age 18 to 46 years and pregnancy status beyond the first trimester. Women believed to be mentally or physically incapable of participating in the survey were excluded. Written consent was obtained for all willing, eligible women, except in Pakistan and Ecuador where verbal consent was permitted. The study was approved by the Ethics Review Committees at all participating institutions and the Data Coordinating Center, Research Triangle Institute, Durham, North Carolina, USA.

Each site was expected to complete at least 750 interviews in order to estimate parameters of knowledge, attitude and behavior with a frequency as low as 5% with a coefficient of variation of approximately 15%. A custom data entry and management system using MS-Access 2002 was used. Data were reviewed for consistency and completeness at the Data Coordinating Center. Questionnaires with incomplete or inconsistent information were returned to the sites for resolution. Completely unavailable data were excluded from the analysis.

The type of fuels for cooking and heating provided by participants included wood, charcoal, coal, crop residue, animal dung, kerosene, liquefied petroleum gas (LPG), biogas and electricity. Biogas, a gas produced by the biological breakdown of organic matter in the absence of oxygen, is a type of biofuel, while LPG is a mixture of hydrocarbon gases. For this analysis, we divided fuel into two groups (i) solid fuels (wood, charcoal, coal, crop residue, animal dung) and (ii) non-solid fuels - usually better quality household fuel (kerosene, LPG, biogas and electricity). Regular smokers were those who had ever smoked daily, and/or had smoked 100 cigarettes or more in their lifetime. Potential exposures to second-hand tobacco smoke were determined by whether smoking was allowed within the home and women's and children's exposure to secondhand tobacco smoke.

Data analyses were performed using SAS version 9. We calculated descriptive statistics (frequencies, percentages, means and standard deviations) for socio-demographic variables such as literacy, employment, electricity use, cooking/fuel use and the tobacco variables. We used chi-squared tests to evaluate the association between exposures to second-hand smoke and fuel used by household.

Results

A total of 7961 pregnant women were enrolled, divided approximately equally among the 10 sites (Table 1). The mean of the women's ages at the sites ranged from about 22 years (Belgaum, India) to 30 years (Pakistan). The majority of the women from Pakistan and India

resided in rural areas while the majority of those from each of the other sites lived in semi-urban or urban areas. The Latin American sites had a higher proportion of literate women (>95%) compared to the Indian and African sites where 59–91% of participants were literate. Most of the women enrolled at the Pakistan site were illiterate. The percent of women employed outside the home ranged from 2.6% (Orissa, India) to 35.2% (Pakistan). Of those who worked outside the home, in south Asia, the majority of the women worked in manual labor/agriculture, while at the other sites, the largest proportion of women who worked outside the home were in the service industry. Availability of electricity in the household ranged from 53.0% in Zambia to 99.5% in Argentina.

Because crowding may be another condition that exacerbates the effect of IAP, we examined two measures of crowding in the woman's current household. The percent of households with seven or more members ranged from 10.6% in Brazil to 69.7% in Pakistan. In the DRC and the Asian sites, more than 30% of the households ≥7 or more members. The mean number of people per room ranged from about two per room in the Latin American sites to 5.5 per room in Pakistan. Only the south Asian sites averaged more than three people per room.

Table 2 shows the percent of households that used various types of cooking and heating fuels with the bottom row showing the percent of the women at the site using any type of solid fuel. In the Latin American sites, almost all the households used a relatively clean burning petroleum-based gas. The majority of women in the African sites used charcoal as fuel (Zambia 85.4% and DRC 93.5%). Most women in the Indian sites used wood (87.5% Orissa, 89.7% Belgaum), followed by crop residue and animal dung. In Pakistan, crop residue (68.3%), animal dung (66.0%) and wood (49.1%) were the major sources of fuel. While electricity for cooking and heating was reported for a number of sites, it was not the predominant fuel used in any site. Overall, the Latin American sites rarely used solid fuels (2.4–25.6%) while in the south Asian and African sites, at least 86% of the households used some form of solid fuel.

Table 3 shows whether cooking was generally accomplished indoors, outdoors or in both locations by site. In the Latin American sites, almost all cooking was indoors (nearly 90% or more at all sites). In these households, except for Guatemala, almost 90% of the households had a separate room for cooking and a chimney was present in the cooking room from 37.5% of the households in Ecuador to 82.3% of those in Argentina. In the African sites, cooking was mostly done over an open flame (99.1% for DRC and 46.7% for Zambia, data not shown), and often indoors (27.5% of DRC and 75.6% of Zambia homes). Less than half of the homes had a separate room for cooking. The cooking room had a chimney in 91.1% of DRC houses compared to only 30.1% of the Zambian houses. In India, cooking usually took place over an open flame (approximately 87% for both sites, data not shown) and inside the house (83.0 and 99.9% for Orissa and Belgaum, respectively). Less than half of the homes had a chimney in the cooking room (36.9% and 40.9% for Orissa and Belgaum, respectively). In the Pakistan site, cooking often occurred outside the home (53.0%), and there was often a separate room for cooking (94.0%), with a chimney in 94.8% of the households with cook rooms.

