# IMPACT OF HOUSEHOLD AIR POLLUTION ON HEALTH QUALITY: DOES WOMEN EMPOWERMENT MATTER?

*By*

Shahtaj Puri

PIDE2018MPHILENV06

Supervisor

Dr. Nasir Iqbal (Associate Professor)

PIDE School of Public Policy

Pakistan Institute of Development Economics

Islamabad

2020

Pakistan Institute of Development Economics, Islamabad

*PIDE School of Public Policy*

## CERTIFICATE

This is to certify that this thesis entitled: **"Impact of Household Air Pollution on Health Quality: Does Women Empowerment Matter?"** submitted by **Ms. Shahtaj Puri** accepted in its present form by the School of Public Policy, Pakistan Institute of Development Economics (PIDE), Islamabad as satisfying the requirements for partial fulfillment of the degree in Master of Philosophy in Environmental Economics.

Supervisor:

**Dr. Nasir Iqbal**
Associate Professor,
Pakistan Institute of Development Economics,
(PIDE) Islamabad.

External Examiner:

**Dr. Ihtesham ul Haq**
Chairman,
Department of Economics
Federal Urdu University of Arts
Islamabad.

Head,
PIDE School of Public Policy:

**Dr. Abedullah**
Chief of Research/HOD
Pakistan Institute of Development Economics,
(PIDE) Islamabad.

# Author's Declaration

I, Shahtaj Puri hereby state that my MPhil thesis titled 'Impact of Household Air Pollution on Health Quality: Does Women Empowerment Matter?' is my own work and has not been submitted previously by me for taking any degree from this university, Pakistan Institute of Development Economics or anywhere else in the country/world.

At any time if my statement is found to be incorrect even after my graduation the university has the right to withdraw my MPhil degree.

Date: 5th August 2020

Signature of Student

Shahtaj Puri

# ACKNOWLEDGEMENTS

I would like to express my deepest thanks to my supervisor Dr. Nasir Iqbal who helped me through my work from the beginning and guiding me with his immense knowledge of this field. I thank him for answering my queries at any time asked without any delays.

I would also like to thank whole staff of PIDE who supported me in times of need and guided me rightly about my concerns.

# ABSTRACT

This study attempts to explore the association of household air pollution with health quality which is then moderated by women empowerment. This study also analyzes the influence of socioeconomic status with women empowerment, health quality and household air pollution. Lastly, it investigates the impact of women empowerment on household air pollution and health quality. The data is obtained from Pakistan Demographic Health Survey 2017-18. The selected adverse health outcomes are acute respiratory infection, low birth weight, stillbirths, caesarean delivery, neonatal mortality, post neonatal mortality, child mortality and under five mortality. The exposure variable taken are polluting cooking fuel choice and exposure to environmental tobacco smoke. The socioeconomic indicators taken are area, income, education of husband/partner, household size and occupation of husband/partner. To examine the results a series of multiple logistic regression models are used. In Pakistan 44.28% households use polluting fuel and 29.78% household are exposed to environmental tobacco smoke. The results of the multiple logistic regression state that both the exposure variables are positively associated with acute respiratory infections, low birth weight and post neonatal mortality but only neonatal mortality and total under five mortality are positively associated with polluting fuel. All the socioeconomic indicators influenced fuel choice and exposure to environmental tobacco smoke except household size which did not influence cooking fuel choice. Women empowerment also tend to be influenced by the socioeconomic indicators. The interaction of women empowerment with household air pollution reduced all the adverse health quality indicators except acute respiratory infections for polluting fuel and child mortality, acute respiratory infections and caesarean delivery for environmental tobacco smoke. To mitigate the effects of household air pollution on health quality government is advised to empower women through awareness programs and providing education.

**Keywords:** Acute Respiratory Infections, Stillbirths, Low Birth Weight, Caesarean Delivery, Neonatal Mortality, Post Neonatal Mortality, Child Mortality, Under Five Mortality, Household Air Pollution, Health Quality, Women Empowerment, Socioeconomic Status

# TABLE OF CONTENTS

# LIST OF FIGURES

# LIST OF TABLES

# LIST OF ABBREVIATIONS

α Alpha
aOR Adjusted Odds Ratio
AIDS Acquired Immunodeficiency Syndrome
APA American Psychological Agency
AJK Azad Jammu Kashmir
ARI Acute Respiratory Infections

β Beta

C Caesarean
CV Covariates
CF Cooking Fuel
CI Confidence Interval

DHS Demographic Health Survey
DTP Diphtheria Pertussis Tetanus

EPA Environmental Protection Agency
EMRO Eastern Mediterranean Regional Office
ETS Environmental Tobacco Smoke
EBs Enumerator Blocks

FATA Federally Administrated Tribal Areas

g Gram

HIV Human Immunodeficiency Virus
HAP Household Air Pollution
HH Household

| | |
|---|---|
| HQ | Health Quality |
| ICF | International Classification of Functioning |
| ICT | Islamabad Capital Territory |
| KPK | Khyber Pakhtunkhwa |
| LPG | Liquid Petroleum Gas |
| LBW | Low Birth Weight |
| NIPS | National Institute of Population Studies |
| PDHS | Pakistan Demographic Health Survey |
| PM | Particulate Matter |
| P | Probability |
| SES | Socioeconomic Status |
| SE | Standard Deviation |
| $ug/m^3$ | Micrograms per Cubic Meter |
| WHO | World Health Organization |
| WE | Women Empowerment |

# Chapter 1

# Introduction

## 1.1 Background

Household air pollution possesses a major threat to the health of the individuals. In developing countries women tend to stay at home with the children which makes them both the most vulnerable towards health risks. Approximately one half of deaths caused by pneumonia within children under five years of age are due to pollutant substance inhaled from household air pollution (WHO, 2018). It doubles the possibility of pneumonia in children and is responsible for nearly 45% of all the deaths occurring from pneumonia in children under five years of age (WHO, 2018). In 2016, household air pollution from traditional fuel use resulted in an approximate 3.8 million untimely deaths. This result is equals to 6.7% of global death rate which is greater than that from HIV/AIDS, malaria and tuberculosis combined. Out of these deaths 403,000 are of children under five years of age (WHO, 2018).

HAP is also linked with ARI in children (Khan & Lohano, 2018), low birth weight of children, stillbirths, and child mortality is also shown to have a significant relationship with HAP (Khan, Nurs, Islam, & Rahman, 2017). Maternal health like gestational time, induced abortion and cesarean deliveries are also linked with HAP.

Various studies conducted, especially in third world countries show the negative impact of HAP on child and maternal health. Bruce & Dherani (2013) show that reducing the HAP can reduce the risks of severe child health outcomes including fatal pneumonia. A group of evidences show respiratory infections, LBWs, cataracts and cardiovascular events occur due to exposure to HAP (Kim, Jahan, & Kabir, 2011). Gordon (2014) found that low- and middle-income countries have strong associations of HAP with diseases like respiratory tract cancers, obstructive pulmonary diseases and bronchitis in women.

In literature various factors are considered as the sources of HAP. The main sources of HAP are cooking fuels and indoor smoking. Pesticides can also cause HAP (EPA, 2018). Around 60% of the world has excess to clean cooking fuels (Ritchie & Roser, 2020). Around three billion people in the world use polluting fuel or stoves fueled by wood, kerosene, crop waste manure and coal (WHO, 2018). Developing world is more prone to HAP (Bruce, Perez-Padilla, & Albalak, 2000).

To mitigate the negative effects of HAP on health, there are two ways to overcome it. First, to switch to clean fuels completely which is not suitable for developing countries. Second, empowering the women because more informed women can either take clean fuel decisions (Austin & Mejia, 2017) or handle the illnesses more effectively (Doku, Bhutta, & Neupane, 2020; Sado, Spaho, & Hotchkiss, 2014).

This study will tackle this issue of HAP and health quality by empowering the women. Previously this has shown potential for improving child and maternal health. The children of empowered women are less likely to be underweight in Nepal (Allendorf, 2007). Empowering women and gender equality are a strategy which has potential to improve maternal and child health in Africa (Singh, Bloom, & Brodish, 2015). Women who have autonomy to decide about their healthcare are less likely to have experience stillbirths and early neonatal mortality (Ahmed, Alam, & Raynes-Greenow, 2018).

## 1.2 Making the Case of Pakistan

According to PDHS 2017-18, in Pakistan LPG, biogas and natural gas is the most common type of fuel used for cooking which constitutes of almost 50% of the total. The use of clean fuel i.e. electricity, LPG, natural gas and biogas is more in urban areas which is 88% rather than rural areas which is only 27% of the total. (NIPS & ICF, 2019). Around 93% of the cooking is done inside the home while only 6% is done in separate buildings in Pakistan (NIPS & ICF, 2019). Exposure to smoke inside the home whether it's from cooking fuel or tobacco smoke has adverse health effects and one in three persons are exposed to tobacco smoke in houses daily. Urban and rural areas of Pakistan have PM10 concentrations of up to 8,555 $\mu g/m^3$ where the kitchens used biofuel as an energy source (Colbeck, Nasir, Hasnain, & Sultan, 2007). HAP in Pakistan accounts for 40 million cases of ARI and 28,000 deaths/year and about 30 deaths per 100,000 are due to indoor air pollution (EMRO, 2020). HAP is one of the causes of adverse health effects including LBW, ARI, stillbirths, caesarean deliveries and total under five mortality. Children in Pakistan from the age of 12-18 months are associated with mortality caused by HAP occurring from cooking fuel (Naz, Page, & Agho, 2017) and children who live in households with polluting fuel are 1.5 times more likely to experience ARI than children who live in households using cleaner fuels (Khan & Lohano, 2018). Women are the strongest indicator of health and success of any society. In Pakistan only 19% of the married women are employed compared to men and approximately 49% of the women can decide alone about how to spend their cash earnings, around 10% of the women make decisions regarding their healthcare alone and 41% jointly with their husband (DHS, 2018).

According to DHS final report in 2019 women's participation in decision making is positively associated with three stated components of reproductive care (antenatal care, delivery from a skilled provider, and postnatal checkups) in Pakistan. This decreases the adverse birth outcomes. Women empowerment acts to enhance the child's nutritional status and wellbeing in Pakistan (Shafiq, et al., 2019). This can lead to good health of the children and they become less prone to infections. The previous literature has focused on association of HAP with health quality especially in Pakistan but very few to none has considered the impact of women empowerment on these negative effects. Previous literature has discussed the nexus between HAP and health quality but very few studies show the impact of women empowerment on these two indicators. This study will help to build up a nexus between HAP and health quality which is moderated by women empowerment. The questions answered in in study will be

1. Does household air pollution have a negative influence on health quality in Pakistan?
2. Does women empowerment improve health quality, influence clean fuel choice, and reduce exposure to ETS in Pakistan?

### 1.4 Objective of the Study

The objectives of this study are as follows:

1. To examine the association between household air pollution and health quality in Pakistan.
2. To examine the association between household air pollution and health quality after controlling for role of women empowerment in Pakistan.

### 1.5 Contribution of the Study

This study provides deep insight about the effects of HAP on health quality of children and maternal health in other countries and Pakistan. It gives knowledge about the different types of sources that create HAP and what type of illnesses it causes. This study is different from previous studies because it will not only find the association between HAP and health quality in Pakistan, but it also examines the role played by the role of women empowerment to control the adverse effects of HAP and how it influences the usage of cleaner fuel choice options.

### 1.6 Significance of the Study

This study tackles the problems created by HAP on maternal and child health quality in Pakistan. This problem is faced by the households which are the major stakeholders that contribute to this problem and affected by it. In the households of Pakistan there is a major role of women in catering all the aspects related to the household and child upbringing. The household economy is run by the women. Knowing this, this study tackles the adverse effects on health quality raised by HAP by empowering the women of Pakistan. Women empowerment either it's from working and having cash earnings or having a say in decision making about the household and healthcare can positively impact the health of themselves and their children and, they lean towards cleaner fuel choices. By empowering the women in Pakistan, better and improved health quality can be achieved. This study will examine the importance of women empowerment in reducing HAP and improving health quality in Pakistan. This study will also recommend policy implications on how to empower women to achieve this goal of reduction in HAP and improving health quality.

### 1.7 Organization of the Study

This study is divided into total of five chapters. First chapter is the introduction which consists of background of the problem, existing situation and importance. As well as objectives of this study, contribution of the author and the case of Pakistan. Second chapter consists of literature review which summarizes all the previous results of the studies done on this topic internationally as well as in Pakistan. This chapter also has the literature gaps which will be studied. Third chapter is the methodology, conceptual framework and data sources. Fourth chapter consists of descriptive analysis. Fifth chapter contains results and discussion. And last chapter concludes the whole study and give policy implication. In the last chapter the limitations of the study have also included.

# Chapter 2

# Literature Review

## 2.1 Introduction

The objective of this chapter is to give an overview about the previously done studies on how HAP affects health quality of the individuals and how women empowerment controlled these adverse effects. It also focuses on the relationship between the socioeconomic status and women empowerment, health quality and HAP.

Many studies have been conducted in developing countries to find out the effects of HAP on child and maternal health. Mostly studies show that HAP does cause under five mortality, stillbirths, low birthweight and ARI, cesarean deliveries etc. Most of the causes of HAP are shown in literature to be solid fuel use and indoor smoking. Very few studies have seen the effect of women empowerment on HAP. Here are some studies showing the relationship between HAP and above-mentioned illnesses.

