Gender inequities in health care utilisation for common infections children under-5 in India

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Declaration

I, Luciana Brondi, declare that this doctoral thesis is entirely my own work and has not been submitted for any other degree or qualification.

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Dedication

To my daughters Mariana and Daisy, and to all girls in South Asia.

Abstract

Common infectious diseases like pneumonia, diarrhoea and malaria, are the leading causes of mortality in young children aged below 5 years, especially in low and middle-income countries (LMICs). Globally, India is the country with the largest number of children under five years old (U5) and the largest number of deaths in this age group and where diarrhoea is the second biggest killer of children. Immunisations, medical treatment and hospital care are some of the available life-saving interventions for children affected by these three common infectious diseases. Nonetheless, not all children benefit equally from these interventions.

In South Asia and in India, gender-based discrimination leads to differences in health outcomes and healthcare access, especially among young children. The estimated excess mortality of young girls (compared to young boys) in India reaches an average of 239,000 excess deaths every year. However, the current body of evidence showing gender-based inequities affecting health care utilisation in the region is less compelling. Furthermore, there is a scarcity of empirical research using nationally representative data and taking into account the theoretical basis of determinants of health care seeking behaviours for children.

This thesis aimed to estimate the effect of gender and other determinants on health care seeking for common infections in young children in India, especially in the case of diarrhoea.

A systematic review of the literature was conducted looking at gender inequalities in hospital admissions and care seeking for common infections in children from South Asia. The results showed that for acute lower respiratory infections - ALRI (predominantly pneumonia) - most of the studies reported significantly higher rates of hospital admissions for boys compared to girls. Although a much smaller number of studies for diarrhoea were selected, the studies from South Asia also reported a higher incidence rate ratio of admissions for boys compared to girls. Of the three studies, which reported in-hospital case fatality ratios for diarrhoea, girls were

almost twice as likely to die when compared to boys (pooled Odds Ratio 1.81 (95% CI 1.55-2.11)). For care seeking behaviours, most studies reported a lower likelihood of girls receiving treatment for common infections compared to boys. Similarly, nearly all of the studies on nutrition and immunisation reported better nutrition outcomes and vaccination coverage for boys compared to girls.

Building on the results from this literature review, and drawing on theoretical concepts from the social sciences, a conceptual framework was developed. An interdisciplinary approach integrating intersectional, ecosocial and epidemiological perspectives was used to allow for the improvement of interpretation of findings.

A quantitative analysis of care seeking behaviours for young children with diarrhoea was conducted, using data from the two recent rounds of large-scale demographic health surveys in India - National Family Health Survey (NFHS-3 and NFHS-4). In the analysis of the NFHS-3 (2005-06), the combined effect of gender and wealth on care seeking for diarrhoea was assessed using a multivariable logistic regression model adjusting for other potential effect modifiers. A lower prevalence of care seeking outside the home for diarrhoea was significantly associated with being a girl (Adjusted Odds Ratio, 0.84 (95% CI, 0.72-0.99)), or belonging to a poorer family (P values varying from 0.024 richer versus richest to <0.001 poorest vs. richest). A further analysis using a heuristic model informed by intersectionality, combined sex and economic class into ten different categories. The results of this further analysis suggest that, in terms of care seeking, boys tend to be less affected by the lower economic status of the household when compared to girls.

Subsequently, data from NFHS-4 (2015-16) were analysed and nine different types of care seeking behaviours for diarrhoea were explored, including type of treatment, place where care was sought, delay in seeking care and *level and cost* of care sought. Coverage for all of these care seeking behaviours for girls and boys were estimated and compared. For most of these care seeking behaviours, carers were more likely to pursue care and treatment for diarrhoea for boys than girls. Apart from gender, the other potential determinants of care seeking behaviours analysed were age, place of residence(rural/urban), number of siblings, social class (i.e. wealth quintile), mother's education level, religion, belonging to a scheduled caste or tribe & backward class, region of residence and distance to nearest health care facility. A bivariate logistic regression analysis was conducted looking at sex and other determinants and the use of the *costliest type of care* available for diarrhoea (i.e., outpatient consultation in a private hospital/doctor/clinic). When compared to other types of care available, boys more often than girls received the costliest type of care. The adjusted results showed that girls in India are on average 16% less likely to receive the costliest type of care for diarrhoea when compared to boys (Odds Ratio 0.86 (95%CI 0.78–0.94)). Infants (children younger than 1-year-old), were also more likely to receive the costliest type of care available (Adjusted OR 0.78 (95%CI 0.71–0.86)). Other important and statistically significant determinants of the use of costly care were *wealth index,* with children in the poorest quintile being the ones less likely to get costly care (OR 0.33 ((95%CI 0.23 (0.18–0.30)) and the *mother's level of education*. Similarly, the analysis revealed a clear regional pattern with a contrast between the group of four most populous High Focus States (i.e., Bihar, Madhya Pradesh, Rajasthan, Uttar Pradesh.), and other states in India. For example, the effect of gender and mothers' level of education on use of the *costliest type of care* for diarrhoea remains significant when the four states of Bihar, Madhya Pradesh, Rajasthan, Uttar Pradesh are analysed as a separate group. However, the analysis of the remaining states did not show the same effects of gender and mothers' level of education on care seeking.

This study reveals important differences in care seeking behaviours for diarrhoea among children in India. These differences were largely driven by gender, age, socio economic class, mothers' level of education and region. The results highlight the importance of gender and its relationship with social class and geography in child health in India. It also reveals a regional pattern in the determinants of child health care seeking.

Policy initiatives targeting equity in access to health care should utilize intersectionality-informed analysis, considering the combined impact of gender with other axes of marginalisation and systems of social oppression, operating at different levels. Clarifying the pathways in which gender affects girl's health in South Asia, as a whole, and India in particular, is a crucial step in the efforts to promote equity in health for all children.

Lay Summary

Infectious diseases like pneumonia, diarrhoea and malaria are leading causes of death in young children (i.e. under 5 years of age) globally. In some developing countries, for example, in India, diarrhoea is the second biggest killer of children aged 1 to 5 years old. Only in 2015, over 112,000 children under 5 died due to diarrhoea in India. Fortunately, some life-saving interventions like vaccination, medical treatment and hospital care can reduce the number of infectious diseases deaths in young children. However, not all children have access to these life-saving interventions. In India, discrimination against women and girls means that girls are less likely to access life-saving treatment for diarrhoea and other infectious diseases when compared to boys.

This research aimed to find out if boys and girls in India were as likely as each other to receive life-saving treatment for infectious diseases. It also compared at different groups of Indian children (e.g. poor compared rich, rural compared urban) to find out who were the children less likely receive treatment for infectious diseases, especially in the case of diarrhoea. This research used data from previous studies conducted in South Asia and from two national surveys conducted in people's homes asking questions about children's health.

The main results showed that girls tended to have less access to several different types of treatment for infectious diseases. It also showed that boys were more likely to receive the costliest type of medical treatment for diarrhoea when compared to girls. Similarly, poorer children, children of less educated mothers, older children and children from four specific Northern states in India were less likely to benefit from treatment for diarrhoea. For example, the richest children were three times more likely to receive the costliest type of treatment when compared to the poorest children. Similarly, girls in the poorer economic classes were less likely to receive quality treatment when compared to boys in the same classes. In the four highly populous Northern states of Bihar, Madhya Pradesh, Rajasthan, Uttar Pradesh, girls were much less likely than boys to receive costly care for diarrhoea

compared to the rest of India. National and international governments and health agencies should consider these results in the future when trying to promote the health of children in India.

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Glossary and acronyms

ALRI	Acute Lower Respiratory Infections
ARI	Acute Respiratory Infections
Child mortality	Probability of dying between exact ages 1 and 5 years.
DHS	Demographic Health Survey, these are nationally-representative household surveys that provide data for a wide range of monitoring and impact evaluation indicators in the areas of population, health, and nutrition.
IDHS	The Indian Demographic and Health Survey (DHS) , also known in India as the National Family Health Survey (NFHS)
DHLS	District Level Household and Facility Survey. A nationwide survey covering the states and union territories of India, including district level. It is funded and supported by both the Indian Government and international agencies.
DHS Program	The **DHS** Program assists developing countries worldwide in the collection and use of data to monitor and evaluate population, health, and nutrition programs. This project is funded by the USAID with contributions from other donors, as well as funds from participating countries, to provide technical assistance to more than 260 surveys in over 90 countries. ICF Macro, an ICF International Company, implements the Demographic and Health Surveys (DHS) Program.
Femininity Ratio	Number of Females per 100 Males in the population.
GII	Gender Inequality Index (GII), according to the UN (UN website): ”Measures gender inequalities in three important aspects of human development—*reproductive health* measured by maternal mortality ratio and adolescent birth rates; *empowerment*, measured by proportion of parliamentary seats occupied by females and proportion of adult females and males aged 25 years and older with at least some secondary education; and *economic status* expressed as labour market participation and measured by labour force participation rate of female and male populations aged 15 years and older.”

HIC	High-Income Countries, according to one of the UN development classifications (https://www.un.org/development/desa/dpad/wp-content/uploads/sites/45/WESP2019_BOOK-ANNEX-en.pdf). In this UN classification, countries' level of development is given by per capita gross national income (GNI). This group includes countries where per capita GNI is of more than US $12,056.
IMCI	Integrated Management of Childhood Illness is an integrated approach to child health that focuses on the well-being of the whole child. It has been developed by WHO and UNICEF and aims to reduce death, illness and disability, and to promote improved growth and development among children under five years of age. IMCI includes both preventive and curative elements, and health facility and community elements as well.
Infant mortality	Probability of dying between birth and exact age 1 year.
Kinship	According to Dube (Dube, 1997), is a "set of organizing principles that control the recruitment of individuals to social groups and their placement within groups, the formation of family and household, residence at marriage, inheritance, and responsibilities of members in the business of living."
LMIC	Low and Middle Income Countries, according to one of the UN development classifications (https://www.un.org/development/desa/dpad/wp-content/uploads/sites/45/WESP2019_BOOK-ANNEX-en.pdf). In this UN classification, countries' level of development is given by per capita gross national income (GNI). LMICs are subgrouped into upper middle income, lower middle income and low-income.
MDG	Millennium Development Goals
MICS	Multiple Indicator Cluster Surveys, household survey supported by the UNICEF which collects collecting and analyses data in order to fill data gaps for monitoring the situation of children and women
MNCH	Maternal, newborn, and child health
NFHS	The USAID funded Demographic Health Survey (DHS)conducted in India and also known in India as the National Family Health Survey (NFHS)
NICE	National Institute for Health and Care Excellence is an executive non-departmental public body within the Department of Health in the United

	Kingdom. This institute provides national guidance and advice to improve health and social care and is highly regarded for their evidence based recommendations and the methods they use.
Patriarchal society	According to Das Gupta (Das Gupta et al., 2003), in South Asia , for example, patriarchy involves patrilineality and patrilocality. Patrilineality is the passing of the main productive assets occur through male line (women might be given moveable goods (e.g. jewellery) in the form of dowry or inheritance. Patrilocality means couple residing in the man's home.
Sex Ratio	Number of Males per 100 Females in the population (normalized to 100, although, sometimes to 1000.). At birth the sex ratio is fairly standard at around 105.
SA	Social Autopsy. Social autopsy is a process of collecting data through interviews aimed at identifying social, behavioral, and health systems contributors to maternal and child deaths. It complements the findings of Verbal Autopsy.
SPA	Service Provision Assessment, a health facility assessment that provides a comprehensive overview of a country's health service delivery
Under – five mortality	Probability of dying between birth and the exact age of 5 years.
UNICEF	United Nation' s Children Fund
USAID	United States Agency for International Development
Verbal Autopsy	A research method using indirect ascertainment to determine probable causes of death in cases where there was no medical record or formal medical attention given. It uses information on symptoms, signs, and circumstances leading to death.
WHO EMRO countries	Afghanistan, Bahrain, Djibouti, Egypt, Iraq, Islamic Republic of Iran, Jordan, Kuwait, Morocco, Occupied Palestinian territory, Oman, Pakistan, Qatar, Saudi Arabia, Somalia, South Sudan, Sudan

Chapter 1. Introduction

"beti to bojh hoti hai,"
Hindi motto: meaning, " a daughter is a burden"(Jayachandran, 2014)

"Rather, the mortality disadvantage of women comes about
mainly through a widespread neglect of health, nutrition and other interests
of women that influence survival" (Osmani, 2003).

Gender discrimination in South Asia

Discrimination against women and girls is a well-recognized problem in Asia and in particular in South Asia. Paraphrasing Beauvoir (Beauvoir, 1949), a good number of South Asian girls *"never had their chances"* to achieve full health and wellbeing. Furthermore, their chances might even get smaller as they go through their life course. Evidence from both the Medical and Social Sciences have highlighted how gender based inequities puts girls in South Asia at social disadvantage and leads to an "excess" of girl deaths in this region (World_Bank, 2012, Alkema et al., 2014).

Although the words *Sex* and *Gender* are often used interchangeably, they tend to express different things in the context of child health. Whilst the word sex emphasizes the biological and physiological differences between males and females (Bhan et al., 2005), gender tends to refer to the socially constructed roles and codes and norms of behaviour which can affect the status of different sexes. In South Asia and other parts of the world where gender discrimination against girls is prevalent, the natural biological health advantage of girls in early childhood can be neutralized by the social disadvantage they suffer leading to an "excess" of female girl deaths (Hill and Upchurch, 1995a).

Evidence from the late 80s highlighted the discrimination against girls as a problem, especially in Asia. For example, a study conducted in rural area (Matlab) in

Bangladesh (D'Souza and Bhuiya, 1982) reported noticeable mortality sex differentials, with higher mortality rates of girls compared to boys. In the same area, Chen(Chen et al., 1981b) reported a gender biased nutrition and health care seeking behaviour that could explain the mortality outcomes in the Matlab study. Das Gupta, in 1987, explored the reasons behind the excess female child mortality in Punjab, India (Gupta, 1987). Amongst the reasons, parent's expenditure in health care for boys was considerably higher than for girls and boys received better quality nutrition compared to girls as well. In the late 80s and early 90s, Amartya Sen (Sen, 1989b, Sen, 1990) estimated that 100 million women "were missing" in parts of Asia and North Africa due to gender discrimination against women (Klasen and Wink, 2003, Sen, 2003b). Sen's debate on the missing women of Asia goes beyond the limits of international public health and addresses the impact of gender discrimination on economic development. Recognising, measuring and addressing gender gaps is priority and a prerequisite for the reductions of gaps in human capital and therefore an essential part of development (Bank, 2011).According to the 2012 World Bank gender equality is at the heart of development and …. *"Too many girls and women are still dying in childhood and reproductive ages".*

The missing women debate, started by Sen and others have been revisited since (Klasen and Wink, 2003, Sen, 2003b) and there has been improvements in female mortality (Hesketh and Xing, 2006). However, since then, other threats to gender equality have arisen.

Gender discrimination affecting sex ratio at birth

Three main factors affect the sex ratio in a population (Hesketh and Xing, 2006): the *sex ratio at birth*, differential mortality rates by sex and migration (losses and gains for the latter). Discrimination against girls will affect the child population sex ratios by increasing the mortality rates of girls compared to boys. On the other hand, if no intervention is present, the sex ratio at birth (i.e., the number of males per 100 females born in a given population) is very constant and also very similar with around 105 boys born for each 100 girls (Coale, 1991). However, in populations with strong “boy preference” (e.g. China, India, South Korea and North Africa), childhood population sex ratios can be skewed (Hesketh and Xing, 2006, Sen, 2003b). In the mid-1980s, the wide availability of non-invasive prenatal sex determination using modern technology (ultrasound) has led to high numbers of female foetuses’ abortions in India, China and South Korea. Therefore, it is correct to affirm that gender discrimination can affect girls even before they are born.

China has one of the highest sex ratios at birth. Apart from the higher mortality rates of girls compared to boys due to neglect, two other factors explain this distortion: sex selective abortion and underreporting of female births due to the one child policy (Hesketh and Xing, 2006). An analysis of the 2005 Chinese intercensus survey (Zhu et al., 2009) highlights the skewed sex ratios of under-fives in China, with 119 (95%CI 119-120) boys per 100 girls under one year of age and 124 (95%CI 123 to 124) boys per 100 girls in the 1 to 4 year old population surveyed. The sex ratios were even higher in rural areas and when the first child born was a girl, reaching 146 (95%CI 143 to 149) in the latter case. Moreover, the survey results suggest that sex selective abortion is responsible for nearly all the excess males in the Chinese under 20 population. In some Chinese provinces, a variant of the one child policy is applied which allows a second child if the first one is a girl. In these provinces, according to the same survey, they found the highest sex ratios.

In India, fewer girls than boys are born nowadays. Like in China, sex selective abortion has increased substantially in the last two decades, explaining the imbalanced numbers of boys versus girls. Using data from three nationally representative surveys, Jha and colleagues (Jha et al., 2011) established the trend in sex ratio according to the birth order. After adjusting for girl’s mortality rates, they estimate that only in the 2000s, female abortions totalled about 4·2–12·1 million in India. They conclude that selective abortion of girls has increased in India from 1990 to 2005, particularly for pregnancies after a first born girl.

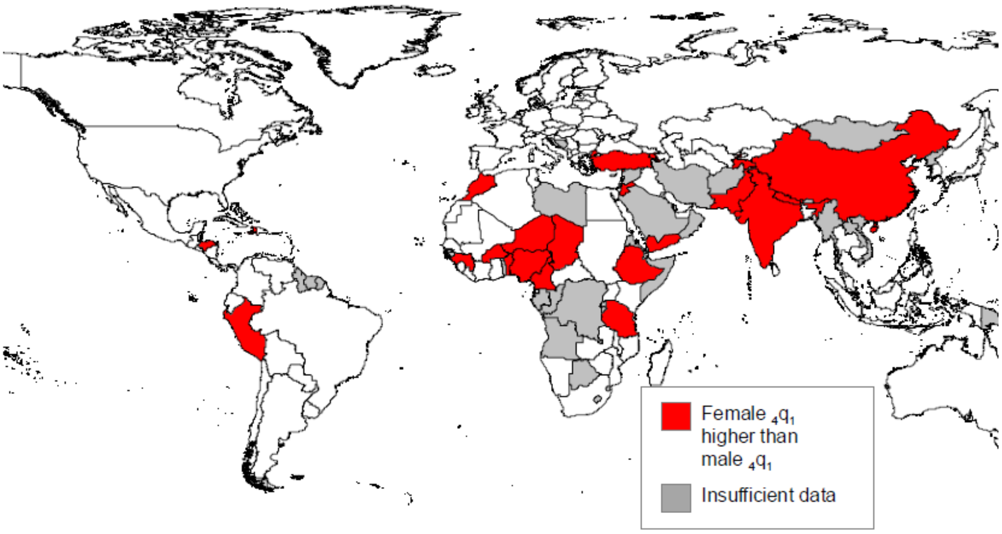
Global patterns of excess female child mortality

The impact of gender discrimination on girl’s mortality has been well documented. Global estimates of sex ratios of mortality of children up to age 5 can mask important regional and country differences. In countries where discrimination against girls is prevalent, the natural biological health advantage of girls in early childhood can be neutralized by the social disadvantage they suffer leading to an "excess" of female girl deaths (Claeson et al., 2000) (Hill and Upchurch, 1995a) (Morris et al., 2011).

The UN gender differentials in mortality report published in 2011 (United Nations, 2011) provided estimates of infant, child and under-five mortality by sex in 109 countries in less developed regions and 40 in the more developed. Using data from vital registration, surveys, and censuses, they report some important findings:

- The median sex-ratio (male : female) mortality in under-fives has been increasing since the 70's in most developing countries as overall under-fives mortality has decreased. This increase is mainly due to increase in sex ratio of mortality in children aged 1-4 years. The average sex ratio of under-five mortality in the less developed regions fell from103 in the 1970s to 99 in the 2000s.
- China and India are an exception to this rising trend though, with sex ratios of under-five mortality well below 100 for both countries, an indication of excess girl's mortality. China and India were the only countries in the world where female infant mortality is higher than male infant mortality in the first decade of the 2000s (or the "2000s"). In China the female mortality disadvantage is concentrated in young infants and in India, in the 1-4 age group.
- Although the girls' previous disadvantage in mortality at ages 1-4 seems to be improving, in many of the less developed regions, the average mortality sex ratios in this age group is still below the ratios experienced by developed countries at similar levels of mortality. In some countries, there is still an excess female child mortality in the 2000s (See Figure 1, from the same report).
- For infants (i.e. children under the age 1) girls still have advantage in survival in all countries except from China and India.

Figure 1. Countries where excess female child (1-4) mortality was found in the years 2000s



Source: United Nations, Department of Economic and Social Affairs, Population Division (2011). Sex Differentials in Childhood Mortality Report(United Nations, 2011).

Sawyer updates the UN estimates(Sawyer, 2012) using the same data described earlier and proposes simple methods for the analysis of available data on under-five mortality per gender, including estimation and interpretation of sex differentials. The methods proposed by Sawyer allow the comparison among countries with different types of data. Like in the UN report, she highlights that the ratio of infant, child and under-five mortality has increased in most countries in less developed regions. However, in a number of developing countries mortality rates for girls from age 1 to 4 y are still higher than for boys in the same age group. These countries are concentrated in the following regions: middle and western sub-Saharan Africa, Northern Africa/Western Asia, and southern Asia (See Figure *1*).

Challenges in the estimation of mortality trends by sex

Several challenges in the estimation of mortality trends by sex by the UN Inter-Agency Group for Child Mortality (UN IGME) are highlighted by Sawyer (Sawyer, 2012) in her paper:

- The fact that the some of the censuses and surveys on which UN estimates are based do not collect the relevant data by sex.
- Sampling errors in child mortality estimates from surveys are large due to small number of deaths in children. These number are even smaller if disaggregated by sex
- In countries with low level of mortality, ratios of male to female mortality for under fives and infants can fluctuate from year to year, due to the small number deaths, therefore requiring some statistical smoothing to allow comparisons

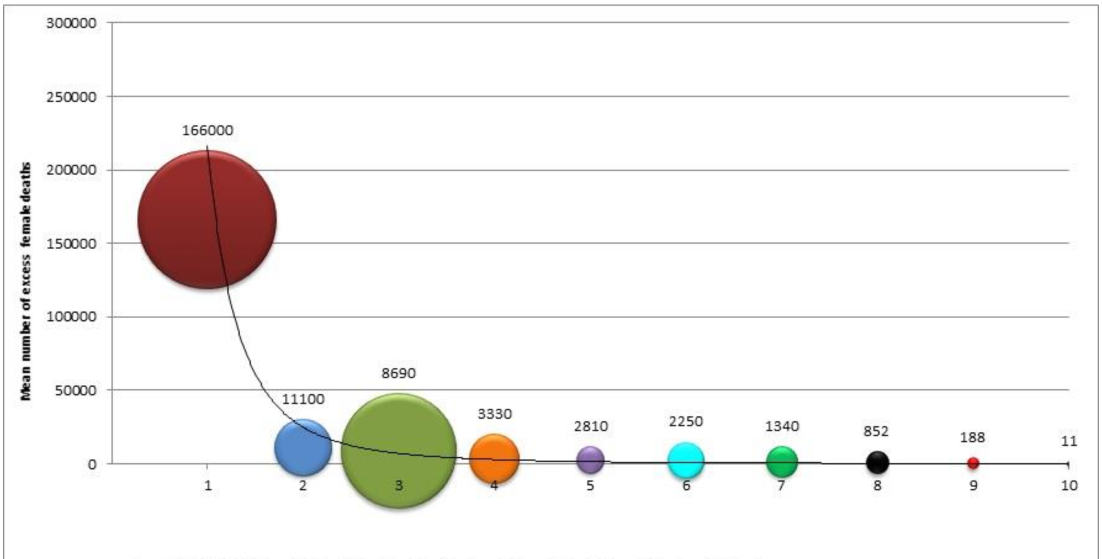
The interpretation of historical sex differentials in childhood mortality in developed countries

Due to biological factors, mortality rates in boys and girls are different. In the same paper (reference to Sawyer again), Sawyer points out that equity in survival between males and females does not imply equal mortality rates for boys and girls. With development, as living conditions improved in the world, including improvements in sanitation and access to treatment and prevention of infectious diseases affecting children, the sex ratio (male to female) mortality rates increased as overall under five mortality rates decreased. Sawyer suggests that in the developed world an “epidemiological transition” occurred where infectious diseases in children became less prevalent and gave more space to perinatal and congenital diseases, which tend to affect and kill infants more than older children and also more boys than girls. Therefore, the sex ratio of mortality increased as mortality decreased in the developed world. However, Sawyer also point out that in many regions of the world the same pattern is not present, in fact the reverse, the survival of girls is lower than for boys. Regions where this is particularly important are South and East Asia, northern Africa/West Asia. For these regions and some countries like China and India, in-depth cross national or subnational analysis and mortality determinants by sex would be beneficial, according to Sawyer.

More recently, Sawyer's previous model has been updated (Alkema et al., 2014). Using a Bayesian hierarchical time series approach, the authors estimate country-specific mortality sex ratios for infants and children under the age of five for 195 countries from 1990 to 2012. They simultaneously estimate the relationship of these mortality estimates with population sex ratios to highlight the *expected and the excess* female mortality rates in countries with outlying sex ratios like India and China (with low sex ratios) or Caucasus and central Asia (with high sex ratios). The authors identified 15 countries with outlying under-five sex ratios (mostly from Africa and Asia), and within these, 10 had higher than expected female mortality in this population in 2012. For the majority of these 15 countries the excess female mortality decreased since 1990, however, the estimated to expected female mortality did not change substantially for most of them and deteriorated for India. This study concludes that in some regions of the world, namely Southern Asia, Eastern Asia and Northern Africa, the ratio of estimated-to-expected under five mortality remains higher than 1 in 2012, suggesting significant disadvantage for girls. Both previous and recent evidence suggests that gender discrimination in child health care in South Asia results in girls' excess mortality in the region (Hill and Upchurch, 1995a, Jha et al., 2011, Alkema et al., 2014). They conclude that decreases in excess female mortality is related to decreasing overall mortality, with a reverse trend for very low infant mortality. Therefore, this study confirms previous findings that in children up to the age of five, the chances of survival of girls compared to boys increase as total mortality decreases. The authors recommend further research on countries and regions where gender discrimination is present. Just as an example, for CMR (i.e. Child Mortality Rate, 1-4 years), the 10 countries with higher female mortality than expected in 1990 and /or 2012 are India, Pakistan, Nepal, Iran, Egypt, Bangladesh, Tunisia, Morocco, Yemen and Niger.

Similarly, South Asia is both the home to over one fifth of all children in the world and the region contributing with the majority of excess girl's deaths in the world. Amongst the 10 countries with highest excess female mortality globally, five are in South Asia (see Figure 2) and four out of the five with the highest excess of U5 female deaths to total number of deaths are also in South Asia (Park and Brondi, 2015a).

Figure 2. Number of excess female deaths in under 5s in countries with outlying sex ratios in 2012, according to Alkema et al. (Park and Brondi, 2015)



Legend: 1=India; 2=Pakistan; 3=China; 4=Bangladesh; 5=Afghanistan;6=Egypt; 7=Iran; 8=Nepal; 9=Jordan; 10=Bahrain
* Countries are ranked in order of highest ratio of excess female deaths to total number of deaths in U5s. The size of the bubblecorresponds to the total U5 population in each country.Source: UNICEF statistics, available at http://data.unicef.org/resources.

In India alone, it is estimated that 74000 *excess* female deaths occurred in children under 5 years between 2001 and 2012 (Ram et al., 2013). A study conducted in rural Bangladesh (D'Souza and Bhuiya, 1982) in the 80's reports noticeable mortality sex differentials affecting girls. Another study in the same area in the 90's reports that in children aged 1- 4 years, girls were 1.8 times (95% CI: 1.5-2.1) more likely to die from severe diarrhoea compared to boys (Fauveau et al., 1991), with no difference in the incidence of diarrhoea was found. Similarly, Fauveau study showed that

Female children with diarrhoea had higher incidence of malnutrition, and were less likely to be taken to hospital and also less likely to be admitted leading to excess mortality.

