2

Indoor Air Pollution and Health: Evidence from DHS and LSMS Surveys

2.1 Inhaling smoke from wood combustion generates effects on human health that depend on the levels or degree of exposure. For example, it is one of the main causes of death due to respiratory complications following fires (Dantzker & Scharf 2000). Some of the effects can be temporary, chronic or even generate permanent lesions like bronchitis or infections such as pneumonia. Death can occur due to complications of any of these pathologies not given appropriate care. In Latin America, however, there are currently few activities related to the health effects of indoor air pollution, although voices of alert on the subject can be traced back at least two decades in local medical literature (Restrepo et al. 1983). Studies in Nicaragua have recently shown that Acute Respiratory Infections (ARI) were the second leading cause of deaths among infants (after diarrhea), in many cases linked to fuelwood smoke exposure. Respiratory illnesses associated to IAP are also one of the main burdens of disease treated by the public health system, and it has been estimated that the cost of treating ARI directly caused by fuelwood smoke reaches a conservative minimum of US $4 million annually in Nicaragua.

2.2 The purpose of this chapter is to present the results of a study to examine the relationship between use of different types of fuels and the implications for the health of women and children in Guatemala. This is an exploratory study based on two large household surveys conducted during the last 5 years. Both of these household surveys have indicators and measures of both health and energy use. The goal is to examine any linkages between energy use and health for Guatemala.

The Survey Samples

2.3 The two main studies that have been used for this study are the Livings Standards Measurement Survey (LSMS) and the Demographic and Health Survey (DHS) that were published between 1998 and 2000. The LSMS is a multipurpose survey that is used as the basis of the poverty assessments for the Country. The DHS survey is aimed to collect

information mainly on children under 5 and the women taking care of them. It has become a fairly standardized approach to evaluating issues of health, mortality and fertility in a range of developing countries. The data from these surveys are analyzed to assess the impact of the use of various types of energy or the use of particular stoves on health in Guatemala. However, it should be cautioned that each of these surveys has a weakness for such analysis, but the results may be suggestive both with regard to substantive findings and the implications for areas of further research. The next section provides a description of each of these very important surveys.

The DHS Sample

2.4 For the DHS survey (ENSMI 98/99), a total of 5,587 households were interviewed on issues involving the health of women and children in the family. Of the total 30,874 family members, a total of 6,756 women between the ages of 15 and 49 were interviewed. This survey of women also provide information on 4,943 children born during the previous 5 years, of which about 5% had died. The survey sample was designed to be representative at the national and regional levels. The distribution of households, individuals and women surveyed, clearly indicates the national scope of the sample. Although the number of interviews in several of the regions was quite small compared to population size–particularly Metropolitan Guatemala (8.1% of the sample versus 32.9% of the universe)–the results are representative of Guatemala.

Table 2.1: Sample Distribution – Guatemala 1998-1999 DHS

Results	*Region*								Total
	Metrop.	*North*	*North East*	*South East*	*Central*	*South West*	*North West*	*Petén*	
Actual Sample									
Households Interviewed	455	413	640	399	752	1,152	703	1,073	5,587
Individuals	2,302	2,319	3,294	2,161	3,827	6,597	4,182	6,192	30,874
Eligible Women (15-49)	599	507	737	456	862	1,463	906	1,226	6,756
Weighted Sample									
Households Interviewed	1,840	362	502	499	580	1,103	549	152	5,587
Eligible Women (15-49)	2,112	389	481	490	571	1,208	617	152	6,021
Household Distribution (%)									
Unweighted Results	8.1	7.4	11.5	7.1	13.5	20.6	12.6	19.2	100.0
Weighted Results	32.9	6.5	9.0	8.9	10.4	19.7	9.8	2.7	100.0

** (Weighted results)/(Unweighted results). The actual weights recorded, reported and used vary by location. See Annex 1
Source: Guatemala 1998-1999 DHS Report.

2.5 The survey coverage for metropolitan areas in Guatemala is somewhat low, but this probably was due to a greater policy interest in rural health and demographic issues. The study design generates information for households that are largely with less representation for metropolitan household characteristics. For descriptive analysis, therefore, care must to be taken to weight each case by its corresponding weighting factor, for otherwise the results might misrepresent Guatemala or some of its regions. The major weakness of the DHS survey for this study is the lack of information on

household income or expenditures. A wealth index composed of various types of household assets is developed and used a proxy for income. Although this is useful for most types of studies, it somewhat of a problem for the analysis carried out in this chapter. The reason is that the type of stove and energy use is actually a part of the wealth index.