Table 4 presents the tobacco use by the pregnant women and second-hand tobacco smoke exposure data from each site. In many of the Latin American countries, smoking was prevalent among women with as many as 53.0% of the women in Uruguay ever being smokers, although smoking during pregnancy was less common. Smoking was often allowed within the home with reports ranging from 17.4% in Guatemala to 55.3% in Argentina. Women in Argentina, Uruguay and Brazil commonly reported that they or their children were frequently or always exposed to tobacco smoke indoors while these exposures

were less common in Ecuador and Guatemala. In the African sites, less than 1% of the women had ever been regular smokers or smoked in pregnancy, but smoking was often permitted inside the home (17.1% and 20.5% for DRC and Zambia, respectively). In the south Asian sites, very few (<3.2%) of the women had ever been regular smokers or smoked in pregnancy, but smoking in the home was generally permitted (about 50% in the Indian households and 91.6% in the Pakistan households). There was a wide range of women reporting tobacco smoke exposures for themselves or their children, with approximately 50% reporting these exposures in Pakistan. Thus in most of the sites, whether the women smoked or not, because smoking by others was often allowed in the house, exposure to second hand tobacco smoke was a common finding.

We also evaluated the relation by site between IAP from solid fuel use and second-hand tobacco smoke using two measures of second-hand tobacco smoke exposure (Table 5). In the first analysis, when data were pooled from all sites, we found a significant association between the type of fuel used (categorized as solid or non-solid) by households and whether smoking was allowed within the home ($p<.001$). This association was also significant for each of the sites in India, Pakistan and Zambia. We also evaluated the relation between solid fuel use and women reporting that they or their young children were frequently or always exposed to tobacco smoke indoors. As with the measure of smoking allowed in the house, the association between solid fuel use and women's and children's tobacco smoke exposure was significant when data were pooled across all sites.

Discussion

The major findings from this study include the very high use of solid fuels for heating and cooking - often over open fires - from a number of sites in LMICs and the additional large contribution to poor quality indoor air in those sites by high exposure to second-hand tobacco smoke. We also observed major differences in the type of cooking and heating fuel use by location. For example, women in south Asia were more likely to use poor quality fuels such as animal dung, crop residue and wood, while African women used mostly charcoal. Latin American women generally used cleaner burning fuels. Smoking by household members was common in all sites. In the south Asian and African sites it was usually the male spouse, while in Latin America, the smokers often included the pregnant women themselves. There were substantial differences among the sites regarding whether smoking was allowed in the house, with the lowest percentages found in Guatemala and the African sites. In most of the other sites, one third to one half of the households allowed indoor smoking. However, in Pakistan, over 90% of the households allowed indoor smoking. Interestingly, over the entire study population, the households that used the poorest quality cooking fuels were often the most likely to allow indoor smoking, thus increasing the exposure to poor quality air. These relations were strong and significant within India and Pakistan. Further contributing to poor quality air, especially in south Asia, were the high number of household members and resultant crowding.

A number of studies have shown the effect of IAP on pregnancy outcome, especially low birthweight (17–23). Three decades ago, in a study from Guatemala, Belizan et al described the relation of IAP to low birthweight (31,32). In a more recent study, also from Guatemala, solid fuel use was associated with a 200 g decrease in mean birthweight (24). In a study from south India, exposure to solid fuels was associated with a 49% increased risk for low birthweight and a 21% increased risk in the six month infant mortality (28). Second-hand tobacco smoke exposure was also associated with these outcomes. An association between IAP and low birthweight has also been reported from Pakistan and Zimbabwe (18,21). Mishra et al documented a significant increase in both first and repeat stillbirths associated with the use of solid fuels for cooking and heating (19). A study from India reported that of

the 24% of pregnant women exposed to environmental tobacco smoke during pregnancy, there was a significantly higher incidence of pre-term birth (24.1% vs. 16.1%; p = 0.027) and small-for-gestational age babies (31.9% vs.17.2%; p<0.001) as compared to unexposed women (29).