Pandey in India (Pandey et al., 2002) reports sex differences negatively affecting girls in West Bengal. Boys and girls affected by diarrhoea and pneumonia and fever are treated differently with respect to delay in seeking care, use of household treatment, expenditure for care and treatment, use of qualified doctors.

In a community based study in the outskirts of New Delhi, Khanna reports a higher mortality rate in female infants compared males was (1.3 times higher). Over 20% of deaths in the Khanna study was due to diarrhoea (Khanna et al., 2003). More recently, Krishnan reports high rates of mortality in girls compared to boys (1.6 – 2.0 times) during the post neonatal period as well as in the 1-4 year olds in Haryana State in India (Morris et al., 2011).

Using 2011 census data from India, Guilmoto and colleagues estimate the effect and intensity of excess female mortality in children under 5 in India using spatial analysis (Guilmoto et al., 2018). The study estimates from 2000-2005, the number of excess female deaths in children under 5 was 239.000 per year (169 000-293 000).It also points out that 90 % of districts in India had excess female deaths. Moreover, most of the deaths occurred in four large states in the North of the country (i.e., Uttar Pradesh, Bihar, Rajasthan, and Madhya Pradesh).

Gender and health and the missing women debate

Evidence from the late 80s highlighted the discrimination against girls as a problem, especially in Asia. For example, a study conducted in rural area (Matlab) in Bangladesh (D'Souza and Bhuiya, 1982) reported noticeable mortality sex differentials, with higher mortality rates of girls compared to boys. In the same area, Chen(Chen et al., 1981b) reported a gender biased nutrition and health care seeking behaviour that could explain the mortality outcomes in the Matlab study. Das Gupta, in 1987, explored the reasons behind the excess female child mortality in Punjab. Amongst the reasons, parent's expenditure in health care for boys was considerably higher than for girls and boys received better quality nutrition compared to girls as well. In the late 80s and early 90s, Amartya Sen (Sen, 1989b, Sen, 1990) estimated that 100 million women "were missing" in parts of Asia and North Africa due to gender discrimination against women (Klasen and Wink, 2003, Sen, 2003b). Sen's debate on the missing women of Asia goes beyond the limits of international public health and addresses the impact of gender discrimination on economic development. Recognising, measuring and addressing gender gaps is a priority and a prerequisite for the reductions of gaps in human capital and therefore an essential part of development (Bank, 2011).According to the 2012 World Bank gender equality is at the heart of development and …. *"Too many girls and women are still dying in childhood and reproductive ages".*

The missing women debate, started by Sen and others has been revisited since (Klasen and Wink, 2003, Sen, 2003b) and there have been improvements in female mortality (Hesketh and Xing, 2006), however, since then, other threats to gender equality have arisen.

Social, economic and cultural determinants of gender discrimination in Asia

According to Sen (Sen, 1990), economic, social and cultural factors interact in a complex way and determine the geography of female well-being and survival

The relationship between the role of women in the context of individual household and the wider society determines the value of each sex in a society (Dube, 1997). Some socio-cultural values have been proposed to explain the persistent gender discrimination against women and girls in some Asian countries. Banister (Banister, 2004) provides a comprehensive historical review of gender discrimination against girls in China. She concludes that son preference, low fertility and technology and also the compulsory family planning policies, including the one child policy, are the main determinants of the shortage of girls in China. Das Gupta (Das Gupta et al., 2003) has explored this issue in detail, aiming to explain the persistent gender discrimination against girls (on son preference) in India, China and the Republic of South Korea. She suggests that similar aspects in family systems (or kinship) in these three countries explain low value attached to daughters in their societies. These three countries have a rigid patrilineal kinship (which includes the passing of the main productive assets, like land only through male line). Because of that, women rarely inherit land, and therefore have lower chances of maintaining their economic status, unless attached to a man, especially in a peasant society. Such a rigid kinship system is in part responsible for the disincentive to raise daughters in these countries.

Gender discrimination and health status of children show important variations in different regions of countries like India. Pandey suggests that girls living in Orissa, Haryana and Punjab are worse affected by discriminatory practices than in other areas in India (Pandey et al., 2002).

Burden of common infections in young children

Pneumonia, diarrhoea and malaria are leading causes of mortality in children before age 5 years, especially in low-income and middle-income countries (LMICs). In 2015 alone, over a third of all 3.3 million deaths in children from 1-59 months of age were due to infectious diseases (Liu et al., 2016) with pneumonia and diarrhoea being the two leading causes (12.8% and 8.6%).In 2010, 4.0 million children under five (aged 28 days to 59 months) died worldwide. For the newborn child (0 - 27 days), preterm birth complications, intrapartum-related events and sepsis and meningitis account for over 33% of all deaths(Liu et al., 2016). Many of these deaths occur in poor countries and could be avoided by improving the coverage of life-saving interventions like immunization and effective treatment of pneumonia, diarrhoea, malaria and appropriate obstetric and newborn care (Bhutta et al., Lawn et al., 2014).

The scale up of life-saving interventions has improved child survival globally in the last several decades. However, the speed of progress of coverage of these interventions varies substantially from region to region and country to country (Liu et al., 2016). In regards to diarrhoea, mortality has declined substantially in many countries since the 1990s, including in some South Asian countries (Troeger et al., 2019). However, in 2017, diarrhoea mortality rates in children under 5 (U5) in India is more similar to African countries than other middle-income countries (i.e., 50-80 deaths per 100.000). Moreover, like many African countries, India's diarrhoea mortality rates are still above the global median mortality for diarrhoea in this age group.

Although coverage of life-saving interventions in LMICs have increased substantially in the last two decades, not all children benefit equally from this increase (Barros and Victora, 2013). Gaps in coverage of life-saving interventions are still prevalent in these settings affecting the most vulnerable children like those living in the poorest, less educated and more rural communities. There is enough evidence that gender discrimination can affect the children's health (Bank, 2011) (Claeson et al., 2000), making them more vulnerable to disabilities and death. However, global burden of disease estimates tend not to include estimates by sex for common causes of child mortality and global estimates of coverage of child life-saving interventions by sex are still needed.

Gender inequalities in child care seeking and admissions

Gender inequity can affect child care and health in different manners. Therefore, understanding health care utilisation is a crucial step in the design of strategies to improve access to life-saving interventions for young children.

Drawing upon three good examples of communicable diseases in three different developing countries (Tuberculosis in India; HIV/AIDS in Kenya; and malaria in Ghana), Theobald and colleagues (Theobald et al., 2006b) discuss how poverty can lead to different levels of vulnerability to communicable diseases in man and women and also the role of gender equity in adults affecting women and children's care for communicable diseases. They conclude that addressing gender equity concerns is crucial for effective communicable diseases management and control in poor settings.

Equally, Colvin and colleagues (Colvin et al., 2010) conducted a systematic review and produced a conceptual framework to explain barriers for careseeking for childhood diseases (pneumonia, diarrhoea and malaria) in Sub Saharan Africa. In his findings he reports that gender norms and values can dictate the household care

seeking behaviours and the speed of response to illness. The need for mothers to get permission from their husbands was one of the most consistent barriers to seek care outside the home. Although women are the main care givers, male partners would act as critical gatekeepers of seeking care outside the home. This review did not look at gender of the child and careseeking behaviours though.
Studies looking at differences in care-seeking according to the sex of the child considered have suggest that girls in South Asia and in specific parts of Africa suffer from discrimination and are less likely to receive appropriate health care and therefore life-saving interventions (Thind, 2004) (Malhotra and Upadhyay, 2013) (Ganatra and Hirve, 1994) (Patra, 2012) (Larson et al., 2006) (Tambe et al., 1999) (Fauveau et al., 1991) . In Khera and colleagues' (Khera et al., 2014) systematic review cited earlier, evidence from studies showing clear gender discrimination against girls across the care seeking spectrum (including emergency, inpatient, outpatient and preventive care) is summarized. Most of the studies reported were from South Asia and China with sporadic reports from Africa and South America.

Other evidence from Asia and other countries suggest that girls suffer from discrimination and are less likely to receive appropriate health care and therefore life-saving interventions (Thind, 2004, Bank, 2011, Krishnan, 2013a). Preferential treatment for boys (or, gender bias against girls) affects care seeking in different manners, including amount of money spent in child's health care, travel distance, delay in seeking care, hospitalization rates, amongst others. Evaluating the effect of gender bias on hospitalization is crucial since hospitalization occurs usually with severe disease and therefore can be a proxy measure for death (Bhan et al., 2005).

Willis conducted a study looking at gender differences in care-seeking for illness in newborns in rural Uttar Pradesh, India. Although he reports a similar overall use of healthcare for boys and girls, the average expenditure for healthcare was nearly four-fold higher in households with males compared to females ($p=0.07$).

In a paper estimating global and regional hospitalisations for childhood pneumonia, Nair and colleagues (Nair et al., 2013b) reported a marked and consistently higher rates of hospitalisation for severe ALRI in boys than girls (particularly in studies from Southeast Asia, where 2 to 3.5 fold differences were reported). These findings were based on data collected from 28 unpublished studies available with the Severe Acute Lower Respiratory Infections (ALRI) Working Group led by Nair. Although studies in general report a higher rate of hospitalisation for boys compared to girls, this is usually only 1.2 to 1.3-fold, and can be explained by increased biological susceptibility for pneumonia in boys.

If these increased gender differences were true for the other leading infectious causes of child mortality (namely diarrhoea and malaria), these differences need to be recognised and addressed if further gains in child mortality need to be achieved rapidly.

Arifeen and colleagues in Bangladesh (Arifeen et al., 2004) conducted a cluster randomized controlled trial to evaluate the impact of improved quality of care (using the Integrated Management of Childhood Illness (IMCI)) on child health indicators. They conducted household surveys and health facilities surveys, both in the control and intervention areas, and showed that implementation of IMCI intervention increased the use of health care facilities. This study was not able to detect significant impact of this intervention in the mortality of under 5-year-old children. Nevertheless, it detected increased care seeking and breastfeeding rates and also a decrease in prevalence of stunting in 2-5-year-old children. They did not find any difference between boys and girls in terms of care seeking.

Access to health care services may also contribute to gender inequalities and inequity but current evidence is conflicting. Previous published data from India (Vilms et al., 2017) also suggests that increased access to health or social care services does not necessarily decrease gender inequalities, or at least not in a monotonic pattern. A study in Vietnam reported that for major childhood infections boys are admitted to hospital more often than girls (Schmidt et al., 2012). The study on admissions was repeated after the government introduced the user fee exemption policy for children under 6 and there was no significant impact on the girls/boys rate ratio of admission, suggesting that cultural norms might take longer to change even when access is improved. Equally, a study exploring both gender and other socio-economic determinants in South Asia reported a persistent gender bias against girls even in more educated and richer families, compared to poorer and less educated ones (Hasan and Khanum, 2000). In principle, gender based discrimination against girls has important social and economic roots and also relates to family organisation norms, especially in South Asia. However, there is evidence that gender bias against girls has become so deeply-rooted in some South Asian countries, that it persists or worsens in more educated and richer families, compared to poorer and less educated ones (Borooah, 2004) (Larson et al., 2006) (Bhan et al., 2005) (Pandey et al., 2002).

Appropriate use of available health services by families can decrease the burden of infectious diseases in children. Apart from health system enabling factors, social characteristics and cultural norms determine health care seeking behaviour (Andersen, 1995). The Pathway to Survival conceptual framework (Waldman R, 1996), which was created to support the implementation of the Integrated Management of Childhood Illness (IMCI) approach can provide an important model for the analysis of gender and its impact on health access and utilisation. The idea of the pathway is to identify and organise *modifiable* social, cultural and health systems affecting home care practices, access and utilization and delivery of health care (Kalter et al., 2011). Another useful model is the “Three delays” Model for maternal mortality (Thaddeus S, 1994). If both were applied to childcare, it could highlight critical delays in care seeking relating to gender and resulting in deaths. Based partially on these models and on the literature review conducted, I propose later on in this thesis a simple framework to understand the role of gender on care seeking for childhood common infections (See Chapter 3).

The predominance of males among care seeking behaviours, including admissions supports the biological susceptibility young boys compared to young girls (under one year of age). Even in countries where there is no gender bias, younger male children, especially under one year old and especially with acute respiratory infections will be brought more often to health care facilities due to their frailty compared to girls. Therefore, differences in biological susceptibility to severe disease may explain part of the gender disparities in care seeking, but profound cultural norms and beliefs may also play an important role.

The recent systematic review by Khera (Khera et al., 2014) highlights the global patterns of gender bias in paediatric care and health. The review summarizes evidence for the high prevalence of gender bias in paediatric healthcare in resource limiting in Low and Middle Income Countries (LMICs), especially in Asia. The study discusses role of societal son preference and in gender disparities in pediatric care. Khera calls for infrastructural overhaul and for a societal awakening in societies in South Asia to overcome the problem with girl child neglect and passive infanticide. Previous systematic reviews into general care seeking for these three conditions (Nair et al., 2015) highlight the scarcity of published data on gender as a determinant factor in careseeking for the main killers of children.

Contextualizing this research

Discrimination against women and girls is a well-recognized problem in South Asia. Evidence from both the Medical and Social Sciences have highlighted how gender based inequities put girls in South Asia at social disadvantage and leads to an "excess" of girl deaths in this region (Bank, 2011) and therefore the evidence for excess mortality of girls in South Asia is well established. However, the extent that gender based inequity health care utilisation, use of preventive practices and other child care factors might contribute to excess female mortality and disability in early childhood in the region is not fully understood yet (Park and Brondi, 2015a).

Inequalities in child health care utilization that are driven by gender (a social construct), rather than sex (a biological variable), are unfair and therefore should be described as gender inequities. Therefore, if gender differences in child care seeking and admissions in South Asia reported earlier (Nair et al., 2013a) are true not only for ALRI but for the other leading causes of child mortality (namely diarrhoea and malaria), these differences need to be recognised.

My research aims to fill this lacuna by providing a comprehensive model, including the most common infections in childhood and paying attention to the array of biological and social determinants of child health, to better explain the mechanisms involved in this phenomenon.

Research aims and objectives

Overview of main goals

The aim of this research is to document gender inequities in child healthcare seeking behaviours and hospitalisations for children under five (U5) living in South Asia. The research work focuses on care seeking for common infections mainly in India and especially for diarrhoea. It also evaluates the potential contribution of other biological, cultural and socio-economic factors in these inequities. The data used here comes from both published literature and large-scale national household demographic and health surveys. The current literature in this field is largely focused on childhood mortality. Therefore, by paying attention to care seeking inequities for child morbidities, and exploring other contextual and social factors apart from gender, it is expected that this study will contribute to the existing literature.

Research Objectives

The thesis focuses on common causes of deaths in children under five (e.g. pneumonia, diarrhoea and malaria) in children from South Asia.

A. Using data from published literature, this thesis aims to estimate the potential effect of gender (depending on the sex of the child) on:

I. Hospital admissions and in-hospital case fatality ratio for acute respiratory infections, diarrhoea and malaria

II. Different types of *health care seeking* behaviours (across the severity spectrum) for these conditions:

- Illness perception or reporting
- Treatment delay
- Utilization of any type of health care treatment (either modern or traditional)
- Use of health care facility for treatment and level of care sought (primary care, secondary care or tertiary care)
- Number of health care providers seen during illness
- Choice of provider used (likelihood to see a better qualified practitioner)

- Use of modern treatment
- Distance travelled for boys compared to girls to reach treatment centre
- Expenditure on health care for boys versus girls
- Use of antibiotics
- Referrals for further treatment followed by action from parents

III. Uptake of preventive measures like immunisation and also nutrition

B. Using data from large-scale national household demographic and health surveys conducted in India, this thesis aims to evaluate:

I. The association of gender (depending on the sex of the child) and seeking behaviours for treatment of symptoms of common infections, focusing on diarrhoea

II. Where the data allows, assess whether and how other factors (such as household income/wealth index, maternal and paternal education and occupation, women's autonomy, child's age, family size, birth order, sex distribution of siblings, regions within the country, setting (rural or urban), religion and caste/tribe) modify the association of gender and care seeking behaviours for diarrhoea

III. Evaluate if sex differences in health care seeking change over time by using surveys conducted in India in 2005_06 and in 2015_16

C. Propose a conceptual framework to explain the role of gender in care seeking behaviours and hospitalizations for common infections in South Asia, using data from published literature.

Chapter 2. Systematic review of the literature

Background

Chapter 1 provided an overall study background for this thesis. This chapter, a systematic review of the literature, aims to provide an in-depth understanding of health care utilisation for common childhood infections—pneumonia, diarrhoea and malaria—in South Asia.

Although the evidence for excess mortality of girls compared to boys in South Asia is well established (Alkema et al., 2014, Jha et al., 2011), there is still a gap on evidence of factors behind inequality in health care utilisation and how this contribute to excess mortality.

The focus of this review is on children from the post-neonatal period, aged 28 days to 59 months. This is because the causes of neonatal mortality and the determinants of health are quite distinct from those in the post neonatal period (1 – 59 months old) (WHO and MCEE Group, 2016) (Liu et al., 2015). Moreover, pneumonia and diarrhoea cause a higher proportion of deaths in children in the post-neonatal period when compared to the neonates.

Traditionally, systematic reviews of observational studies attempt to estimate the size of an effect that is assumed to be independent of context (Balshem et al., 2011), usually a strong biological factor like an infection or a treatment. However, gender, like many social determinants of health, is both a broad and a context specific factor. Furthermore, different methodologies (approach and case definitions) are employed in such studies, making it a challenge to even attempt measuring a specific effect size related to gender. These issues are carefully considered in this review (selection and synthesis of results) and it is hoped that such findings will contribute to understanding gender differences in health care utilization for common childhood infections in South Asia.

The objectives of this review was to estimate the effect(s) of gender (*i.e.* depending on the sex of the child) on:

1) child health careseeking behaviours;
2) hospitalisation rates; and
3) in-hospital case fatality.

The outcome will be explored across the three common childhood infections (*i.e.* pneumonia, diarrhoea and malaria) depending on data reported in selected studies.

Methods

This subsection provides detailed steps of the search strategy, selection criteria, data extraction, quality, data analysis and synthesis of results.

Databases and search strategy

The literature searches were conducted in English language databases (MEDLINE, EMBASE, Global Health, CINAHL, Web of Science, WHOLIS, IndMed, and SIGLE); Chinese language databases (CNKI, Wanfang data, and Chongqing VIP); and Latin American language databases (LILACS). Search terms related to careseeking behaviours (*e.g.* careseeking, morbidity, ambulatory care), admissions (*e.g.* hospitalisation, length of stay, patient admission), mortality, and common childhood infections (pneumonia, diarrhoea and malaria) were combined. Studies published on or after January 1990 were included, and there were no language restrictions. Further studies were retrieved, including unpublished and grey documents, from Google Scholar, based on expert recommendations, and website referrals.

Part of the results of the initial systematic review have been published elsewhere (Nair et al., 2015) earlier and for the work of this thesis. The focus is in South Asia and the addition of other countries, especially for the admission outcomes, is for comparison purposes.

The search strategy was developed in consultation with a Medical Librarian at the University of Edinburgh for each database using a combination of Medical Subject Headings (MeSH) terms and keyword search to include at least the following terms ("deaths", "patient admission", "careseeking", "pneumonia", "diarrhoea", and "malaria") Finally, the reference lists of the selected studies were double scanned to ensure completeness of the literature search. Search strategy for Medline is shown in Table 1 . Detailed searches across all other databases are presented in Appendix 1.

Table 1.Medline search strategy

1. exp "Cause of Death"/ or exp Death/
2. mortality/ or "cause of death"/ or exp child mortality/ or fatal outcome/ or hospital mortality/ or exp infant mortality/ or mortality, premature.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
3. (careseeking or care-seeking).mp. or ambulatory care/ or hospitalization/ or "length of stay"/ or patient admission/ or burden.mp. or exp Morbidity/sn, td [Statistics & Numerical Data, Trends]
4. (girl* or boy* or gender or female or male).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
5. exp pneumonia/ or *pneumonia/ or acute lower respiratory infections.mp.
6. exp diarrhea/ or exp diarrhea, infantile/ or diarrhoea.mp.
7. exp malaria/
8. 1 or 2 or 3
9. 5 or 6 or 7
10. 4 and 8 and 9
11. limit 10 to (humans and yr="1990 -Current" and ("infant (1 to 23 months)" or "preschool child (2 to 5 years)" or "child (6 to 12 years)"))

Selection of studies

For the careseeking outcomes, the criteria used for inclusion were less strict when compared to the admissions since many of the studies looking at careseeking behaviours are based on national, regional or local household demographic and health surveys. Therefore, the criteria for admission studies would not be suitable since the household surveys collect data from children's carers at home and not medical professionals. Most of data on careseeking outcomes were obtained from large nationally representative household-based surveys similar to the Demographic Health Surveys (DHS) or smaller surveys in specific areas of a country, but equally well designed and representative, which was fundamental to the quality check applied.

Although the search strategy included the three main common childhood infections (pneumonia, diarrhoea and malaria), articles that reported on mixed infections or mixed diseases were also added to the review, provided they were relevant and mainly for careseeking behaviours.

For the admissions part of the review, all studies reporting incidence rates (stratified by sex) for hospitalised pneumonia, diarrhoea and malaria or mixed infections and studies reporting admissions and in-hospital fatality rates were identified. For the Chinese databases, the review was carried out by a Chinese speaking researcher according to the same criteria and under my supervision.

Comparing South Asian studies with other regions

For careseeking behaviours and in-hospital case-fatality rates, only South Asian studies were retained for the review presented here. However, for the admission/hospitalisation outcomes, studies from other regions and countries, including developed countries were retained to facilitate comparisons. Part of the reason for retaining these studies was to exclude the potential increased severity risk for hospitalisation, especially for pneumonia, in young boys compared to young girls (Hoo et al., 2002b), which is in part, attributable to the smaller size of airway in young boys. See Box 1 for inclusion and exclusion criteria.

Box 1.Inclusion and exclusion criteria

Inclusion criteria:

- Studies conducted in paediatric population and reporting data on pneumonia, diarrhoea and malaria;
- Studies reporting incidence rates (stratified by gender) for hospitalised pneumonia, diarrhoea and malaria from hospital-based studies; or reporting number of cases (and denominator population) by gender.
- Studies describing hospitalisation rates and in-hospital mortality by gender in paediatric population.
- Studies specified both the total number of girls and boys and the numbers which sought care (different types of across spectrum) and/ the ones who died.

Exclusion criteria:

- Studies in individuals older than 5 years
- Studies with sample size smaller than 100
- Studies that do not specify the numbers, proportions or incidence rates of boys and girls that were admitted
- For the studies looking at case fatality rates the studies that do not specify the numbers or proportions of boys and girls who died;
- Studies that reported less than 12 consecutive months of hospitalisation rates or less than the first year of life period.

Quality grading

Quality of the selected studies was assessed by adapting previously used guideline (Stanifer et al., 2014, Pai et al., 2004, Guyatt and Rennie, 2002, Juni et al., 2001). This was based on representativeness of the sample, appropriateness of study design and analysis, and application of standard definitions (or process) for case ascertainment. The maximum obtainable score was 5 (sampling 2, case ascertainment 2, and analysis 1). See Table 2 for details. Studies were graded as high (with score of 5 or 4), moderate (with score of 3 or 2), and low (with score of 1 or 0). Only moderate and high quality studies were included in the analysis.

Table 2. Quality criteria employed in final selection of studies

Criteria	Sub-criteria	Score	Total score
Representativeness of sample	Nationally representative	2	2
	Sub-national	1	
	Ambiguous	0	
Appropriateness of study design and analysis	Yes	1	1
	No	0	
Case ascertainment	Standard definition	2	2
	Any definition	1	
	Not-reported	0	

Adapted from (Stanifer et al., 2014, Pai et al., 2004, Guyatt and Rennie, 2002, Juni et al., 2001).

A widely used and tested systematic approach to rate studies included in Systematic Reviews and evidence syntheses is the Grading of Recommendations, Assessment, Development and Evaluations (GRADE) (Balshem et al., 2011). However, if GRADE was applied to most of the studies used here they would end up being graded as low evidence given its stringency, as many of the studies used are observational (including many cross-sectional ones) rather than being Randomised Clinical Trials (RCTs). Therefore, guidelines which contained the core elements of GRADE but also accommodated for observational studies were checked. Then, systematic and explicit consideration was then given to study design, study quality, consistency, and directness of evidence in judgments about quality of evidence. Therefore, from previously used guidelines (Stanifer et al., 2014, Pai et al., 2004, Guyatt and Rennie, 2002, Juni et al., 2001), it was ensured that these core elements were represented, which thus provides a basis for comparison.

Data extraction and synthesis

Main data extracted included those on demographics, careseeking, admission and case fatality rates. All data were extracted once, except for the Chinese language studies that were double checked with a Chinese speaking researcher. Data was stored in 2016 Microsoft Excel file format. Disagreements in extraction were resolved following discussion with my supervisors.

Data was separately analysed for the different types of outcomes, *i.e*. careseeking behaviours, admissions, and case fatality. Odds Ratios or Relative Risks (and confidence intervals (CI)) comparing outcomes for boys and girls were extracted, or calculated from prevalence estimates when not reported.

Measures for each outcome were grouped using tables—describing evidence from the literature. This evidence is used to support the conceptual framework proposed in Chapter 3. Whenever data allowed, Incidence Rate Ratios of admissions rather than Odds Ratios were presented. Conversely, the careseeking outcomes were more diverse and represented a bigger challenge in terms of description. Therefore, a rather large number of different types of careseeking behaviours are described on the tables.

Data analysis

First, a narrative synthesis providing the variations in estimates reported across studies was conducted. Then, a random-effects meta-analysis was conducted on odds ratios (representing degree of inequality in the outcome for boys and girls). This was conducted separately for each of the outcomes (care seeking, admission and case fatality). Log transformed odds ratio and standard errors, and pooled overall odds ratio for each outcome were generated using the DerSimonian and Laird Method (DerSimonian and Laird, 1986) approach. Heterogeneity between studies was calculated using Higgins I^2 (Higgins et al., 2008), and set at $P<0.05$. This was inspected also in the results of the sub-group analysis. All analysis were conducted on Microsoft Excel (Microsoft 2016) and STATA 13/IC (StataCorp, 2013a).

Results

Overview

Although this review aimed to identify studies reporting on inequality in health care utilisation for three important common childhood infections (*i.e.* pneumonia, diarrhoea and malaria), not many studies reported sex differences on health care utilisation for malaria in South Asia. As noted, outcomes were reported separately for each of these infections. Thus, for each of the outcomes reviewed (*i.e.* hospital admissions, in-hospital fatality rates and careseeking behaviours), the study characteristics, qualitative synthesis of evidence and also quantitative analysis were reported, where data allowed this. The results reported here focus on careseeking behaviours, hospital admission rates, and in-hospital case fatality rates. During this review, 12 South Asian studies reporting on gender inequalities for immunisations and nutrition outcomes were also identified. A summary table has been included in the appendix. This was also briefly discussed in Chapter 3, where the Conceptual Framework is presented.