The LSMS Sample

2.6 The sample for the LSMS study was designed to be representative nationally and regionally. As indicated, this is a multipurpose survey of which health is just a small component. A total of 7,276 households with 37,926 individuals were surveyed in ENCOVI 2000, distributed by region and urban/rural breakdown as shown in Table 2.2. The survey covered 6,074 live children under the age of five years old.

Table 2.2: Sample Distribution – Guatemala 2000 LSMS

LSMS Sample	Region								
	Metrop.	North	North East	South East	Central	South West	North West	Petén	Total
Unweighted Results									
Urban Households	807	392	375	326	427	427	404	266	3,424
Urban Persons	3,431	1,916	1,658	1,575	2,048	2,128	2,120	1,312	16,188
Rural Households	119	406	224	479	824	688	793	319	3,852
Rural Persons	596	2,419	1,114	2,581	4,304	3,925	4,881	1,918	21,738
Total Households	926	798	599	805	1,251	1,115	1,197	585	7,276
Total Persons	4,027	4,335	2,772	4,156	6,352	6,053	7,001	3,230	37,926
Weighted Results (000s)									
Urban Households	480	29	53	46	112	161	46	20	951
Urban Persons	2,113	146	241	230	540	818	246	102	4,441
Rural Households	70	129	139	141	129	386	198	44	1,239
Rural Persons	387	773	693	769	682	2,212	1,223	269	7,012
Total Households	551	159	192	188	242	547	244	65	2,191
Total Persons	2,501	919	935	999	1,222	3,030	1,470	372	11,453
% Distribution									
Urban									
Sample	23.6	11.4	11.0	9.5	12.5	12.5	11.8	7.8	100
Universe	50.5	3.1	5.6	4.9	11.9	16.9	4.9	2.2	100
Rural									
Sample	3.1	10.5	5.8	12.4	21.4	17.9	20.6	8.3	100
Universe	5.7	10.5	11.3	11.4	10.4	31.2	16.0	3.6	100
TOTAL	12.7	11.0	8.2	11.1	17.2	15.3	16.5	8.0	100
Sample									
Universe	25.2	7.3	8.8	8.6	11.1	25.0	11.2	3.0	100

** (Weighted results)/(Unweighted results). The actual weights recorded, reported and used vary by location.

Source: Guatemala ENCOVI 2000 data files (OCT/2001 version).

2.7 As opposed to the DHS survey, one of the main features of the LSMS is to explicitly measure household income, consumer expenditures and poverty levels. In terms of energy use, it also includes more detailed questions on energy use, the type of kitchen and stoves being used by the household, and additional variables related to indoor air pollution not part of the more crude categories in the DHS. The survey measures each fuel used for cooking, along with the time spent cooking the previous day by each household member. This can serve as a proxy for the exposure to IAP, particularly for young infants who typically spend much of their time with their mothers. However, the treatment of health in the LSMS, especially those questions related to acute respiratory illness, is much less specific than those found in the DHS.

2.8 Thus, each survey has both strong and weak points. The LSMS survey is very strong on measuring social and economic characteristics of rural households, but relatively weak in terms of its attention to health issues. By contrast, the DHS survey is very strong on measuring women's and child's health, but fairly weak in examining the socioeconomic characteristics of the families in the study.

Socioeconomic Profile

2.9 While the two surveys differ in sampling and questioning techniques, they share enough variables in common to allow joint presentation of socioeconomic and energy use aspects. This section will highlight those socioeconomic aspects considered most relevant to the analysis of indoor air pollution and infant health.

2.10 The urban/rural distribution of households by region, indicates that roughly 56% of the population in Guatemala is rural and 44% urban. The average urban household in Guatemala has between 4.67 and 4.97 members, according to DHS and LSMS, respectively. Rural households averaged 5.66 members in both surveys. Between 18.4% and 19.5% of households are headed by women, and more so in urban settings (23.1% according to LSMS and 23.7% according to DHS).