## 2.2 Household Air Pollution and its Effects on Health Quality

Through studying the effects of cooking fuel and environmental smoke (ETS) on ARI in children Mishra, Smith, & Retherford (2005) find that exposure to smoke from polluting fuel compared to cleaner fuel has significant impact on ARI.

Naz, Page & Agho (2017) in a study done in Nepal using multi-level logistic regression model find that use of cooking fuel is associated with neonatal mortality and under five mortality. Higher associations are found in the rural areas and in households with no separate kitchen space using dirty fuel and where children are never breastfed.

Nisha, Alam, & Greenow (2018) examine the association between pollution occurring from cooking fuel and perinatal mortality in Bangladesh. Bivariate and multivariate analyses are conducted. The results show that exposure to dirty fuel is associated with early neonatal mortality but not with stillbirths. The effect of cooking with agricultural crop waste and wood is greater for stillbirth and for early neonatal mortality. Using dirty fuels in an indoor kitchen is associated with increased stillbirths. Cooking with dirty fuels is linked with perinatal mortality. The collective linkage of polluting cooking fuels and indoor kitchen location is greater for stillbirth.

Nandasena, Wickremasinghe, & Sathiakumar (2012) examine the health effects of both outdoor and indoor air pollution on children in Sri Lanka. They findings suggest that indoor cooking with unclean fuels is the source of wheezing among children.

Rana, Uddin, Peltier, & Oulhote (2019) examine the link between polluting fuel use and ARI among children under five in Afghanistan. This study also figures out that whether sex of the child and socioeconomic status varies in the results using mixed-effect Poisson regression models. The key findings are that the occurrence of ARI is higher in children living in households with polluting fuel use compared to children living in households with clean fuel use. No effect change is observed by socioeconomic status or child sex. While observing exposure variables including the kitchen's location, children highly exposed to indoor air pollution have a higher chance of ARI compared to unexposed children. Socioeconomic status changed this link with the strongest association seen among children from the middle wealth status.

Naz et al. (2015) examine the association between HAP from cooking fuels and under five mortality and how behavior and environmental effects alter these associations in Bangladesh. The results are found using multi-level logistic regression models which show HAP is not strongly associated with neonatal mortality, infant mortality or under five mortality in the situation of decreasing trends in under five mortality. The association is stronger for households with an indoor kitchen using polluting fuels, and in women who had never breastfed her children. Decrease in exposure to pollution from cooking fuel can cause further declines in under-five mortality with household structures and behavioral interferences.

Naz et al. (2016) examine the linkage between HAP and under five mortality and to what extent environmental and behavioral factors vary this association India. The association is found using multi-level regression models by the survey done by DHS program. The results state that pollution from cooking fuel is associated with increased risk of under-five mortality. Households in rural areas without separate kitchen space and women who never breastfed have higher associations.

Khan et al. (2017) conducted a nationwide study in Bangladesh and examined the adverse health and birth outcomes of exposure to the pollution resulting from cooking fuel. The results states that cooking inside the house increase the risk of ARI, neonatal mortality, infant mortality, LBW and cesarean delivery. Use of polluting fuel apart from cooking place increase the risk of pregnancy complications. The risks are higher within those who cook inside irrespective of type of fuel.

Gosh, Wilhelm, & Ritz (2013) examined the effects of household air quality and ventilation on premature births and LBWs in the city of  Los Angeles using multinomial logistic regression models. Results state that women living with exposure to passive smoke have increased risk of LBW and premature births, but no increase of risk is increased with women exposed to passive smoke but had high or moderate window ventilation. Links are also observed for products which are used, but only for women reporting low or no window airing.

The association between polluting fuel use and respiratory infections in rural children and women is examined by Po, FitzGerald, & Carlsten (2011). The study shows significant associations of polluting fuel with ARI in children whereas no significant association with polluting fuel and asthma in children is detected.

Smith, Samet, Romieu, & Bruce (2000) studied regarding indoor air pollution and acute lower respiratory infections in children. They found strong significant increase in risk of young children who are exposed to HAP compared with those living in households using cleaner fuels or being less exposed to HAP.

Amegah, Quanash, & Jaakkola (2014) concerning HAP from polluting fuel use and risk of adverse birth outcomes results show household ignition of polluting fuels results in 35% and 29% increase in risk of LBW and stillbirth respectively and an 86.43 g decrease in birth weight.

Edwards & Langpap (2009) studied the effects of indoor air pollution resulting from firewood burning on health of children under five in Guatemala. Other investigations are the impact of cooking indoors, importance of mother cooking while taking care of kids, and smoke absorbency of construction materials used in house. The results conclude that children of households where there is wood burning, and exposure to HAP is higher because the mother cooks while looking after the children or because cooking takes place indoors have symptoms of ARI.

Franklin, Tan, Hemy, & Hall (2019) conducted a study to investigate whether indoor air pollutants are associated with adverse birth outcomes. The results show that only formaldehyde is associated with any adverse birth outcomes such as a decrease in birth weight and head circumference.

Lakshmi et al. (2013) examined the association between fuel choice and prevalence of stillbirths in India. Prevalence ratio is found using Poisson regression. Results state that women who use kerosene or firewood for cooking are more likely to experience stillbirths than those who use LPG or electricity for cooking purposes. The use of kerosene lighting lamps are also linked with stillbirths compared to use of electric lighting lamps.

Pope et al. (2010) conducted a study regarding the occurrence of low birth weight and stillbirths linked with HAP from polluting fuel use. The results show an increase in occurrence of low birth weight and stillbirths.

Pandey & Yuan (2012) examined the effects of tobacco use, domestic violence and HAP from use of polluting fuel on child mortality. The results show that mothers who use tobacco show the greatest risk for child mortality, followed by fathers who use tobacco, households which use polluting fuel for cooking and physical abuse upon mothers.

Naz et al. (2017) examined the effects of HAP on under five mortality in Pakistan. Multi-level logistic regression models are used to estimate the results. Use of polluting cooking fuel is inadequately associated with under-five mortality, with tougher associations for the analysis of children aged 12–59 months. Strong links between use of polluting cooking fuel and mortality are seen in those aged 12–59 months for households without a separate space for cooking using dirty fuels, and in children who never breastfed. The results of this study stated that HAP from polluting cooking fuel is linked with increase in death of children who are aged under five in Pakistan, but especially in those aged 12–59 months, and those living in poor socioeconomic environment.

Khan & Lohano (2018) examined the consequence of using polluting fuels for cooking purposes on the respiratory health of children in Pakistan. The results show that children living in households using polluting fuels for cooking purposes are 1.5 times more prone to experiencing acute respiratory infection than children living in households using cleaner fuels for cooking purposes.

### 2.3 Household Air Pollution, Health Quality and Women Empowerment

Austin & Mejia (2017) conducted a research on HAP and women's status state that women's status, measured through schooling years, fertility rates and use of contraceptives, represents the empowerment status influencing the number of people depending on polluting fuels across developing countries. This finding establishes that women are important in manipulating the type of fuel used in households where women with more education and reproductive authority are in empowered social positions to encourage the use of cleaner fuels or purchase safer heating and cooking options.

Shafiq et al. (2019) researched about the effect of women empowerment on the children's nutritional status in Pakistan by using the PDHS 2012-13. This study estimated the results by using binary logistic regression and found out that women empowerment acts to enhance the child's nutritional status and wellbeing.

Sado, Spaho & Hotchkiss (2014) investigated regarding the influence of women's empowerment on the attainment of maternal healthcare. The data for the study is extracted from the DHS of Albania in the year of 2008-09 and is estimated through using bivariate and multivariate analyses. The findings explored that women's contribution in decision making about certain aspects of lives have a positive influence on maternal health.

Doku, Bhutta & Neupane (2020) assessed the association of women's empowerment status with neonatal, infant and under five mortality. The study used individual participant data of 59 countries. The results show that women empowerment status is linked with given mortalities and policies regarding empowering women can decrease these adverse health effects.

### 2.4 Socioeconomic Status Influences Women Empowerment, Household Air Pollution and Health Quality

Through assessing the socioeconomic indicators of women empowerment status in Pakistan by surveying the 200 female respondents of Lahore and using simple regression model to estimate the results Bushra & Wajiha (2015) find that poverty and economic prospects given to women, which is socioeconomic indicator increases their chances of empowerment.

Raspanti et al. (2016) assessed HAP and risk of lung cancer among nonsmokers in Nepal. This study is based on hospital patients with 606 lung cancer sample of patients. The results revealed that there is a significant decrease in lung cancer risk among those people with higher SES status.

Sepehri & Guliani (2015) analyze the socioeconomic status and its effects on children's health by using multilevel modelling. The results showed that children from poor wealth groups are worse off than children from richer wealth groups. This is mostly affected to children ranging from age group of zero to three years of age. The study is conducted for the Vietnamese children.

Nasir, Murtaza & Colbeck (2015) conducted a study in Pakistan by using multinomial logit model to predict fuel choice determinants. They found out that although poverty is linked with poor fuel choices, other socioeconomic factors such as household area and locality, household size and asset ownership structure also influence the fuel choices of the people.

**2.5 Conclusion**

A lot of previously done researches are based on just the adverse health impact of HAP. Limited research is conducted on the association of women empowerment and HAP. Also, the effect of women empowerment on the mitigation of HAP and its impacts will also be studied in the context of Pakistan.

# Chapter 3

# Conceptual Framework, Data Description and Methodology

## 3.1 Introduction

This chapters explains the nexus between the HAP and health quality moderated by women empowerment and how the socioeconomic status influences all the three given parameters. It also explains all the data sources, variables and methodology and estimation techniques used in this study.

## 3.2 Conceptual Framework

HAP and health quality have been discussed widely in literature through years. Different nexuses have been built to connect the HAP with health quality and related aspects. Khan et al. (2018) use the household health model which is originally created by Grossman (1972) and then exceeded by Portney and Harrington (1987). The model is created by dose response function to further analyze the child health. Many use demand for health theory (Grossman, 1972) to analyze the demand for healthcare created by decreased health quality connecting it to HAP. Kumar & Sahu (2019) use the Cox Proportional Hazard Theory created by Cox (1972) to analyze the mortality occurring through cooking fuel choice. For this study, fundamental cause theory is used to create a nexus between HAP and health quality moderated by women empowerment.

The fundamental cause theory describes the basis of the concept of impact of HAP on health quality (Link & Phelan, 1995). The fundamental cause theory explains that socioeconomic status (SES) is the important cause of diseases because it involves access to resources which then allows people to avoid diseases and their consequences and it affects multiple risk factors and disease outcomes that change over time (Chang & Lauderdale, 2009). It has been widely used in literature to assess the mortality relating specific diseases and their link with socioeconomic status (Link & Phelan, 1995). This study links the socioeconomic status with poor fuel choices and ill health practices. This is backed by literature as Bushra & Wajiha (2015) state that less poverty and more economic opportunity increases the chances of women empowerment. Raspanti et al. (2016) found significant decrease in lung cancer risk among those people with higher socioeconomic status. As a household has poor socioeconomic status, it will be compelled to use dirty fuels that create air pollution. Several studies have done to prove a link between SES, health quality and air pollution. Higher socioeconomic status decreased the occurrence of lung cancer (Raspanti, et al., 2016). Children from poor households tend to be in worse health than children from rich households (Sepehri & Guliani, 2015). Poor socioeconomic status like rural area is linked with poor fuel choices (Nasir, Murtaza, & Colbeck, 2015). Poverty makes a significant contribution to fuel choices but other socioeconomic factors such as household location and area, low level of human capital, household size, ownership of assets and access to basic utilities are the important factors affecting the fuel choice (Nasir, Murtaza, & Colbeck, 2015). Moderate and lower socioeconomic status explained by middle income, education and low income, low education respectively causes an increase of the highest level in air pollution and bad self-reported health quality (Jiao, Xu, & Liu, 2018). Low socioeconomic status of the people affects their health due to lack of healthcare services and treatment provided (Arpey, Gaglioti, & Rosenbaum, 2017). Individuals have increased risk of low health quality i.e. respiratory illnesses and reduction in lung function due to increased ambient air pollution which is caused by low socioeconomic status determined by low income and less education (Cakmak, Hebbern, Cakmak, & Vanos, 2016). Low socioeconomic status forces people to use traditional stoves and dirty fuels for cooking and heating purposes due to lack of money or availability which in return effects the type and level of pollutants released into household air (Arth, Broadwin, & Lam, 2009). The levels of ETS (ETS) are higher within people with low socioeconomic status because of less education, lower occupational groups and moderate neighborhood income (Whitlock, et al., 1998)

One of the major sources of HAP in developing countries is fuel used for cooking and heating (Apte & Salvi, 2016) and smoking indoors (Mishra, Smith, & Retherford, 2005). Health quality is the illnesses created by HAP. Well empowered women can either take preventive measures to reduce HAP (Austin & Mejia, 2017) or secondly, they can take extra steps to ensure better health status (Shafiq, et al., 2019).