The relation between indoor air pollution and exposure to second-hand tobacco smoke and adverse pregnancy outcomes is likely to be causal. A number of investigators have demonstrated indoor air levels of particulate matter and carbon monoxide to be 100 to nearly 1000 fold higher in many LMIC households than in high income countries (1). Carbon monoxide appears to directly inhibit fetal growth and also increases maternal carboxyhemoglobin levels, therefore reducing oxygen availability to the fetus (33). These studies, together with findings from our study, emphasize that although women in some LMICs have many reasons for poor pregnancy outcomes, exposure to poor quality indoor air secondary to the use of poor quality fuels, open fires, second-hand tobacco smoke and poor ventilation, is likely play an important role in these adverse outcomes.

The issue of electricity use bears mention. While available in the majority of the households in every site and occasionally used for cooking in some, most people in LMICs can only afford to use electricity for lighting and running small electrical appliances. It is rarely used as the major energy source for cooking and almost never for heating. Thus, it is very unlikely that electricity use substantially reduces IAP in most LMIC households (1).

Our study had several limitations. The participants were a convenience sample of pregnant women recruited from health facilities and therefore may not be representative of the entire population. The data were obtained by questionnaire without independent confirmation of the IAP or tobacco smoke exposures. However, the reported exposures are consistent with previous reports of non-pregnant women from similar low income areas in the countries studied. The strengths of the study included the focus on pregnant women, the inclusion of a broad range of countries from different regions utilizing the same questionnaire, the large number of subjects per site, and the extensive interviewer training with the questions read aloud to each woman. Furthermore, we believe it was important that the questionnaire focused on both cooking fuels as well as second-hand tobacco smoke exposure as components of poor quality indoor air. To date, most studies on indoor air pollution and on second-hand tobacco smoke exposure have examined these issues separately.

In summary, the results of this study indicate that exposure to IAP from the use of poor quality fuels and indoor cooking with poor ventilation is extremely common in a number of low income countries and is likely exacerbated by exposure to second-hand tobacco smoke. Other studies confirm that adverse pregnancy outcomes are increased by these exposures. While this was an observational study on exposures, it seems likely that programs that focus on the improvement of indoor air quality by reducing exposure to both second-hand tobacco smoke and poor quality cooking fuel will likely have the greatest effect. Further research should determine how indoor air quality can be improved and the effect that such measures may have on improving maternal and child health outcomes.

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Abbreviations

DRC Democratic Republic of the Congo

IAP	Indoor air pollution
LMIC	low and middle income countries
LPG	liquefied petroleum gas

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Table 1

Demographic Characteristics of the Study Population by Site

	Latin America					Africa		South Asia		
Demographic Characteristics*	**Argentina (n=796)**	**Uruguay (n=716)**	**Ecuador (n=746)**	**Brazil (n=749)**	**Guatemala (n=752)**	**DRC (n=847)**	**Zambia (n=909)**	**Orissa, India (n=886)**	**Belgaum, India (n=736)**	**Pakistan (n=824)**
Age, mean (range)	27 (18–46)	27 (18–46)	27 (18–45)	26 (18–45)	24 (18–43)	27 (18–45)	25 (18–46)	24 (18–40)	22 (18–38)	30 (19–45)
Semi-urban/urban residence	777 (98.5)	675 (94.8)	556 (74.9)	716 (96.0)	746 (99.2)	844 (100.0)	882 (97.1)	110 (12.4)	35 (4.8)	156 (18.9)
Rural residence	12 (1.5)	37 (5.2)	186 (25.0)	30 (4.0)	6 (0.8)	0 (0)	26 (2.9)	776 (87.6)	694 (95.2)	668 (81.1)
Literate	785 (98.9)	712 (99.6)	732 (98.4)	719 (96.0)	715 (95.1)	769 (90.8)	681 (75.0)	630 (71.1)	435 (59.3)	200 (24.3)
Employed	219 (27.5)	107 (15.0)	245 (33.9)	199 (26.6)	117 (15.6)	238 (28.1)	132 (14.5)	23 (2.6)	161 (21.9)	290 (35.2)
If employed, type of work										
Factory/Office	21 (10.1)	3 (2.8)	80 (30.1)	12 (6.0)	29 (24.7)	9 (3.8)	29 (22.2)	1 (4.3)	4 (2.5)	1 (0.3)
Manual/Agriculture	35 (16.9)	22 (20.4)	57 (21.5)	17 (8.5)	4 (3.5)	58 (24.3)	36 (27.5)	18 (78.3)	129 (79.7)	274 (94.5)
Service/Other	151 (72.9)	83 (76.9)	129 (48.4)	170 (85.4)	84 (71.8)	171 (71.8)	66 (50.4)	4 (17.3)	29 (17.9)	15 (5.1)
≥ 7 People living in house	125 (15.7)	93 (13.0)	115 (15.4)	79 (10.6)	158 (21.0)	296 (35.0)	113 (12.4)	294 (33.1)	319 (43.4)	574 (69.7)
People per room, mean (SD)	2.3 (1.0)	2.3 (1.0)	2.2 (1.2)	2.2 (1.2)	2.4 (1.5)	2.9 (1.4)	2.6 (1.3)	3.3 (1.9)	3.6 (2.1)	5.5 (2.9)
Electricity in household	791 (99.5)	698 (97.6)	726 (97.3)	748 (99.9)	746 (99.2)	730 (86.7)	482 (53.0)	486 (54.9)	662 (90.0)	730 (88.9)