2.11 The level of household income and poverty was examined only in the LSMS study. According to the LSMS, only 1.7% of the urban population can be classified under extreme poverty, in contrast to 17.8% of the rural population – for a national average of 10.8%. Non-extreme poverty in urban areas affects 18.3% of the population, compared to 47.8% in rural areas. While only 34.4% of Guatemala's rural population classifies as non-poor, this level of well-being has been reached by 80% of the country's urban population. Extreme poverty is highest among the rural areas of the North (35.7% within the region) and Northwest (28.2%), but in absolute terms 29.1% of the country's rural population under extreme poverty lives in the Southwest, followed by the Northwest (25.3%) and North (21.0%).

2.12 In the absence of income data in DHS surveys, analysts such as Filmer & Pritchett (1998) have found a standard list of household assets and basic services such as running

water and garbage disposal obtained in these questionnaires one can generate an "asset index" as a proxy for relative household wealth. The technique used was to develop a household asset index in the LSMS that is similar to the one used by the DHS study. The percentage of the total variance explained by the DHS style wealth index is about 28% for income per person 22% for family income in the country and is even less for rural households.[8] Thus the DHS study index as a proxy for family income does have some weaknesses.

2.13 The relationship between parental education with childcare, child health and infant survival rates is also very important. A common classification of the educational attainment of the mothers and fathers of the children present in Guatemalan households, and both study indicated in general indicate less formal schooling among mothers than fathers, less educational attainment among parents in rural households than in urban, lowest lack of schooling among parents in metropolitan Guatemala and highest lack of schooling in the Northwest and North.

Table 2.3: Electricity in Guatemalan Households

Area	*Survey*	
	DHS98/99 (%)	*LSMS 2000 (%)*
Total	70.9	73.1
Urban	91.4	95.4
Rural	54.0	56.4
Region		
Metropolitan	91.0	95.8
North	33.1	30.1
North East	59.3	62.9
South East	73.0	69.9
Central	73.3	80.4
South West	72.0	76.1
North West	43.6	56.5
Petén	30.9	36.0

2.14 Around 76% of Guatemalan households live in homes of their own, particularly in rural areas, but rented homes are common in urban areas, specially in the metropolitan region . Construction materials of these dwellings are good indicators of relative well-being or quality of life. Over 50% of rural households and approximately 20% of urban households live in homes with earth floors. Regionally, earth floors are predominant in the North (72%) and Northwest (68 – 69%), as well as Petén. These three regions

[8] The correlation between income per person and consumer expenditure per person is 0.613 and with the asset index similar to the one in the DHS survey is 0.471, which means there is an R square of 0.38 and 0.22 respectively. This is based on 7,275 cases and the coefficients are significant at .001 level. The correlation between the asset index and expenditures per person in the family is 0.529 with an R square of 0.28.

generally lag behind the others in the different socioeconomic indicators we present, while the metropolitan area generally presents the best conditions. As for roofs, these are predominantly sheet metal (zinc) or made of other finished materials (concrete, etc.), with very few natural materials such or straw used.

2.15 The amenities in the home also can have a significant impact on family health. Electricity is available to slightly over 70% of Guatemalan households, with urban coverage surpassing 90% and rural households reaching around 55%. As expected, the region with highest coverage is the metropolitan area, while the North, Petén and Northwest lag behind the rest of the country in availability of this energy service. Approximately 42% of all households still use traditional pit latrines and 13% have no toilet facilities at all. Approximately 80% of all households possess radios. Access to television is also very widespread, reaching around 80% of urban households and 37% of rural homes, for a national average of about 55%. Telephone coverage is still very precarious (less than 7% in rural areas and only 17% nationally). Few households own cars or motorcycles.

Household Energy Use and IAP Factors

2.16 Cooking with fuelwood under poor ventilation conditions has been demonstrated in the literature to be associated to higher risk of infant mortality or morbidity due to acute respiratory infections. Most of the evidence for this, however, is based on detailed case studies with small sample sizes. In national surveys, the number of cases is much larger and more representative of whole populations, but the precision in definition of physical, technical or even family parameters is weak when the questionnaires are not designed specifically for the particular type of analysis to be undertaken. Because DHS and LSMS surveys pursue many other objectives and were not designed specifically to measure the effect of indoor air pollution on health, they do not directly measure such pollution directly as is becoming common in this type of research. They simply measure factors which most would agree are associated indoor air pollution, such as types of fuels being used for cooking, the types of kitchens, the existence of chimneys to vent smoke, and for the LSMS the amount of time spent cooking per day by household members older than 7 years old.