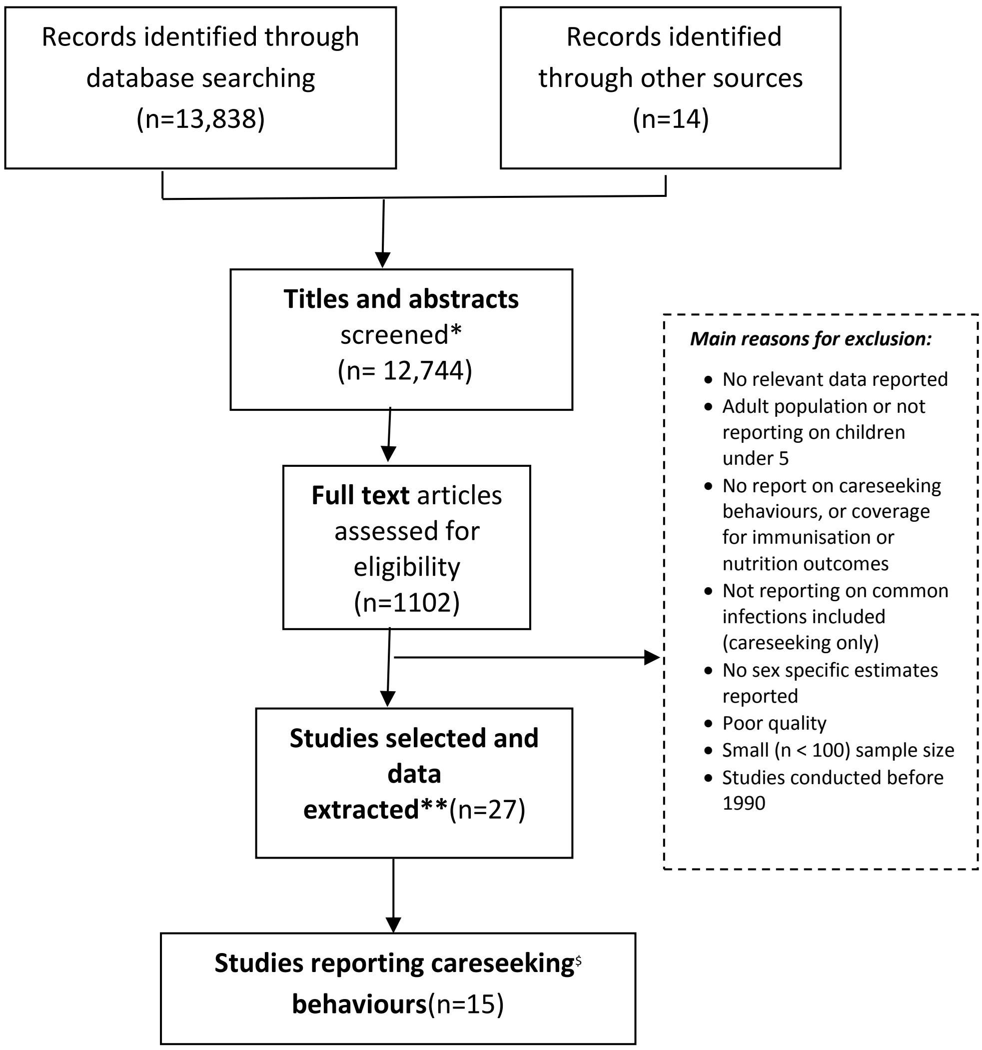
Search results

Studies were selected according to the outcome reported. It should be noted that because some studies from which data were extracted reported on more than one outcome, the numbers of outcomes presented on the results (datapoints) might be bigger than the total number of studies selected.

Careseeking behaviours studies

Out of the 13,838 articles initially identified in our searches, and 14 through other sources (i.e., a total of 13,852 studies), 15 studies reporting on care-seeking behaviours were retained (Fauveau et al., 1991, Ganatra and Hirve, 1994, Hussain et al., 1999, Tambe et al., 1999, Hasan and Khanum, 2000, Mitra et al., 2000, Pandey et al., 2002, El Arifeen et al., 2004, Thind, 2004, Pokhrel et al., 2005, Larson et al., 2006, Nuruddin et al., 2009a, Dongre et al., 2010, Malhotra and Upadhyay, 2013, Willis et al., 2009). See Figure 3 for details on study selection steps for careseeking behaviours.

Figure 3. Flowchart showing steps for selection of South Asian studies reporting on careseeking behaviours

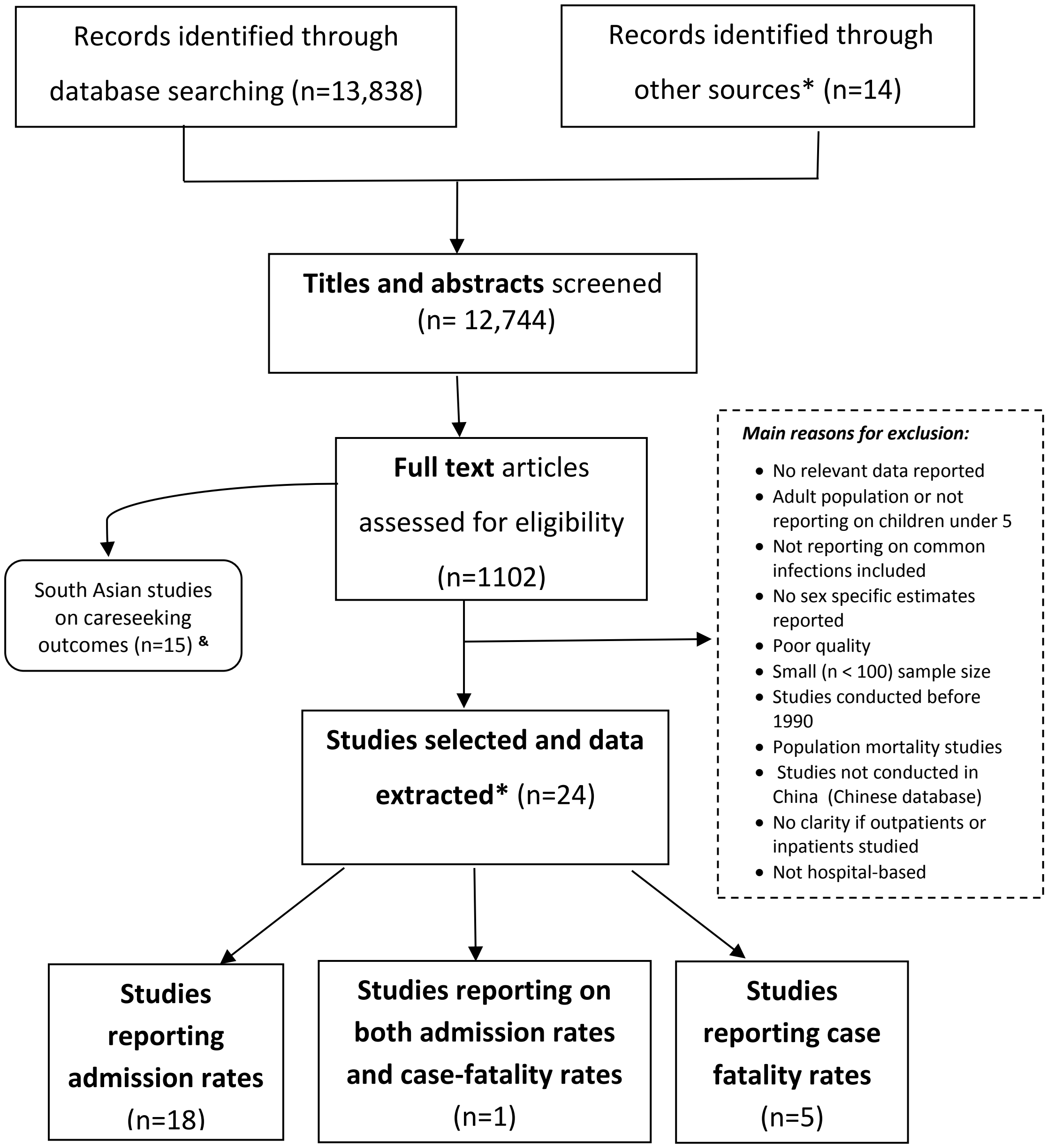


*After deduplication
**Up to this point, this flowchart is contained in ide the previous flowchart for the global systematic review looking at admissions for common infections and therefore, the same numbers apply, but reasons for exclusion are slightly different here.
$ Apart from studies reporting on careseeking behaviours, 12 other studies reporting on immunisation and nutrition were retained and are presented in the Conceptual Framework Chapter

Admission rates and in-hospital case-fatality rates studies

Similarly, out of the 13,852 records initially identified in our searches and through other sources, 24 studies were selected for the admissions part of the review. Out of these 24 studies selected, eighteen reported on admission rates only, five reported on in-hospital case-fatality rates only and one reported on both of these outcomes. After data extraction, the evidence was organised into different tables according to the different outcomes. See Figure 4 for more details on study selection steps for admission rates and in-hospital case fatality rates.

Figure 4. Flowchart diagram for selection of studies reporting on hospital admissions for pneumonia, diarrhoea and malaria in children under five (U5).



& See details of the steps for the selection of the 15 South Asian studies reporting on careseeking outcomes and also other outcomes (immunisation and nutrition) on the next Flowchart, Figure 3.
*For admission rates, studies selected are form different UN regions. For case-fatality rates, all six studies are from Asia, being three of them from Bangladesh (South Asia) and the other three are from South East Asian countries (Indonesia, Philippines and Malaysia). One study from Bangladesh reported both on admission rates and case-fatality rates (Fauveau et al.,1991).
**Apart from the main studies on admission rates and case-fatality rates, 23 other Asian (not only South Asian) studies reporting on number of admissions (without denominators) were identified and retained. These results are presented in Appendix 1.

Careseeking outcomes

Overview

For careseeking behaviours outcomes, there were 33 data points from three South Asian countries—Bangladesh (15), India (14) and Pakistan (4). For the geographical scope of the data points, please, see **Figure 5** .Most studies (58%) were conducted in the 0-59 months age group. Over 50% were conducted in rural settings, and mainly cross-sectional in general design (67%) (Table 3). Looking further at design, most of the studies presenting careseeking outcomes are either nationally representative household-based surveys (n=5) similar to the Demographic Health Surveys (DHS) supported by international agencies or smaller surveys in specific areas of a country, but equally well designed and representative (n=5). Others study designs include studies on sites where demographic surveillance has been in place (n=2), cohort studies looking at population careseeking behaviours (n=2) or verbal autopsy studies looking at careseeking behaviours before a fatal event (n=2) or baseline health careseeking studies (n=3) in sites where a randomised clinical trial of a specific child health care intervention was to be introduced. Therefore, most of the data on careseeking behaviours presented here come from well designed and conducted studies, with representative samples, randomly chosen, with reasonable power to detect differences in careseeking behaviours whilst controlling for other potential effect modifiers for the association of gender and careseeking. However, it is important to note that half of the studies are surveys and will suffer from the limitations of this type of the study, including recall bias and difficulty to infer causation. Moreover, in the case of DHS type surveys, the difficulties in assessing severity of disease and accurate disease diagnosis. Eleven different types of careseeking behaviours were identified in the twenty studies. Results are reported according to each specific outcome (see Table 3 for details on data-points). These outcomes reflect to a certain extent the different decisions steps carers are faced with when dealing with a sick child.

Table 3. Characteristics of studies reporting on health care-seeking behaviour

Author	Country	Setting	Disease	Design	Care-seeking	Protective / Harmful	Age	Total (N)	Girls	Boys	Prevalence (girls)	Prevalence (boys)	OR	LCI	UCI	Gender bias ?
Faveau, 1991	B	R	Diar	Prospective	**ModTreat**	P	0-59	46871	109	98	25.8	38.6	**0.67**	**0.66**	**0.68**	Y
Faveau, 1991	B	R	Diar	Prospective	**Trad**	H	0-59	46871	56	50	38.6	19.6	**0.57**	**0.56**	**0.58**	Y
Faveau, 1991	B	R	Diar	Prospective	**Prov_type**	P	0-59	46871	104	77	24.6	30.2	**0.81**	**0.79**	**0.84**	Y
Faveau, 1991	B	R	Diar	Prospective	**Hosp**	P	0-59	46871	28	24	9.4	6.6	**0.70**	**0.68**	**0.72**	Y
Ganatra & Hirve, 1994	I	M	ARI /Diar	Cross sectional	**Prov_type**	P	0-59	456			76.50	88.90	**0.40**	**0.21**	**0.77**	Y
Ganatra & Hirve, 1994	I	M	ARI /Diar	Cross sectional	**Dist**	P	0-59	456			54.90	69.80	**0.50**	**0.31**	**0.83**	Y
Ganatra & Hirve, 1994	I	M	ARI /Diar	Cross sectional	**Cost**	P	0-59	456			5.80	19.40	**0.27**	**0.12**	**0.63**	Y
Ganatra & Hirve, 1994	I	M	ARI /Diar	Cross sectional	**Refer**	P	0-59	456			25.00	69.20	**0.15**	**0.02**	**1.11**	Y
Hussain, 1999	B	U	Mixed	Cross sectional	**ModTreat**	P	0-12	265	152	105	44.8	46.7	**0.47**	**0.28**	**0.80**	Y
Tambe, 1999	I	R	ARI	Cross sectional	**AnyTreat**	P	0-59	965	497	468	68.60	76.70	**0.66**	**0.50**	**0.88**	v
Mitra, 2000	B	U	Diar	Cross sectional	**Delay**	H	0-59	466	166	296	4.2	2.5	**0.60**	**0.53**	**0.63**	Y

Author	Country	Setting	Disease	Design	Care-seeking	Protective / Harmful	Age	Total (N)	Girls	Boys	Prevalence (girls)	Prevalence (boys)	OR	LCI	UCI	Gender bias ?
Hasan,2000	P	U	Mixed	Retrospective	**AnyTreat**	P	0-59	259	112	147	61	80	**0.38**	**0.21**	**0.68**	Y
Pandey, 2002	I	R	Mixed	Cohort	**Prov_type**	P	0-59	530	267	263	37	54.8	**0.38**	**0.15**	**0.83**	Y
Pandey, 2002	I	R	Mixed	Cohort	**Delay**	H	0-60				24	6.5	**0.20**	**0.08**	**0.56**	Y
Pandey, 2002	I	R	Mixed	Cohort	**Cost**	P	0-61				20	50	**0.24**	**0.09**	**0.63**	Y
El Arifeen,2004	B	R	Mixed	Cohort	**ModTreat**	P	0-59	3559	1683	1876	11.1	10.9	**0.98**	**0.97**	**0.98**	No
Thind, 2004	I	R	ARI/ Diar	Cross sectional	**ModTreat**	P	0-36	840	411	429	46.7	53.3	**0.65**	**0.45**	**0.94**	Y
Larson, 2006	B	R	Diar	Cross sectional	**ModTreat**	P	6-59	4049	1949	2100	6.1	7.1	**0.74**	**0.65**	**0.86**	Y
Larson, 2006	B	U	Diar	Cross sectional	**ModTreat**	P	6-59	1972	916	1056	20.8	23.8	**0.88**	**0.73**	**1.1**	No
Larson, 2006	B	M	Diar	Cross sectional	**ModTreat**	P	6-59	646	298	348	11.4	16.1	**0.82**	**0.58**	**1.2**	No
Larson, 2006	B	M	Diar	Cross sectional	**ModTreat**	P	6-59	640	281	359	35.3	45.1	**0.57**	**0.41**	**0.81**	Y

Author	Country	Setting	Disease	Design	Care-seeking	Protective / Harmful	Age	Total (N)	Girls	Boys	Prevalence (girls)	Prevalence (boys)	OR	LCI	UCI	Gender bias ?
Larson, 2006	B	R	Diar	Cross sectional	**Prov_type**	P	6-59	2424			30.7	35.9	**0.8**	**0.61**	**1**	No
Larson, 2006	B	U	Diar	Cross sectional	**Prov_type**	P	6-59	1211			37.3	39.7	**0.73**	**0.57**	**0.94**	Y
Larson, 2006	B	M	Diar	Cross sectional	**Prov_type**	P	6-59	398			34.6	40.2	**0.71**	**0.43**	**1.2**	No
Larson, 2006	B	M	Diar	Cross sectional	**Prov_type**	P	6-59	446			46.3	58.2	**0.77**	**0.51**	**1.20**	No
Nuruddin, 2009	P	R	Mixed	Cross sectional	**Perc**	P	0-59	3740					**0.89**	**0.80**	**1.02**	No
Nuruddin, 2009	P	R	Mixed	Cross sectional	**Cost**	P	0-59	3740					**0.99**	**0.87**	**1.13**	No
Nuruddin, 2009	P	R	Mixed	Cross sectional	**Facil**	P	0-59	3740					**0.95**	**0.88**	**1.02**	No
Willis,2009	I	R	Mixed	Cross sectional	**Perc**	P	0-12	255	125	130	56	67.7	**0.57**	**0.34**	**0.96**	Y
Dongre, 2010	I	R	Mixed	Cohort	**Cost**	P	0-59	202	96	106	8.9	10.9	**0.82**	**0.79**	**0.84**	Y
Patel, 2012	I	U	Diar	Prospective	**Delay**	H	6-59	808	331	477	41	59.03	**0.88**	**0.76**	**1.02**	Y

Author	Country	Setting	Disease	Design	Care-seeking	Protective / Harmful	Age	Total (N)	Girls	Boys	Prevalence (girls)	Prevalence (boys)	OR	LCI	UCI	Gender bias ?
Malhotra, 2013	I	M	Diar	Cross sectional	**Facil**	P	0-59	2610	1151	1459	44.1	55.9	**0.93**	**0.79**	**1.08**	No
Malhotra, 2013	I	M	Diar	Cross sectional	**Delay**	H	0-59	2610					**1.41**	**1.09**	**1.82**	No

Country codes: I (India); P(Pakistan)B(Bangladesh); Setting codes: U (Urban); R (Rural); M (Mixed);

Protective behaviour (P):

Perc: Illness perception and reporting, **AnyTreat:** Utilisation of any health care treatment**, Prov_type:** Type/choice of health care provider used(likelihood of seeing a better qualified provider), **ModTT:** Modern treatment used, **Dist:** Distance travelled to treatment centre, **Cost:** Expenditure in health care treatment, **Facil:** Sought care at a health care facility (not necessarily admission), **Refer:** Referrals for further treatment followed.

Potentially harmful behaviour (H):

Delay: Delay in seeking care, **Trad:** Use of traditional healers.

Figure 5. Map showing geographical scope of datapoints for careseeking outcomes.

Pooled odds ratio of inequality in health-careseeking

The overall odds ratio (OR, girls versus boys inequality) for health careseeking behaviour is 0.71 (95% CI: 0.64-0.79). This is a significant finding of inequality in careseeking with girls dis-advantaged compared to boys. Figure 6 shows the distribution using box plots, with prevalence of health seeking relatively lower among girls compare to boys.

When each disease was examined, the ORs were also significant ranging from 0.66 (95% CI 0.50-0.88) for acute respiratory infections (ARI) to 0.75 (95% CI 0.69-0.82) for diarrhoea, and mixed infections reaching 0.88 (95% CI 0.74-0.92).

Figure *7*). Meanwhile, from type of careseeking outcome with three or more datapoints, mode of treatment (0.73, 0.6-0.9), provider type (0.76, 0.67-0.86) and cost of treatment (0.75, 0.57-0.97) all have significant odds of boys favoured compared to girls (Figure 8).

Figure 6. Prevalence distribution of careseeking across both genders.

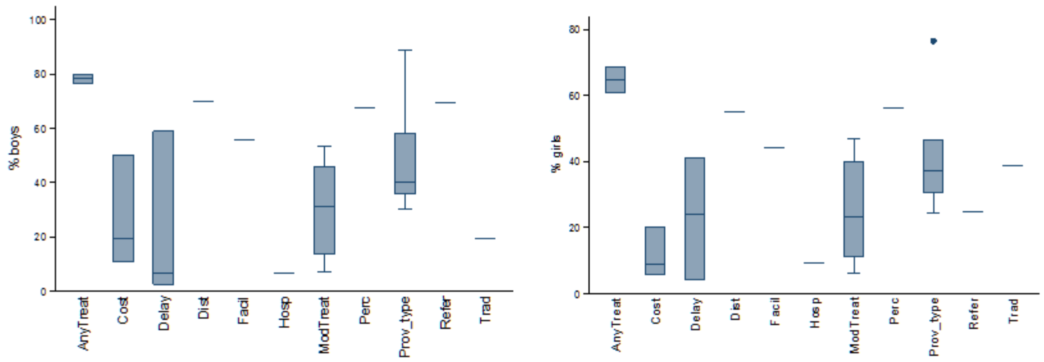
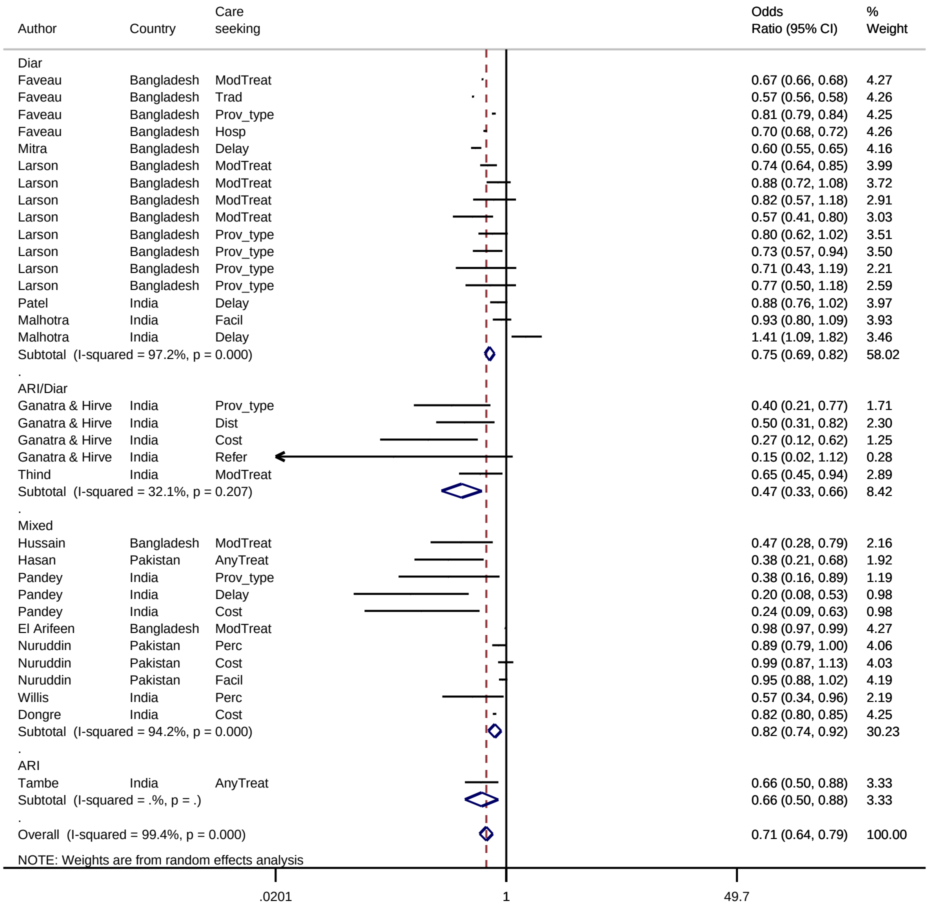
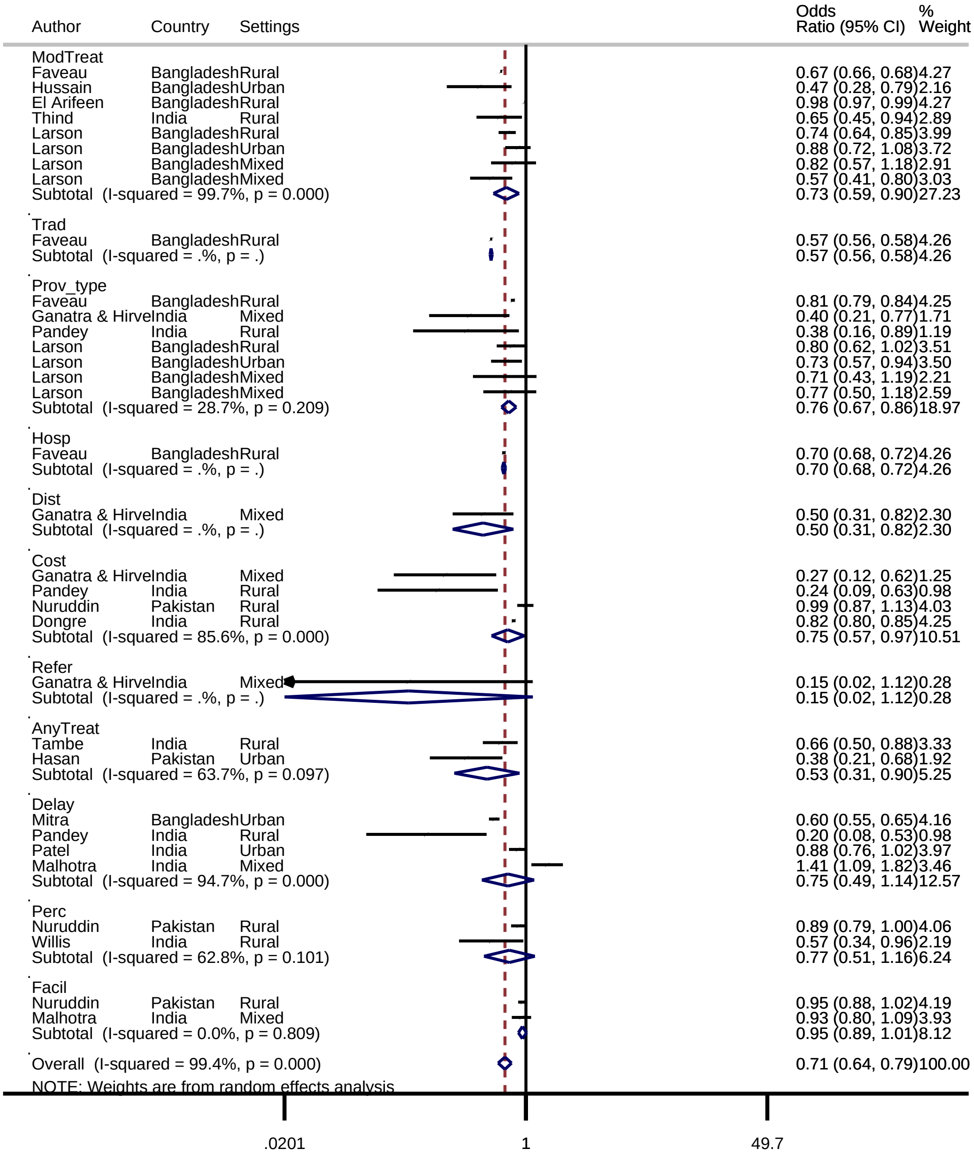


Figure 7. Pooled risk (odds ratio) of care-seeking inequality by disease type



Note: Estimates towards the left imply that girls have lower odds of receiving care compared to boys.

Figure 8. Pooled odds ratio (girls x boys) for care seeking behaviour by type of careseeking behaviour



Estimates towards the left imply that girls have lower odds of receiving care compared to boys

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Narrative synthesis of health careseeking inequality

Although the pooled ORs have been reported. It is important to understand the individual peculiarities of these findings from each study that reported inequality in care-seeking. This is done to complement the overarching discussion of the results contained in Chapter 7.

Illness perception or reporting in boys and girls

Two studies (Nuruddin et al., 2009a, Willis et al., 2009), all reporting on mixed diseases, evaluated this type of outcome and all three of them reported higher rates of symptom recognition and reporting in boys vis-a-vis girls. However, when adjusted for other potential determinants of careseeking, one of them (Willis et al., 2009) reported significant effect of gender in illness reporting (10% significance level). However, the authors of the other study (Nuruddin et al., 2009a) where adjusted prevalence ratios of reporting was not significant, suggested that the study might not have the power to detect small differences.

Treatment delay for boys versus girls

Three out of the four studies (Pandey et al., 2002, Malhotra and Upadhyay, 2013, Schmidt et al., 2012a, Mitra et al., 2000) reported a significant effect of sex of the child on delay to seek care, where delay in seeking care for girls was higher than for boys, even when adjusted for other relevant careseeking determinants like age, severity of disease, socioeconomic status and mother education.