Providing all these theoretical arguments we build a nexus that how SES determine HAP or ill health practices and decrease in women empowerment. Due to low SES of household's individuals are forced to opt for dirty fuels (Colbeck, Nasir, Hasnain, & Sultan, 2007) and take inadequate health measures (Arpey, Gaglioti, & Rosenbaum, 2017) because of non-availability, higher costs and lack of knowledge relating the resources. We build a nexus that HAP determines poor health quality with is moderated by women empowerment and then the socioeconomic status of the households determine all three factors i.e. HAP, health quality and women empowerment.

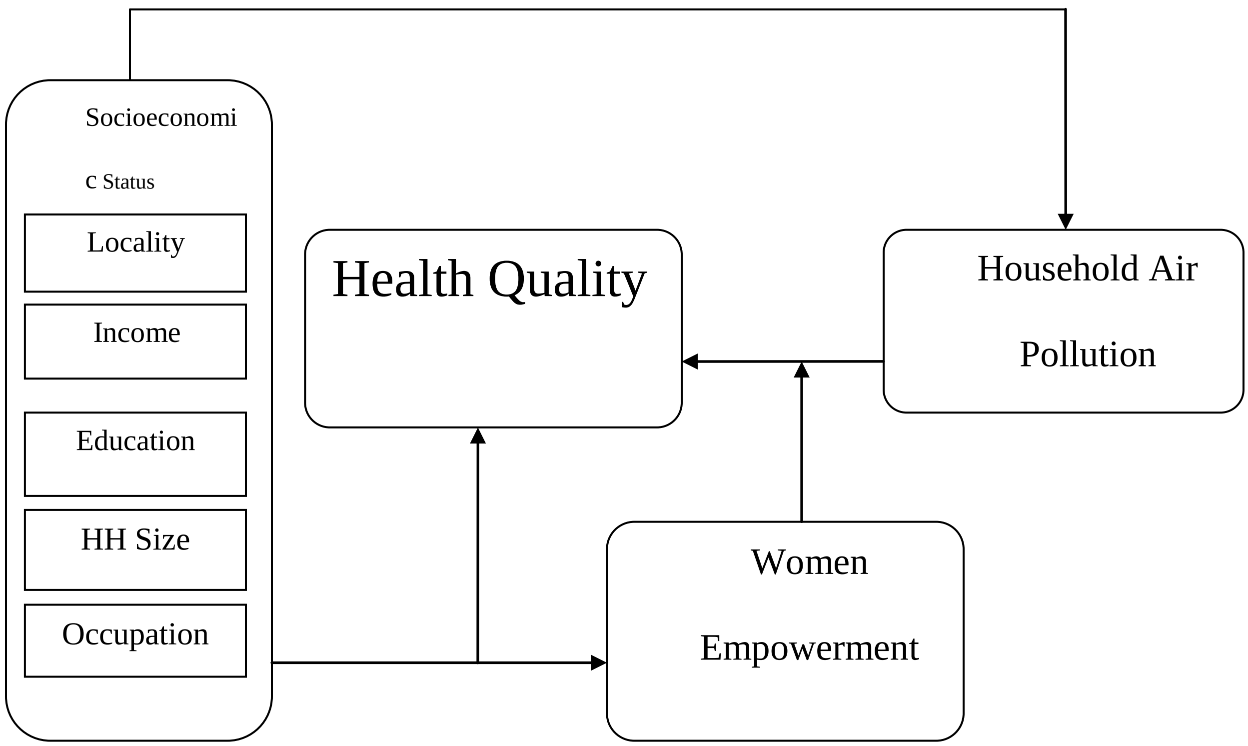


***Figure 3. 1*** **Conceptual Framework**

Figure 3.1 explains the nexus between socioeconomic status and how it determines household air pollution and health quality moderated by women empowerment. The socioeconomic status namely income, locality, husband's education, household size and husband's occupation influence the fuel choice and environmental tobacco smoke exposure. The socioeconomic status also influences the health quality i.e. under-five mortality, child mortality, post neonatal, neonatal mortality stillbirths, caesarean delivery, low birth weight and ARI by determining the healthcare services provided, access to healthcare due to income and knowledge regarding prevention of diseases. Socioeconomic status also influences the degree of decision making of women which is denoted as women empowerment. Both health quality and household air pollution are moderated by women empowerment.

### 3.2.1 Women Empowerment

Women empowerment is the process by which women take authority over their lives, attaining the capability to make strategic choices (United Nations, 2002). Socioeconomic status consists of combination of income, occupation and education (APA, 2020) therefore higher education level and income of women have led to more power over decision-making (Pambe, Gnoumou, & Kaboré, 2013).

The women empowerment index has been created by using two indicators of women empowerment. In this study the decision about the mother/woman’s health and decision about making large household purchases is considered as women empowerment indicators. The index has been created by combining the score of different categories of given indicators. The categories which are assembled are divided into three which are as follows:

i. Wife only

ii. Husband and Wife Both

iii. Husband Only

From the discussion above these hypotheses below will be tested to compute significant results.

Health Quality: Health quality will more likely to deteriorate from the presence of HAP due to polluting fuel and ETS.

Women Empowerment: Women empowerment through decision making ability increases health quality of the individuals and helps in lowering the HAP by making cleaner fuel choices and reducing ETS.

Moderation Effect: Health quality of the individuals increases when fuel choice is interacted with women empowerment.

Socioeconomic Status: The socioeconomic status of individuals/households will influence its fuel choice, presence of ETS and degree of women empowerment.

### 3.3 Data

This study uses Pakistan Demographic Health Survey data for analysis. The objective of the survey is to provide dependable estimates of family planning and fertility, domestic violence, breastfeeding practices, nutrition, childhood mortality, maternal health, women's empowerment, HIV/AIDS, child health, disability, migration, and other health-related problems that can be used by policymakers to evaluate and improve existing policies. This PDHS is the fourth to be conducted in Pakistan since 1990-91. Health and demographic data are obtained from ever-married women and men aged 15-49 using stratified sampling of households based on two staged cluster design. This stratification is gained by separating each of the eight regions i.e. KPK, Sindh, Baluchistan, Punjab, ICT, FATA, AJK and Gilgit Baltistan into urban and rural areas. Total of 16 sampling strata are created. Samples are selected independently in every stratum through a two-stage selection procedure. Probability-proportional-to-size selection is done at the first stage of sampling by selecting the enumeration blocks. Total 580 clusters are selected consisting of EBs. The second stage included systematic sampling of households. Fixed number of 28 households per cluster is selected with an equal probability systematic selection process, for a total sample size of approximately 16,240 households.

National figures and background characteristics of the 2017-18 PDHS excludes Gilgit Baltistan and Azad Jammu and Kashmir regions. For the research purpose both urban and rural households of KPK, Punjab, Sindh, Baluchistan, Islamabad Capital Territory and FATA are considered. Out of 12,815 households in Pakistan excluding AJK and GB, 12,338 are occupied out of which 11,869 are interviewed. Out of 13,118 eligible women of age 15-49 in Pakistan excluding AJK and GB, 12,364 are interviewed with the response rate of 94.3%. These ever-married women are either permanent residents of the household or are staying there a night before both are eligible for the survey. Out of 10,473 children selected for study 10,204 are selected for the analysis of total under-five mortality and its subgroups. Total 269 non singleton children are dropped from the study to have accurate results because previous studies showed that twins have low life expectancy. For the analysis of LBW only 1,681 live born children are taken whose weight is either recorded or verbally recalled by mother. For the analysis of acute respiratory analysis total 9,867 alive children are selected for the estimation who had cough with rapid breathing during the past two weeks. The children who are born in the past five years are taken as the study subjects to reduce recall bias of birth and death information which is self-reported by the mother.

**Table 3.1 PSU Information DHS 2017-18**

| | Pakistan | | |
|---|---|---|---|
| **Result** | Urban | Rural | Total |
| **Household Interviews** | | | |
| Selected | 6631 | 6184 | 12815 |
| Occupied | 6389 | 5949 | 12338 |
| Interviewed | 6091 | 5778 | 11869 |
| **Household Response Rate**[1] | 95.3 | 97.1 | 96.2 |
| **Interviews with Ever Married Women Aged 15-49** | | | |
| Total Eligible Women | 6545 | 6573 | 13118 |
| Total Eligible women Interviewed | 6098 | 6266 | 12364 |
| **Eligible Women Response Rate**[2] | 93.2 | 95.3 | 94.3 |
| **Household interviews in subsample** | | | |
| Selected | 2368 | 2208 | 4576 |
| Occupied | 2296 | 2136 | 4432 |
| Interviewed | 2187 | 2076 | 4263 |
| **Household response rate in subsample**[1] | 95.3 | 97.2 | 96.2 |
| **Interviews with Ever Married Women Aged 15-49** | | | |
| Total Eligible Men | 1928 | 1706 | 3634 |
| Total Eligible Men Interviewed | 1640 | 1505 | 3154 |
| **Eligible Men Response Rate**[2] | 85.1 | 88.2 | 86.5 |

Table 3.1 gives the complete detail about the primary sampling units taken for this survey.

### 3.4 Variables

#### 3.4.1 Health Quality Index

The outcome variables for this study are selected as neonatal mortality ranging from 0 to 28 days, post neonatal mortality typically ranging from 1 to 11 months, child mortality which ranges from 12 to 58 months and total under five mortality which ranges from 0 to 58 months (Naz & Page, 2015; Naz, Page, & Agho, 2017). Acute respiratory infections (ARI), cough with rapid breathing (Khan & Lohano, 2018;

[1] Households interviewed/households occupied
[2] Respondents interviewed/eligible respondents

Khan, Nurs, Islam, & Rahman, 2017), low birth weight (LBW), weight <2500g (Amegah, Quansah, & Jaakkola, 2014; Wang, Ding, Rayn, & Xu, 1997; Pope, et al., 2010) stillbirths, baby born still or pregnancy finishing at 7 months or more (Khan, Nurs, Islam, & Rahman, 2017; Lakshmi, et al., 2013) and cesarean delivery, surgical procedure for delivery of the baby (Khan, Nurs, Islam, & Rahman, 2017). These outcome variables are seen in many of the previous literature as the affected health outcomes of exposure to HAP.

**Table 3.2 Description of Outcome Variables**

| Outcome Variable | Description |
|---|---|
| **Acute Respiratory Infection** | Cough with rapid breathing |
| **Low Birth Weight** | Weight at birth is less than 2500g |
| **Neonatal Mortality** | Death of child occurring within zero to 28 days |
| **Post Neonatal Mortality** | Death of child occurring from one to 11 months |
| **Child Mortality** | Death of child occurring from 12 to 58 months |
| **Under Five Mortality** | Death of child occurring before fifth birthday |
| **Caesarean Delivery** | Surgical procedure of baby delivery |
| **Stillbirths** | Baby born still or pregnancy ending at seven months |

### 3.4.2 Household Air Pollution

Exposure variables will be type of cooking fuel and environmental tobacco smoke (ETS). The cooking fuel will be divided into two categories. Polluting fuel i.e. shrubs/straw/grass, kerosene, charcoal, coal/lignite, animal dung, wood, and clean fuel i.e. electricity, liquid petroleum gas (LPG), natural gas and biogas. This classification is done by various other literature (Khan, Nurs, Islam, & Rahman, 2017; Naz, Page, & Agho, 2017). ETSs refer to the frequency household members smoke inside the house which will be categorized as daily or never. The variable of ETS as the factor causing the HAP can be seen in (Pandey & Yuan, 2012; Mishra, Smith, & Retherford, 2005).

**Table 3.3 Description of Exposure Variables**

| Exposure Variables | Description |
|---|---|
| **Cooking Fuel** | Using polluting fuel like agricultural waste, wood, charcoal, lignite/coal, grass/straw/shrubs, for cooking purposes |
| **ETS** | Frequency of household members smoking cigarettes, pipes, huqqa inside the household |

### 3.4.3 Potential Covariates and Socioeconomic Indicators

These are the variables which are included in the study by studying previous literature which give a complete estimate of the association are place of residence (rural or urban), household wealth index (high, middle and low income), kitchen location (separate or inside), mother's age and breast feeding status, sex of child (Naz, Page, & Emwinyore, 2017), prenatal care (Van Dijk, Anderko, & Stetzer, 2011), last pregnancy a c-section (Abebe, Gebeyehu, Kidane, & Eyassu, 2015), vaccination status of child (Khan & Lohano, 2018).

**Table 3.4 Description of Potential Covariates**

| Covariates/Socioeconomic Indicators | Description |
|---|---|
| **Place of Residence** | Type of place of house rural/urban |
| **Household Wealth Index** | Household income i.e. poor, middle and rich |
| **Kitchen Location** | Location of kitchen is outside the building of the house of inside |
| **Mother's Age** | Grouped age of mother of child |
| **Breastfeeding Status** | If the child ever breastfed in life |
| **Sex of Child** | Either child is male or female |
| **Prenatal Care** | Mother received health care checkups during pregnancy from doctor, healthcare worker etc. |
| **Last Pregnancy a C-Section** | Last child born through surgical delivery |
| **Vaccination Status** | DTP 1, DTP 2 and DTP 3 received by the child |
| **Education** | Education of the husband/partner |
| **Occupation** | Occupation of husband/partner |
| **Household Size** | Number of people living in the household |

Locality of house (urban or rural), wealth status (high, middle and low income), education level of the male of the household (higher, secondary, primary and no education), household size (2-15, 16-30, 31-44 members) and occupation of the male head of the household (managerial, professional, clerical, technical, sales, services, skilled labor, unskilled labor and agricultural-self-employed) are taken as household indicators.