2.17 The DHS study contained questions on the "main fuel" used for cooking. The two main cooking fuels in Guatemala are fuelwood and LPG. The primary use of electricity, kerosene and other fuels for cooking involves only about 1% of the households in the country (Table 2.4). In urban areas today, LPG has far surpassed fuelwood as a cooking fuel, as in metropolitan Guatemala over 75% of households use this fuel for cooking. In rural areas fuelwood dominates the household cooking scene because it is used in about 97% of homes in the North, 96% in the Northwest, 93% in Petén and 90% in the Southwest. Thus, rural households everywhere depend on fuelwood as their primary fuel. Nonetheless, because rural populations near urban areas use LPG as their main cooking fuel in higher numbers, the national rural average of 22% of rural homes use clean fuels.

Table 2.4: Distribution of Main or Single Fuels Used for Cooking in Guatemala – DHS

Main Fuel	*Region (%)*								
	Metrop.	**North**	**North East**	**South East**	**Central**	**South West**	**North West**	**Petén**	**Total**
Dirty Fuels	**22.3**	**41.5**	**37.5**	**50.4**	**36.8**	**39.3**	**76.1**	**59.7**	**31.6**
Wood	22.3	41.5	37.5	50.4	36.8	39.3	76.1	59.7	31.6
Clean Fuels	**77.7**	**58.5**	**62.5**	**49.5**	**63.1**	**60.7**	**23.9**	**40.3**	**68.4**
Kerosene	0.9	1.9	1.6	1.2	1.1	0.5	1.0	1.0	1.0
LPG	75.4	55.1	54.6	43.9	60.0	59.1	21.9	38.8	65.4
Electricity	1.4	1.5	0.3	1.5	0.2	0.2	1.0	--	1.1
Other	--	--	6.0	2.9	1.8	0.9	--	0.5	0.9
Dirty Fuels	**17.9**	**97.3**	**85.7**	**73.8**	**74.4**	**90.1**	**96.4**	**92.7**	**77.8**
Wood	17.9	97.3	85.7	73.8	74.4	90.1	96.4	92.7	77.8
Clean Fuels	**82.0**	**2.6**	**14.4**	**26.1**	**25.6**	**10.0**	**3.5**	**7.3**	**22.2**
Kerosene	--	--	0.4	0.7	--	0.3	--	0.4	0.2
LPG	78.3	2.3	13.2	24.0	23.9	9.1	3.2	6.4	20.8
Electricity	2.8	--	0.8	--	--	0.2	--	--	0.5
Other	0.9	0.3	--	1.4	1.7	0.4	0.3	0.5	0.7
Dirty Fuels	**21.3**	**85.7**	**68.1**	**66.2**	**57.3**	**75.2**	**93.5**	**85.7**	**57.0**
Wood	21.3	85.7	68.1	66.2	57.3	75.2	93.5	85.7	57.0
Clean Fuels	**78.8**	**14.3**	**31.9**	**33.9**	**42.7**	**24.8**	**6.4**	**14.3**	**43.0**
Kerosene	0.7	0.4	0.8	0.9	0.5	0.3	0.1	0.5	0.5
LPG	76.1	13.3	28.3	30.6	40.3	23.7	5.9	13.3	40.9
Electricity	1.8	0.3	0.6	0.5	0.1	0.2	0.1	--	0.8
Other	0.2	0.3	2.2	1.9	1.8	0.6	0.3	0.5	0.8

Source: Weighted sample estimate from ENSMI 98/99 data bases.

2.18 The LSMS for Guatemala took a different approach to determining the fuels that are used for cooking. Instead of asking about the "main cooking fuel," the LSMS posed questions on whether the household had used a fuel for cooking during the last month, regardless of the level of its use (Table 2.5). This allows households using more than one fuel to give more than one answer. In this survey, it was found that approximately 95% of rural households and remarkably 45% of urban households use fuelwood for cooking. LPG is used by 78% of urban households, including 83% in the metropolitan areas. In rural areas, over 20% of households now use LPG as well, but as indicated for the DHS study the pattern of use is influenced by rural people residing in or near the metropolitan

area. Kerosene is used for cooking by more than 8% of rural households and almost 25% of urban households. The implications of this simultaneous use of various fuels are somewhat complex, but represent the reality of how people cook in Guatemala.