*Data expressed as n (%) except where noted

Table 2

Study Site and type of fuel used for cooking and heating

	Latin America					Africa		South Asia		
	Argentina (n=796)	**Uruguay (n=716)**	**Ecuador (n=746)**	**Brazil (n=749)**	**Guatemala (n=752)**	**DRC (n=847)**	**Zambia (n=909)**	**Orissa, India (n=886)**	**Belgaum, India (n=736)**	**Pakistan (n=824)**
Solid Fuels*										
Wood	17 (2.1)	182 (25.5)	78 (10.5)	12 (1.6)	52 (6.9)	121 (14.4)	77 (8.5)	775 (87.5)	660 (89.7)	404 (49.1)
Charcoal	11 (1.4)	1 (0.1)	5 (0.7)	1 (0.1)	1 (0.1)	788 (93.5)	776 (85.4)	1 (0.1)	8 (1.1)	3 (0.4)
Coal/Coke/Lignite	5 (0.6)	0 (0.0)	1 (0.1)	5 (0.7)	16 (2.1)	2 (0.2)	1 (0.1)	4 (0.5)	0 (0.0)	2 (0.2)
Crop residue	0 (0.0)	0 (0.0)	1 (0.1)	0 (0.0)	0 (0.0)	10 (1.2)	0 (0.0)	131 (14.8)	149 (20.2)	562 (68.3)
Animal dung	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	212 (23.9)	345 (46.9)	543 (66.0)
Any Use of Solid Fuel	29 (3.7)	183 (25.6)	81 (10.9)	18 (2.4)	68 (9.0)	822 (97.5)	787 (86.6)	793 (89.5)	664 (90.2)	715 (86.9)
Non-solid Fuels*										
Kerosene	8 (1.0)	20 (2.8)	0 (0.0)	0 (0.0)	0 (0.0)	2 (0.2)	4 (0.4)	61 (6.9)	333 (45.2)	35 (4.3)
Liquefied petrol gas	550 (69.1)	629 (88.0)	713 (95.7)	731 (97.6)	733 (97.5)	8 (0.9)	1 (0.1)	83 (9.4)	81 (11.0)	94 (11.4)
Biogas	250 (31.4)	9 (1.3)	4 (0.5)	3 (0.4)	0 (0.0)	1 (0.1)	1 (0.1)	4 (0.5)	59 (8.0)	14 (1.7)
Electricity	123 (15.5)	191 (26.7)	1 (0.1)	0 (0.0)	43 (5.7)	516 (61.2)	435 (47.9)	46 (5.2)	3 (0.4)	2 (0.2)

*More than one response possible; data expressed as n (%)

Table 3

Cooking site characteristics

	Latin America					Africa		South Asia		
Cooking characteristic*	**Argentina (n=796)**	**Uruguay (n=716)**	**Ecuador (n=746)**	**Brazil (n=749)**	**Guatemala (n=752)**	**DRC (n=847)**	**Zambia (n=909)**	**Orissa, India (n=886)**	**Belgaum, India (n=736)**	**Pakistan (n=824)**
Cooking site										
Inside	768 (96.6)	694 (97.2)	728 (98.2)	729 (97.3)	675 (89.8)	232 (27.5)	687 (75.6)	735 (83.0)	734 (99.9)	310 (37.7)
Outside	8 (1.0)	6 (0.8)	6 (0.8)	12 (1.6)	27 (3.6)	383 (45.4)	96 (10.6)	106 (12.0)	1 (0.1)	436 (53.0)
Both	19 (2.4)	14 (2.0)	7 (0.9)	8 (1.1)	50 (6.6)	229 (27.1)	126 (13.9)	45 (5.1)	0 (0.0)	77 (9.4)
If cook inside										
Separate room for cooking	729 (92.6)	648 (91.7)	641 (87.0)	670 (90.9)	526 (72.6)	156 (33.9)	344 (42.5)	NA**	506 (68.8)	362 (94.0)
Cooking room has chimney	645 (82.3)	474 (67.2)	275 (37.5)	345 (46.8)	338 (46.6)	419 (91.1)	245 (30.1)	288 (36.9)	300 (40.9)	366 (94.8)