Utilisation of any health care treatment for boys and girls (either modern or traditional)

All five studies presenting this outcome reported that boys were more likely to be offered any type of treatment compared to girls. This difference was also statistically significant (5% significance level in two studies and 1% at least in two others) in all five studies. At least three studies reported that this difference in careseeking persisted when adjusting for other relevant factors. In the study by Hussain and colleagues in Bangladesh (Hussain et al., 1999)this difference in treatment for boys versus girls was statistically significant only for poorer households.

Proportion of boys versus girls taken to a health care facility for treatment

Four studies reported on this outcome. Only one study (Malhotra and Upadhyay, 2013) reported significantly higher proportion of boys taken to a health facility (p=0.04), however, that difference did not persist when other factors were added to the model. Otherwise there is no evidence in these studies to suggest discrimination against girls when looking at this specific careseeking outcome.

Proportion of boys versus girls seen by more than one Health Care provider

Only one study in Bangladesh (Fauveau et al., 1991) looked at careseeking for diarrhoea reported this type of outcome. When fatal disease was investigated, boys were more likely to taken to more than one health care provider and this difference was significant (p=0.0005).

Choice of provider used for boys versus girls (i.e., likelihood to see a better qualified practitioner)

All six studies reporting on this type of outcome reported that boys were more likely to be taken to a better qualified health care professional than girls. Not all studies adjusted for all relevant determinants, but the studies providing adjusted ratios the sex disparity was statistically significant even when adjusting for determinants like severity of illness, socioeconomic characteristics (e.g. asset quartile, income, duration of illness, parent's education level). A study on careseeking for diarrhoea in Bangladesh (Larson et al., 2006) reported that families living in urban households were more likely to show gender bias against girls when compared to families rural and city corporation settings.

Use of modern treatment for boys and girls

Two studies, both on mixed diseases and both conducted in Bangladesh reported on this type of outcome. One of them (El Arifeen et al., 2004), a Cluster Randomised Controlled Trial looking at the implementation of the Integrated (IMCI) strategy reported no significant impact of gender in careseeking in rural Bangladesh. The other study by Hussain and colleagues (Hussain et al., 1999) looked at child (under 9 years) mortality and its determinants in a slum population in Dhaka. They detected an excess female mortality in infancy (<12 months) and report that modern treatment was made available more frequently to boys than girls in infancy.

Distance travelled for boys compared to girls to reach treatment centre

The role of geographical access in health care use cannot be ignored. Two studies in India compared the distance travelled by families to reach treatment centre for boys versus girls. One of them (Pandey et al., 2002) looked at gender differences in careseeking for common diseases in West Bengal and found in the univariate analysis that parents were more likely to cover longer distances to reach care for boys compared to girls. However, this difference did not persist when other variables (i.e. type and severity of illness; age and birth order of child, education of mother, occupation of household head and per-capita income) were put into the statistical model. The other study, cross-sectional survey of 3,100 families in rural Pune district in Maharastra (Ganatra and Hirve, 1994), reported that parents were twice as likely to cover a longer distance to take their male children to health care treatment centres when compared to their female children,. Moreover, this difference persisted even when after the authors adjusted for severity of illness, parent's income, occupation and education, and the child’s birth order.

Expenditure in health care for boys versus girls

Four studies in India and one in Pakistan reported on this type of outcome. Two Indian studies (Ganatra and Hirve, 1994, Pandey et al., 2002) reported that parents spent roughly four times more in treatment for boys compared to girls and this difference persisted after adjusting for important factors like type and severity of illness, parent’s education and income.

The other Indian study, looking at careseeking behaviours for neonates in rural Uttar Pradesh (Willis et al., 2009), reported that parents spent in average nearly four times more in health care treatment for boys compared to girls. However, due to sample size, this outcome was not adjusted for other variables.

The other two studies, one in a peri-urban area of Maharashtra in India, and the other one in rural Pakistan found no differences in household health expenditures for boys compared to girls. However, the latter study might have lacked power to detect small gender differences.

Use of antibiotics for boys and girls

Only one study in Bangladesh (Larson et al., 2006), a nationally representative, randomly selected, cross-sectional, cluster-sample survey carried out in selected rural and urban populations. This study, by Larson and colleagues, looked at diarrhoeal illness. At least in rural communities and non-slum community city corporation dwellings they report that boys were on average 35% to 75% more likely to receive antibiotics for diarrhoeal illness than girls. This difference is the based on the adjusted Odds Ratio, where other potential determinants were adjusted for in the model (i.e. asset quartile, age, duration of illness, mother's education, father's occupation, bloody diarrhoea). The authors conclude that higher income and urban households tend to practice greater gender discrimination against girls in terms of careseeking and treatment.

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Hospital admissions and in-hospital mortality outcomes

Study characteristics

There were 22 data points from 19 studies conducted across 13 specific countries and a multicountry study (Nair et al., 2013a). Most studies were conducted in Asia (36.8%), and in rural settings (45.5%). There were more studies focusing on acute lower respiratory infection (ALRI) (54.6%) and mostly among children aged 0-59 months (38%) (Table 5).

The total number of studies reporting on admission rates were 19, and 14 of these studies were conducted outside South Asia. See Table 4 and Figure *9* for details on geographical location of studies and development classification, according to the United Nations development classification (United Nations, 2014). This regional grouping classification is supposed to be relevant Millennium Development Indicators.

Six South Asian studies reported admission rates (Hasan et al., 2014, Nair et al., 2013, Schmidt et al., 2012b, Bhan et al., 2005, Nuruddin et al., 2009a, Fauveau et al., 1991) and within these, four studies provided admission rates using catchment population denominator (Nair et al., 2013, Bhan et al., 2005, Schmidt et al., 2012b, Hasan and Khanum, 2000) and the other two (Nuruddin et al., 2009b, Fauveau et al., 1991) used the proportion of sick children in the community who were admitted to hospital. One of the population studies is a meta-analysis by Nair and colleagues (Nair et al., 2013) and includes 28 unpublished studies, where 9 of them are from Asian (and seven of the studies from South Asian sites) and the admission rates in Asian countries are compared to global rates. Most of the data for the admission rates outcomes comes from studies in children under five (Table 5), including the 28 unpublished studies in the meta-analysis. Most of the studies report on common infections requiring hospitalization, mainly diarrhoea, pneumonia and fever. The majority of the data for the admission rates outcome was collected in South Asian countries.

Table 4. Geographical* location and development classification of studies reporting on admission rates for common infections

Author, year	Country (number of studies)	UN Sub-Region	n (%)	UN development grouping	UN Region	n (%)
Faveau, 1991; Bahn, 2005; Baqui, 2007; Nair,2013;	Bangladesh (2); Mixture of countries (1); India (1)	South Asia	4 (21.1%)	Developing	Asia	7 (36.8%)
He, 2010	China (1)	East Asia	1 (5%)	Developing		
Schimidt, 2012; Hasan, 2014;	Vietnam (1); Thailand (1)	South East Asia	2 (11%)	Developing		
Tornhein, 2007; Tornhein, 2010	Kenya (2)	East Africa	2 (11%)	Developing	Africa	2(11%)
Bjorn, 2003; Jensen-Fangel,2004; Clark, 2007; Koch,2013;	Denmark(2); Sweden (1); England (1)	Northern Europe	4 (21.1%)	Developed	Europe	4 (21%)
Malik, 2006; Parashar, 1999;	USA (2)	North-America	2 (11%)	Developed	Americas	4 (21%)
Boccolini, 2012; Cesar, 1997	Brazil (2)	South-America	2 (11%)	Developing		
Moore, 2012; Grant, 2011	Australia (1); New Zealand (1)	Australia and New Zealand	2 (11%)	Developed	Oceania	2(11%)
Total						19 (100%)

*UN region division used (http://mdgs.un.org/unsd/mdg/Host.aspx?Content=Data/RegionalGroupings.htm)

Note that studies like Boccolini were published in 2012, but report on outcomes for the years 1999, 2008.

Figure 9. Geographical scope of datapoints for admission rates outcomes

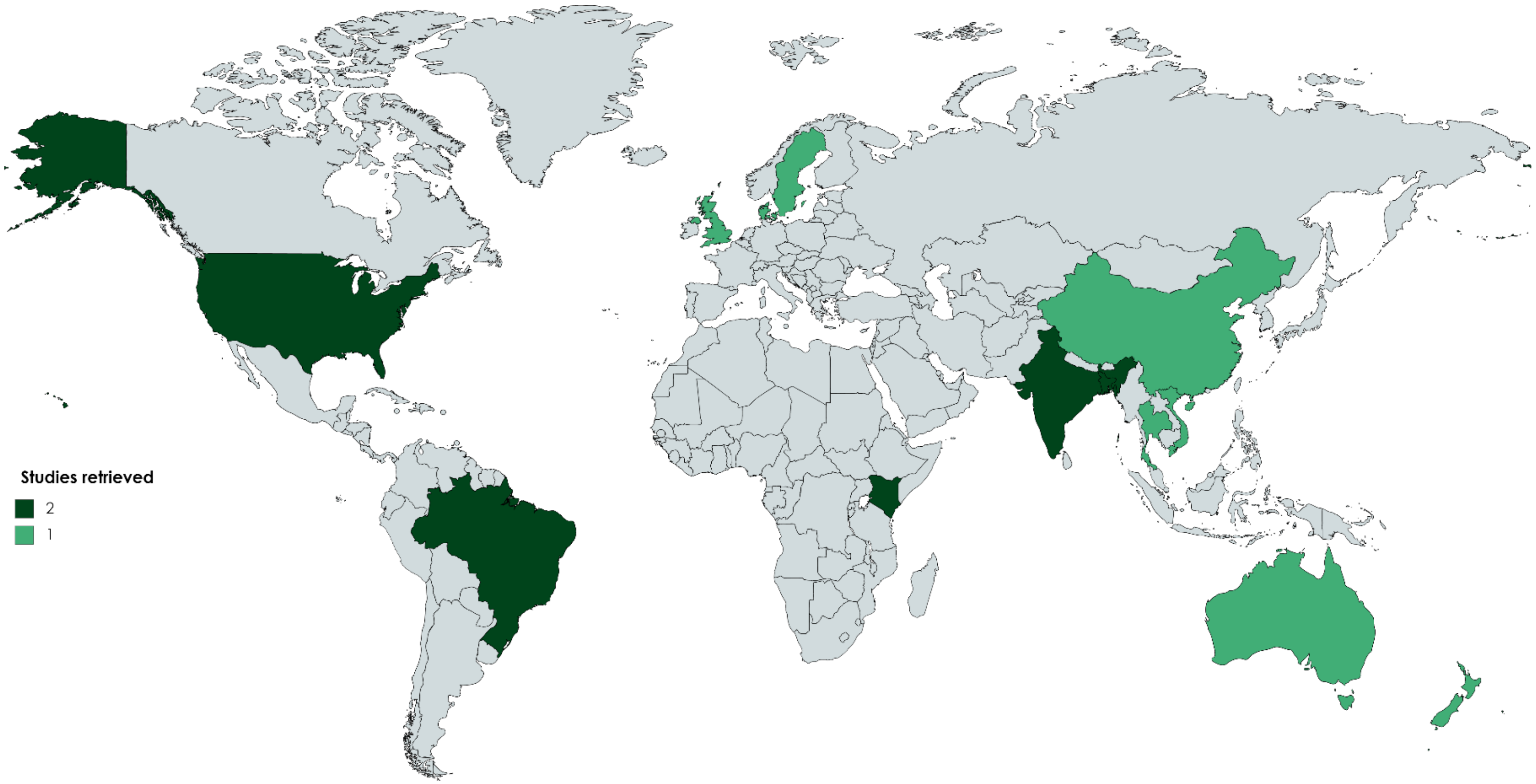


Table 5. Data points from all studies on admission rates' inequality

Author	Country	Setting	Region	Age (months)	Disease	Design	Pop. At risk (girls)	Pop. at risk (boys)	Admissions (female)	Admissions (male)	Incidence/IRR * admissions (girls) (95% CI)	Incidence/IRR-admissions (boys) 95% CI)	IRR/ OR	LCI	UCI
Faveau, 1991	B	R	South Asia	1-59	Diarrhoea	cohort	22652	24219	814	1199			1.40	1.28	1.53
Bahn, 2005	I	U	South Asia	0-12	Mixed	cohort	40480	45153	1564	2854	38.6	63.2	1.64	1.62	1.66
Bahn,2005	I	U	South Asia	0-12	Mixed	cohort	40481	45153	312	500	7.7	11.1	1.44	1.40	1.47
Bacqui, 2007	B	R	South Asia	0-11	ALRI	cohort					22.1	34.2	1.55	1.30	2.07
Bacqui, 2007	B	R	South Asia	12-59	ALRI	cohort			461	789	82.8	133.9	1.62	1.54	1.71
He, 2010	Chi	M	Asia	0-59	Diarrhoea	surveillance	7856	1134	101	174	12.85	15.35	1.09	1.05	1.13
Schimidt, 2012	Viet	R	Asia	0-23	ALRI	cohort							1.47	1.30	1.69
Schimidt, 2012	Viet	R	Asia	0-24	Diarrhoea	cohort							1.45	1.30	1.59
Hasan, 2014	Thai	R	Asia	0-59	ALRI	surveillance			11697	16846			1.38	1.35	1.41

Tornhein , 2007	K	R	Africa	0-59	ALRI	cohort					693	826	0.84	0.75	0.95
Tornhein , 2010	K	R	Africa	0-59	Diarrho ea	cohort					513	692	0.74	0.65	0.84
Koch, 2013	Den	U	Europe	0-23	ALRI	cohort							1.61	1.14	2.29
Bjor, 2003	Swe	M	Europe	0-11	ALRI	cohort							1.4	1.18	1.66
Jensen-Fangel, 2004	Den	M	Europe	0-59	ALRI	cohort			7024	9437	1.27	1.24	1.32	1.27	1.24
Clark, 2007	En	M	Europe	0-59	ALRI	cohort					27.9	35.2	1.26	1.05	1.50
Malek, 2006	USA	M	North Americ a	0-60	Diarrho ea	cohort	67354	83051			72	85	1.18	1.08	1.28
Parashar , 1999	USA	M	North Americ a	1-59	Diarrho ea	cohort			5146	6178	4.6	5.24	1.14	1.04	1.24
Bocolini, 1999	Br	U	Latin Americ a	1-11	Diarrho ea	cohort	347015	315026	3341	4418			1.26	1.20	1.32

Bocolini, 2008	Br	U	Latin America	1-11	Diarrhoea	cohort	299763	315026	1513	1995			1.26	1.17	1.34
Cesar, 1997	Br	U	Latin America	0-11	ALRI	surveillance	2696	2608					1.19	0.86	1.65
Moore, 2010	Aus	R	Oceania	0-23	ALRI	cohort			111072	116575			1.28	1.22	1.45
Moore, 2010	Aus	R	Oceania	0-23	ALRI	cohort			8577	8889			1.13	1.03	1.23
Grant, 2011	NZ	U	Oceania	0-59	ALRI	cohort			132	157			1.28	0.96	1.72
Nair-META, 2013	Mult	M	South Asia	0-11	ALRI	cohort							1.88	1.49	2.38
	Mult	M	South Asia	12-23	ALRI	cohort							1.42	1.22	1.65
	Mult	M	South Asia	24-59	ALRI	cohort							1.9	1.41	2.45

***IRR:** incidence rate rate
Country codes: Aus(Australia); I (India); P(Pakistan)B(Bangladesh); Br(Brazil);USA (United States of America); Sw(Sweden);Den (DenMark); En (England); K (Kenya); CH (China); Viet(Vietnam); Th (Thailand); NZ(New Zealand); Mult (Multicountry)
Setting codes: U (Urban); R (Rural); M (Mixed)

Pooled Odds Ratio for admission rate

As observed for health careseeking, more boys are getting treated/admitted for common childhood infections compared to girls (OR 1.27, 1.18-36). Inequality for mixed diseases was the highest (OR 1.5, 1.35-1.75), followed by ALRI (OR 1.3, 1.2-1.4) and then diarrhoea (OR 1.2, 1.1-1.3). Inequality was highest in South Asia (OR 1.5) and Asia (OR 1.3), while the only study from Africa showed no inequality towards girls (OR 0.84, 0.75-0.95). See Figure 10 and Figure 11 for details.

Figure 10. Pooled risk of inequality of admission rate by disease type (note: right is favourable for boys)

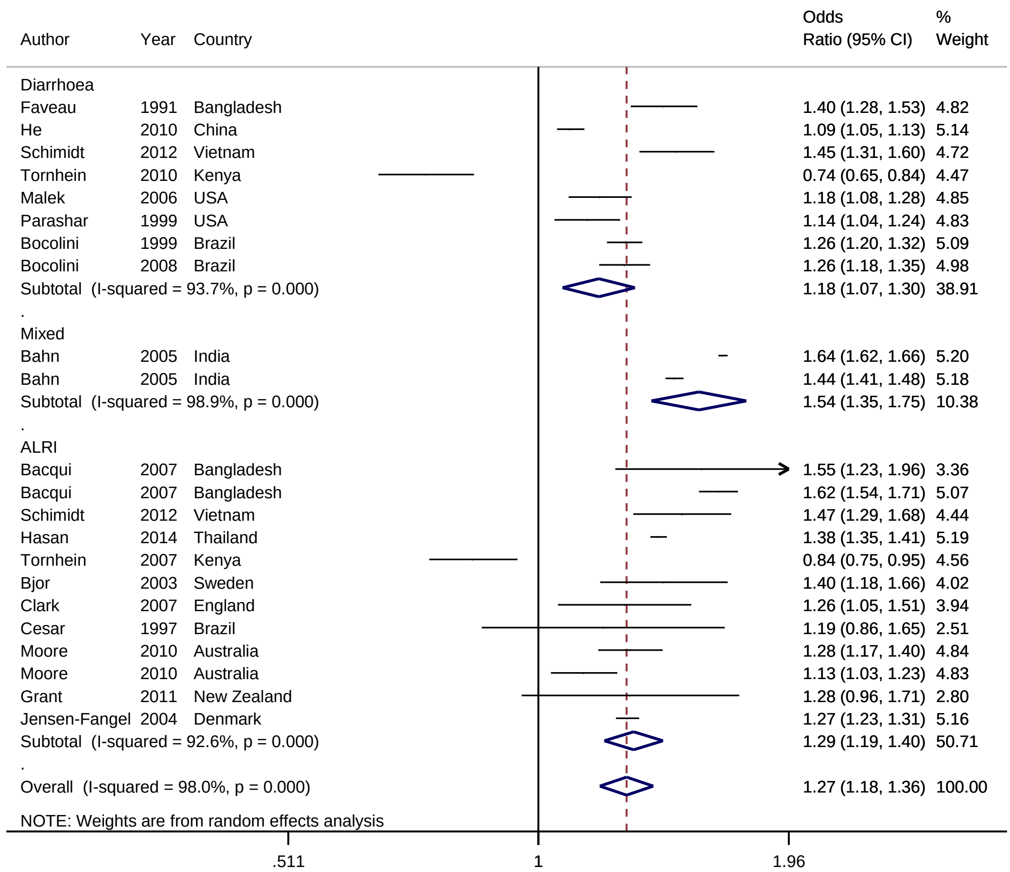
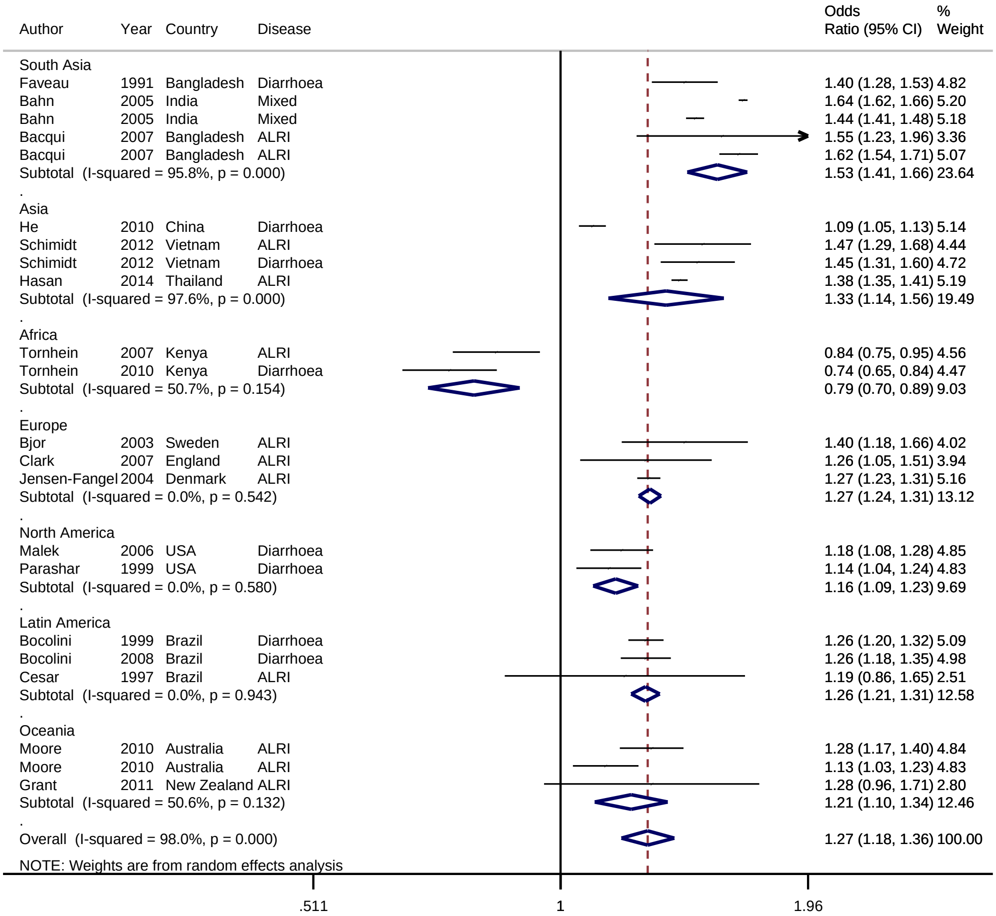


Figure 11. Pooled risk of inequality of admission rate by world region (note right is favourable for boys).



Narrative synthesis

All of the studies, except one (Nuruddin et al., 2009b) report significantly higher rates of hospital admissions for boys compared to girls. The data presented in Table 2 suggests that hospital admission bias favouring boys is not restricted to respiratory infections only and persists even after adjustment for various other potential determinants of careseeking. The association between gender and hospital admissions in the studies persisted after controlling for child's specific circumstances like young age, baseline morbidity previous to admission, incidence of disease in the community and also severity of disease. In these studies, the difference remained when mother and/or father's education were controlled for. Household and family situation determinants like socioeconomic status, distance to health care facility, family size, occupation of head of household and living setting (rural or urban) are supposed to affect careseeking and hospitalization for children. Again, the effect of gender in the studies selected persisted even after controlling for these important household and family situation determinants. One study in Vietnam (Schmidt et al., 2012a) reported no impact on the association of gender and hospital admissions for diarrhoea, pneumonia and dengue fever after the introduction of health care fee exemption for children in that country. Another study in India (Bhan et al., 2005) used Verbal Autopsy and detected higher death rates for girls compared to boys in a community. However, despite that, girls were hospitalized much less frequently than boys for both severe and non-severe infections. The same study suggests that families with lower socioeconomic status and where mothers are less educated were less likely to discriminate against girls in terms of hospital admissions.

All of the studies reported admission ratios (male /female) higher than one. These admission ratios tend to be higher than the mean male to male child population ratio in the country.

Admissions only

Twenty-three studies reported on number of admissions only without population denominators. Most of them (47%) report data from South Asian countries, one third of them reports on data from South East Asia and the rest from East Asia. Most of them report on number of admissions for pneumonia, diarrhoea and malaria for young children. Detail on these studies selected can be found in Appendix 1 of this thesis.

In-hospital case fatality rates

Study characteristics

All but one study reported data on children under five years old. Three studies were from South Asia and three from South East Asia (Table 6). Six studies reported on in-hospital case fatality rates (Butler et al., 1991, Fauveau et al., 1991, Lee and Ooi, 1999, Mitra et al., 2000, Djelantik et al., 2003, Lupisan et al., 2007) and within these, only one study in Bangladesh (Fauveau et al., 1991) provided both case fatality rates and admission rates (where boys were significantly more likely to be admitted than girls). Three studies were conducted in urban settings, and four focused on diarrhoea (Table 6).

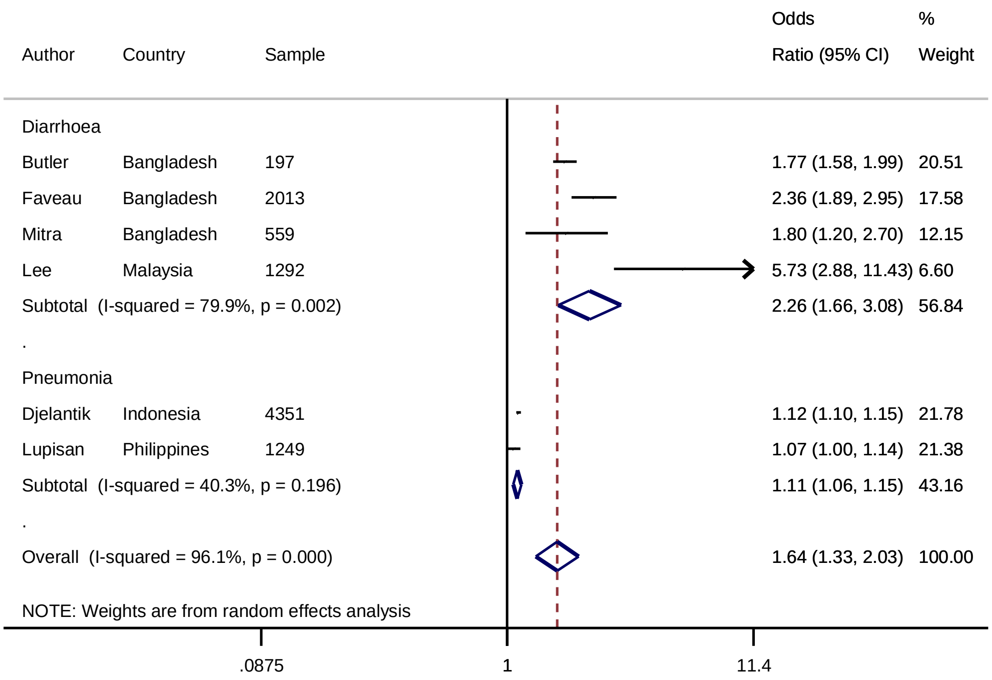
Table 6. Data points from studies on inequality in hospital case-fatality rates

Author	Year	region	Country	Setting	disease	Age	Total (N)	Girls	Boys	death _girls	death _boys	CFR short results (female:male)			Gender bias
Butler	1991	SA	Bangladesh	Urban	Diarrhoea	0-59	197	82	115	17	11	1.77	1.58	1.99	Yes
Faveau	1990	SA	Bangladesh	Rural	Diarrhoea	1-59	2013	814	1199	61	38	2.36	1.60	2.50	Yes
Mitra	2000	SA	Bangladesh	Urban	Diarrhoea	0-59	559	170	296	88	112	1.8	1.2	2.7	Yes
Djelantik	2003	SEA	Indonesia	Mixed	Pneumonia	0-23	4351	1704	2647	212	293	1.12	1.1	1.15	Yes
Lupisan	2007	SEA	Philippines	Rural	Pneumonia	1-59	1249	521	728	17	13	1.07	1.00	1.14	Yes
Lee	1999	SEA	Malaysia	Urban	Diarrhoea	0-12	1292	531	761	8	2	5.73	2.31	9.16	Yes

Pooled risk of inequality in in-hospital case fatality

Across the six studies, girls were more likely to die in hospital compared to boys. This was higher for diarrhoea (OR 2.26, 1.66-3.08), compared to pneumonia (OR 1.11, 1.06-1.15). The overall pooled odds ratio was 1.64 (1.33-2.03). Please see Figure *12*. Pooled odds of inequality of in-hospital deaths by disease type

Figure 12. Pooled odds of inequality of in-hospital deaths by disease type



Note: Estimates towards the right is favourable for boys

Narrative synthesis

The five studies reporting only on admission numbers reported a higher percentage of boys compared to girls being admitted for both diarrhoea and pneumonia (See Table 6 for details). In three out of the six studies, case fatality rates in girls were significantly higher than in boys, as measured by the 95 % confidence intervals of Case Fatality Rates Odds Ratio or Risk Ratios in Table 3. In the other three studies, case fatality rates in boys and girls were significantly different, including in one

Indonesian study (Djelantik et al., 2003) , where very young (0-23 months) boys and girls were admitted for pneumonia. This is the only study reporting where the mean Odds Ratio for the case fatality ratio is smaller than one (OR CFR: 0.95 (0.80 – 1.1)).