Table 2.5: Summary of All Fuels Used for Cooking by Guatemalan Households – LSMS **

Fuels Used	*Urban*	*Rural*	*Region (%)*								
			Metrop.	*North*	*North East*	*South East*	*Central*	*South West*	*North West*	*Petén*	*Total*
Fuelwood	45.2	95.4	32.0	94.0	77.9	89.7	79.8	87.9	95.3	92.1	73.6
Kerosene	1.4	8.4	0.8	7.3	8.9	6.2	5.6	7.4	2.9	18.3	5.4
LPG	78.0	20.3	82.9	15.4	45.9	31.9	49.2	35.8	13.9	22.3	45.3
Charcoal	24.6	3.4	31.0	1.6	11.1	5.8	12.4	5.7	3.3	2.4	12.6
Electricity	4.8	0.8	4.1	1.0	4.9	1.8	2.6	1.7	1.9	0.7	2.5
Other	3.1	11.5	2.7	2.5	8.2	5.3	2.1	15.1	16.1	1.4	7.9

2.19 To discern the role of each fuel in satisfying cooking needs and begin to clarify health implications, we estimate the distribution of different combinations used by both urban and rural households in each of the country's regions. In urban areas, between 37% and 49% of households simultaneously use fuelwood and LPG or other clean cooking fuels, in proportions between them which cannot be discerned from this survey. Are the two fuels used daily and for how much time are they used? Though the survey does not examine the causes and customs of this dual fuel consumer behavior, recent studies in urban Nicaragua show this is likely due to financial considerations and the types of foods consumed. For example, beans are a staple in these households' diets, and cooking them requires 4 or more hours once or twice a week. Some urban households find it cheaper to cook their beans with fuelwood, but use LPG more continuously for other foods (rice, meats, etc.).

2.20 Most rural households rely only on fuelwood as their sole fuel for their cooking needs (69% nationally), and very few have indeed made the switch to solely clean fuels (3% nationally). Yet it is becoming more usual for these households to combine the use of fuelwood with clean fuels like their urban counterparts, and this blend now ranges between 7% in Petén or 8% in the North to almost 38% in the Northeast and Metropolitan regions. In many rural areas of Latin America, where firewood is generally self-collected and thus perceived as "free," dual-fuel households are common. They often use the "modern" or clean fuel for "quick" cooking, such as preparing breakfasts for children going off to school or heating water, etc., but tend to maintain the use the fuelwood as their source of cooking. The main conclusion is that the LSMS results on cooking fuels do indicate that DHS overestimates the use of clean fuels in Guatemala when it ignores that approximately two out of every three consumers of these fuels maintain some – albeit not here quantifiable – simultaneous reliance on fuelwood.

2.21 Besides the fuels used for cooking, other factors related to exposure to indoor air pollution include the type of kitchens used and ventilation. Neither of the surveys

gathered direct information on sizes of rooms or the presence of windows. But both classified the types of kitchens and found out whether or not they used chimneys. Close to 80 percent households do have a kitchen used exclusively for cooking, and this is true for both for urban and rural homes. The rest of households live either in single-room dwellings or cook in rooms shared with other uses. In such rooms, exposure to fuelwood smoke fuelwood would be higher for their occupants. In addition, despite the progress on implementing the improved stoves program, it is also rather uncommon for kitchens to have chimneys.

Table 2.6: Combination of Fuels and Kitchen Facilities in Guatemalan Homes, LSMS

Fuel/ Kitchen Combi-nation	*Type of Fuel*	*Type of Kitchen*	*Region (%)*								
			Metrop.	*North*	*North East*	*South East*	*Central*	*South West*	*North West*	*Petén*	*Total*
Urban											
1. Worst	Dirty	Shared	2.2	10.6	3.5	6.2	10.0	2.1	13.5	9.9	4.4
2.	Mixed	Shared	18.9	6.3	16.0	12.3	24.0	9.9	13.2	11.1	16.7
3.	Dirty	Exclusive	2.7	29.1	15.8	19.5	17.6	20.7	22.4	27.5	11.4
4.	Mixed	Exclusive	24.9	30.2	24.4	31.1	24.4	35.6	32.1	28.9	27.5
5. Best	Clean	Outdoors	51.3	23.8	40.4	30.8	24.0	31.7	18.7	22.6	40.1
Rural											
1. Worst	Dirty	Shared	12.6	38.9	14.8	7.8	30.2	16.0	24.8	19.5	20.1
2.	Mixed	Shared	7.3	1.2	12.0	4.7	11.1	13.4	9.9	0.8	9.4
3.	Dirty	Exclusive	41.9	51.7	38.7	61.5	31.1	44.9	52.8	68.2	47.3
4.	Mixed	Exclusive	29.9	6.4	24.8	18.0	16.8	20.6	11.1	6.2	17.4
5. Best	Clean	Outdoors	8.3	1.9	9.6	8.1	10.9	5.1	1.4	5.2	5.8
Total											
1. Worst	Dirty	Shared	3.5	33.7	11.7	7.4	20.7	11.9	22.7	16.5	13.3
2.	Mixed	Shared	17.4	2.1	13.1	6.6	17.1	12.4	10.6	4.1	12.5
3.	Dirty	Exclusive	7.7	47.5	32.3	51.1	24.8	37.8	47.1	55.3	31.7
4.	Mixed	Exclusive	25.5	10.8	24.7	21.2	20.3	25.0	15.1	13.4	21.8
5. Best	Clean	Outdoors	45.8	5.9	18.1	13.7	17.1	12.9	4.6	10.7	20.7
Total			100	100	100	100	100	100	100	100	100