*Data expressed as n, (%)

**Not available

Table 4

Tobacco smoke exposure in the home

	Latin America					Africa		South Asia		
Women Smoking	**Argentina (n=796)**	**Uruguay (n=716)**	**Ecuador (n=746)**	**Brazil (n=749)**	**Guatemala (n=752)**	**DRC (n=847)**	**Zambia (n=909)**	**Orissa, India (n=886)**	**Belgaum, India (n=736)**	**Pakistan (n=824)**
Woman has ever smoked n(%)	353 (44.3)	379 (53.0)	32 (4.3)	154 (20.6)	78 (10.4)	5 (0.6)	3 (0.3)	1 (0.1)	0 (0.0)	26 (3.2)
Woman is a current smoker n(%)	82 (10.3)	131 (18.3)	6 (0.8)	46 (6.1)	6 (0.8)	2 (0)	2 (0)	0 (0)	0 (0)	25 (3.0)
Second-hand smoke										
Smoking permitted inside home n(%)	440 (55.3)	389 (54.4)	199 (26.9)	271 (36.2)	131 (17.4)	144 (17.1)	186 (20.5)	491 (55.4)	319 (43.3)	754 (91.6)
Women frequently/always exposed to tobacco smoke indoors[†] n(%)	244 (30.7)	189 (26.5)	96 (12.9)	222 (29.6)	99 (13.2)	70 (8.3)	124 (13.7)	96 (10.8)	146 (19.9)	411 (49.9)
Young children are frequently/always exposed to tobacco smoke inside home[‡] n(%)	45 (13.6)	56 (18.2)	16 (5.2)	65 (20.9)	20 (5.9)	35 (6.5)	64 (13.1)	59 (10.7)	140 (27.8)	389 (51.4)

[†]All participants were asked, “How often are you indoors and around people who are smoking cigarettes or other types of tobacco products?”

[‡]All participants were asked, “How often are your children 5 years or younger, indoors and around people who are smoking cigarettes or other types of tobacco products?” Participants without children 5 years or younger were excluded from the analysis.

Table 5

Association of solid vs. non-solid fuel and exposure to smoke in the home

Tobacco Exposure	Total		Latin America										Africa				South Asia					
	Pooled data (n=7961)		Argentina (n=796)		Uruguay (n=716)		Ecuador (n=746)		Brazil (n=749)		Guatemala (n=752)		DRC (n=847)		Zambia (n=909)		Orissa, India (n=886)		Belgaum, India (n=736)		Pakistan (n=824)	
	Solid Fuel (n=4160)		Solid Fuel (n=29)		Solid Fuel (n=183)		Solid Fuel (n=81)		Solid Fuel (n=18)		Solid Fuel (n=68)		Solid Fuel (n=822)		Solid Fuel (n=787)		Solid Fuel (n=793)		Solid Fuel (n=664)		Solid Fuel (n=715)	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Smoking permitted inside home, (%)	45.5	37.8	44.8	55.6	54.1	54.5	27.2	26.7	55.6	35.8	17.7	17.4	17.2	14.3	21.8	12.4	58.3	31.2	44.9	29.2	92.9	83.3
	P <0.0001		P=0.25		P=0.93		P=0.93		P=0.08		P=0.96		P=1.0		P=0.02		P<0.0001		P=0.01		P=0.0009	
Women frequently/ always exposed to tobacco smoke indoors,(%)	20.2	22.6	27.6	30.8	26.3	26.6	6.2	13.8	38.9	29.3	16.2	12.9	8.2	14.3	13.2	6.4	10.5	14.0	20.3	16.7	52.2	35.2
	P = 0.0095		P=0.71		P=0.93		P=0.05		P=0.38		P=0.44		P=0.41		P=0.34		P=0.30		P=0.46		P=0.001	
Young children are frequently/always exposed to tobacco smoke inside home, (%)	23.5	14.3	21.4	13.3	16.5	19.1	0	6.0	23.1	20.8	8.8	5.6	6.4	7.7	12.7	15.8	10.4	14.3	29.5	12.2	53.3	37.9
	P <0.0001		P=0.42		P=0.59		P=0.24		P=0.74		P=0.44		P=0.59		P=0.52		P=0.44		P=0.01		P=0.005	

* Solid fuel use includes wood, charcoal, coal, crop residue, animal dung