Conclusion

From all the three types of health care service utilisation outcomes explored in this chapter, the odds of inequality was generally higher among girls compared to boys. Gender differences in admission rates for girls compared to boys are more skewed when South Asian countries are compared to other regions. There are several limitations in this study, especially with limited data from many countries in South Asia and indeed many low- and middle-income countries, which could have provided more evidence for comparisons. Although, studies on malaria were retrieved from other LMICs, there were no suitable studies on malaria from South Asian countries for comparisons; thus, these studies were discarded. A comprehensive discussion on the findings and limitations of this systematic review is provided as part of the overall thesis discussion in Chapter 7.

Chapter 3. Conceptual Framework

"We will pay the extra rupee to treat our son"- a conceptual framework explaining gender inequity in child health care and health care utilisation in South Asia.

Overview

This chapter presents the key theoretical concepts guiding this thesis research. Equally, a conceptual framework is proposed and was used to refine the main research questions and the interpretation of findings. This framework is shaped by an interdisciplinary, ecosocial and epidemiologically sound approach and informed by an extensive literature review. At the end of the chapter, an example of the operationalisation of the proposed theoretical concepts into a research question, using the nationally representative household survey, the Demographic and Health Survey conducted in India (DHS 2005-06).

This chapter, unlike all the other chapters in this thesis, is written mostly in the first person. Although this breaks the consistency of the writing style of the thesis, it might help the chapter flow of ideas. To aid the understanding of multidimensional concepts, constructs, ideas and relationships, a number of diagrams, evidence tables and explanatory boxes are provided. Similarly, a couple of definitions used in this chapter are provided in the beginning of the thesis under "List of abbreviations, definitions and acronyms".

And finally, a summary overview of the structure of the chapter, highlighting the main sub-sections is provided under.

Introduction

As mentioned earlier in the Introduction Chapter, in the last two decades, coverage of life-saving interventions for young children (I.e., under 5 years of age), has increased substantially in low and middle-income countries (LMICs). However, not all children benefit equally from this increase (Barros and Victora, 2013). The most obvious group of vulnerable children in these countries are those living in the poorest, less educated and more rural communities. In the patriarchal societies of South Asia, gender inequality remains an important structural marginalisation factor and leads to son preference (Das Gupta et al., 2003, Gupta and Bhat, 1997, Pande and Astone, 2007). Son preference affects the life of young children (i.e. children under 5 (U5)) putting girls at a social and health disadvantage (Hill and Upchurch, 1995b, Bank, 2012a, Krishnan, 2013b). Therefore, in these societies, girls should be regarded as a vulnerable group of children.

Historical evidence shows that since the mid 1800's in most of the regions of the world, and especially in developed countries, women of all ages tend to live longer than men (Stolnitz, 1956). In South Asia, this is not the case (El-Badry, 1969, D'Souza and Chen, 1980, Langsten, 1981, Sen, 1992). Excess female mortality of South Asian women, especially during childhood and reproductive years, even when compared regions of the world in the same stage of development, suggest the role of social discrimination rather than economic development (Sen, 1989a, Dasgupta, 1987, Pandey et al., 2002, Bank, 1980, Bank, 2012b, Jha et al., 2011, Alkema et al., 2014). Sex-selective abortions, female infanticide, and inadequate healthcare and nutrition for girls compared to boys, are examples of prevalent practices which reflect discrimination against girls in the South Asian region (Klasen, 1994, Chen et al., 1981a, D'Souza and Bhuiya, 1982, Fikree and Pasha, 2004, Sawyer, 2012, Krishnan, 2013a). These practices affect girls' health and lead to excess deaths in girls compared to boys, the "missing girls" phenomena in South Asia. Sex-selective abortion of girls is still present in India (Jha et al., 2011) and has also increased substantially from 1990 to 2005. Besides the pre-natal selection, increased mortality in young girls compared to boys is still an important issue in both South

Asia as a whole (i.e. India, Pakistan, Bangladesh, Afghanistan and Nepal) and India (Alkema et al., 2014).

Providing young children with adequate care, which includes medical care, is key to ensure their health, development and wellbeing. Guaranteeing that life-saving interventions (e.g. immunisations, medical treatment for infections and hospital care) reach the children in need is a crucial aspect of this care. Provision of affordable, accessible and good quality health care services in developing countries play an important part in these efforts. Governments and society as a whole should be accountable for making sure that these life-saving interventions are accessible to children who need them. However, families and communities also play an important role by providing adequate child care and *reaching and accepting* the available care, including medical care (Geldsetzer et al., 2014a). Without families' appropriate general child care, care seeking and care acceptance behaviours, children, and more specifically, girls in South Asia, might still be disabled or die even when care resources are in reach. Therefore, in this context, understanding the role and dynamics of gender inequities in child health care utilization is vital (Park and Brondi, 2015b).

Although the existing body of evidence showing gender based inequities affecting child health care utilisation is substantial, it is less organised, divided into the medical and social sciences and lacks an underlying theoretical basis. In the biomedical literature, much of this evidence lacks an explicit theoretical basis. Few attempts in the past aim to combine research methods employed by social and medical scientists to understand the impact of social, economic and biological determinants on child morbidity or mortality in LMICs. Among these is the Analytical Framework for the Study of Child Survival in Developing Countries by Mosley and Chen (Mosley and Chen, 1984). However, like other attempts, this framework focuses on "the proximal-distal" divide (Krieger, 2008), laying disproportionate emphasis on biological determinants of disease, relegating social and ecological determinants to the murky "blurry" domain of distal cause.

Conceptualisations on the effect of gender discrimination on health access and outcomes have been proposed by others both in relation to developed and developing countries (Doyal, 2000, Doyal, 2001, Doyal, 2003, Krieger, 2003, Theobald et al., 2006a, Sen and Östlin, 2008), including in South Asia (Iyer et al., 2007, Sen et al., 2007). Nonetheless, although informative, the conceptual work available focuses mainly on the pathways through which gender affects health access and utilisation in adult women, or how gender issues affecting adult women impact on their offspring. There is also a scarcity of conceptualisation using the value of the female child for the family as a key determinant of allocation of care resources by families. The conceptualization of this phenomena is a clear challenge and requires a theory that includes simultaneously social, biological and ecological aspects with a spatiotemporal dimension. Additionally, as others have previously recommended (Doyal, 2003), gender discrimination affecting health should be considered together with other structural essential determinants of health (e.g. socioeconomic status, age, race and ethnicity), i.e. using an intersectional approach. In summary, this lack of a theoretical basis to underpin these issues is a real epidemiological challenge.

Whilst the importance and impact of women's empowerment in child health outcomes cannot be denied (Osmani and Sen, 2003), the focus of my work is specific. I aim to explore the different pathways through which gender affects health access and utilisation of girls, focusing on the health consequences on girls' health *because they are girls*. Evidence of gender effects on child health care have been reported by both social and medical researchers. However, so far, no comprehensive conceptual model including biological, social, economic and cultural factors to explain this phenomenon have been proposed.

This aim of this chapter is therefore to provide a sociological angle to the quantitative and biomedically informed exercise looking at the relationship of gender and child health care utilisation in SA. Going beyond the description of gender inequities in patterns of health care utilisation and providing some explanations on *why* it happens. The conceptualization can fulfil two purposes, i.e., it guides the analytical framework and also provides support for the discussion and interpretation of the quantitative findings of this thesis.

What makes young South Asian girls sick? *The importance of being interdisciplinary*

Studying the effects of gender discrimination in child health poses a fairly complex challenge from the epidemiologists. Child health care utilisation is a very broad topic and gender is a complex concept. Particularly in the medical literature, there is still confusion and imprecision in the use of the terms gender, sex, sex-link biology, gender role, etc. (Krieger, 2003). Partially, this is due to the fact that gender as a determinant of health is a relatively new idea and field of study, particularly in the biomedical sciences. During my literature review, I also realized quickly that doing a systematic literature review on this theme presents various challenges in terms of conceptualization and indexing. For example, take the United States National Library of Medicine (NLM) databases system. To improve the quality of medical literature searches they provide a service to help researchers to use the right controlled vocabulary thesaurus used for indexing articles in their databases, including the widely regarded MEDLINE and PubMed. This vocabulary thesaurus database is called the NLM Medical Subject Headings (Medicine_PubMed, 2016), or MESH for short, and is widely used by systematic reviewers and health researchers. Currently (i.e. June, 2016), this thesaurus database has 27,883 descriptors with 87,000 entry terms aiming to help users finding the most appropriate MeSH for their bibliographic research. However, there are several inconsistencies, not least that most subheadings relating to gender are not well described or indexed, at least not as a social construct, reflecting in my opinion a strong biomedical bias of this database. First, Gender as a MESH term was only indexed in 1975. Second, typing the word Gender into the MESH browser will invariably direct you to a MESH term relating to gender identity, with a clear psychological sciences bias. Third, the MESH Browser also suggests in their historic notes that if you want to identify articles on gender that were published before 2003, you should use the work Sex instead. Fourth, there is no definition of gender or gender role in the MESH database, only the definition of gender identity. Fifth and more recently, the word sexism has been indexed (2013) and defined in the MESH thesaurus, albeit still a definition of gender as a broader concept is missing.

Therefore, the challenges understanding gender discrimination in child health care requires a truly interdisciplinary approach, using *concomitantly* biological, sociological, psychological and ecological tools and concepts. Attempting to understand such a complex phenomenon without using an interdisciplinary approach is naïve, to say the least, and deficient and reductionist to be more precise (Doyal, 1995). Ideally, a review of the literature should include social sciences evidence, and not rely purely on biomedical literature when approaching gender-based health inequity.

The work presented here highlights important sociological, anthropological, demographic, economic and developmental aspects of gender inequities in health mainly in developing countries and especially in South Asia. Why should we consider these social sciences aspects of gender discrimination before even addressing health care utilisation? Because a purely 'biomedical model' is not good enough to explain or help addressing the health troubles of South Asian girls, even the troubles relating to health care utilisation. In fact, without a more 'humanised' approach, women and girls' health and wellbeing issues cannot be understood or addressed (Doyal, 1995).

A full list of main themes explored by authors from different disciplines about gender and health in general and gender inequalities in South Asia is provided in Table 7. There are key themes in the literature compiled that helps to understand some of the mechanisms driving gender discrimination and health disparity for girls in South Asia. These are:

- Son preference, family composition aspirations in India and Asia (Arnold, 1987, Basu, 1989, Hesketh and Xing, 2006, Das Gupta et al., 2003, Hussain et al., 2000, Arnold et al., 1998).

- The "missing girls" phenomena, son preference and development (Sen, 1989a, Sen, 1992, Sen, 2003a)
- Social constructs, power relations (Annandale and Hunt, 2000, Connell, 2012, Doyal, 2000, Springer et al., 2012)
- Demographic aspects of son preference (Sen, 2003a, Zhu et al., 2009, Hesketh and Xing, 2006)
- Anthropological aspects like domestic and community traditions, kinship, social reproduction, religion (Jeffery and Jeffery, 2010, Jeffery et al., 1989)
- The political, economy of health (Doyal, 1995)
- Intersectionality and women's health (Doyal, 2003)
- Methodological aspects studying gender and health(Doyal, 2003) (Doyal, 2000)
- Gender discrimination health care access (George et al., 2005b, Iyer et al., 2007, Sen and Iyer, 2012).

To understand gender discrimination and health disparity for girls in South Asia, it is crucial to understand first *the role of gender in South Asia and how and why girls and women are affected by it.* Others have argued that women in South Asia suffer a "life cycle" of discrimination with important consequences for their health (Fikree and Pasha, 2004). Fikree and Pasha (ibid) argue that most of the gender based health disparities in South Asia could be traced back to three underlying factors: son preference (magnified by decrease of fecundity), the practice of dowry in most groups in in the region and the marginalisation of women in agriculture. Therefore, if we accept this argument, it is plausible to understand why many South Asian families see daughters as a financial liability lasting for a long period of time, i.e. from their birth till their marriage. In India, according to some authors, the persistence of the Dowry tradition reinforces this gender bias (Das Gupta et al., 2003). If their resources are scarce this "liability" perception might even be increased. And, I argue, that is the main reason why girls are neglected.

However, as we and others have proposed before (Bhan et al., 2005, Park and Brondi, 2015b), evidence suggests that gender bias against girls can become so deeply–rooted in some South Asian countries that it might persist or worsen in more educated and richer families, compared to those who are poorer and less educated.

Bringing the knowledge from different disciplines have enriched the work conducted in this thesis and provided a "bridge" to understand gender inequalities and inequities in child health in South Asia.

Table 7. Research work from multiple disciplines relevant to this framework

Main themes explored and findings/conclusions	Author, year	Discipline/ Field
Son preference, family composition, fertility, family planning, Dowry tradition, Excess female mortality	Arnold et al., 1987; Hussain, et al.,2000; Sen, 2003, Das Gupta et al.,2003; Zhu et al.,2009;	Ep, De
Family composition, fertility, family planning	Arnold et al., 1987; Arnold et al., 1998;	Ep
Sex selective abortions and abnormal sex ratios; missing women; women empowerment and gender bias; Sex differentials mortality; gender bias and development;	Hesketh and Xin,2006; Zhu et al.,2009; Sen, 2003; Mukherjee, 2013; Basu, 1989; Sen, 1989;	De, Ec
Societal relations of power and gender inequalities; conceptual and methodological challenges in gender and inequalities in health research; social complexity of gender	Annandale and Hunt, 2000;	So
Understanding gender on a world scale; gendered embodiment; Gender as a multidimensional structure of embodied social relations; transnational ideas of gender	Connell, 2012;	So
Gender and intersectionality	Doyal, 2003;	So
Gender and the political economy of health; social, cultural and political determinants of gender based health inequalities; women's sexual and reproductive health;	Doyal, 1995;	So
Women as property; childbirth; domestic policies and ethnicity; discrimination against female children; attitudes toward family size, contraception, value of children; impact of government policy on childbearing and women's status	Jeffery et al., 1989;	An
Maternal mortality and institutional delivery in India; high fertility and impact on women's health; mistrust of state services; ethnographic research;	Jeffery and Jeffery, 2010;	An, So
Care seeking for obstetric care; gender bias maternal care and survival; gender biased health systems;	George et al.,2005;	So
Gender and class dynamics in access health care; class was a gendered phenomenon operating through women; quantitative intersectional analysis;	Iyer et al., 2007; Sen and Iyer, 2012;	De, Sq

Ep: epidemiology; So: sociology; Sq: quantitative sociology; An: Anthropology; Ec: Economics Dev: development studies; De: demography;

Not all South Asian girls are the same: *the importance of being intersectional*

To add to this complexity, it is important to remember that gender as a social determinant of health does not come in a simple package but "enveloped" together with the other diversities and inequalities (Walby et al., 2012). Moreover, the combined impact of gender together with other axes of social oppression is not simply additive, suggesting an interaction of these determinants (Hankivsky, 2012, Rouhani, 2014). These diversities and inequalities include socioeconomic status, ethnicity and in parts of South Asia a very important social structure, i.e., Caste.

For example, although there is evidence in the literature suggesting that for pneumonia, South Asian girls tend to be admitted to hospital less often compared to boys, there is a lack of data looking at subgroups of girls and boys. If we just take India as an example, how does a low Caste, poor, rural girl compare with a low Caste, poor urban girl in terms of access to hospital care when faced with pneumonia? They are probably different in terms of access to health services and in the way they experience pneumonia. Or, how does a poor, low Caste boy in urban Nepal compares to a poor, low Caste girl in urban Nepal? These nuances of inequalities are very informative because as others have demonstrated (Sen et al., 2009) social class in some instances appears to work *through* gender and affecting women disproportionately. Equally, although the results of both empirical and the non-empirical literature point out to son preference and patriarchal kinship arrangements as an important determinant leading to gender discrimination of girls, patriarchalism takes different shapes in different contexts in South Asia and also in individual countries.

Therefore, any conceptual framework intending to support understanding of the impact of gender discrimination on health in general or health care utilisation has to consider the importance different axes of inequalities, i.e., intersectionality, especially in developing countries. In South Asia, other important determinants (at different levels) might influence the strength of impact of gender on health care and health care utilisation patterns (e.g. social class, parent's education level, living settings and Caste). Therefore, considering the intersectional way gender works together with other axes of inequalities is not one way to understand gender inequities in health care utilisation, it is the only way.

There are some relevant examples of research using an intersectional approach looking at different aspects of health and in different settings. George and colleagues (George et al., 2005a) studied care seeking for obstetric care and maternal survival and found that gender bias placed constraints on the health systems. In this case, a biased health system could not support women's obstetric health and guarantee their survival. The same authors (Iyer et al., 2007), working in the same district, and looking at care seeking for long-term ailments explored the dynamics of gender and social class in access to health care. Their quantitative intersectional analysis suggests that class was a gendered phenomenon in this case that operated through women, not men, i.e. affected women disproportionaly. In other words, class differences might not be gender neutral and vice versa. Similarly, Sen and Iyer (Sen and Iyer, 2012), using the same data from Karnatakata, describe an intersectional analysis of social inequalities and examine how multiple dimensions interact with each other and how the burden of inequity is borne by each group. They found important similarities between middle groups of non-poor women and poor men in relation to some key care seeking outcomes (See Appendix 2 of this thesis for middle groups). One of the important outcomes of an intersectional quantitative approach is that it highlights differences along the social spectrum, not only the differences between the extremes. Being able to demonstrate how different axes of disadvantage (e.g. gender, social, caste, ethnicity) impact on people's health is clearly an advantage.

However, although evidence on the use of quantitative methods looking at social Inequalities in health using an intersectional approach exist (Sen et al., 2009, Joe et al., 2009), this is a very new area and there are still limitations in the quantitative methods used.

In my analytical framework, I aim to use an intersectional quantitative approach to analyse data from nationally representative household surveys looking at care seeking for important infections in South Asia. In the conceptual framework I provide more details on the various axes of social inequality I aim to explore in my analysis. Sex/gender and its influence in on health should be seen as complex domain (Annandale and Hunt, 2000), and therefore as a determinant it is simultaneously social and biological rather than a domain where the social and biological simply “overlap”. Gender inequities in health encompasses multiple dimensions, the sociological, the economic, the political, the demographic, the cultural and also the biological dimension, in a world where social relations are ins constant change. Therefore, an intersectional approach is an useful way to understand the influence of gender in child health care utilisation in South Asia.

Summary findings of literature review

In this section, using the findings of the literature review reported on Chapter 2 of this thesis, I highlight how gender discrimination shapes different outcomes of child health care and health care utilisation for important infections in South Asia. The data presented here influenced the construction of the conceptual framework depicted in the section entitled *"Gendered barriers in child health care utilisation for important common infections in* South Asia ". For the purposes of the conceptual framework I focus here only on the extra findings of the systematic review, the studies reporting on nutrition and immunisation. The systematic review methods and the findings for careseeking and hospitalizations have been reported in Chapter 2. The findings of this systematic review support the conceptualisation of the framework rather than define it.

Immunisation and nutrition

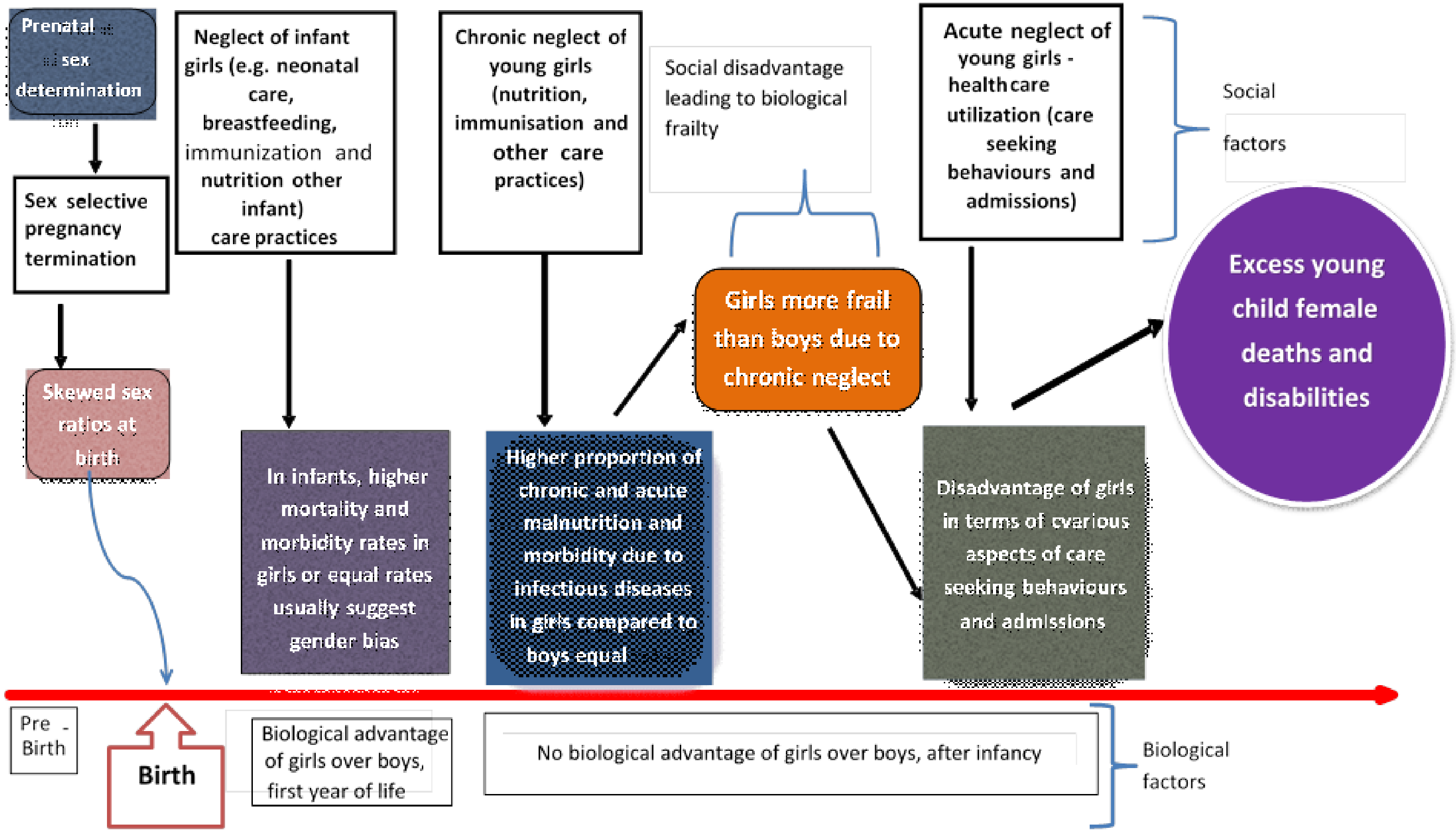
Data from 12 studies reporting mainly on immunisation and nutrition outcomes were selected, analysed and a table with the main findings is presented in the Appendix 1 of this thesis.

Of the 12 articles reporting on child care, two studies reported on both outcomes, four reported on immunisation coverage only and six studies on nutrition only (See Appendix 1.3). All of them used data from India, either national data or from specific regions or states. Data from Bangladesh and Nepal is reported together with data from India in one of the studies and in another study, data from Pakistan is also reported. Findings of all six articles reporting on immunisation suggest that girls are less likely to receive full immunisation compared to boys, and also less timely immunisation. This gender disparity is likely to be intensified by the presence of older siblings (e.g. girl with girls with 2+ older surviving sisters). For studies reporting on nutrition outcomes, the results are more nuanced. In seven out of eight studies, findings are suggestive of gender bias in nutrition outcomes benefitting boys. In one of them (Corsi et al., 2015) no female disadvantage in anthropometric measures is detected. And in another study, looking at intra households allocation of food (Aurino, 2016), no significant gender disparity in dietary diversity is detected for 5, 8 or 12 years old children but a pro-boy gap emerged at 15 years of age. Moreover, three studies reporting on breastfeeding suggest that girls were breastfed for shorter periods than boys and this effect is intensified by birth order and sibling composition. In a recent study reporting on national data from India, Bangladesh and Nepal (Raj, 2014), girls who had brothers were at increased risk for acute malnutrition. Conversely, in the same study, girls were at increased risk of chronic malnutrition if they had sisters and in contrast, boy's malnutrition seemed less affected by siblings. Surprisingly, gender disparities were not always worse for children belonging from families in the lower socioeconomic classes.

In summary, the evidence presented here suggests that immunisation coverage and malnutrition is more prevalent in girls and family composition affects girls more than it affects boys. Similarly, with regards to children with common important infections like pneumonia and diarrhoea, South Asian girls are less likely to be hospitalised and to receive outpatient care than boys. They are also less likely to be taken to qualified health professionals and parents are less likely to spend on health care for girls compared to boys. Regional context, family composition, birth order, economic and physical accessibility to care, religion and rural or urban living setting might affect these differences. However, families with higher income might still practice discrimination against girls, suggesting that gender bias against girls can be pervasive and might persist in families even when resources are not so scarce. I found no empirical data on the role of health care professionals in these differences. Population based, methodologically sound studies for admissions are scarce.

The summary findings of the literature review conducted highlight the important effects of gender inequities in the health of young girls in South Asia. As a preamble to the further steps in building an analytical framework for the study of gender inequities in child health utilisation I prepared a diagram sketching the overall impact of gender discrimination throughout young South Asian girls life course. It goes from birth to the age of five years old (Figure 13).

Figure 13. Overall impact of gender discrimination throughout young South Asian girl's life course



Methodological considerations, or "the importance of being epidemiological"

As argued in the previous sections, it is important to be both multidisciplinary and intersectional in the analysis of gender inequities impacting on child health care utilisation, especially in South Asia. Besides that, what are other methodological aspects that should be considered when approaching this phenomenon? In this section I discuss two main important methodological issues which are relevant to the study of gender inequities in child health care utilisation. First, we need to consider male infant biological frailty and second, the cumulative effect of chronic neglect affecting girl's health in South Asia which may impact on patterns of health care utilisation for important acute infections.

The study of causation and more broadly speaking the evaluation of potential determinants of health require both methodological rigour and a sizeable number of good quality studies evidence available in the literature which provide relevant evidence. As epidemiologists, we cannot always design and implement our own and ideal studies when trying to determine causation. More often than we wish, we have to rely on the observational non-intervention studies or surveys and the evidence that is presented to us by others, like DHS surveys. Both issues mentioned earlier, i.e., male infant biological frailty and second, the cumulative effect of chronic neglect affecting girl's health in South Asia (which lead to increased severity of acute infections) are important and ideally should be addressed in the design of epidemiological studies. However, if secondary data is to be used, a common occurrence in research, caution in the interpretation of findings should be exercised. In this thesis, the main quantitative data used in the analysis is from nationally representative household surveys like the USAID funded Demographic and Health Surveys (DHS). I also use a systematic review of the empirical literature to measure the effect of gender discrimination on health care utilisation. A sizeable number of the studies on child health in South Asia available in the literature also use nationally representative household surveys of the literature like DHS surveys. DHS surveys provide an invaluable range of information on demographic and health issues in low and middle-income countries. Since its implementation in 1984 (Measure DHS, 2015), more than 300 Demographic and Health Surveys in more than 90 countries have been conducted with the support of the DHS Program. This type of data is widely used by governments and agencies to develop policies and programs and are likely to continue to be used in the future. Therefore, although the discussion of the methodological limitations and caveats of analysing such type of data is important for my doctoral research work, it can be also informative for others who aim to use such data to address gender inequalities in child health.