### 3.5 Methodology

The methodology proposed for this study is based on the previous research conducted by (Khan, Nurs, Islam, & Rahman, 2017). In his study he used multiple logistic regression for estimation of effect of HAP on health quality.

The model created for estimation of association of health quality with HAP is as follows:

$$HQ = \alpha + \beta_0(HAP) + \beta_1 \sum(CV) + \varepsilon \qquad (3.1)$$

Where HQ is health quality, which is the dependent variable consists of neonatal mortality, post-neonatal mortality, child mortality, total under-five mortality, low birth weight, stillbirths, acute respiratory infections and cesarean delivery. As for independent variable HAP which is household air pollution, stands for cooking fuel choice either polluting or clean fuel and ETS stands for environmental tobacco smoke whether the frequency of exposure to tobacco smoke is either daily or never. All the HQ and HAP variables are dichotomous 1 for ‘yes’ if the condition exists and 0 for 'no’ if the condition does not exist. CV stands for covariates which includes are place of residence (rural or urban), household wealth index (high, middle and low income), kitchen location (separate or inside), mother’s age and breast feeding status, prenatal care, last pregnancy a stillbirth, vaccination status of child, sex of child. All the covariates are also dichotomous in nature.

The models created for estimation of association of health quality with socioeconomic indicators is as follows:

$$HQ = \alpha + \beta_0(SES) + \varepsilon \qquad (3.2)$$

$$HAP = \alpha + \beta_0(SES) + \varepsilon \qquad (3.3)$$

$$WE = \alpha + \beta_0(SES) + \varepsilon \qquad (3.4)$$

Where HQ stands for health quality, HAP stands for household air pollution which consists of fuel choice and ETS and WE stand for women empowerment. SES stands for socioeconomic status which consists of Locality of house (urban or rural), wealth status (high, middle and low income), education level of the male of the household (higher, secondary, primary and no education), household size (2-15, 16-30, 31-44 members) and occupation of the male head of the household (managerial, technical, professional, clerical, sales, services, skilled labor, unskilled labor and agricultural work.

The models created for estimation of association of health quality, HAP with women empowerment is as follows:

$$HAP = \alpha + \beta_0(WE) + \beta_1 \sum(CV) + \varepsilon \qquad (3.5)$$

$$HQ = \alpha + \beta_0(WE) + \beta_1 \sum(CV) + \varepsilon \qquad (3.6)$$

The model created after interaction of HAP with women empowerment is as follows:

$$HQ = \alpha + \beta_0(HAP * WE) + \beta_1 \sum(CV) + \varepsilon \qquad (3.7)$$

A series of multiple logistic regression models will be used to investigate the association between type of cooking fuels and ETS with health outcomes such as neonatal, post-neonatal, child and under-five mortality, stillbirths, caesarean delivery, low birth weight and ARI in children under five estimated for the covariates i.e. wealth index, place of residence, mother's age, location of kitchen and breast feeding status, prenatal care, vaccination status etc. This technique is backed up by Khan et al. (2017). The impact of socioeconomic status on health quality, HAP and women empowerment are also estimated by using logistic regression analysis. The impact of women empowerment on health quality and HAP is also analyzed separately using logistic regression analysis. Endogeneity did not occur otherwise be solved with generalized structural modelling through estimating maximum likelihood.

The effect of moderation of women empowerment is also analyzed by estimating the interaction of HAP and women empowerment, after estimating for the respective covariates. Due to non-proportional sample distribution, the sample is not self-weighting. Weighting factors have been calculated and previously added to the data file and applied so that results are representative at the national level for Pakistan.

# Chapter 4

## Descriptive Statistics

### 4.1 Introduction

This chapters provides brief statistics about the outcome variables i.e. health quality, exposure variables cooking fuel choice and ETS and all the covariates including socioeconomic status and women empowerment index. The statistics will be provided by giving percentages and frequencies of concerned variables.

**Table 4. 1 Descriptive Statistics of Outcome and Exposure Variables**

| Study Factors | Categories | Percentage | Frequency |
|---|---|---|---|
| **Outcome Variables** | | | |
| **Low Birth Weight (mean 3.57kg) (SE 0.01)** | <2500g | 32.72% | 550 |
| **Neonatal Mortality** | 0-28 days | 3.34% | 341 |
| **Post Neonatal Mortality** | 1-11 days | 1.64% | 167 |
| **Child Mortality** | 12-58 days | 0.49% | 50 |
| **Under-Five Mortality** | 0-58 months | 5.47% | 558 |
| **Caesarean Delivery** | Surgical process of delivering the baby | 18.12% | 1,898 |
| **Stillbirth** | Baby born still or pregnancy finishing at 7 months or more | 6.80% | 540 |
| **Acute Respiratory Infection (ARI)** | Cough with Rapid Breathing | 17.09% | 1,686 |
| **Exposure Variables** | | | |
| **Cooking Fuel (CF)** | Polluting Fuel | 44.28% | 4,637 |
| **Environmental Tobacco Smoke (ETS)** | Daily | 29.78% | 3,119 |

The statistics show that around 32.72% babies are born with weight below 2500g. Out of total 5.47% deaths of children under five, 3.34% died at the age of 0-29 days, 1.64% died at 1-11 months of age and 0.49% died at 12-58 months of age. Out of total 10,473 births, 1898 (18.12%) are caesarean deliveries which means surgical procedures are done to deliver the child. Total of 540 children are stillborn which make them 6.80% which means they are born still, or pregnancy ended at 7 months or more. Total of 1,686 children 17.09% suffered from acute respiratory infection with the symptoms of cough with rapid breathing. A total sum of 4,634 children lived in the households with polluting fuel and 3,119 children lived in households where members daily smoke within the house.

**Table 4. 2 Descriptive Statistics of Potential Covariates**

| **Potential Covariates** | **Categories** | **Percentage** | **Frequency** |
|---|---|---|---|
| **Place of Residence** | Rural | 54.82% | 5,741 |
| **Age of Mother (mean 29.13 years) (SE 0.12)** | <30<br>30-39<br>40-49 | 55.81%<br>38.54%<br>5.65% | 5,845<br>4,036<br>592 |
| **Sex of Child** | Male<br>Female | 50.99%<br>49.01% | 5,340<br>5,133 |
| **Kitchen Location** | Inside | 90.46% | 9,474 |
| **Breastfeeding Status** | Never Breastfed | 5.45% | 571 |
| **Wealth Index** | Low Income<br>Middle Income | 44.33%<br>18.91% | 4643<br>1980 |
| **Prenatal Care** | No | 45.57% | 4,773 |
| **Smoking Status of Mother** | Smoker | 6.12% | 641 |
| **Last Birth C-Section** | Yes | 18.90% | 1,979 |
| **Vaccination Status** | DPT1<br>DPT2<br>DPT3 | 71.46%<br>64.03%<br>56.09% | 4,203<br>3,765<br>3,298 |

Total sum of children born in rural households with kitchen location inside are 54.82% and 90.46% respectively. Total of 44.33% children belong to low income households, 18.91% belongs from middle income households and 12.73% belong to high income households. The age of mothers in which the children are born are 55.81% below 30 years of age, 38.54% are from 30-39 years of age and 5.65% are from 40-49 years of age. Approximately 6.12% children are born to mothers who smoke. Around 45.57% children are born to mothers with no prenatal care and 18.90% of the mothers had last birth through c-section. Total 94.55% children are ever breastfed out of which out of which 50.99% are male and 49.01% are female. Vaccination status of children stood at 71.46%, 64.03%, 56.09% to DPT1, DPT2 and DPT3 respectively.

**Table 4. 3 Descriptive Statistics of Women Empowerment Index**

| Women Empowerment | Categories | Percentage | Frequency |
|---|---|---|---|
| **Education of Mother (mean 4.3 years) (SE 0.19)** | No Education<br>Primary<br>Secondary | 55.09<br>13.52<br>18.66 | 5,770<br>1,416<br>1,954 |
| **Decision Making Status** | | | |
| **Woman's Healthcare** | Wife Alone<br>Husband and Wife<br>Husband Alone | 6.49<br>33.43<br>45.76 | 680<br>3,501<br>4,792 |
| **Household Purchases** | Wife Alone<br>Husband and Wife<br>Husband Alone | 3.70<br>30.13<br>42.66 | 388<br>3,156<br>4,468 |

Women empowerment variables showed that 55.09% of the children are born to mothers with no education, 13.52% to mothers with primary education, 18.66% have secondary education and only 12.73% are born to mothers with higher education. The decision making about mother's own health is 6.49% by themselves, 33.43% decide mutually with their husbands/partners and 45.76% times husband decides alone. Decision making about large household purchases 3.70% women decide alone, 30.13 women decide mutually with their husbands and 42.66% have no say in household purchases and husbands decide alone.

**Table 4. 4 Descriptive Statistics of Socioeconomic Indicators**

| Socioeconomic Indicators | Frequency | Percentage |
|---|---|---|
| **Area** | | |
| **Rural** | 5,741 | 54.82% |
| **Urban** | 4,732 | 45.18% |
| **Wealth** | | |
| **Higher** | 3,850 | 36.76% |
| **Middle** | 1,980 | 18.91% |
| **Low** | 4,643 | 44.33% |
| **Education** | | |
| **Higher** | 2,246 | 21.72% |
| **Secondary** | 3,431 | 33.17% |
| **Primary** | 1,543 | 14.92% |
| **No Education** | 3,100 | 29.97% |
| **Household Size** | | |
| **2-15** | 9,298 | 88.78% |
| **16-30** | 1,096 | 10.47% |
| **31-44** | 79 | 0.75% |
| **Occupation** | | |
| **Technical/Professional/ Clerical/Managerial** | 1,707 | 16.54% |
| **Services/Sales** | 1,999 | 19.37% |
| **Skilled Labor** | 2,181 | 21.13% |
| **Unskilled Labor** | 2,384 | 23.10% |
| **Agricultural Work** | 1,663 | 16.11% |

Table 4.4 shows the statistics for socioeconomic indicators. In Pakistan 54.82% households are in rural areas where 36.76% belong to higher income groups, 18.91% belong to middle income groups and 44.33% belong to lower income groups. Around

21.72% males have higher education, 33.17% have secondary education, 14.92% have primary education and 29.97% are not educated. In Pakistan 88.78 children belong to households with 2-15 members, 10.47% belong to 16-30 members and 0.75% belong to 31-44 members in a household. Percentage of professional. technical, managerial and clerical occupation of male household head is 16.54, sales and services 19.37, skilled labor 21.13, unskilled labor 23.10 and agricultural work is 16.11%.

# Chapter 5

# Results and Discussion

## 5.1 Introduction

This chapter is separated into two parts. First part contains the results which are derived from estimating the regression analysis in STATA. Second part consists of discussion about the given results and their interpretations.

## 5.2 Association of Household Air Pollution with Health Quality

Table 5.1 summarizes the results of association of HAP with health quality. In the presence of polluting fuel there is a 7% chance of increase in occurrence of low birth weight, 37% decrease in stillbirths, 20% decrease in caesarean deliveries, 15% increase in ARI, 33% increase in neonatal mortality, 34% increase in post neonatal mortality, 11% decrease in child mortality and 27% increase in under five mortality.

Exposure to ETS increases the chance of low birth weight by 8% and ARI by one percent. Chances of Stillbirths decrease by 4% and caesarean delivery by 12%. There is an 8% decrease in neonatal mortality, 2% in child mortality and 2% in under five mortality. There is a 9% increase in post neonatal mortality in the presence of ETS.

The use of polluting fuels for cooking (shrub/straw/grass, kerosene, charcoal, lignite/coal, animal dung, wood) is associated with higher risk of low birth weight (aOR = 1.07, 95% CI = 0.70-1.64, P = 0.750), after estimating for place of residence, kitchen location, wealth index, age of mother, prenatal care, smoking status of mother and sex of child. The presence of ETS is also associated with higher risk of low birth weight (aOR = 1.08, 95% CI = 0.76-1.56, P = 0.638) after estimating for all the potential covariates.

Stillbirths showed negative association for both exposure variables; polluting fuel (aOR = 0.62, 95%CI = 0.39-1.00, P = 0.052) and ETS (aOR = 0.96, 95%CI = 0.71-1.30, P = 0.814), after estimating for its potential covariates namely place of residence, kitchen location, wealth index, prenatal care, age of mother and smoking status of mother.

Caesarean delivery also showed negative association for both exposure variables namely polluting fuel smoke (aOR = 0.87, 95%CI = 0.58-1.33, P = 0.537) and ETS (aOR = 0.78, 95%CI = 0.45-1.43, P = 0.420), after estimating for place of residence, kitchen location, wealth index, age of mother, smoking status of mother and history of caesarean births.