Note: Worst to best from the perspective of exposure to indoor air pollution. When clean fuels are used, emissions are none or negligible, so these do not matter. When cooking outdoors, exposure to indoor air pollution is considered negligible here regardless of the fuel used.

2.22 To emulate the level of indoor air pollution, a single category has been created from a combination of clean fuel and any type of kitchen with that of an outdoor kitchen with any kind of fuel (Table 2.6). For urban households about 40% can be classified as having low exposure levels, while only 6% of rural household home environments meet the same criteria. The highest exposure conditions – that is, cooking with fuelwood within spaces shared with other household activities such as sleeping – are present in 20% of rural households. This is not surprising given the heavy reliance on fuelwood for cooking in rural areas.

2.23 The exposure of women and children to cooking smoke also is an important health issue for Guatemala. The time spent by male members cooking, not passively visiting kitchens, is negligible. Females, noticeably the mothers in the household, perform most cooking for the family. Most mothers who depend solely on fuelwood spend more time cooking than those using a mixture of clean and dirty fuels, and always spend more time than those using only clean fuels. These women spend between 2.01 and 3.04 person-hours per day cooking when they use only fuelwood compared to a range between 1.45 and 2.34 hours daily when they cook with modern fuels. Given the child-care patterns observed by Naeher and others in Guatemalan villages, it is possible that infants below 12 or 15 months could be exposed to the high concentrations of CO and PM for much of the 2.26 hours average that their mothers spend cooking.

Infant Respiratory Illness Analysis and the National Surveys

2.24 The ultimate objective of this study is to explore the data generated by Guatemala's national DHS and LSMS surveys for evidence of the differential effects that exposure to indoor air pollution or, more specifically, fuelwood smoke, might have on infant mortality and respiratory illness. In this section we explore the relationship between energy use and the conditions associated with indoor air pollution and respiratory health in children under 5. This age group has been selected because the literature reviewed shows they are very vulnerable to ARI and also because the two national surveys limit their measurement of respiratory illness to infants and young children.

2.25 The two types of infant health issues that can be addressed utilizing these national surveys include infant morbidity and mortality. Only the DHS study has information on mortality of children under five. However, out of a total of 4435 children up to five years old, only 227 cases (5.1%) were reported to have died. As a consequence, it was impossible to examine the relationship between household characteristics and the infant mortality rate through the DHS. Likewise, the LSMS does not account for deceased children. However, both surveys provide information on children's respiratory illness. The DHS study asked the caretakers whether their children had experienced respiratory illness during the previous two weeks. The recall time period for similar questions in the LSMS study was a full month. Thus, in this section we examine only the relationship between children's respiratory illness and factors related to indoor air pollution.

Evidence from The DHS Study

2.26 In the DHS study information was collected both on respiratory illness and for the types of fuels and cooking environments in the home. Questions were asked to the parent on illnesses during the last two weeks of the children in the family. One category of the illnesses in the study was the respiratory problem of a cough and shortness of breath and another category was for the same symptoms that also involve a fever. Combining this information with the information on household characteristics of fuel use and type of

kitchen can indicate whether the presence of smoke in the household has an impact on children's health.