Cumulative chronic care neglect affecting South Asian girl's health status: *the importance of temporality*

In the framework presented here, my first interest was to look at health care utilisation for children with important and common infections like diarrhoea and pneumonia. Although diarrhoea and pneumonia are acute conditions (at least for the purpose of my research), it is important to understand that looking at children with these conditions without understanding their overall health status and care received might lead to erroneous interpretations. The medium- and long-term care (health and nutritional mainly) received by children even before they acquire a potentially lethal acute infection is likely to affect their prognosis. Thinking in a temporal scale, therefore, and considering the chronic neglect that affect girls in South Asia is therefore crucial. This chronic neglect can cause physical and psychological frailty usually before they fall acutely ill with an important infection like pneumonia and diarrhoea that could lead to death. In this sense, each child with pneumonia or diarrhoea reaching a medical professional or health facility to receive treatment reflects in terms of disease severity and prognosis not only the small window of days or weeks previous to their acute illness onset. Rather, they reflect also the care they received, or not received in the previous days, weeks, months and years of life lived before then. And therefore, the importance of accounting for girl's potential chronic neglect in the context of South Asia. This child care in turn reflects the local societal relations where girls tend to be neglected in comparison with their counterpart boys. And therefore, a girl and a boy from a similar socioeconomic status (to cite only one other determinant), in average, is likely to be physically more frail than a boy at the point when both receive acute care, as some authors have suggested before (Butler et al., 1991, Mitra et al., 2000). Therefore, even if both receive equal care at that point, their chances of survival will to a certain extent reflect their past health and care experiences as well as their present context. Although there are caveats to this conceptualisation, especially to do with the biological frailty of male in the first year of life (Waldron, 1985), this assumption should hold true for most of the cases and should guide the study of health care utilisation for acute important infections.

Important alternative explanations: young male frailty and severity of disease

In my research work I attempt to use epidemiological and statistical techniques in order to accurately measure the "specific" effect of gender and the potential effect modifiers contributing to the outcomes (i.e. health care utilisation ones). I also attempt to measure the level of interaction amongst different determinants. However, I also recognise that to a certain extent, "gender" and "sex" are entangled and my efforts to "control" or adjust for sex differences to measure the specific impact of gender based discrimination and vice-versa will not always be fully rewarded.

One of the difficult issues that affects the analysis of impact of gender as opposed to sex-linked biology is the related to the biological young male frailty (Drevenstedt et al., 2008, Hoo et al., 2002a, Monto and Ullman, 1974, Selwyn, 1990). This "frailty" is present especially in the first year of life and relates more specifically to respiratory infections. It does represent a challenge when evaluating the impact of gender discrimination, a social determinant in the health outcomes of children (U5). Additionally, it is important to clarify that the paths by which both sex-linked biology and gender relations shape child health and health care are affected by other factors. Age is one of these factors, because of the biological frailty of young males, as mentioned earlier.

Krieger (Krieger, 2003) proposes association relations of sex-linked biology and gender relations and health outcomes. In terms of health care utilisation (HCU) for important infections in children, the interpretation of findings in terms of health outcomes for girls and boys in children under 1 year of age has to be controlled by severity of disease and or by age. Equally, even for older ages, ideally, severity of diseases should be evaluated. In some of the studies analysed in the review this was performed and the results were still suggestive of gender bias. For others this was not performed. Because of male frailty and severity of disease, it is possible that a number of families will seek for care more often for boys than girls in the first year of life. Because of male frailty, this embodiment of discrimination in terms of investment in girl's care, lead to a biological vulnerability in girls, especially between the ages of 1 to 4 years, once biological young male frailty is not an issue anymore. Similarly, using the concept of Embodiment as proposed by Krieger (Krieger, 2012), I depict in a diagram the potential consequences of care neglect affecting girls compared to boys in South Asia (See Figure *14*).

Figure 14. Embodiment of discrimination in girls due to gender based health inequities in South Asia

Care neglect

When compared to boys, girls are more likely to:

- Not receive appropriate immunisation
- Not receive sufficient and appropriate nutrients, both in terms of breastfeeding and other foods
- Not receive appropriate care seeking (e.g. delays, lower quality services used, lower quality treatment (e.g. no antibiotic), less investment (money and transport), etc.)
- Not being admitted to hospital or their referral followed less often

Consequences

When compared to boys, girls are more likely to:

- Have malnutrition (chronic and acute) and lower immunity (lack of immunisation)
- Present with increased severity of disease due to previous chronic and acute neglect (see examples above), this include chronic depletion due to chronic non treated mild infections (e.g. worms)
- Suffer from psychological impact of neglect (?)

Main constructs and propositions of the Ecosocial theory and implications for this conceptual framework

The scope of my doctoral research is to conduct an enquiry on the impact of gender discrimination on health care utilisation for important infections in children from South Asia. So far, I have emphasised the importance of using the empirical findings in the literature, the necessity of being interdisciplinary and intersectional and the importance of using an epidemiological approach. In the next section I propose a conceptual framework depicting the gendered barriers in child health care utilisation for important common infections in South Asia. However, before that I would like to reflect in some of the core constructs and propositions of the Ecosocial theory of diseases distribution and disease causation, which was initially proposed by Krieger in the early 1990s (Krieger, 2001). ***Embodiment*** is a central construct to this theory (Krieger, 2012). Notwithstanding the fact that it is beyond the scope of this doctoral research to evaluate the full health and wellbeing impact of the chronic neglect of girls in South Asia, especially looking at long term embodiment of gender discrimination, Krieger's ideas are still very enlightening. In other words, in this PhD research I will not able to use Krieger's theory in full to test my hypothesis, since the data I will be using for my data analysis comes from a household survey and therefore is limited in terms of assessing chronic child care and potential neglect of girls. Equally, most of the studies retrieved in the literature review do not use a design that enables to assess chronic child care or severity of disease and therefore it is difficult to assess the girl's neglect factor. However, reflecting on the core constructs and propositions of this theory should aid considerably in the interpretation of my results. This is because Krieger's propositions will allow me to contextualize an acute health phenomenon (i.e. pneumonia and diarrhoea), within a chronic context of neglect affecting health, an insight that is very unique to her conceptualisation. With this in mind, I will present in this section the core propositions of the Ecosocial theory and some implications for child health care in South Asia, which I developed.

Embodiment of gender inequities in child health care in South Asia

Embodiment in Krieger's theory refer to how an individual literally incorporate in their living bodies (or biologically) the social and ecological context, or, paraphrasing Krieger “the material and social world which they live in” (ibid). This is the first and main construct of Krieger’s theory. Apart from this core construct, other three constructs are added, i.e., the pathways of embodiment; the cumulative interplay of exposure, susceptibility, and resistance across the life course and finally the accountability and agency (See Table 8).

To help understand the terms used in this discussion check Appendix 2.3 where a Glossary and explanatory text about the implications of the Ecosocial theory for this conceptual framework is provided.

Table 8. Summary of Krieger's theory core propositions* and main implications for gender inequities in child health care utilisation

A summary of Krieger's theory core propositions	Main implications for gender inequities in child health care utilisation in South Asia (South Asia)
Societies' epidemiological profiles are shaped societal by arrangements of power, property, and the production and reproduction of both social and biological life	Patriarchal kinship arrangements in **South Asia** means that parents and families (including extended) families tend to see girls as a liability, both financially (given their reduced earning power) and also as a supporting member of the family (given that they became part of the husband's family after marriage and is not able to provide support for her ageing parents). Besides, the children daughters give birth to will not continue the lineage of her parent's family but carry the father's lineage. Besides, patrilineality means that women do not receive any inheritance and because of that are vulnerable within the family power structure. That certainly can affect their health.
Determinants of current and changing societal patterns of disease distribution, including health inequities, are (a) exogenous to people's bodies, and (b) manifest at different levels and involve different spatiotemporal scales.	In line with ecological theorizing, these socially structured determined patterns are dynamic, and can vary over time and depending on location. Different patterns and causal links for ill health in young girls in **South Asia** will depend on the specific local context and also depending on macro and micro level determinants. In South Asia, some counties, regions, sub regions will display different stages of "epidemiologic transition" and in others, different stages will co-exist (it is not a linear succession). Two hypothetical examples: inadequate child health care provision in one Indian district might increase the health gap of girls compared to boys if compared to another district where good service provision is available. If resources are scarce the gap between girls and boys can increase ("rationing bias" on top of "pure" gender bias (Iyer et al., 2007) . Both gender and other determinants can change over time.
In societies exhibiting social divisions based on property and power, in which those with most power and resources comprise a small percent of the population, the more prevalent the health outcome, the greater the absolute burden	Girls are not the bigger percentage of the population but represent roughly half of the population of children in South Asia, where most countries have a sizeable young population. Yet, girls in the higher socioeconomic classes (to speak only about class and gender) might not suffer so much discrimination, which reduce the burden of disease due to gender discrimination. However, one could argue that given that girls in lower socioeconomic class are in higher number, it is likely that the burden of disease caused by gender inequalities in **South Asia** will be considerable. Additionally, even if we only consider the case of India, where one fifth of all children in the world live and where the largest number of excess female child mortality occurs, it is clear that gender inequity in child health care is an important global burden of disease issue (Park and Brondi, 2015b)

A summary of Krieger's theory core propositions	Main implications for gender inequities in child health care utilisation in South Asia (SA)
People literally embody, biologically, their lived experience	Social relations in **South Asia** mean that girls tend to be neglected compared to boys in terms of child care and in consequence, girls will express in their biology the (physically and psychologically) the results of this neglect. This might render these girls relatively frail compared to boys
Explanations of disease distribution cannot be reduced solely to explanations of disease mechanisms	Using disease mechanisms only to explain the distribution of common relevant infections in children (e.g. pneumonia and diarrhoea) in **South Asia** and the health care utilisation and the final outcomes (potentially death) is a very deficient way to explain the patterns, rates, trends and burden of disease. The understanding of this distribution only makes sense complex and dynamic ways by which social, biological and ecological determinants affect this distribution
Practice of a reflexive epidemiology situated in broader societal context will improve the understanding population patterns of health, disease, and well-being	Epidemiologists and public health researchers studying child health issues in **South Asia** should consider the broader social and historical context which permeates the life and death of children in this region. The importance of considering the broader social context in relation to theory, hypotheses, methodology and methods used and also interpretation of findings is crucial. This will enable more balanced view of the results, its limitations, and explanations of disease patterns.

Sociologists have previously conceptualized the "corporeal" nature of social life and the role of embodiment in social dynamics. For example, the idea of *habitus,* as proposed by Bourdieu (Bourdieu, 1990), which he used mainly to explain social and cultural reproduction (Nash, 1990) is very informative to understand embodiment in Krieger's theory. As Bourdieu himself puts it: "The habitus-embodied history, internalized as a second nature and so forgotten as history – is the active presence of the whole past of which it is the product" (Bourdieu, 1990). In a Bourdieuan sense, the body reflects the social, economic and cultural structure it has lived in and is living in.

The second and third constructs of Krieger's theory refer to embodiment as well. The second refers to the pathways of embodiment, how the societal arrangements, biology and ecological context shape people's health in different causal pathways. Krieger (Krieger, 2008) suggests that these causal pathways involve "exposure, susceptibility and resistance" and are structured simultaneously.

The third construct refers to the cumulative effect of all these factors (ecological, biological and societal) when they are considered according to their distribution in the population. The cumulative interplay and effect of exposure, susceptibility and resistance involves multiple levels, according to Krieger (ibid). In the case of SA children, from individual child circumstances to village and district to national and international level. It also involve different domains (e.g. home and family, extended family, Caste, religion, health institutions, school, etc.). And finally, these processes are manifested at multiple scales of time and space.

The fourth construct of Krieger's theory refers to accountability and agency. In this particular case, who and what is responsible for gender discrimination of young girls in South Asia? Applying this construct to this specific problem, the responsibility to address gender equality in child care lies not only with institutions or governments but also on communities, households and individuals in South Asia. And going further, as Krieger goes, epidemiologists and scientists should be more critical and able to examine and overcome the limitations of epidemiological studies looking at gender inequality in child health. Because this phenomenon is complex, has multiple levels and scales and because it poses difficulties assessing causal relationships, more robust conceptualisation and methods are still needed. Perhaps one of the more important research issues to be addressed is the need for more interdisciplinary research gender inequity in health.

The final construct of Krieger's theory refers to analytical implications and predictions. Krieger calls for a less reductionist approach to the study of disease distribution, an approach that is not restricted to disease mechanisms only. In this sense, the population patterns of health and disease distribution of girls and boys in South Asia reflects the political economy and ecology of each of these countries. Furthermore, policies and practices that increase the privilege of men and boys in the region will simultaneously determine the living conditions of each young girl in these countries and determine also their wellbeing, morbidity and mortality.

Gendered barriers in child health care utilisation for important common infections in South Asia

Finally, I propose a multiple step decision making chart explaining how gender influences child health care utilisation for important infections (e.g. pneumonia and diarrhoea). To do this, I use mainly the ideas proposed by Andersen (Andersen, 1995) in his Behavioural Model of Health Services Use and also the evidence collected using a systematic review of the literature looking at gender inequities in care seeking and hospital admissions for important infections in South Asia (summary findings presented in the previous section). I enriched it by adding intersectionality to the study of gender.

The Behavioural Model proposed by Andersen in 1968 (Andersen, 1968) is one of the most influential theoretical models for the health care utilisation. Andersen had proposed three main determinants of health care use by families, i.e., *predisposing characteristics* (demographic, social and health beliefs), *enabling resources* (personal/family and community) and *need* (perceived need more specifically). Later on, Andersen (Andersen, 1995) enriched his initial model including health status outcomes (i.e., perceived and evaluated health status and consumer satisfaction) as an important further determinant that feedbacks dynamically into future health care use.

Although Andersen's model seems popular amongst health care systems researchers and does propose some useful ideas, it does not emphasize enough the importance of social context and therefore, it cannot alone explain gender discrimination affecting health or health or health care utilisation. Andersen's Behavioural Model tends to leave nearly untouched inequality and discrimination issues by placing too much agency in the individual.

My proposed conceptual framework is depicted in a diagram where I describe the gendered barriers in child health care utilisation for important common infections in South Asia (**Figure 15**). In this diagram, some of the concepts of Andersen's Behavioural model here is enriched by evidence from the social sciences on gender bias in South Asia, and also, by informed by an intersectional approach. The focus of the steps of the diagram is on the gender disparities in health care use by boys and girls. Others researchers have have constructed similar models, both when looking at child health or another type of health issue. Some examples include the Pathway to survival conceptual framework (Waldman R, 1996) and the maternal mortality models proposed initially by Thaddeus and Maine (Thaddeus S, 1994) and revisited by Gabrysch and Campbell (Gabrysch and Campbell, 2009). Both the original "Three delays model" for maternal mortality, an influential review published in the mid 90's looking at factors contributing to inadequate access to obstetric care in developing countries, and a more recent expanded model on use of delivery services highlight important *critical delays* in accessing health care services. However, in my framework I consider barriers, which include but are not restricted to "delays" only. The 5 barriers identified which may contribute to gender inequities in child health care utilisation are:

Barrier 1: Illness recognition.

Barrier 2: Decision to seek care

Barrier 3: Promptness in seeking care

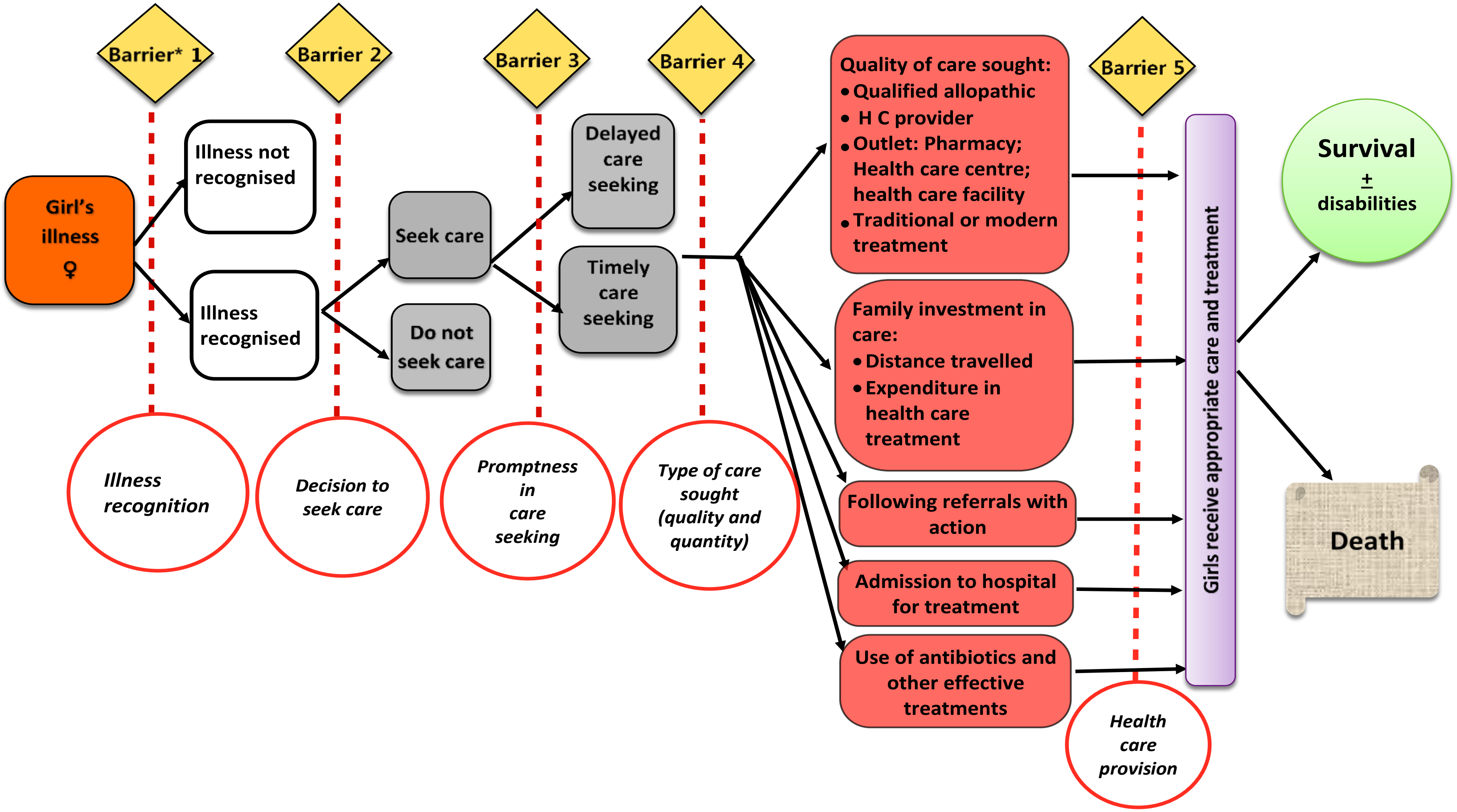
Barrier 4: Quality and quantity of care sought

Barrier 5: Health care provided by health care professionals

The five barriers identified above are not exhaustive, only the main ones which have been often discussed in the literature. One could add to them more specific details, as usually these barriers involve more complex sub barriers or steps. For instance, authors working with Verbal Autopsy(VA) tools have developed specific categories for Circumstances Of Mortality (COMCATs) to pinpoint circumstantial determinants of death, which complement the medical causes assigned by VA (Hussain-Alkhateeb et al., 2019). In this sense, one could add a category 3b to the five barriers above, namely agency to seek care (e.g. intra-household power of decision of the main child carer, availability of transport, money). Similarly, a sub barrier to Barrier 4 could be related to the unavailability of care sought.

In the gender barriers diagram presented (Figure 15) I refer in the footnotes the other determinants to be considered when evaluating sex and gender as determinants of child health. In South Asia, other important determinants (at different levels) might influence the strength of impact of gender on health care and health care utilisation patterns (e.g. social class, parent's education level, living settings, Caste). Speaking in a more epidemiological manner, whilst severity due to male frailty should be considered a mediating variable in the causal pathway (to distinguish from a confounder) (Van Stralen et al., 2010). The other social determinants are considered potential effect modifiers contributing to shape the way gender and sex affects child health care and health care utilisation (i.e. my outcomes). Making this methodological distinction enables both researchers and public health stakeholders to think more clearly about the mechanisms involved in gender discrimination in child health care, especially in a context like South Asia.

Figure 15. Gendered barriers in child health care utilisation for important common infections in South Asia



Effect modifiers: Country and region; district or region of country; mother's education; father's education; severity of illness; child's age; house support (helper); household income; occupation of mother (at home or out of village); birth order of child; sibling composition; district or region of country; religion; Caste/tribe; rural/urban living;
* The gendered barriers represent the various points in the pathway to survival where girls can be discriminated against in countries where gender bias exist;

A guide for an intersectional analytical framework looking at gender inequities in child health care utilisation in South Asia: an example

Several important concepts from different disciplines presented here were used to delineate an *intersectional analytical framework* to understand the gendered barriers to health care utilisation for important infections in South Asia. Building on theoretical ideas as well as empirical research of the literature which were used in the construction of the framework, this final section outlines one of the core research questions guiding my research. This core question is used in the analysis of the Indian Demographic and Health Surveys databases. Some details on the operationalisation of these concepts is also presented under, however full details of operationalisation are covered in both the methods and results chapter.

Question1. For children with pneumonia or diarrhoea, are there sex differences in care seeking behaviours[1] ? How does other axes of inequalities interact with gender to shape gender inequalities in health care seeking behaviours?

Based on this conceptualisation of how gender discrimination impacts health care utilisation for children I explore the impact of this bias on care seeking behaviours. Building on the work of others (Mumtaz and Salway, 2005, Iyer et al., 2007) that suggest that other inequalities might not be gender neutral and vice versa, I hypothesize that the interaction of gender and other inequalities, works to the disadvantage of girls when it comes to health care seeking. These other axes of

[1] **Examples of care seeking behaviours to be explored in the DHS database:**

- Illness perception or reporting
- ***Place*** where treatment or advice was sought (private or public and level of complexity) *a*
- Choice of ***provider*** used
- Type of treatment ***administered*** to the child
- Treatment delay and options

inequalities are distributed in different levels and domains of girl's lives and include, but are not restricted to:

- Social economic status
- Caste and tribe
- Birth order and sibling composition
- Mother's and father's education
- Mother's occupation
- Religion
- Rural or urban living

In a intersectional analysis of gender inequalities, I am interested in the independent effect of gender as a determinant of care seeking. However, I want to go further and understand the impact of intersections (of gender with other axes of inequality) affecting these care seeking behaviours. To exemplify the operationalisation of a quantitative analysis of intersecting inequalities, I will give the example of a preliminary analysis I conducted in the India Demographic and Health Survey (DHS) 2005-06 dataset. In this case, I first carried out a descriptive analysis calculating the weighted percentages of care seeking outside home for diarrhoea, combining the sex of the child with economic class. Further, to test my hypothesis quantitatively, I also built a specific multivariate logistic model to test the association of careseeking with these combined potential determinants.

This exercise allowed me to look at the interaction of the two important main determinants (e.g. sex and economic class). In practice, "subgroups" or, dummy variables (see Box 2), of combined axes of inequality were created and the prevalence of careseeking behaviour for each group was calculated. These subgroups are similar to the subgroups created by Sen and Iyer (Sen and Iyer, 2012), in their intersectional analysis of health-seeking for long-term ailments and social inequalities, explained in the Appendix of this chapter. This allowed me to test if social class, as an axis of inequality impacted care seeking in a gender neutral fashion or not. In this preliminary analysis the results suggested that social class worked to the disadvantage of girls in terms of care seeking. More details of this analysis are described in the methods and results chapter of this thesis.

Box 2. Dummy variables to study the interaction of sex and wealth effects on careseeking for diarrhoea in the India DHS 2005-06 dataset.

Subpopulation 1: poorest female

Subpopulation 2: poorest male

Subpopulation 3: poorer female

Subpopulation 4: poorer male

Subpopulation 5: middle female

Subpopulation 6: middle male

Subpopulation 7: richer female

Subpopulation 8: richer male

Subpopulation 9: richest female

Subpopulation 10: richest male (reference)

Although the intersectional quantitative analysis approach is very interesting, the interpretations of findings of this analysis are also very relevant.

Conclusion

Defining causal pathways clarifies thinking in Public Health, which is more likely to promote clear and effective action to correct health inequities (Krieger, 2008). Therefore, research methods employed in gender and child health and health care utilisation should be based on sound critical theory reflecting this paradigm. This should enable a more accurate interpretation of findings and therefore a positive impact on policy.

However, there is a lack of conceptual and empirical work examining how and why gender discrimination affects young children's health in South Asia and also what role it plays in health care and health care utilisation. The conceptual framework presented here and the work of my PhD research is an attempt to close this gap. The framework uses a multidisciplinary and intersectional approach to the analysis of gender inequities in health care utilisation. It also relies on some of the ideas proposed by Krieger in her Ecosocial theory of diseases distribution and in the Behavioural Model of Health Services Use (Andersen, 1995) .

Gender discrimination in child health utilisation is a complex phenomenon and poses a real challenge for health researchers and policy makers. The multidimensional and dynamic nature of this phenomenon, involving multilevels of influence (as depicted in my diagrams) and the important context nuances have to be recognised. Therefore, simply compiling a list of differences between boys and girls and attempting to fully control for gender (Springer et al., 2012) is clearly not enough. Therefore, this chapter calls for a more intersectional approach in the study of gender discrimination in child health care utilisation in South Asia, where different axes of oppression are considered is evident. Therefore, there is a need to remember that intersectionality is crucial to understand and approach this complex phenomenon both from the research and the policy perspective.

Finally, I hope that my attempt to conceptualize gender discrimination affecting child health in South Asia and this doctoral research will support research and policy efforts in this field. The importance of adequate theory in public health has been recognised before. Krieger (Krieger, 2001) argues that with regards to social inequalities in health: “adequate theory is a necessity, not a luxury”. Using more rigorous and theory grounded methods is crucial to better understand and address gender discrimination affecting health outcomes. Therefore, the role of health researchers in clarifying the extent that gender discrimination affects girl's health care utilisation in South Asia is a crucial step in the efforts to promote equity in health for all children.

Chapter 4. Overall approach, methods and methodology

Introduction

This chapter starts with some discussion about key methodological issues in quantitative research, especially with regards to secondary data analysis using Complex Survey data from nationally representative household surveys. Further, an overview of the USAID funded Demographic and Health Surveys with special emphasis on the two rounds of the Indian Demographic and Health Surveys (IDHS) (also known as the National Family Health Survey (NFHS)) used in this research is provided. This overview is followed by a brief discussion of the suitability of the third and fourth rounds of the NFHS as a source of data for this research. Subsequently, a description of the steps used in the operationalisation of the thesis key research questions and theoretical concepts is presented. The last part of the chapter focuses on the methods used for data management and statistical analysis in this thesis.

Methodology

The use of pre-existing data collected by others to answer specific research questions by a researcher is called "secondary analysis" (Goodwin, 2012).

This thesis uses quantitative analysis of secondary data, both from the published literature and mainly from Demographic and Health Surveys databases. Therefore, the theoretical underpinnings of the research conducted here is associated with positivism. Within this perspective, the social world and its components, including health phenomena, can be studied, measured and understood using a systematic approach which involves quantification of social, demographic and health phenomena (Crotty, 1998).