ARI have a positive association with both exposure variables polluting fuel (aOR = 1.15, 95%CI = 8796184 1.514723, P = 0.300), and ETS (aOR = 1.01, 95%CI .8244406-1.242196, P = 0.909), after estimating for place of residence, kitchen location, wealth index, breastfeeding status, age of mother, sex of child, smoking status of mother and dpt vaccination status. Association of polluting fuel with neonatal (aOR = 1.33, 95%CI 0.74-2.38, P = 0.334) and post-neonatal (aOR = 1.34, 95%CI 0.72-2.50, P = 0.359) mortality is positive while being negative for child mortality (aOR = 0.89, 95%CI 0.40-1.94, P = 0.764), after estimating for potential covariates namely place of residence, kitchen location, wealth index, breastfeeding status, sex of child, age of mother and smoking status of mother.

**Table 5. 1 Association of Household Air Pollution with Health Quality**

| Study Factors | Polluting Fuel Odds Ratio (95% CI) P-Value | Polluting Fuel Odds Ratio (95% CI) P-Value | Environmental Tobacco Smoke Odds Ratio (95% CI) P-Value | Environmental Tobacco Smoke Odds Ratio (95% CI) P-Value |
|---|---|---|---|---|
| **LBW** | 1.63 (1.14-2.33) 0.008** | 1.07 (0.70-1.64) 0.750 | 1.17 (0.81-1.68) 0.393 | 1.08 (0.76-1.56) 0.638 |
| **Stillbirths** | 1.07 (0.80-1.43) 0.662 | 0.63 (0.39-1.00) 0.052 | 0.97 (0.72-1.31) 0.822 | 0.96 (0.71-1.31) 0.814 |
| **Caesarean Delivery** | 0.32 (0.25-0.40) 0.000** | 0.80 (0.43-1.43) 0.420 | 0.98 (0.79-1.23) 0.881 | 0.88 (0.58-1.33) 0.537 |
| **ARI** | 1.31 (1.08-1.60) 0.006** | 1.15 (0.88-1.51) 0.300 | 1.09 (0.91-1.29) 0.343 | 1.01 (0.82-1.24) 0.909 |
| **Neonatal Mortality** | 1.40 (1.05-1.88) 0.024 | 1.33 (0.74-2.39) 0.334 | 0.99 (0.74-1.33) 0.967 | 0.92 (0.65-1.30) 0.627 |
| **Post Neonatal Mortality** | 1.91 (1.21-3.04) 0.006** | 1.34 (0.72-2.50) 0.359 | 1.11 (0.69-1.77) 0.677 | 1.09 (0.69-1.73) 0.705 |
| **Child Mortality** | 1.54 (0.69-3.43) 0.287 | 0.89 (0.40-1.95) 0.764 | 1.04 (0.50-2.18) 0.917 | 0.98 (0.48-2.01) 0.954 |
| **Under Five Mortality** | 1.56 (1.21-2.00) 0.001** | 1.27 (0.87-1.86) 0.216 | 1.03 (0.79-1.34) 0.828 | 0.98 (0.74-1.30) 0.906 |
| **Covariates** | **Without** | **With** | **Without** | **With** |

**significance level at 5%

The adjusted total under-five mortality (OR, 1.272159; P, 0.216; 95% CI, 0.8682796-1.863904) is positively associated with polluting fuel. The association of ETS with post-neonatal mortality (OR, 1.09; P, 0.705; CI, 0.69-1.73) but negative with neonatal (OR, 0.92; 95%CI, .64-1.30, P=0.627) and child mortality (OR, 0.979; P, 0.954; CI, 0.47-2.01) after estimating for potential covariates. Overall association with adjusted under-five mortality is negative (OR, 0.98; P, 0.906; CI, 0.74-1.30).

### 5.1.2 Impact of Socioeconomic Status on Household Air Pollution, Health Quality and Women Empowerment

The socioeconomic status consists of area, income, education of husband/partner, household size and occupation of husband/partner. The findings show that fuel choice and exposure to ETS are both positively associated with rural area. There are 21.77 time more odds of fuel choice being polluting when in rural area and 1.50 time more odds of exposure to ETS when in rural area respectively. As income decreases the odds of HAP increases. Education also has a positive association with HAP. Exposure to ETS increases with number of household members but fuel choice shows unfavorable results. Odds of having polluting fuel increases with type of education. Professional/Technical Managerial/Clerical showed the least odds (0.30) of occurrence of polluting fuel at 0.000 significance level. While agricultural work showed 4.54 times occurrence of polluting fuel at 0.000 significance level. Similarly, the occurrence of ETS is less in Professional/Technical Managerial/Clerical work while it is most in agricultural work with the significance level of 0.001 for both indicators. Similar socioeconomic indicators area, income, education of husband/partner, household size and occupation of husband/partner, influence women empowerment as well. Women living in urban areas have more odds of being empowered than of women who live in rural areas with 1.51 and 0.66 odds respectively and 0.000 level of significance.

**Table 5. 2 Association of Household Air Pollution with Socioeconomic Indicators**

| Study Factors | Environmental Tobacco Smoke | | | Fuel Choice | | |
|---|---|---|---|---|---|---|
| | **Odds Ratio** | **P-Value** | **95% CI** | **Odds Ratio** | **P-Value** | **95% CI** |
| **Area** | | | | | | |
| Urban[r] | | | | | | |
| Rural | 1.50 | 0.000** | 1.20-1.88 | 21.77 | 0.000** | 13.36-35.46 |
| **Income** | | | | | | |
| High Income[r] | | | | | | |
| Middle Income | 0.99 | 0.916 | 0.78-1.25 | 0.98 | 0.894 | 0.75-1.28 |
| Low Income | 1.20 | 0.097 | 0.97-1.48 | 23.18 | 0.000** | 15.95-33.70 |
| **Education** | | | | | | |
| Higher[r] | | | | | | |
| Secondary | 1.09 | 0.366 | 0.90-1.31 | 0.63 | 0.000** | 0.52-0.77 |
| Primary | 1.17 | 0.173 | 0.93-1.48 | 1.41 | 0.003** | 1.13-1.79 |
| Not Educated | 1.23 | 0.067 | 0.99-1.53 | 3.77 | 0.000** | 3.01-4.71 |
| **Household Size** | | | | | | |
| 2-15 Members[r] | | | | | | |
| 16-30 Members | 1.06 | 0.759 | 0.72-1.56 | 0.90 | 0.620 | 0.60-1.36 |
| 31-44 Members | 2.26 | 0.242 | 0.57-8.92 | 0.70 | 0.588 | 0.18-2.65 |
| **Employment Status** | | | | | | |
| Professional/Technical Managerial/Clerical[r] | | | | | | |
| Sales/Services | 1.00 | 0.984 | 0.81-1.22 | 0.45 | 0.000** | 0.35-0.56 |
| Skilled Labor | 1.00 | 0.990 | 0.81-1.24 | 0.78 | 0.047 | 0.61-0.10 |
| Unskilled Labor | 0.90 | 0.314 | 0.73-1.11 | 1.60 | 0.000** | 1.28-2.01 |
| Agricultural Work | 1.55 | 0.001** | 1.19-2.02 | 4.54 | 0.000** | 3.17-6.50 |

** significance level at 5%

Similarly, empowerment increases with income as high-income groups have more empowered women with odds of 1.29 and significance of 0.018. The group where the male has attained higher education have more women empowerment with odds of 1.53 and significance of 0.000. As the household size decreases the women empowerment increases 2.63 (2-15 members) times with 0.000 significance.

[r] reference category

**Table 5. 3 Association of Women Empowerment with Socioeconomic Status**

| Indicators | Women Empowerment | | |
|---|---|---|---|
| | **Odds Ratio** | **P-Value** | **95% CI** |
| **Area** | | | |
| Urban[r] | | | |
| Rural | 0.66 | 0.000** | 0.54-0.81 |
| **Income** | | | |
| High Income[r] | | | |
| Middle Income | 0.91 | 0.408 | 0.73-1.14 |
| Low Income | 0.84 | 0.092 | 0.68-1.03 |
| **Education** | | | |
| Higher[r] | | | |
| Secondary | 0.85 | 0.067 | 0.72-1.01 |
| Primary | 1.04 | 0.704 | 0.84-1.29 |
| Not Educated | 0.85 | 0.099 | 0.70-1.03 |
| **Household Size** | | | |
| 2-15 Members[r] | | | |
| 16-30 Members | 0.39 | 0.000** | 0.27-0.57 |
| 31-44 Members | 0.19 | 0.001** | 0.07-0.51 |
| **Employment Status** | | | |
| Professional/Technical[r] Managerial/Clerical | | | |
| Sales/Services | 0.94 | 0.530 | 0.77-1.15 |
| Skilled Labor | 1.01 | 0.940 | 0.84-1.21 |
| Unskilled Labor | 1.15 | 0.132 | 0.96-1.39 |
| Agricultural Work | 0.83 | 0.128 | 0.65-1.06 |

** significance level at 5%

Professional/Technical/Managerial/Clerical occupation of husband/partner had most empowered women with odds being 1.28 and significance of 0.047. Agricultural occupation had least empowered women with odds of 0.83.

[r] reference category

ARI had low chances of occurrence in urban areas (OR=0.830) and more chances of occurrence in rural areas (1.20). The odds of suffering from ARI are 0.72 for high income, 1.01 for middle income and 1.34 for low income where high- and low-income levels show significant results at 0.003 and 0.004 respectively. The odds of ARI at higher level of education of husband/partner are 0.68, for secondary education are 1.00, primary 1.16 and not educated at all have 1.17 odds with only higher education being significant at 0.001. Household size 2-15 had odds of 0.97, 16-30 had odds of 1.01 and 31-44 had the odds of 1.36. Skilled labor had the highest odds of 1.23 at 0.021 significance level. Professional/Technical Managerial/Clerical had the odds of 0.93. Low birth weight and stillbirths both occurred in rural areas rather than urban areas with odds of 1.45 and 1.44 respectively. Caesarean delivery occurred 2.21 time more when the child is born in urban areas with 0.000 level of significance. The odds of LBW in high, middle- and low-income groups are 0.58, 1.26 and 1.90 respectively with high- and low-income groups being significant at 0.002 and 0.001. The odds of occurrence of stillbirths for high, middle- and low-income groups are 0.65, 0.94 and 1.51 respectively with high- and low-income groups being significant at 0.015 and 0.010. The occurrence of caesarean delivery is the highest in high income groups with the odds of 4.11 and significance level of 0.000. There is 1.28 times more occurrence of low birth weight whose husband/partners had higher education. The ones who had primary education had most occurrence of stillbirths at odds of 1.36.

**Table 5. 4 Association of Health Quality with Socioeconomic Status**

| Study Factors | ARI | LBW | Stillbirths | Caesarean Delivery |
|---|---|---|---|---|
| **Area** | | | | |
| Urban[r] | | | | |
| Rural | 1.20 (0.97-1.48) 0.089 | 1.45 (1.04-2.03) 0.030** | 1.44 (1.07-1.94) 0.016** | 0.45 (0.36-0.57) 0.000** |
| **Income** | | | | |
| High Income[r] | | | | |
| Middle Income | 1.01 (0.81-1.25) 0.958 | 1.26 (0.82-1.94) 0.287 | 0.94 (0.61-1.45) 0.782 | 0.86 (0.67-1.10) 0.236 |
| Low Income | 1.34 (1.10-1.64) 0.004** | 1.90 (1.30-2.78) 0.001** | 1.51 (1.10-2.07) 0.010** | 0.23 (0.18-0.29) 0.000** |
| **Education** | | | | |
| Higher[r] | | | | |
| Secondary | 1.00 (0.85-1.19) 0.960 | 0.85 (0.64-1.13) 0.273 | 0.67 (0.50-0.90) 0.007** | 1.62 (1.32-2.00) 0.000 |
| Primary | 1.16 (0.95-1.43) 0.146 | 1.00 (0.63-1.61) 0.987 | 1.3 (0.97-1.10) 0.073 | 0.54 (0.43-0.68) 0.000 |
| Not Educated | 1.17 (0.96-1.42) 0.119 | 0.94 (0.65-1.34) 0.717 | 1.21 (0.92-1.59) 0.173 | 0.34 (0.27-0.42) 0.000 |
| **Household Size** | | | | |
| 2-15 Members[r] | | | | |
| 16-30 Members | 1.01 (0.75-1.37) 0.930 | 0.94 (0.64-1.38) 0.750 | 1.11 (0.74-1.68) 0.603 | 0.87 (0.59-1.29) 0.499 |
| 31-44 Members | 1.36 (0.78-2.39) 0.276 | 0.86 (0.24-3.11) 0.812 | 1.59 (0.74-3.39) 0.233 | 0.63 (0.21-1.92) 0.416 |
| **Employment Status** | | | | |
| Professional/Technical Managerial/Clerical[r] | | | | |
| Sales/Services | 1.12 (0.93-1.35) 0.235 | 0.82 (0.56-1.19) 0.292 | 0.10 (0.63-1.26) 0.529 | 1.17 (0.94-1.46) 0.149 |
| Skilled Labor | 1.23 (1.03-1.47) 0.021 | 1.10 (0.71-1.59) 0.781 | 1.16 (0.81-1.66) 0.416 | 1.12 (0.88-1.42) 0.349 |
| Unskilled Labor | 0.95 (0.77-1.17) 0.614 | 1.01 (0.72-1.42) 0.945 | 1.15 (0.84-1.58) 0.391 | 0.65 (0.50-0.84) 0.001 |
| Agricultural Work | 0.80 (0.63-1.02) 0.069 | 0.84 (0.43-1.65) 0.613 | 0.94 (0.65-1.37) 0.751 | 0.56 (0.42-0.76) 0.000 |

** significance level at 5%

[r] reference category

Caesarean delivery occurred most in high education groups with odds of 2.50 at 0.000. The odds of low birth weight are 1.07 time more if the household had 2-15 members, 0.94 at 16-30 members and 0.812 at 31-44 members with no significant results. The odds of occurrence of stillbirths is 0.88 for 2-15 members, 1.11 for 16-30 members and 1.59 for 31-44 members. Caesarean delivery odds are 1.16, 0.87 and 0.63 for 2-15, 16-30 and 31-44 members respectively with all the results being significant at <0.05. The lowest occurrence of low birth weight is recorded for sales/services sector with odds of 0.82 and the highest is recorded for Professional/Technical Managerial/Clerical work with the odds of 1.16. None of the results are significant. Skilled labor recorded the highest occurrence of stillbirths at the odds of 1.16 and lowest at 0.82 odds for clerical, managerial, technical, professional workers. None of the results showed any significance. The odds of occurrence of caesarean delivery are 2.36 times higher for those whose husbands/partners worked as clerical, managerial, technical, professional positions with 0.000 level of significance. The odds are 1.17 for sales/services, 1.12 for skilled labor, 0.65 for unskilled labor and 0.56 for agricultural work. Unskilled labor is significant at 0.001 and agricultural work is significant at 0.000. Rest of the indicators are insignificant. Neonatal, post-neonatal, child and under-five mortality have less odds of occurrence in urban areas while increased odds of occurrence in rural areas with 1.21 for neonatal, 1.46 for post-neonatal, 1.86 for child mortality and 1.33 for under-five mortality. Only total under-five mortality is significant at 0.036 for both urban and rural areas. The high-income level has less odds of occurrence of all four mortalities with the odds ratio of 0.68, 0.59, 0.41 and 0.62 for neonatal, post-neonatal, child and under-five mortality respectively.