Table 2.7: Respiratory Symptoms in Children by Fuel and Cooking Space–DHS

Part A **Fuel Type & Cooking Areas**	**Type of Fuel**		**Type of Cooking Area**		
	Biomass	**LPG**	**No Kitchen**	**Kitchen**	**Total**
No Symptoms	68	74	65	71	69
Cough and Breath Shortness	16	15	17	16	16
Cough, Breath Shortness and Fever	15	11	18	13	14
Total %	100	100	100	100	100
Total Children (Cases)	3303	769	1012	2074	4086
Part B **Fuel Type Combined with Cooking areas**	*Biomass & No Kitchen & No Chimney*	*Biomass & Kitchen & No Chimney*	*Biomass & Kitchen & Chimney*	*LPG*	*Total*
No Symptoms	65	69	72	74	69
Cough and Breath Shortness	16	17	14	15	16
Cough, Breath Shortness & Fever	19	14	14	11	15
Total %	100	100	100	100	100
Total Children (Cases)	773	1987	487	769	4016

2.27 The findings from this study are consistent with some of the recent literature on indoor air pollution and health. The most serious ARI symptoms were present in 15% of children living in homes cooking with fuelwood, whereas only 11% of children living in homes using clean fuels have the same symptoms (Table 2.7). A separate room for cooking also seems important for preventing ARI symptoms. About 18% of children in homes with common cooking, sleeping or living quarters have serious symptoms compared to 13% of children living in homes with separate kitchens. Combining these two findings in one the same table, the homes using biomass fuels and with a kitchen not separate from the living areas have a serious infection rate of 19% compared to just 11 percent of households that are using LPG. Conversely, the highest proportion of children with no symptoms is 75% compared to 65% for household using biomass in a common room. It would also appear that having a separate kitchen combined with a chimney has almost as much impact as using LPG.

2.28 Before jumping to conclusion about these significant findings, it should be cautioned that the households using LPG are more urban and more wealthy than those using biomass and living in virtually one room homes. Poor diet, lack of sanitary conditions and many other factors may be contributing to these findings. However, it is likely that cooking smoke at least may have a contributing effect along with these other causes. Sorting out these cause and effect issues is beyond the scope of this chapter.

Evidence from The LSMS Study

2.29 As indicated, according to the DHS study, the nature and severity of respiratory illness is reflected in the combination of cough, fever and shortness of breath symptoms in children over the previous two weeks. This measure of respiratory illness is much better than the one found on LSMS study. In the LSMS study, the single question asked about respiratory illness covers a spectrum of symptoms that, while certainly referring to respiratory illnesses, cannot be unequivocally elevated to "Acute Respiratory Infection." Also, the reference period is one full month, which also poses problems of correct recall by respondents. The longer recall period does have the advantage of having a higher number of respondents displaying some kind of symptoms and also the study covers 6074 children below 5 years old.

Table 2.8: Respiratory Symptoms in Children by Fuel and Cooking Space–LSMS

Part A Fuel Type	***Type of Fuel***			
	Fuelwood Alone	*Mix of Fuelwood, LPG, & Other*	*Only Clean Mainly LPG*	*Total*
No Symptoms	52	54	60	53
Respiratory Illness	48	46	40	47
Total %	100	100	100	100
Total Children (Cases)	3631	1769	649	6049

Part B Fuel Type and cooking area	***Type of Fuel and Type of Room for Cooking***					
	Biomass & No Kitchen	*Mixed & No Kitchen*	*Biomass & Kitchen*	*Mixed & Kitchen*	*LPG & Kitchen*	*Total*
No Symptoms	50	47	53	57	58	53
Respiratory Illness	50	53	47	43	42	47
Total %	100	100	100	100	100	100
Total Children (Cases)	1167	661	2314	1069	841	6052

2.30 Once again, it should be cautioned that the findings presented in Table 2.8 indicate association and other factors such as income class, access to health facilities, and sanitary conditions may be contributing to these findings. However, there does seem to be a fairly significant association between respiratory symptoms and the type of fuel being used in the home and whether or not there is a separate kitchen for cooking. Generally, in homes using fuelwood alone or in combination with petroleum fuels the level of respiratory illness symptoms among children was between 45% and 51%. By contrast, for homes using mainly petroleum fuels such as LPG or in which there is no cooking, the symptoms of respiratory illness dropped to between 40% and 42%. Thus, the use of kitchens used exclusively for cooking decreases this incidence of respiratory illness, but is also related to whether fuelwood is used in conjunction with clean fuels or alone.