For the secondary analysis of complex survey data, the methodology and methods described in this session include two components. First, the methodology and methods used to produce the original Complex Survey data, e.g., survey research methodology, sampling, measurements, questionnaires, interviews etc. Secondly, they also include the methodology and methods used to analyse the data produced by these Complex Surveys. Both of these components rely heavily on a positivist theoretic epistemology (Crotty, 1998). Therefore, the quantitative findings presented here are characterized by ascription of objectivity, validity and generalisability, given its positivist underpinnings (Crotty, 1998).

Traditional epidemiology and quantitative sociology emphasize the measurement of social, demographic and heath phenomena looking for causal relationships. These quantitative methods involve pre-constructed standardized instruments with pre-established categories/responses. Equally, representative samples are required in order to generalize the research findings. The participants individual or personal experiences or trajectories are not relevant and the researcher is supposed to be neutral (Patton, 2002).

Ethical considerations and data access

The analysis in this PhD project met the University of Edinburgh, Centre for Population Health Sciences Research Ethics criteria for level 1 self-audit, with absence of foreseeable ethical risks (See checklist in Appendix 3).

Access to the NFHS datasets for this PhD project was granted by a DHS Programme Clearance in May 2014.The title of the project for this data request is "Common childhood infections and gender inequalities". Initially, in 2014, only the first three rounds of the NFHS were available (i.e., NFHS-1; NFHS-2; NFHS-3). The delay in the implementation and data release of the NFHS-4 dataset meant that the dataset used for this round was made available only in mid-2018. The latest updated dataset (version 74) was made available by DHS in June 2018 and downloaded after that.

Methods

Population based demographic and health household surveys

According to UNESCO (UNESCO, 2019):

> *"A 'Household Survey' is the process of collecting and analysing data to help us understand the general situation and specific characteristics of individual household or all households in the population. During a household survey, field researchers investigate and record facts, observations and experiences from the sample households which are representative of all households in the study area."*

Large-scale surveys are an important source of demographic and health data used by policy makers to design efficient policies. Social and Demographic Surveys and Demographic and Heath Surveys have evolved considerably since their start several decades ago in developed countries. Apart from the experience gained by conducting many large-scale surveys, the knowledge about social and health phenomena and statistical theory has shaped the current Large-Scale Demographic and Health Survey (Lee and Forthofer, 2005). Such surveys were initially carried out to respond to the need for information in order to understand socio-political and public health challenges (Lee and Forthofer, 2005). Examples of national household surveys in the United Kingdom, a developed country, include the Health Survey for England (HSE), an annual survey conducted since 1991 and The Scottish Health Survey (SHeS), running since 1995(Marshall Library).

Demographic and Health Surveys in LMICs

Population based demographic and health household surveys are an important source of useful information for the development of health policies and planning especially in Low- and Middle-income countries (LMICs). The use of health care utilisation data coming from such surveys is widespread, including data on coverage of reproductive, maternal, newborn, and child health interventions in LMICs. Therefore, understanding strengths and limitations of such data is an important step before using it to formulate policies and programmes (Hancioglu and Arnold, 2013). The United States Agency for International Development (USAID) and the United Nations Children Fund (UNICEF) lead the two main global household surveys programmes in LMICs. USAID supports the Demographic and Health Surveys (DHS) and UNICEF the Multiple Indicator Cluster Surveys (MICS).

Demographic and Health Surveys in India

In India, population-based data on child and maternal health and on reproductive issues and health care coverage has been gathered since the early 1990s (Dandona et al., 2016). The three major Health Surveys in India are:

- The National Family Health Survey (NFHS)
- The District Level Household and Facility Survey (DLHS)
- The Annual Health Survey (AHS)

All three of these surveys collect sociodemographic data, household characteristics, morbidity and mortality data and in the more recent rounds, data on health care use. Of interest for the work of this thesis, the three surveys also provide a wide range of data on child morbidity, using an extensive questionnaire.

The NFHS, is the equivalent of the USAID sponsored Demographic and Health Survey in India. It is the longest running survey in India and its first round took place in 1992-93. ICF International implements the DHS Programme sponsored by USAID, and that includes the NFHS Survey (IIPS, 2019c). Although DHS Programme provides technical supports to this survey, it is conducted by the Institute for Population Sciences (IIPS) in Mumbai and overseen by the Ministry of Health of India (IIPS, 2019d). Data from the NFHS survey covers all states of India.

The DLHS survey, in contrast, had its first round in 1998-99. The survey was created to supply the need for district level data on child and reproductive health and therefore support district-based health planning by the government (Dandona et al., 2016).

The DLHS is also conducted by the International Institute for Population Sciences (IIPS), but without substantial support of international agencies. This survey includes health care facility information for the sampled villages. Four rounds have been conducted since its beginning: 1998-99, 2002-04, 2007-08 and 2012-2014

(IIPS, 2019b). The fourth round of the DLHS does not include the nine less developed states of India (i.e., Assam, Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Odisha, Rajasthan, Uttar Pradesh and Uttarakhand), which are covered by the Annual Health Survey (AHS).

The Annual Health Survey (AHS), although funded by the Ministry of health of India, is implemented by the Office of the Registrar General & Census Commissioner and, as mentioned above, covers only the nine less developed states of India, also known as the “High Focus States”(Office of the Registrar General, 2013). This survey started much more recently, with its first round carried out in 2010-11 (baseline) and subsequent ones in 2011–2012 and 2012–2013. In contrast to the other two major surveys above, the second and third round of the AHS collects data from the same households collected in the first round (baseline).

For the purposes of this thesis, several aspects of all three surveys were considered before a final decision was made about the choice survey dataset to be used. Because the AHS is a complementary survey o DLHS, if the DLHS survey was to be chosen, the AHS would also be used. Therefore, the final decision to use the NFHS survey instead of DLHS was taken after the following steps:

- Reviewing of the available literature (both peer reviewed or not)
- Reading the extensive background material for both DHS and NFHS, in the case of NFHS, included general DHS guidelines provided by the DHS program
- Conducting an exploratory analysis exercise using datasets from both NFHS and DLHS to get a more in depth understanding of the data
- Consulting with international experts (i.e., researchers and analysts) on the strengths and weaknesses of each survey

Since both surveys collect similar data on child health care seeking for common (my main dependent variable) and on potential determinants of care seeking (sociodemographic variables, independent variables), the choice of data to use was based on other aspects.

When compared to DLHS, the following characteristics of the NFHS made it a better choice for this PhD:

- NFHS covers all Indian states and territories, where the latest rounds DLHS would have to be used in conjunction with the AHS data, which in turn has only been available since 2016
- The most recent round of the NFHS was conducted in 2015-16, compared to 2012-13 for DLHS
- The last round (NFHS-4) provides district level data for 640 districts, whilst DLHS-4 covered 336 districts in 26 states and union territories of India
- Better quality of data, due to strict processes in data collection, checks, compilation and cleaning
- An initial assessment of data quality of both surveys, looking specifically at the variables relevant to this thesis, revealed that missing data in the NFHS surveys is very low (due to DS program strict data checking and cleaning procedures), which is not always the case with DLHS
- NFHS data is easier to access and available in a more user-friendly format, facilitating data management
- Easier to access support for data management and analysis issues using manual available online and specific support from the DHS program analysts and users available on request
- Consistency of questionnaires across rounds of surveys with extensive material covering any changes in order to facilitate comparisons
- More accessible for international researchers

It is important to notice that the methods and procedures involved in the whole process of the NFHS survey execution (from planning, design, until conclusion and database delivery) is more transparent than for other surveys, especially for analysts who are not based in India. The standard survey procedures, which are followed by both the DHS programme and by NFHS, are thoroughly documented and widely available both in published format and via the DHS website. Similarly, at each round of the NFHS, the IIPS has had the concern to clarify the mechanisms of data quality assurance and control for this survey. The volume of information available for the DHS surveys is reassuring for international data analysts who rely on the quality of the primary data for their secondary data analysis.

Therefore, based on these advantages, the latest two rounds of the National Family Health Survey (NFHS), NFHS-3 and NFHS-4, were chosen for the analyses in this PhD thesis.

DHS surveys

Background

As mentioned earlier, the National Family Health Survey (NFHS) is the Indian version of the USAID funded Demographic and Health Surveys (DHS). Most of the background information on DHS surveys around the globe are also valid for the NFHS, and therefore an introduction to the DHS surveys is helpful to understand the NFHS.

The USAID funded Demographic and Health Surveys (DHS) are nationally representative household surveys provide invaluable range of information on demographic and health issues in LMIC. More than 400 demographic and health surveys in more than 90 countries have been conducted with the support of the DHS Program since its implementation in 1984 (ICF, 2019).The DHS Program collects, analyses and disseminates data on population, health and nutrition. Ideally, DHS data should be used to implement policy and programs to improve health outcomes of populations in developing countries (Fabic et al., 2012). One of the main ideas behind the design of DHS surveys is to collect data that is comparable across different countries (Rutstein and Rojas, 2006). However, in order to produce this invaluable information, survey implementers have to follow a number of complex steps and procedures, from the design and implementation to the release of survey reports.

The DHS program, responsible for the development and support of the implementation of USAID DHS surveys, recommend that before starting the analysis of these surveys, researchers should get acquainted with the survey methodologies and procedures. The Measure DHS Program provides many resources to guide users to conduct data analysis using DHS datasets. They are very useful and most of them available online (Measure DHS, 2015). The materials provided by DHS include design issues, implementation, specificities of each survey and their methodology. Furthermore, the DHS Program user Forum (http://userforum.dhsprogram.com/) is a very friendly and helpful source of information.

Given the complexities of DHS surveys and context specific issues, DHS Measure Program experts also emphasize that researchers should get acquainted with the materials of each particular survey as well as understanding DHS surveys in general. Changes in the model questionnaires and variables, including recode file version, structure of datasets, and specificities of each round of the survey should be understood before data analysis is conducted. Another important aspect to be considered before the analysis are the sampling weights used by DHS, the household weights and individual weights, which are explained further in this document and in other DHS documents.

For the data analysis of the DHS dataset conducted in this thesis, whilst aiming to follow good practices in data management and analysis, the data management and analysis steps reflected also the specificities of the Indian DHS (i.e., NFHS).

Design and weights in DHS surveys

DHS surveys aim to cover 100 percent of the target population in a country where the target population for the survey is all women age 15-49 and children under five (U5) years of age living in residential households. The DHS design involves stratified sampling to guarantee that each subgroup in of population is represented in the sample (International, 2012b). In a complex survey, cases are not selected via a simple random sampling, but rather a more complex procedure that usually involves sampling weights, where different observations might have different probabilities of being sampled, e.g. urban population might be oversampled for a specific reason”. Also, cluster sampling is often used, where collections of individuals (e.g. clusters of houses) rather than each individual independently, are sampled. For example, in the NFHS4 the primary sampling unit (PSU) is the same as the cluster variable. In NFHS4, a cluster is either a PSU or a segment of a PSU (IIPS, 2017).

Finally, there is stratification, by which groups of clusters are sampled separately. An example of stratification is when urban and rural counties are sampled separately (StataCorp, 2013b).

There are two main sampling weights in DHS surveys, the household and individual one. The weight correction is simply a correction of sampling probability. In the DHS surveys corrections for response rates are also made and according to the DHS Manual (Croft T, 2018):

- *“The household weight (hv005) for a particular household is the inverse of its household selection probability multiplied by the inverse of the household response rate in the stratum.”*
- *“The individual weight for women (v005) is the household weight (hv005) multiplied by the inverse of the individual response rate for women in the stratum*.“

Understanding and dealing with weights in Complex Surveys analysis is pivotal. For a simplified version of the equation showing the formula for the calculation of the household and individual weight in DHS surveys, see Data Analysis Plan in Appendix 3.4.

Apart from weights, two other aspects are also important during analysis of Complex Survey Data, the survey design, including weighting, cluster and stratification specificities (StataCorp, 2013b). Ultimately, using weights correcting for the analysis of Complex Survey Data, as is the case of the NFHS survey data, decreases the chances of overstating the reliability of the results (Treiman, 2014). Using design based techniques for analysis of these type of surveys data improves accuracy of point estimates and correct standard errors by adjusting for sampling errors resulting from multistage designs, which in turn result in clustering of observations (Williams, 2019a, Treiman, 2014). In contrast, treating a Complex Survey Data with multiple stage sampling as a simple random sample, increases the chance of Type I error, i.e., rejecting the null hypothesis when such hypothesis is true. This type of error happens because the sampling error is understated in the first place.

There are two main sampling weights in DHS surveys, the household and individual one. The weight correction is simply a correction of sampling probability.

Data quality in DHS surveys data sets, including non-response rates

The DHS programme performs numerous procedures to check and clean data before release. The data quality procedures carried out by DHS are well described in various documents published by the DHS programme, e.g. the Guide to DHS Statistics (Croft T, 2018), the DHS Data Editing and Imputation Manual (Croft T) and all different recode versions of the DHS Questionnaire and Manuals as part of the DHS Toolkit of methodology (Croft, 2018b).

However, it is still important to be familiar with the dataset and check data quality before conducting the analysis. The validation of each relevant variable is part of this process. This step involves understanding and describing the following for each relevant variable:

- Type and format of variables (e.g. continuous or categorical)
- Category codes (values and definitions)
- Missing data information: total, proportion, pattern

Dealing with missing data in DHS questionnaires requires that analysists should be aware of missing values and other special codes that are used in DHS surveys. For instance, although missing values in DHS are coded 9,99,999,9999, etc. depending on the number of digits, there are some variables where missing codes are not accepted. DHS also has especial codes for inconsistency responses and for the answer “don’t know”. All these important coding issues and data rules as well as the DHS procedures used to dealt with them were considered in this thesis as explained in the Guide to DHS Statistics (Croft, 2018b).

DHS survey corrections for response rates are also made and according to the DHS Manual (Measure DHS, 2003). Several field procedures guarantee a high level of response for DHS Surveys, including NFHS (IIPS, 2019a). Editing and imputation policies and procedures carried by the DHS Programme, including in India, guarantees that DHS data files not only reflect the population studied but are also readily available for analysis (DHS Program, 2019).

Introducing the National Family Health Survey (NFHS) of India

Overview

The Indian Demographic Health Survey (IDHS) is known in India as the National Family and Health Survey (NFHS). Since the early 1990s, four rounds of the NFHS have been conducted, where the first one (NFHS-1) was conducted in 1992-93. The fifth round of the NFHS (NFHS-5) is currently under way (Kaul, 2019) and data from this round should hopefully be available by 2021 (IIPS).

Table 9 presents a brief overview of the main characteristics of the first four rounds of the NFHS, with emphasis on the Child Morbidity aspects, the subject of this thesis work.

Table 9. Overview of NFHS surveys conducted so far in India

Name	*Survey years*	*Households sample*	*Respondent* (age-years)*	*Children sample size*	*Child morbidity questions***
NFHS-1	1992–1993	88,562	Ever-married women (13-49)	45,363	Last three births in the last 4 years
NFHS-2	1998-1999	91,196	Ever -married women (15–49)	30,372	Last two births in the last 3 years
NFHS-3	2005–2006	109,041	Ever and never-married women (15–49)	51,555	All births in the last 5 years
NFHS-4	2015–2016	568,200	Ever and never-married women (15–49)	259,627	All births in the last 5 years

*For Woman's questionnaire, where variables for the analysis presented here come from
**Which children are included?

Data from the two latest NFHS rounds, i.e., NFHS-3 and NFHS-4 were used in the PhD analysis, the final release of the full dataset of NFHS-4 was substantially delayed.

NFHS-3 survey

A total of 109,041 households were included third round of the National Family Health Survey or NFHS-3 with a response rate of 98% for India as a whole (IIPS and Macro, 2007). Data on 51,555 children under five (U5) was collected through interviews conducted with 124,385 ever-married women aged 15-49 years in this particular survey.

The final sample size calculation was based on several considerations including the magnitude of key indicators, subgroups of interest, desired precision of estimates as well as resources available and logistical considerations (IIPS and Macro, 2007). The complex sample framework involved a two-stage sample procedure for rural areas and a three-stage procedure for urban ones, conducted similarly in all Indian states. Like for other DHS surveys, the DHS design involved stratified sampling to guarantee that each subgroup of population was represented in the sample (International, 2012a). The weighting system in the NFHS-3 was designed to guarantee for self-weighting at the domain level, i.e. urban and rural areas of each state and slum and non-slum areas of the eight cities selected for the purposes of HIV prevalence estimates. This procedure ensures that all households in each domain will share a common household and individual weight. More details about the weighting system used by DHS is provided in the Initial Data Analysis Plan for this Thesis (see Appendix 3.4). Detailed information on the sampling methods used in DHS surveys generally and this particular survey in India, including sample size calculation techniques, sampling frame, stratification, households selection, data collection and sample weights are published elsewhere (International, 2012a).

The health history of each live child in the household was collected using the questions from section 43 of DHS questionnaire (Measure DHS). It contains up to six entries relating to children born in the last three to five years. This DHS Data on child morbidity is then compiled and formatted and is part of the child recode files which DHS Measure makes available for data analysis. The DHS recode used for this survey was DHS recode V (Measure DHS).

Operationalising analytical concepts

Child morbidity in NFHS surveys

This thesis aims to investigate the association between gender and health care seeking for children with for common infections. In any DHS survey, child morbidity questions like those on prevalence of diarrhoea, are part of the woman's questionnaire. From the questions in that particular questionnaire, **d**ifferent types of datasets are produced after a DHS survey is conducted. One of these dataset files is the child recode data file, where the unit of analysis (individual case) is the children of women born in the last few years. Therefore, for the analysis conducted here the main NFHS data file used was the Children's Recode dataset**.**

DHS child recode datasets contain information about the child's pregnancy, postnatal care and other health issues. It also includes data on the mother of the child (Measure DHS, 2019). Specifically for NFHS-3 and NFHS-4, the information available is for all children born to women I the last 5 years (0-59 months). Similarly, information on child morbidity is available, including the prevalence of symptoms or syndromes like fever, diarrhoea and cough and on the type of care sought for these conditions**.**

Therefore, an initial exploratory exercise of the NFHS child recode dataset was conducted in order to select and check relevant variables. All variables considered to be useful for this analysis of care seeking behaviours for diarrhoea, acute respiratory and fever in children under five (U5) were explored in detail.

Several criteria were used to choose and manage the variables to be included in the analysis. They mainly reflect the suitability and feasibility of each variable in the child recode dataset in answering each of the thesis research questions posed.

After reviewing the relevant questions, three main groups of variables were created:

I. Indexing, weight, filter (stratification) variables: These are the variables used for indexing and defining unit of analysis. Examples include case identification, region, etc. In this group the weight variables and filter variables (e.g. variable b5, which identifies if the child is alive or not) are also included.
II. Outcome variables: These are the variables present mainly in the Child Morbidity section
III. Explanatory/independent variables: In this study, sex of the child (variable b4 in DHS V recode) is the main explanatory variable. Other explanatory variables include the age of the child, number of children 5 and under in household sibling sex composition, mother education level, place of residence, etc.

More details on these groups of variables can be found in the initial Analysis Plan for this thesis, which was written before the initial analysis was conducted (See Appendix 3.4).

Data checks

After the initial exploratory analysis, a series of data checks for both data sets (NHFS-3 and NFHS-4) were conducted using data check routines in Stata.

A series of data checks were conducted to evaluate the quality and completeness of the variables used in this analysis. Routines using the codebook command in Stata and several different cross tabulations of variables were performed in both data sets (NHFS-3 and NFHS-4). Do-files and log files were used to perform checks and save information.

There were very few missing data for the variables used in the analysis, i.e., mostly under 1% and quite often under 0.5%. The quality of NFHS survey data sets reflect the policies and procedures followed by the DHS program. Others have previously reported on the good quality of DHS data sets (Gabrysch, 2010).

Measurement of dependent and independent variables using NFHS surveys

Following the discussion in the Systematic Review Chapter and the Conceptual Framework, the association between sex and other social determinants and care seeking for common infections was explored. Both the bivariate and multivariable association analysis conducted aim to answer the research questions proposed earlier in the Aims section of Introduction Chapter. In summary, for most of the analysis conducted using NFHS surveys in this thesis work, the main dependent variable is care seeking for diarrhoea and the main independent variable is the sex of the child. Other covariates include age, religion, caste/tribe, wealth index, residence setting, region, mother education and number of children the household.

The question on distance to the health care facility is a question that appears in the women questionnaire when asking women about seeking medical care for her own self. In the NFHS-4 Woman's questionnaire, it appears on SECTION 7 (Other health issues). Unfortunately, in the child morbidity questionnaire, there are no questions asked in terms of physical distance to a health care facility. The specific question used here is specifically related to the actual distance to the health care facility and not related to transport costs or logistics and should be considered a proxy question assessing physical distance to a health care facility. Therefore, interpretation of answers to this question in this study should be cautious.

Variables in the NFHS-3

For most of the variables used in the analysis of care seeking for diarrhoea, fever and symptoms compatible with acute respiratory infections there was no need for recoding. For a comprehensive list containing the variables used in the analysis of care seeking using the NFHS-3 survey is provided in the initial Analysis Plan (Appendix 3.4). These are very similar to the variables used for the NFHS-4 dataset analysis. The analysis of association focused on diarrhoea.

NFHS-4

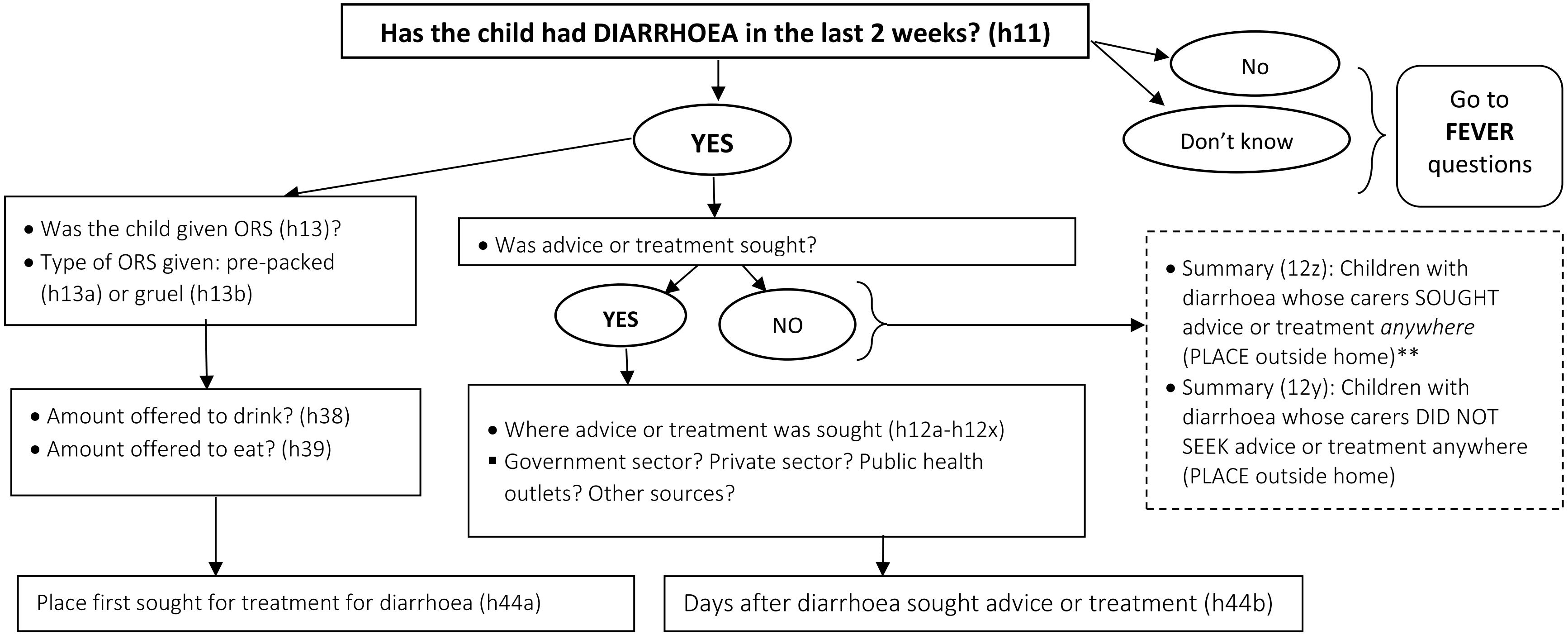
Similar to the NFHS-3 analysis, most of the variables used in the analysis of care seeking for diarrhoea, fever and symptoms compatible with acute respiratory infections using the NFHS-4 did not require any recoding or a very small adjustment.

For children with diarrhoea, for example, the NFHS-4 women's questionnaire in the NFHS-4 asks about diarrhoea in the last two weeks (variable h11 in the dataset). For those children with diarrhoea, several questions relating to care seeking behaviours are then asked exploring different aspects of care. A flowchart showing the sequence of questions relating to diarrhoea in the both the questionnaire and dataset is provided to improve the understanding of the operationalisation of the research questions (Figure 16 under).

However, for some of the variables a more complex recoding procedure was necessary. This is the case of the acute respiratory infection (ARI) variable. A full explanation of the procedures used in to produce this ARI variable is provided in the Appendix 3.

In the case of the regional variables, the regional subdivision used in this thesis is the macro region division where the States have been grouped into six zones having an Advisory among these States(IIPS, 2007). This division was set up in 1956, as part of the States Reorganization Act (India, 1956) , based both on geographical basis and cultural setting, and used since by others in health research (Singh, 2013). A more detailed explanation of this division is provided in Appendix 3.3.

Figure 16. Flowchart: Care seeking behaviour for diarrhoea[1]: variables used in the analysis of NFHS4 datasets



Demographics of NFHS-3 survey

The analysis using the third round of the NHFS (NHFS-3) explores the relationship between gender and child health care utilisation. More specifically, gender and poverty are combined and their association with seeking care outside the home for children with diarrhoea are explored. The demographics of the sample used for the NFHS-3 analysis is presented here, but descriptive results and the association analysis in Chapter 5. An overview of the variables used in the care seeking analysis (both descriptive and association) conducted in Chapter 5 is provided here as well.

Table 10 provides a description of the main demographic characteristics of the NFHS-3 sample of children under 5 (U5), who were alive at the time of the survey. Some of the characteristics include:

- The majority of the 51,555 children born to the women in the last 5 years were alive at the time of the survey (93.75%)
- Nearly a fifth (18.4%) of these children were infants (i.e., under 1 year of age)
- There were 23,378 girls and 25,301 boys, which corresponds to a sex ratio (SR) of 924 girls per 1000 boys
- For religion, 78.3% of the families in the households interviewed belonged to Hindu families and 21.7% belonged other religions
- Overall, 72.8% were children from families who belonged to either a Scheduled Caste or Tribe or other backward class
- At the time of the survey, 50.0 % of the mothers had no formal education, whilst 14 % had only primary education
- One-fifth (25.6%) of the children's families in the sample belonged to the poorest wealth quintile, 22.4% belonged to the poorer quintile, whilst 19.8% belonged to the middle wealth quintile. Only 14.3% belonged to the richest wealth quintile
- Nearly 60% the children's families had more than 2 children under five (U5) in their household. Equally, 33.9% of the families had 2 children U5

- The majority of the families interviewed lived in the rural setting (74.6%)
- A quarter (25.3%) of the women interviewed, considered distance to a health care facility a big problem

Table 10. Demographic characteristics of all live children under 5 (U5), India, 2005-06 (NFHS-3 sample).