**Table 5. 5 Association of Health Quality with Socioeconomic Status**

| Exposure Variables | Neonatal Mortality | Post-Neonatal Mortality | Child Mortality | Under-Five Mortality |
|---|---|---|---|---|
| **Area** | | | | |
| Urban[r] | | | | |
| Rural | 1.21(0.86-1.68) 0.269 | 1.46 (0.93-2.29) 0.101 | 1.86 (0.77-4.51) 0.169 | 1.33 (1.02-1.74) 0.036** |
| **Income** | | | | |
| High Income[r] | | | | |
| Middle Income | 0.90 (0.69-1.39) 0.98 | 0.68 (0.38-1.22) 0.190 | 1.39 (0.63-3.08) 0.418 | 0.92 (0.70-1.21) 0.560 |
| Low Income | 1.43 (1.05-1.95) 0.022** | 1.99 (1.27-3.12) 0.003** | 1.59 (0.73-3.43) 0.242 | 1.61 (1.27-2.04) 0.000** |
| **Education** | | | | |
| Higher[r] | | | | |
| Secondary | 1.07 (0.80-1.42) 0.650 | 0.89 (0.57-1.38) 0.595 | 0.74 (0.30-1.77) 0.492 | 0.98 (0.78-1.23) 0.862 |
| Primary | 1.23 (0.82-1.85) 0.306 | 1.73 (1.07-2.81) 0.027** | 0.84 (0.30-2.35) 0.732 | 1.34 (1.00-1.78) 0.049 |
| Not Educated | 0.75 (0.56-0.99) 0.043** | 0.89 (0.52-1.52) 0.675 | 1.57 (0.65-3.74) 0.313 | 0.85 (0.67-1.06) 0.148 |
| **Household Size** | | | | |
| 2-15 Members[r] | | | | |
| 16-30 Members | 0.87 (0.54-1.43) 0.590 | 2.67 (1.60-4.47) 0.000** | 2.19 (0.78-6.15) 0.138 | 1.46 (1.02-2.10) 0.038** |
| 31-44 Members | - | 0.35 (0.46-2.74) 0.319** | 0.96 (0.12-7.67) 0.965 | 0.18 (0.04-0.77) 0.021** |
| **Employment Status** | | | | |
| Professional/Technical/Managerial/Clerical[r] | | | | |
| Sales/Services | 0.97 (0.70-1.36) 0.879 | 1.51 (0.91-2.51) 0.107 | 0.43 (0.16-1.17) 0.099 | 1.05 (0.81-1.37) 0.704 |
| Skilled Labor | 0.80 (0.57-1.12) 0.187 | 0.76 (0.43-1.33) 0.336 | 1.10 (0.45-2.68) 0.827 | 0.81 (0.63-1.05) 0.107 |
| Unskilled Labor | 1.05 (0.77-1.43) 0.749 | 0.70 (0.41-1.20) 0.195 | 0.79 (0.30-2.12) 0.643 | 0.92 (0.72-1.18) 0.519 |
| Agricultural Work | 0.91 (0.60-1.37) 0.643 | 0.98 (0.57-1.68) 0.936 | 2.79 (1.18-6.61) 0.020 | 1.07 (0.79-1.44) 0.666 |

** significance level at 5%

[r] reference category

Low income groups had the highest odds of occurrence of neonatal, post-neonatal, child and under-five mortality with the odds ratio of 1.43, 1.99, 1.59 and 1.61 respectively. All except child mortality are significant at <0.05.

Higher education of husband/partner had the odds of 1.07 neonatal mortality, 0.78 odds of post-neonatal mortality, 0.98 odds of child mortality and 0.98 odds of under-five mortality. Not educated husbands/partners showed 0.75 odds of neonatal mortality, 0.89 odds of post-neonatal mortality, 1.57 odds of child mortality and 0.85 odds of under-five mortality. Secondary education only showed higher odds in neonatal mortality and primary education showed lower odds in only child mortality. The household size of 2-15 showed greater odds in neonatal mortality of 1.20, household size of 1-30 showed the highest odds of occurrence of post-neonatal mortality which is 2.67, child mortality at 2.19 and under-five mortality at 1.46 with only post-neonatal and under-five mortality being significant meaning level of significance <0.05. The household size of 31-44 did not show greater odds of occurrence of neonatal mortality, post-neonatal mortality and under-five mortality where under-five mortality is significant at 0.021. Professional/Technical Managerial/Clerical jobs and unskilled labor had the positive association with neonatal mortality at odds of 1.27 and 1.05 respectively. Professional/Technical Managerial/Clerical and sales/services have positive association with post-neonatal mortality with the odds of 1.20 and 1.51 respectively. Skilled labor and agricultural work had positive association with child mortality with the odds of 1.10 and 2.79 respectively where agricultural work is significant at 0.020. Under-five mortality is positively associated with Professional/Technical Managerial/Clerical jobs, sales/services and agricultural work with the odds of 1.19, 1.05 and 1.07 respectively.

### 5.1.3 Association of Women Empowerment with Health Quality and Household Air Pollution

Table 5.6 shows association of women empowerment with HAP. Polluting fuel (aOR=0.69; 95% CI= 0.55-0.88; P=0.003) is negatively associated with women empowerment and environmental tobacco smoke (aOR=1.01; 95% CI=0.83-1.22; P=0.952) is positively associated with women empowerment after estimating for place of residence, wealth index and education.

**Table 5. 6 Association of Household Air Pollution with Women Empowerment**

| **Study Factors** | **Women Empowerment** | |
|---|---|---|
| | Odds Ratio (95% CI)<br>P-Value | |
| **Polluting Fuel** | 0.63 (0.51-0.77)<br>0.000** | 0.69 (0.55-0.88)<br>0.003** |
| **Environmental Tobacco Smoke** | 0.98 (0.82-1.18)<br>0.856 | 1.01 (0.83-1.22)<br>0.952 |
| **Covariates** | **Without** | **With** |

** significance level at 5%

Due to the presence of women empowerment there is a 31% decrease in polluting fuel and 1% increase in occurrence of ETS.

Table 5.7 shows the association of women empowerment with health quality. ARI (aOR=0.83; 95% CI=0.67-1.03; P=0.085) is negatively associated with women empowerment, after estimating for place of residence, wealth index, kitchen location, breastfeeding status, age of mother, smoking status of mother and sex of child and vaccination status. Neonatal mortality (aOR=0.94; 95% CI=0.65-1.34; P=0.722), post-neonatal mortality (aOR=0.94; 95% CI=0.60-1.47; P=0.790) and total under-five mortality (aOR=0.96; 95% CI=0.74-1.24; P=0.741) are also negatively associated with women empowerment after estimating for place of residence, kitchen location, breastfeeding status, wealth index, sex of child, age of mother and smoking status of mother. Low birth weight, caesarean delivery, stillbirths and child mortality are positively associated with women

empowerment.

**Table 5. 7 Association of Health Quality with Women Empowerment**

| Study Factors | aOdds Ratio (95% CI) | P-Value |
|---|---|---|
| **ARI** | 0.83 (0.67-1.03) | 0.085 |
| **LBW** | 1.10 (0.76-1.57) | 0.630 |
| **CD** | 1.20 (0.72-1.99) | 0.484 |
| **Stillbirths** | 1.00 (0.74-1.37) | 0.979 |
| **Neonatal Mortality** | 0.94 (0.65-1.34) | 0.722 |
| **Post-Neonatal Mortality** | 0.94 (0.60-1.47) | 0.790 |
| **Child Mortality** | 1.12 (0.56-2.25) | 0.753 |
| **Under-Five Mortality** | 0.96 (0.74-1.24) | 0.741 |

Due to the presence of women empowerment there is a 17% decrease in chances of ARI, 10% increase in occurrence of low birth weight, 20% increase in risk of caesarean deliveries, no change in stillbirths, 6% decrease in neonatal mortality and post neonatal mortality, 12% increase in child mortality and 4% decrease in under five mortality.

### 5.1.4 Effect of Education on Women Empowerment

Table 5.8 shows that women empowerment is linked with the magnitude of education of the women. When a woman is not educated, she is 0.63 times not likely to be empowered. The odds of women who are educated till primary are 1.01 times more. Whereas the women who have secondary education have the odds of 1.30 and higher education have the odds of 1.80 of being empowered. If a woman is not educated there is a 37% less chances of her being empowered. A primary educated woman will increase the chances of empowerment by one percent. Secondary educated woman will be 30% more empowered and higher educated woman will be 80% more empowered.

**Table 5. 8 Association of Women Empowerment with Education**

| **Study Factors** | **Women Empowerment** | | |
|---|---|---|---|
| | Odd Ratio | 95% CI | P-Value |
| **Not Educated** | 0.63 | 0.52-0.77 | 0.000** |
| **Primary** | 1.01 | 0.80-1.28 | 0.936 |
| **Secondary** | 1.30 | 1.05-1.60 | 0.017** |
| **Higher** | 1.80 | 1.39-2.33 | 0.000** |

** significance level at 5%

### 5.1.5 Interaction between Polluting fuel and Women Empowerment

The interaction has been estimated for HAP (ETS and Polluting fuel) with women empowerment. If we compare table 5.1 with table 5.9 the results show that when interacted with women empowerment, under-five mortality, post neonatal, neonatal and rate LBW decreased for both ETS and polluting fuel, while caesarean delivery and child mortality decreased for polluting fuel only. In other terms when polluting fuel is interacted with women empowerment there is a 36% increase in ARI, 40% decrease in occurrence of low birth weight, 71% decrease in caesarean delivery, 20% decrease in stillbirths, 12% reduction in neonatal, 9% reduction in post neonatal, 42% reduction in child mortality and 16% reduction in under-five mortality. When ETS is interacted with women empowerment there is a 24% increase in ARI, 23% decrease in occurrence of low birth weight 34% increase in caesarean delivery, 3% decrease in stillbirths, 45% decrease in neonatal mortality, 41% reduction in post neonatal mortality, 6% increase in child mortality and 41% decrease in under five mortality.

**Table 5. 9 Association of Health Quality and HAP with Moderation of Women Empowerment**

| Study Factors | Polluting Fuel | | Environmental Tobacco Smoke | |
|---|---|---|---|---|
| | Women Empowerment | | | |
| | aOdd Ratio (95% CI) | P-Value | aOdd Ratio (95% CI) | P-Value |
| **ARI** | 1.36 (0.75-1.39) | 0.174 | 1.24 (0.81-1.88) | 0.325 |
| **LBW** | 0.60 (0.26-1.39) | 0.233 | 0.77 (0.37-1.63) | 0.495 |
| **Caesarean Delivery** | 0.29 (0.11-0.73) | 0.009** | 1.34 (0.50-3.64) | 0.560 |
| **Stillbirths** | 0.80 (0.47-1.34) | 0.391 | 0.97 (0.54-1.76) | 0.927 |
| **Neonatal Mortality** | 0.88 (0.48-1.59 | 0.667 | 0.55 (0.26-1.17) | 0.122 |
| **Post Neonatal Mortality** | 0.91 (0.33-2.56) | 0.861 | 0.59 (0.24-1.43) | 0.241 |
| **Child Mortality** | 0.58 (0.13-2.61) | 0.477 | 1.06 (0.15-7.59) | 0.953 |
| **Under-Five Mortality** | 0.84 (0.52-1.35) | 0.471 | 0.59 (0.34-1.03) | 0.065 |

## 5.2 Discussion

Using the national data of Pakistan (rural and urban) this study administered the association between HAP and health quality including maternal and child health issues, role of socioeconomic status in fuel choice, ETS, health quality and level of women empowerment. Also, this study will examine the effect of women empowerment determined by decision making on overall health quality.