2.31 In conclusion, the results of the LSMS study are very similar to those found in the DHS survey. Reductions in respiratory illness symptoms are associated with both the use of petroleum fuels and the use of a separate room for cooking. However, there is a need to disentangle some of the causal associations involving cooking and respiratory illness, such as income, sanitary conditions, drinking water, and others which may be contributing factors.

2.32 Recently there has been some effort to assess whether such factors as the use of a chimney or the use of wood are in any way related to respiratory illness among children. The study uses the data from the LSMS study described in this chapter, and the results of this work highlight how difficult it is to sort out causes and effects (Martinez, 2003).[9] The results of the study indicate that the use of wood for cooking increases the incidence of respiratory illness among children by about 35 percent and the use of a chimney for cooking reduces the incidence by about 45 percent. The conclusion of this study is that even after controlling for other important factors, there is a relationship between clean air in the home and a reduction of children's respiratory illness. At this point, given the difficulties involved in attributing causality with cross-sectional health data, we would have to conclude that the findings to date are not conclusive, but instead represent preliminary steps in the complex process of linking indoor air pollution and health.

Conclusion

2.33 The literature reviewed points to a growing body of work undertaken throughout the developing world that has detected alarmingly high levels of indoor air pollution in homes which use traditional solid fuels. A number of studies in Guatemala confirm the high exposure to toxic pollutants from fuelwood combustion that women and children endure. The literature also points to the strong association between indoor air pollution and health conditions, particularly among children in their first few years of life. This paper has drawn upon the 1998–1999 DHS and the 2000 LSMS databases available for Guatemala to verify whether large national surveys can broaden to the national level the evidence already discerned by Naeher, Smith, Leaderer, Mage, Boy, McCracken and others of their colleagues at test village, household and cookstove levels in Guatemala's highlands. The results of this work have shown that there is evidence of a relationship between both infant mortality and ARI and the use of wood without chimneys for cooking.

2.34 Several limitations were confronted in the analysis of both surveys. First, both questionnaires employed lacked specific information more directly related to the subject. In the case of DHS, we confront lack of direct information on household income, limited information on ARI symptoms, lack of information on women's respiratory illness. In the case of LSMS, we face a lack of clarity on ARI symptoms and on relative usage of

[9] The model utilized involves a simultaneous estimation of whether a household chooses to use wood or a chimney as it relates to the health of children in the family. The results are suggestive that there is a significant relationship between the choice of fuels and stove and the incidence of respiratory illness among children in the family.

various fuels when households use more than one fuel. Though for comparative international analysis it is interesting to use these standardized databases, among their thousands of variables, rather few are pertinent for the type of specific analysis desired. As indoor air pollution becomes a more visible issue, it would be advisable to incorporate a more specific module or set of questions related to health and kitchen smoke in DHS or LSMS questionnaires. For example, inclusion of questions on size and ventilation conditions of the kitchen, hours/minutes of exposure to smoke per typical day, more precise symptoms of ARI both for children and women, etc.

2.35 The combined evidence from health and indoor air pollution studies and national survey analysis indicate there is association between fuelwood smoke and infant respiratory illness in Guatemala. However, much ambiguity remains that it is necessary to improve our level of knowledge of the phenomenon in this country on the basis of more specific surveys and measurements with representative sampling techniques at the national level if we are to design and substantiate public policies geared at mitigating the effects of IAP on human health. This would include the development and use of specific questions or modules in future LSMS and DHS surveys aimed at pinpointing ARI symptoms in children and adults, fuel and kitchen use patterns, ventilation, exposure times to fuelwood smoke. It may also be advisable to develop self standing national scale survey and measurement instruments with sampling techniques, questionnaires and use of technologies directly designed to establish energy/pollution/health interactions. For public policy purposes, a nexus between the epidemiological and econometric approaches to the analysis of the effects of indoor air pollution on human health could be developed.

2.36 In conclusion, cooking patterns in Guatemala, while not totally clarified by the two surveys analyzed, seem to have radically shifted from fuelwood use to LPG, particularly in urban areas and quite specifically in the metropolitan region, but remain predominantly traditional in rural areas. However, consumer choice is not a clear-cut question of “either … or”, and evidence of the large proportion of households that combine the use of both clean and polluting fuels is very strong in the LSMS survey. This means that it will become increasingly complex to ascertain the levels and impacts of IAP on human health among households, more so from available indirect information.