Our findings prove that almost majority of Pakistan uses polluting fuels and most rural households are exposed to ETS caused by smoking cigarettes and other items.

The results showed that low birth weight (<2500g), ARI (cough with rapid breathing), neonatal mortality (death within 0-28 days), post-neonatal mortality (death from 1-11 months) and total under-five mortality (0-58 months) are associated with use of polluting fuel after estimating for appropriate covariates. The exposure to ETS is associated with low birth weight, ARI and post-neonatal mortality after covariate adjustment. In house kitchen location played a significant role in low birth weight of children. This is because exposure of HAP is high among women because they spend most of their time at home (World Health Organization, 2018). Exposure to passive smoke is also the cause of low birth weight which is consistent with past study of (Mainous & Hueston, 1994). Stillbirth is rather significantly associated with old age of the mother at the time of birth. Caesarean delivery showed no association with HAP rather they were strongly positively associated with history of last birth a c-section. ARI is positively associated with both polluting fuel and ETS. These are significantly associated for those children whose mothers are smokers. Children mostly tend to stay with their mothers that is why they are affected more. Neonatal mortality is positively associated with both exposure variables; polluting fuel and ETS, while only post-neonatal mortality is positively associated with ETS. ARI are the main causes of death of children under-five and between 1.9 million and 2.2 million deaths of children globally (Jamison, Feachem, & Makgoba, 2006). Children whose parents smoked or were exposed to ETS had increased frequency of ARI (Office on Smoking and Health (US), 2006). These results are also consistent with another study by (Naz, Page, & Agho, 2017) that showed associations between HAP, under-five mortality, neonatal mortality and post-neonatal mortality. In Pakistan according to DHS 2017-18, 94.55% children under-five are breastfed at some point of their lives. Breastfeeding makes the child resistant to infections and illnesses like ARI and bronchitis (The Mother and Child Health and Education Trust, 2019). This may be the reason for weak association between HAP and under-five mortality in this study.

Our results showed that there is a decrease in the occurrence of under-five mortality, post neonatal, neonatal and rate LBW decreased for both ETS and polluting fuel, while caesarean delivery and child mortality decreased for polluting fuel only This might be the case due to good nutritional status of children of empowered women, a study conducted in Pakistan showed (Shafiq, et al., 2019).

In this study the socioeconomic status is classified by area (urban and rural), wealth (high, middle and low income), education of husband/partner (higher, secondary, primary and no education), household size (2-15, 16-30 and 31-44 members) and lastly husband's occupation (managerial, professional, clerical, technical services, sales, skilled labor, unskilled labor and agricultural work). Rural area showed an increase in ARI, LBW, stillbirths, neonatal, post neonatal, child and under-five mortality except caesarean delivery which had a higher chance of happening in urban area. This correlates with the previous study which states that women who live in urban areas are have twofold more chances to deliver by caesarean section than women who live in rural areas (Loenzien, Schantz, Luu, & Dumont, 2019). The occurrence of LBW, ARI, stillbirths increases as the income increases from low to high. Similarly, the occurrence of neonatal, post-neonatal, child and under-five mortality also decrease with an increase in income level. On the other hand, the occurrence of caesarean delivery decreases as the income decreases. Higher income level has four times more chance of delivering the baby by a caesarean section. ARI decreases with an increase in father's education. Higher education had the lowest odds of occurrence of ARI in children. The occurrence of caesarean delivery increased as the education of husband/partner increased. LBW, stillbirths and all under-five mortalities showed inconsistent results for husband/partner's education. ARI and stillbirths increased as the size of the household increased. Only the occurrence of caesarean delivery increased with the husband/partner better occupation. Rest of the health quality indicators showed inconsistent results Income and wealth support good health because with more income people can afford resources that lead to good health (Center on Society and Health, 2015). Rural region is significant for low birth weight, stillbirths and under-five mortality. Rural areas lack the access to health care services including shortage of healthcare workers and hospitals (Weisgrau, 1995). Lastly, no education factor is significant for low birth weight, neonatal mortality, post-neonatal mortality, child mortality and under-five mortality. It is consistent with a study which states that health and preventive service use is related with education (Feinstein, Sabates, Anderson, Sorhaindo, & Hammond, 2006).

Exposure to ETS increased with the presence of all the poor socioeconomic factors i.e. rural area, low income of the household, secondary, primary and no education of husband/partner, household size ranging from 16-30 and 31-44 and agricultural work of husband/partner. The exposure to ETS tends to be high on families with low socioeconomic status (Ong, et al., 2017). The choice of polluting fuel occurred in low socioeconomic status households with rural area locality, low income, primary and no education of husband/partner, unskilled labor and agricultural work of husband/partner. This finding is consistent with previous studies which stated that socioeconomic status influences the fuel choices of the households (Nasir, Murtaza, & Colbeck, 2015). Women empowerment tend to exist in the households with good socioeconomic status i.e. urban area of the house, high income of the household, higher and primary education of the husband, household size of 2-15, professional/technical/managerial/clerical, skilled labor and unskilled labor occupation of the husband/partner. It is also shown that wealth index of the household has a positive impact on the women empowerment (Akram, 2017). Women are more likely to be empowered in urban areas (Khalid, Samargandi, Shah, & Almandeel, 2019).

The effect of a women's education has also been examined in this study. It is clearly recognized that as women's education increases its magnitude of empowerment and say in decision making also increases. Empowerment is relatively is influenced by the educational qualification of the women (Sundaram, Sekar, & Subburaj, 2015). The association of women empowerment with health quality and HAP has also been investigated in this study. It has been found out that women empowerment is negatively associated with fuel choice meaning that empowered women make cleaner fuel choices. But women empowerment did not help with the reduction of exposure to ETS. The results also indicate that the odds of ARI post neonatal and neonatal and total under five mortality decrease where the women are empowered. This might be the case due to good nutritional status of children of empowered women, a study conducted in Pakistan showed (Shafiq, et al., 2019). The results are also deduced after creating an interaction of HAP indicators (polluting fuel and ETS) and women empowerment. The results showed that when polluting fuel is interacted with women empowerment it decreases the odds of occurrence of caesarean delivery, low birth weight, stillbirths, under five, child, post neonatal and neonatal mortality except ARI. Also, it deduced that when ETS is interacted with women empowerment it decreases the odds of LBW, stillbirths, under five, post neonatal and neonatal mortality. This means that women empowerment plays an important role in increasing the health quality even if HAP exists.

# Chapter 6

# Conclusion and Policy Implication

## 6.1 Conclusion

Polluting fuel choices for cooking and exposure to ETS has shown various adverse birth outcomes, maternal health complications and child health and mortality issues mostly increasing post neonatal mortality. Similarly, poor socioeconomic conditions of the households especially residence in rural areas also contribute towards poor health quality, low women empowerment. Poor socioeconomic conditions can also influence the fuel choices to be polluting. Husband/partner's education level also has a significant effect on the women empowerment. Women living in urban areas are more empowered than women living in rural areas and women residing in agricultural households tend to be the least empowered group of women according to the study. The study showed that these adverse health effects can be mitigated through women empowerment. Health quality can be improved through women empowerment channels even if HAP exists. Empowerment is related with education of women. More educated women are more empowered. The socioeconomic status like area and household income can also influence women empowerment.

## 6.2 Policy Implications

The health quality and fuel choices can be made cleaner through educating and giving awareness to women of the households. Pakistan is a third world country with limited resources. Spreading awareness about how to manage different illnesses and opting cleaner fuel choices will be optimal as Pakistan lacks resources to provide clean fuel all around the country. Breastfeeding has shown to eliminate various risks of under-five mortality and ARI. Awareness regarding the benefits of breastfeeding the child can be given to mother to overcome certain illnesses. Initiatives should be taken to promote biogas for cooking and heating purposes.The ETS from smoking cigarettes, pipe etc. is found to be present in rural areas and in low income households. The taxation on tobacco will not be effective because people of low-income households still seem to smoke tobacco despite being low on income. Tobacco awareness campaigns in such areas can help with decreasing the exposure towards ETS because as this study shows women empowerment cannot seem to curb this exposure.

### 6.3 Limitations of the Study

Various limits of this study can be taken into consideration when interpreting the results. The estimated odds ratio of the health quality is small and can be easily influenced by missing covariates. Other indicators that haven't been considered in this study can be contributors of health quality. Other variables which can empower the women could be missing in this study. Other potential covariates of caesarean delivery, stillbirths, ARI, low birth weight and under five mortality are missing like main cause of death, obstetric history of mother, birth defects, blood pressure monitoring etc. which is not recorded in PDHS 2017-18. Exposure from cooking fuel is not measured but taken from the use of cooking fuel type. Also, fuel used for heating and lighting purposes is not mentioned in the study. Total time spent cooking is not measured as it can increase or decrease exposure to HAP. For ETS, the number of household members are not considered which could increase or decrease the exposure level.  Only one type of fuel choice is measured but it is a possibility that mixed fuels are used for cooking and heating purposes.

# References


Abebe, F. E., Gebeyehu, A. W., Kidane, A. N., & Eyassu, G. A. (2015). Factors leading to cesarean section delivery at Felegehiwot referral hospital, Northwest Ethiopia: a retrospective record review. *Reproductive Health, 13*, 6. doi:10.1186/s12978-015-0114-8

Ahmed, J., Alam, A., & Raynes-Greenow, C. (2018). Maternal empowerment and healthcare access determines stillbirths and earlyneonatal mortality in Pakistan: analysis ofdemographic and health survey 2012-13. *Journal of Global Health Reports, 2*. doi:10.29392/joghr.2.e2018030

Akram, N. (2017). Women's Empowerment in Pakistan: Its Dimensions and Determinants. *Social Indicators Research*. doi:10.1007/s11205-017-1793-z

Allendorf, K. (2007, November). Do Women's Land Rights Promote Empowerment and Child Health in Nepal? *World Development, 35*(11), 1975-1988. doi:10.1016/j.worlddev.2006.12.005

Amegah, A. K., Quansah, R., & Jaakkola, J. J. (2014). Household Air Pollution from Solid Fuel Use and Risk of Adverse Pregnancy Outcomes: A Systematic Review and Meta-Analysis of the Empirical Evidence. *PLoS ONE, 9*(12).

APA. (2020, June 17). *Socioeconomic Status*. Retrieved from American Psychological Association: https://www.apa.org/topics/socioeconomic-status/

Apte, K., & Salvi, S. (2016). Household air pollution and its effects on health. *F1000Research, 5*. doi:10.12688/f1000research.7552.1

Arpey, N. C., Gaglioti, A. H., & Rosenbaum, M. E. (2017). How Socioeconomic Status Affects Patient Perceptions of Health Care: A Qualitative Study. *Journal of*

*Primary Care and Community Health*, 169-175. doi:https://doi.org/10.1177/2150131917697439

Arth, Broadwin, & Lam. (2009).

Austin, K. F., & Mejia, M. T. (2017). Household air pollution as a silent killer: women's status and solid fuel use in developing nations. *Population and Environment*.

Bruce, N. G., & Dherani, M. K. (2013). Control of household air pollution for child survival: estimates for intervention impacts. *BMC Public Health*.

Bruce, N., Perez-Padilla, R., & Albalak, R. (2000). Indoor air pollution in developing countries: a major environmental and public health challenge. *Bulletin of the World Health Organization, 78*(9).

Bushra, A., & Wajiha, N. (2015). Assessing the Socio-Economic Determinants of Women Empowerment in Pakistan. *Procedia - Social and Behavioral Sciences, 177*, 3-8. doi:10.1016/j.sbspro.2015.02.321

Cakmak, S., Hebbern, C., Cakmak, J. D., & Vanos, J. (2016). The Modifying Effect of Socioeconomic Status on the Relationship Between Traffic, Air Pollution and Respiratory Health in Elementary Schoolchildren. *Journal of Environmental Management, 177*, 1-8. doi:10.1016/j.jenvman.2016.03.051

Center on Society and Health. (2015). *How Are Income and Wealth Linked to Health and Longevity?* Virginia: Urban Institute.

Chang, V. W., & Lauderdale, D. S. (2009). Fundamental Cause Theory, Technological Innovation, and Health Disparities: The Case of Cholesterol in the Era of Statins. *Journal of Health and Social Behaviour*, 245–260.

Colbeck, I., Nasir, Z. A., Hasnain, S., & Sultan, S. (2007).

Colbeck, I., Nasir, Z. A., Hasnain, S., & Sultan, S. (2007). Indoor Air Quality at Rural and Urban Sites in Pakistan. *Water, Air and Soil Pollution, 8*, 61-69. doi:10.1007/s11267-007-9139-5

Cox, D. R. (1972). Regression Models and Life-Tables. *Journal of the Royal Statistical Society. Series B, 34*(2), 187-220.

dhs. (n.d.).

(2018). *DHS.* Maryland: DHS.

Doku, D. T., Bhutta, Z. A., & Neupane, S. (2020). Associations of women's empowerment with neonatal, infant and under-5 mortality in low- and /middle-income countries: meta-analysis of individual participant data from 59 countries. *BMJ Global Health, 5*.

Edwards, J. H., & Langpap, C. (2009). Fuel choice, indoor air pollution and children's health. *Environment and Development Economics, 7*(4).

EMRO, W. (2020). *Environmental Health.* WHO.

EPA. (2018, May 8). *Indoor Air Quality*. Retrieved from epa.gov: https://www.epa.gov/indoor-air-quality-iaq/pesticides-impact-indoor-air-quality

Feinstein, L., Sabates, R., Anderson, T. M., Sorhaindo, A., & Hammond, C. (2006). *What are the effects of education on health?* . Copenhagen: OECD.

Franklin, P., Tan, M., Hemy, N., & Hall, G. L. (2019). Maternal Exposure to Indoor Air Pollution and birth outcomes. *International Journal of Environmental Research and Public Health*.

Gordon, S. B. (2014). Respiratory risks from household air pollution in low and middle income countries. *The Lancet Respiratory Medicine Commission*, 823-60.

Gosh, J. C., Wilhelm, M., & Ritz, B. (2013). Effects of Residential Indoor Air Quality and Household Ventilation on Preterm Birth and Term Low Birth Weight in Los Angeles County, California. *American Journal of Public Health, 103*(4).

Grossman, M. (1972). On the Concept of Health Capital and Demand for Health. *Journal of Political Economy*, 223-255.

Harrington, W., & Portney, P. (1987). Valuing the benefits of health and safety regulations. *Journal of Urban Economics, 22*, 101–112.

Jamison, D., Feachem, R., & Makgoba, M. (2006). Acute Respiratory Infections. In *Disease and Mortality in Sub-Saharan Africa* (2nd ed.). Washington (D.C).

Jiao, K., Xu, M., & Liu, M. (2018). Health status and air pollution related socioeconomic concerns in urban China. *International Journal of Equity Health*, 17. doi:https://doi.org/10.1186/s12939-018-0719-y

Khalid, M. W., Samargandi, N., Shah, A. H., & Almandeel, S. (2019). International Economic Journal. *Socio-Economic Factors and Women's Empowerment: Evidence from Punjab, Pakistan*. doi:10.1080/10168737.2019.1677742

Khan, M. N., Nurs, C. Z., Islam, M. M., & Rahman, M. M. (2017). Household air pollution from cooking and risk of adverse health and birth outcomes in Bangladesh: a nationwide population-based study. *Environmental Health*.

Khan, M. S., & Lohano, H. D. (2018). Household air pollution from cooking fuel and respiratory health risks for children in Pakistan. *Environmental Science and Pollution Research, 25*(25), 24778-24786.

Kim, K.-H., Jahan, S. A., & Kabir, E. (2011). A review of diseases associated with household air pollution due to the use of biomass fuels. *Journal of Hazardous Materials*, 425-431.

Kumar, S., & Sahu, D. (2019). Socio-economic, Demographic and Environmental Factors Effects on Under-Five Mortality in Empowered Action Group States of India: An Evidence from NFHS-4. *Public Health Research*, *9*(2), 23-29. doi:10.5923/j.phr.20190902.01

Lakshmi, P., Virdi, N. K., Sharma, A., Tripathy, J. P., Smith, K. R., Bates, M. N., & Kumar, R. (2013). Household air pollution and stillbirths in India: Analysis of the DLHS-II National Survey. *Environmental Research* , 17-22.

Link, B. G., & Phelan, J. C. (1995). Social Conditions as Fundamental Causes of Disease. *Journal of Health and Social Behaviour*, 80-94.

Loenzien, M. d., Schantz, C., Luu, B. N., & Dumont, A. (2019). Magnitude and correlates of caesarean section in urban and rural areas: A multivariate study in Vietnam. *PLoS One*, *14*(7). doi:10.1371/journal.pone.0213129

Mainous, A. 3., & Hueston, W. (1994). Passive smoke and low birth weight: evidence of a threshold effect. *Archives of Family Medicine, 3*(10), 875–8.

Mishra, V., Smith, K. R., & Retherford, R. D. (2005). Effects of Cooking Smoke and Environmental Tobacco Smoke on Acute Respiratory Infections in Young Indian Children. *Population and Environment*, *26*(5). doi:DOI: 10.1007/s11111-005-0005-y

Nandasena, S., Wickremasinghe, A. R., & Sathiakumar, N. (2012). Respiratory health status of children from two different air pollution exposure settings of Sri Lanka:

A cross- sectional study. *American Journal of Industrial Medicine, 55*(12), 1137-1145. doi:10.1002/ajim.22020

Nasir, Z. A., Murtaza, F., & Colbeck, I. (2015). Role of poverty in fuel choice and exposure to indoor air pollution in Pakistan. *Journal of Integrative Environmental Sciences, 12*(2), 107-117. doi:10.1080/1943815X.2015.1005105

Nasir, Z. A., Murtaza, F., & Colbeck, I. (2015). Role of poverty in fuel choice and exposure to indoor air pollution in Pakistan. *Journal of Integrative Environmental Sciences, 12*(2), 107-117. doi:10.1080/1943815X.2015.1005105

Naz, S., & Page, A. A. (2015). Household Air Pollution and Under-Five Mortality in Bangladesh (2004–2011). *International journal of environmental research and public health*, *12*(10), 12847–12862. doi:10.3390/ijerph121012847

Naz, S., & Page, A. A. (2016). Household air pollution and under-five mortality in India (1992–2006). *Environmental health: A global access science source, 15,* 54. doi:10.1186/s12940-016-0138-8

Naz, S., Page, A., & Agho, K. (2017). Potential Impacts of Modifiable Behavioral and Environmental Exposures on Reducing Burden of Under-five Mortality Associated with Household Air Pollution in Nepal. *Maternal and Child Health Journal, 22*. doi:10.1007/s10995-017-2355-3

Naz, S., Page, A., & Agho, K. E. (2017). Household air pollution from use of cooking fuel and under-five mortality: The role of breastfeeding status and kitchen location in Pakistan. *PLoS One, 12*(3). doi:10.1371/JOURNAL.PONE.0173256

Naz, S., Page, A., & Agho, K. E. (2017). Potential Impacts of Modifiable Behavioral and Environmental Exposures on Reducing Burden of Under-five Mortality

Associated with Household Air Pollution in Nepal. *Maternal and Child Health Journal*.

Naz, S., Page, A., & Emwinyore, A. K. (2017). Household air pollution from use of cooking fuel and under-five mortality: The role of breastfeeding status and kitchen location in Pakistan. *PLoS ONE, 12*(3). doi:10.1371/journal.pone.0173256

NIPS & ICF. (2019). *Pakistan Demographic and Health Survey 2017-18.* Islamabad, Pakistan, and Rockville, Maryland, USA: NIPS and ICF: DHS.

Nisha, M. K., Alam, A., & Greenow, C. R. (2018). Variations in perinatal mortality associated with different polluting fuel types and kitchen location in Bangladesh. *International Journal of Occupational and Environmental Health, 24*(1-2), 47-54. doi:10.1080/10773525.2018.1507868

OECD. (1997). *Glossary of Statistical Terms*. Retrieved June 11, 2020, from https://stats.oecd.org/glossary/detail.asp?ID=1336

Office on Smoking and Health (US). (2006). *The Health Consequences of Involuntary Exposure to Tobacco Smoke: A Report of the Surgeon General.* Atlanta (GA): Centers for Disease Control and Prevention (US).

Ong, T., Schechter, M., Yang, J., Peng, L., Emerson, J., Gibson, R. L., . . . Rosenfeld, M. (2017, February 1). Socioeconomic Status, Smoke Exposure, and Health Outcomes in Young Children With Cystic Fibrosis. *The Official Journal of American Academy of Pediatrics, 139*(2). doi:doi.org/10.1542/peds.2016-2730

Pambe, M. W., Gnoumou, B., & Kaboré, I. (2013, August). Relationship between Women’s Socioeconomic Status and Empowerment in Burkina Faso:. Calverton, Maryland, USA.

Pandey, S., & Yuan, L. (2012). Adjusted Effects of Domestic Violence, Tobacco use, and Indoor Air Pollution from Use of Solid Fuel on Child Mortality. *Maternal and Child Health Journal*.

*Pesticides Impact Indoor Air Quality*. (n.d.). Retrieved January 20, 2020, from EPA: https://www.epa.gov/indoor-air-quality-iaq/pesticides-impact-indoor-air-quality

Po, J. Y., FitzGerald, J. M., & Carlsten, C. (2011). Respiratory disease associated with solid biomass fuel exposure in rural women and children: systematic review and meta-analysis. *Thorax*, 232-239.

Pope, D. P., Mishra, V., Thompson, L., Siddiqui, A. R., Rehfuess, E. A., Weber, M., & Bruce, N. G. (2010). Risk of Low Birth Weight and Stillbirth Associated With Indoor Air Pollution From Solid Fuel Use In Developing Countries. *Epidemiologic Reviews, 32*.

Rana, J., Uddin, J., Peltier, R., & Oulhote, Y. (2019). Associations between Indoor Air Pollution and Acute Respiratory Infections among Under-Five Children in Afghanistan: Do SES and Sex Matter? *International Journal of Environmental Research and Public Health*.

Raspanti, G. A., Hashibe, M., Siwakoti, B., Wei, M., Thakur, B. K., Pun, C. B., . . . Sapkota, A. (2016). Household air pollution and lung cancer risk among never-smokers in Nepal. *Environmental Research, 147*, 141-145. doi:10.1016/J.ENVRES.2016.02.008

Ritchie, H., & Roser, M. (2020). Indoor Air Pollution. Retrieved January 20, 2020, from https://ourworldindata.org/indoor-air-pollution

Sado, L., Spaho, A., & Hotchkiss, D. R. (2014). The influence of women's empowerment on maternal health care utilization: evidence from Albania. *Social science & medicine*, *114*, 169–177. doi:10.1016/j.socscimed.2014.05.047

Sepehri, A., & Guliani, H. (2015). Socioeconomic status and children's health: evidence from a low-income country. *Social Science and Medicine*, *130*, 23-31. doi:10.1016/j.socscimed.2015.01.045

Shafiq, A., Hussain, A., Asif, M., Hwang, J., Jameel, A., & Kanwel, S. (2019). The Effect of Women Empowerment on Child Nutritional Status in Pakistan. *International Journal of Environmental Research and Public Health*.

Shafiq, A., Hussain, A., Asif, M., Hwang, J., Jameel, A., & Kanwel, S. (2019). The Effect of "Women's Empowerment" on Child Nutritional Status in Pakistan. *International Journal of Environmental Research and Public Health*, *16*, 4499. doi:doi:10.3390/ijerph16224499

Singh, K., Bloom, S., & Brodish, P. (2015). Gender Equality as a Means to Improve Maternal and Child Health in Africa. *Health Care for Women International*, *36*(1), 57-69. doi:10.1080/07399332.2013.824971

Smith, K. R., Samet, J. M., Romieu, I., & Bruce, N. (2000). Indoor air pollution in developing countries and acute lower respiratory infections in children. *Thorax*, 518-532.

Sundaram, M. S., Sekar, M., & Subburaj, A. (2015). Women Empowerment: Role of Education. *International Journal in Management and Social Science, 2*(12), 76-85.

The Mother and Child Health and Education Trust. (2019, September 14). *Benefits of Breastfeeding.* Retrieved from motherchildnutrition.org: https://motherchildnutrition.org/healthy-nutrition/about-essential-nutrition-actions/benefits-of-breastfeeding.html#:~:text=Compared%20with%20formula-fed%20children,Increased%20resistance%20to%20infections.

United Nations. (2002). Agreed Conclusions on eradicating poverty, including through the empowerment of women throughout their life cycle, in a globalising world. *UN Commission on the Status of Women.*

Van Dijk, J. A., Anderko, L., & Stetzer, F. (2011). The Impact of Prenatal Care Coordination on Birth Outcomes. *JOGNN, 40*, 98-108. doi:DOI: 10.1111/j.1552-6909.2010.01206.x

Wang, X., Ding, H., Rayn, L., & Xu, X. (1997). Association between air pollution and low birth weight: a community-based study. *Environmental health perspectives, 105*(5), 514–520. doi:10.1289/ehp.97105514

Weisgrau, S. (1995). Issues in Rural Health: Access, Hospitals, and Reform. *Healthcare Financing Review, 17*(1), 1-14.

Whitlock, G., S, M., Hoorn, S. V., P, D., R, J., & Norton, R. (1998). Association of environmental tobacco smoke exposure with socioeconomic status in a population of 7725 New Zealanders. *Tobacco control, 7*(3), 276–280. doi:10.1136/tc.7.3.276

WHO. (2018). *Household Air Pollution and Health.* Geneva. Retrieved from https://www.who.int/en/news-room/fact-sheets/detail/household-air-pollution-and-health

WHO. (2020, June 11). *who.int air pollution*. Retrieved from who.int: https://www.who.int/airpollution/household/pollutants/en/

World Health Organization. (2018, May). *Household Air Pollution*. Retrieved from World Health Organization: https://www.who.int/news-room/fact-sheets/detail/household-air-pollution-and-health