		Unweighted	***Weighted***	
Measure		***Live children (n=48,679)***	***%***	***95% CI***
Sex	*Girls*	23,378	47.8	(47.3–48.4)
	Boys	25,301	52.1	(51.5–52.7)
Young age (years)	*< 1*	9,569	18.4	(18.0–18.8)
	1-4	41,986	81.6	(81.2–8.2)
Religion[a]	*not Hindu*	16,003	21.7	(20.1–23.4)
	Hindu	35,499	78.3	(76.6–79.9)
Belongs to Scheduled Caste/Tribe or other Backward class (SCT_OBC)?	*SCT_OBC*	34,229	72.8	(71.3–74.3)
	Don't belong to any SCT_OBC	15,074	27.2	(25.7–28.7)
Mother's education level	*no formal*	21,057	50.0	(48.5–51.5)
	primary	7,476	14.0	(13.4–14.6)
	secondary	19,102	30.9	(29.8–32.1)
	higher	3,919	5.0	(4.6–5.4)
Wealth quintile	*poorest*	9,200	25.6	(24.1–26.8)
	poorer	9,571	22.4	(21.5–23.3)
	middle	10,659	19.8	(19.1–20.6)
	richer	11,300	18.0	(17.1–18.9)
	richest	10,825	14.3	(13.3–15.3)
Number of children U5 in the household	*> 2 children*	29,747	58.9	(58.1–59.8)
	2 children	18,653	33.9	(33.2–34.7)
	1 child	3,155	7.1	(6.7–7.5)
Residence	*rural*	32,072	74.6	(72.6–76.6)
	urban	19,483	25.3	(23.4–27.4)
Distance to HCF[b]	*Less or not a big problem*	37,385	68.8	(67.3–70.3)
	a big problem	19,483	25.3	(23.4–27.4)

Abbreviations: CI, Confidence Intervals; U5, children under 5 years; HFC, Health Care Facility; NFHS-3, third round of the National Family Health Survey;
a Buddhists includes neo-Buddhists; Other religious groups include small minority religious groups like Jain, Jewish, Parsi/Zoroastrian, no religion, other.

Variables used in the NFHS-3 care seeking analysis

The focus of this analysis is on care seeking outcomes for diarrhoea. The child health questions in this DHS survey apply to all living children born in the last five years (IIPS and Macro, 2007).

Reporting of diarrhoea

In the DHS recode version V, the questionnaire recode used in this particular survey, question “h11” is the main question asking about diarrhoea. The question posed to the respondent was “whether the child had diarrhoea in the last two weeks”. A slightly modified version of the h11 question was used, where a few records (less than <0.41% of the total) with missing information were excluded (see Appendix 3 for more details).

Care seeking behaviours for children with diarrhoea

Place where care was sought

For children reported as having diarrhoea in the last two weeks, the interviewer then asks several questions relating to actions taken for that episode of diarrhoea. Some of these questions are multiple code questions and some are not and in the final dataset, these questions are reflected in 43 variables relating to treatment and care seeking for diarrhoea. The first set of question identifies if any treatment or advice was sought outside the house and also the *place* where treatment or advice was *sought* outside the house (e.g. was the child taken to a Government Hospital?). The places included in this question include private providers and public medical facilities of different levels, an in addition, pharmacy, shops and traditional practitioners. After these questions, a summary variable (h12z) refers to whether the child was taken to a medical facility for treatment, including public and medical sector facilities, except pharmacies. In the DHS questionnaire, variable h12z is classified as a summary variable. It summarizes the previous variables and is used in the final reports produced for each country (Measure DHS).

Treatment administered to sick child

After these questions, another set of questions is asked about the kind (if any) of treatment was *administered* to the child (e.g. "Has the child received a sugar-salt-water solution from a special packet (ORS)?"). This second set of questions refers to actual treatment offered to the child (usually, a solution, medicine or herbal remedy). There is also a question (and a variable) to specifically identify if no treatment was given to the sick child.

After both sets of questions are asked, a global summary variable (h21) identifies "whether the child received any treatment or whether advice or treatment was sought for the child" (MEASURE DHS). An overview of diarrhoea symptoms reporting and different care seeking behaviours in this sample are described in Table 12.

Main outcome variable used in this analysis

The main variable in the analysis presented here is the summary variable h12z, which identifies whether the child had been taken to a medical facility for treatment of the current episode of diarrhoea. In other words, it identifies if the child was taken outside the home for treatment for this episode of diarrhoea. In DHS recode V this is the variable h12z, which summarizes previous answers to questions (i.e. questions h12a to h12y) given by the respondents on where care was sought or if no care outside the home was sought. A positive answer to this question usually includes Public Sector facilities and all Medical Private Sector Facilities and excludes Pharmacy. Variable h12z is a dichotomous variable and with very few missing information records.

Demographics of NFHS-4 survey

Sample selected for analysis

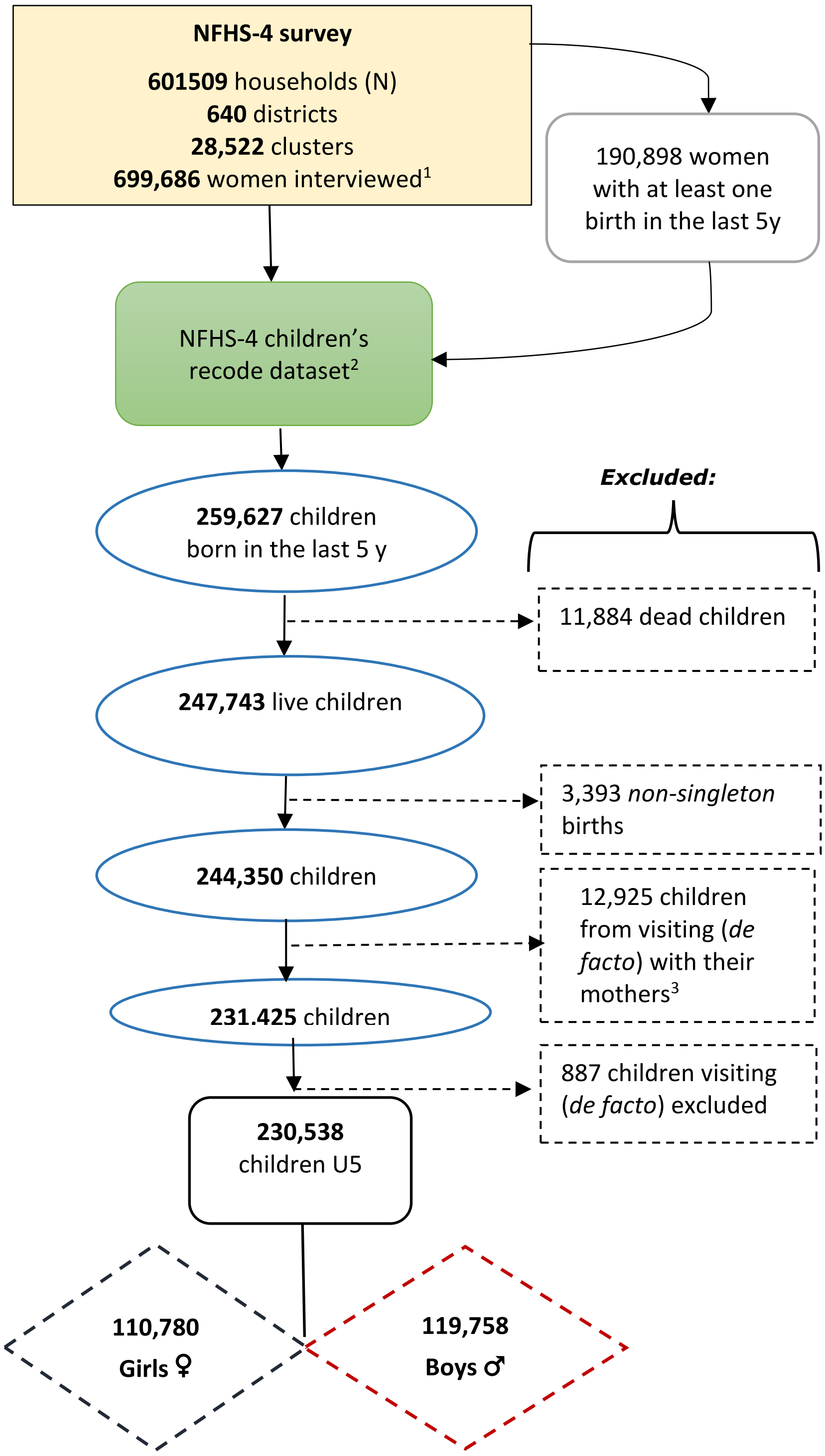
NFHS surveys has a high response rate. Of a total of 628,900 households initially sampled for NFHS-4, only 616,346 were occupied. Of those households occupied, 601,509 were interviewed, reaching a 98% response rate. In total, 699,686 of all 723,875 eligible women (age 15-49 years) were interviewed (97% response rate).

The NFHS-4 survey collected data on 259,627 children who were born to mothers in the last 5 years before the NFHS-4 survey. However, for our statistics, only a restricted number of children were selected (N=230,538).

The children in the sample studied were children who were alive at the time of survey, were singleton births, the ones who were usual residents of the household and whose mothers were also usual residents (i.e., *de jure* residents). Using these filters makes the analysis using the sample more meaningful. Altering the sample of analysis by restricting a variable from the original sample (e.g., singleton births) avoids having to adjust for an extra potential confounder (Rothman et al., 2008b).However, my study did not aim to look at these families originally. Equally, taking this approach means that a potential effect-measure modification by the same variable (if that existed) could not be studied. Because families with twins tend to be quite particular in many aspects, they should probably be studied separately. Moreover, others authors have taken the same approach when doing similar analysis (Rajan and Morgan, 2018) . And finally, restricting my sample implies that the findings of this analysis might not be fully applicable to families with twins. Although the demographics of the NFHS-4 sample of children under 5 and the initial descriptive results of this analysis are presented here, the association analysis is presented in Chapter 6 of this thesis.

A flowchart depicting the NFHS-4 sample selection process is provided under (see Figure 17).

Figure 17. Flowchart depicting NFHS-4* (2015–16) sample selection process for analysis



1. In NFHS-4, all women aged 15 to 49 years old, irrespective of marital status, were interviewed and that is where data from their children under 5 were obtained.
2.The most updated NFHS-4 children's recode dataset, in Stata format (IAKRFL.dta), was downloaded from the DHS program website (https://dhsprogram.com/data/dataset/India_Standard-DHS_2015.cfm?flag=0). The records in the child recode dataset (KR file) contains information on each child born in the past five years before the survey.
3. After deducting the children who died and the non-singleton births, there were 887 children who were visiting the household on their own and children and 9,397 who were visiting with their mothers.

NFHS- 4 main demographic characteristics

After the final sample selection, several demographic characteristics of all live children under 5 (U5) and their families in this sample was explored. Some of these characteristics are used as independent variables in the association analysis presented in Chapter 6.

The final sample consists of 110,780 girls and 119,758 boys and the full description of the demographics is present in Table 11. Some relevant findings include:

- Of all 230,538 children U5, 18.4% of the children were infants, i.e., under 1 year of age. Equally, 110,780 were girls and 119,758 boys, which corresponds to a sex ratio (SR) of 925. This SR is very similar to the current national sex ratio of U5 in the full NFHS4 sample, i.e., 925 girls per 1000 boys.
- Overall, 78.5% of the children in the households interviewed belonged to Hindu families and 16.6% were Muslims. The other families belonging to other religions together (including Christians, Sikh and Buddhists) formed a minority of the sample (around 5%).
- As for Caste or Tribe, the great majority of the children were from families who belonged to either a Caste or Tribe (96.3%). Overall, 76% were children from families who belonged to either a Scheduled Caste or Tribe or other backward class, whilst 19.5% belonged to Non-Scheduled Caste/Tribes.
- At the time of the survey, 54% of the mothers were 27 years old or younger and only 16.6% of them were working. As for education, 30.3% of the mothers had no formal education, whilst 13.9% had only primary education and 45.1% had secondary education. Equally, 17.5% of the fathers had no formal education, whilst 14.8% had only primary education and 54,1% had secondary education.
- One-fifth (25.2%) of the children's families in the sample belonged to the poorest wealth quintile, whilst 21.8% belonged to the poorer quintile. Equally, 19.8% belonged to the middle wealth quintile and only 15% belonged to the richest.
- For the number of household members, 45% of the children's families had 1-5 members in their household. Equally, 41% of the families had only one

child under 5 in their household, whilst 41.5% of the households had 2 children U5 and the remaining had 3 or more.

- Overall, 71% of the children lived in an urban residence and 28.4% lived in rural areas**.**
- More than half (52.8%) of the children lived in the Central and East region of the country. Meanwhile, only 3.7% lived in the Northeast region whilst 12.6% lived in the Northern region, 18.1% lived in the South and 12.8% in the Western region.
- When asked if the distance to a health care facility was a problem, 66.6% of the women interviewed answered that it was not a problem or not a big problem.

Table 11. Demographic characteristics of all live children under 5 (U5), India, 2015-16 (NFHS-4 sample)

		Unweighted	*Weighted*	
Measure		***Total number (N=230,538)***	***%***	***95% CI***
Sex	*Girls*	110,780	47.9	47.6-48.2
	Boys	119,758	52.1	51.8-52.4
Age (years)	*0*	43,406	18.4	18.2-18.6
	1	45,870	20.0	19.8-20.3
	2	45,940	20.0	19.7-20.2
	3	48,399	21.1	20.9-21.4
	4	46,923	20.4	20.2-20.7
Mother's level				
Religion[a]	*Hindu*	165,331	78.5	77.9-79.1
	Muslim	36,310	16.6	16.1-17.2
	Christian	19,602	2.1	1.9-2.2
	Sikh	3,726	1.3	1.2-1.4
	Buddhist	2,333	0.8	0.6-0.9
	Other[b]	3,236	0.7	0.6-0.9
Belongs to a Caste or Tribe? [c]	*Yes, caste*	180,900	88.8	88.4-89.2
	Yes, tribe	39,041	7.5	7.3-7.9
	No	8,993	3.6	3.3-3.9
Belongs to SCT_OBC or other Non-Scheduled Caste or Tribe? [d]	*Scheduled Caste*	43,256	21.5	21.1-22.0
	Scheduled Tribe	47,566	10.6	10.3-11.0
	Other Backward Class	89,259	43.9	43.3-44.5
	Non-Scheduled Caste/Tribe	39,971	19.5	18.9-20.0
	Don't belong to any Caste/Tribe	8,993	3.6	3.3-3.9
Mother's employment status, last 12 months[$]	*Don't know*	1,493	0.9	0.8-1.0
	Not working	30,399	77.7	76.9-78.6
	Worked in the last year	2,655	5.6	5.2-6.1
	Currently working	6,992	16.6	15.9-17.4
Mother's current age	*15-24*	73,588	34.1	33.7-34.5
	25-26	44,135	19.9	19.6-20.2
	27-30	62,321	26.7	26.327.0
	31-49	50,494	19.3	19.0-19.6
Mother's education	*No education*	72,211	30.3	29.7-30.8
	Primary	33,507	13.9	13.6-14.2
	Secondary	103,959	45.5	45.0-46.0
	Higher	20,861	10.3	10.0-10.6
Father's level				
Father's education[$,e]	*no education*	7,219	17.5	16.7-18.2
	primary	5,914	14.8	14.1-15.5
	secondary	21,777	54.1	53.1-55.1
	higher	4,991	13.4	12.7-14.1
Household level				
Wealth quintile	*poorest*	60,528	25.2	24.6-25.8
	poorer	54,395	21.8	21.4-22.2
	middle	46,051	19.8	19.4-20.1
	richer	38,312	18.3	17.9-18.7
	richest	31,252	15.0	14.5-15.4
	1 to 5	101,168	45.0	44.5-45.4

		Unweighted	Weighted	
Measure		***Total number (N=230,538)***	***%***	***95% CI***
Number of household members	*6*	39,919	16.9	16.7-17.2
	7 to 8	47,402	19.7	19.4-20.0
	9 or more	42,049	18.4	18.0-18.7
Number of children U5 in the HH	*1*	94,779	41.6	41.2-42.0
	2	96,281	41.5	41.1-41.9
	3 or more	39,478	16.9	16.5-17.2
Residence	*rural*	54,964	28.6	27.7-29.5
	urban	175,574	71.4	70.5-72.3
Region	*0_Central*	70,035	27.1	26.4-27.8
	1_East	48,026	25.7	24.9-26.5
	2_Northern	38,388	12.6	12.0-13.1
	3_Northeast	34,829	3.7	3.5-3.9
	4_South	22,985	18.1	17.4-18.8
	5_Western	16,275	12.8	12.1-13.6
Distance to HCF	*no problem/not a big problem*	149,152	66.6	66.1-77.2
	a big problem	81,386	33.3	32.8-33.9

Note: All frequency counts are unweighted and percentages are weighted. Percentages, unless stated, exclude missing and don't know answers. Questions marked with a $ were asked to a subsample of 15% of the households initially sampled, and adding up to 40,046 of child recode records selected here.
a Budhists includes neo-Buddhists and Christians have been oversampled(?)
b Other religious groups, together did not reach 1% (weighted). Breakdown: Jain (0.00%), Jewish (0.00%), Parsi/Zoroastrian (0.00%), no religion (0.00%), other (0.00%)).
c General question on Caste or Tribe (variable v131); 755 missing answers (0.3%), and 849 "don't know" answers (0.7%).
d This statistics is a combination of 2 different variables (v131 (belongs to caste or Tribe?) and s116 (belongs to SCT or OBC?)). For v131: see above; For s116: No missing answers and 911(0.37%) "don't know" answers.
e For this question, 113 respondents did not know the answer (0.2%);
Note: The narrow confidence intervals in the table above reflect the size of the NFHS sample, a nationally representative survey, given the huge population of India. It leads to narrow confidence intervals with more precision of the estimates, i.e., there is less uncertainty about the population mean specific to different aspects estimated (Rothman et al., 2008a).

Care seeking behaviours for children with diarrhoea-NFHS4

Descriptive analysis- variables used for the analysis

Symptoms of common infections

In the descriptive section of the NFHS-4 results chapter (Chapter 6), tables and figures describing the prevalence of symptoms of common infections in children U5 are provided. Besides describing the proportions in all children U5, the proportions in infants (children under 1 year old) and in children from 1 to under 5 years old is also provided. Reporting symptoms for all children U5 and also separately for infants and older children is useful since both male child biological frailty and gender discrimination could explain differential reporting of illness in boys compared to girls.

The three variables used for the prevalence symptoms of common infections in U5 are diarrhoea, acute respiratory infection (ARI) and fever. As explained earlier, in this chapter, for diarrhoea and fever the original variables in the NFHS-4 questionnaire are used and for ARI, a new variable had to be created.

The new ARI proxy variable created was based on questions asked about child's symptoms of acute respiratory infection. The original questions used were: Has the child had cough in last two weeks (variable h31)? Has the child had short, rapid breaths (variable h31b)? Has the child presented with problems in the chest or blocked or running nose (variable h31c)?

Note that **ARI** is positive only if:

h31=yes ***AND*** (h31b = yes & h31c=chest only or both chest and nose)

Table 4 provides information on missing information for these variables in different age brackets, i.e., all U5, infants (Younger than 1 year) and children between 1 and 5 years old. The proportions presented in the results chapter exclude the missing information/don’t know answer. There were no missing answers and the proportion of “don’t know answers” was very small.

The definition used for ARI in this thesis is consistent with the definition described in the NFHS-4 report (IIPS, 2017) and recommended by DHS experts in consultation and taking in account the DHS questionnaire recode used.

Estimating episodes of childhood pneumonia in LMICs remains a challenge. A recent study suggest that symptoms of "acute respiratory infection" as captured by demographic and household surveys such as DHS and Multiple (MICS) do not accurately distinguish episodes of cough/cold from confirms that they do not accurately discern episodes of pneumonia from cough/cold in children under five (Ayede et al., 2018). However, given the scarcity of data on rates of pneumonia in LMICs, the use of DHS and MICS data on ARI symptoms may be useful in providing information about care seeking for both ARI and pneumonia. Since our study focused on comparing the recognition, reporting and care seeking of these symptoms in both boys and girls, and not the real prevalence of disease, I believe using these standard definitions provides a good basis for comparison (Campbell et al., 2013) (Kirolos et al., 2018) (Carter et al., 2018b). Moreover, other studies have also used the same definition of ARI (Bawankule et al., 2017, Noordam et al., 2015, Diaz et al., 2013) .

A full description of the construction of the **ARI** proxy variable is provided in Appendix 3.2.

Age brackets

For the descriptive analysis, the prevalence of symptoms reported is for all children under 5, infants and older children (1 to 5-year-olds). One of the reasons for reporting it for these different age brackets is to evaluate the role of biological male frailty and also the influence of gender on symptoms reporting in boys and girls.

Biological male frailty could potentially affect the relative proportions of girls versus boys who are reported to have symptoms of common infections, if boys were more likely to present with more severe symptoms in the first year of life. Equally, gender discrimination could also mean that carers might report symptoms of illness for boys more often than they report for girls. Therefore, it is important to evaluate the prevalence of reported symptoms in these different age brackets (and not only in all children U5).

Table 12. Missing information for questions on symptoms of common infections in children U5

Age (years)		**Diarrhoea N (%)**	**ARI N (%)**	**Fever N (%)**
All < 5	Missing	0	0	0
	Don't know	406 (0.14%)	527	350 (0.12)
< 1	Missing	0	0	0
	Don't know	47 (0.08 %)	81 (0.14%)	40 (0.08%)
1 to < 5	Missing	0	0	0
	Don't know	359 (0.15%)	46 (0.19%)	310 (0.13%)
Sample Size		90,047	97,085	18,7132

Care seeking behaviours for diarrhoea

For the descriptive tables of symptoms of common infections, the P -values reflect comparisons between proportions of boys and girls. Also, percentages exclude don't know and missing answer which are minimal (< 1%). Care seeking summary variables are provided by DHS surveys as a final combination of several specific questions. In this specific case here, they relate to ***treatment*** given (e.g. rehydration therapy or antibiotics) an also relating to the type of ***place*** where care was sought by parents for children with diarrhoea and other common infections.

Comparing care sought outside the home across ages

The variable h12z in DHS, answers the question if carers sought advice or treatment outside home for the specific episode of diarrhoea in their child. In Chapter 5, which uses data from the NFHS-3, a detailed analysis of this variable comparing boys and girls is provided.

Place first sought for treatment for diarrhoea

To be able tease out the important information and provide relevant comparisons, I created the recoded variables using the original variable called h44a. The label of the h44a variable reads "Place first sought for treatment for diarrhoea" and aims to determine the first point of care carers sought for children with diarrhoea. Table 13 shows the recoded variables and their definitions:

Table 13. Recoded variables created from variable h44a ("Place first sought for treatment for diarrhoea")

Recode variable name	***Label***
DIARR_POC1	various levels of care, from community to referral both private and public
POC_priv_others	first point of care, private care versus other types of care
POC1_COST	costliest type of care versus others (private hospital/doctor/clinic versus others)

*Private Hospital or Clinic is the costliest type of care available;

Initially, the association of the independent variables, including sex, with the variable "PCO1_COST" (use of costliest type of care (private hospital/doctor/clinic versus others) was checked. To measure the association of each potential independent variable on the type of care (PCO1_COST) sought for boys versus girl, logistic regression was used. Then, a bivariate logistic regression was used to explore the association of each one of the potential determinants, including sex (independent variables) and PCO1_COST (dependent variable). For a full list of determinants, check Table 11.

Methods for Statistical Analysis

The principles of the Workflow of Data Analysis framework for Stata (Long and Long, 2009) guided the data management and analysis conducted in this thesis. Coordinated procedures for planning, organizing and documenting research and also cleaning data, analysing and backing up and archiving materials were followed, especially for the analysis of the NFHS-4 dataset. All stages were documented using syntax, using do-files and log files.

Both the data management and analysis for this thesis was conducted using STATA®. For the NFHS-3 dataset analysis, STATA 13/IC (StataCorp, 2013a) was used. However, a different version of Stata, i.e., STATA 15/SE (StataCorp, 2015), was used in order to cope with the large NFHS-4 dataset. Although the NFHS-4 dataset is a much larger dataset than the NFHS-3, only minor changes in the names and contents of variables studied were noticed between the two rounds of the survey. A complete case analysis approach was used given the small number of missing values.

Complex Survey Data Analysis techniques

Stata `SVY` commands and techniques were used to account for the complex survey design and sampling (Lee and Forthofer, 2005). Both descriptive and association analyses were conducted according to the guidance of the Stata Survey Data Reference Manual (StataCorp, 2013b). Specific guidance on estimation and post estimation commands were also taken into account (Williams, 2019b, StataCorp, 2013b). Similarly, subsample analyses were conducted using the `subpop` option command after `svy`, to guarantee that all cases in the full sample were used in the of the standard errors (Williams, 2019b). Expert advice on DHS data management and analysis techniques was also sought at the DHS Program User Forum (DHS, 2019). The national women's weight was used as the weight unit (v005) and the cluster number as the primary sampling unit.

For the contingency table analysis, P values and 95% confidence intervals (CI) are based on the recommended Rao Scott second-order corrected Pearson F statistic, which accounts for the complex survey design (Lee and Forthofer, 2005).

Association Analysis techniques

To investigate the association of between sex of the child and care seeking outcome, multivariable logistic regression models were built. For the logistic regression using both of the rounds of the NFHS data, the models built are binomial logistic regression models, since the main dependent variable was receiving or not a certain type of care (Treiman, 2009). Models were fitted via an approximate likelihood, which incorporates the sampling weights of the survey (Hosmer Jr et al., 2013a). Therefore, model significance and testing of coefficients were performed using F-adjusted Wald tests rather than likelihood ratio tests.

NFHS-3 association analysis approach

One of the main aims of this thesis is to document gender inequities in child healthcare seeking behaviours for children under five (U5) living in South Asia using *large-scale national household surveys*. It also aims to evaluate the impact of other biological, cultural and socio-economic factors in these inequities.

In line with these aims and the research objectives involving household survey data analysis, an analysis of care seeking outcomes for diarrhoea in children under five in India was carried out using the third round of the NFHS (NFHS-3).

This analysis aims to determine whether there is an association between the sex of the child and seeking care outside the home for diarrhoea. Furthermore, it aims to determine if and how other biological, social and gender inequity factors modify the effect of gender (determined by the sex of the child) on this particular care seeking outcome.

Although in developed countries, a percentage of cases of diarrhoea in children can be treated at home, the reason to choose this outcome/variable for this analysis is twofold. First, in developing countries, management of diarrhoea without formal medical advice can be poor and therefore, children taken to health facilities due to diarrhoea are more likely to recover faster and survive. Secondly, this variable can reflect access to health care and also highlights an important step in the management of childhood illnesses. Either delay or lack of care seeking outside the home or not seeking care outside the home at all is recognised as an important step in childhood illnesses management. In fact, not seeking care outside the home for childhood diseases can lead to poor case management and also death for children in developing countries (Källander et al., 2011).

The analysis of diarrhoea and care seeking behaviours presented in both here and in Chapter 5 is restricted to children who were alive at the time of the survey since for children who have died the child health history not available. The unit of the analysis is each child.

To evaluate the independent effect of other biological, cultural and socio-economic factors in these inequities, I also looked at other potential determinants of care seeking. These factors included place of residence, distance to health care facility, wealth quintile, religion, belonging to schedule caste or tribe and other backward classes, mother education, young age of child and number of children living in the household.

The sex distribution and prevalence of diarrhoea and some care seeking behaviours characteristics of the sample of children included in the survey is presented in Chapter 5.

Similarly, to further understand the impact of intersections of inequalities affecting care seeking behaviours a descriptive analysis of sex and other inequalities, using the other potential determinants of care seeking was conducted (Chapter 5).

The work of others (Mumtaz and Salway, 2005, Iyer et al., 2007), suggests that class differences might not be gender neutral and vice versa. Based on this, a new hypothesis was proposed in the earlier stages of this thesis work. The hypothesis is that, in India, *the intersection of gender and other inequalities and especially economic class, works to the disadvantage of girls when it comes to health care seeking*.

Therefore, firstly, in Chapter 5 a full description of weighted percentages of care seeking outside home for diarrhoea for boys and girls is provided. Then, another descriptive table combining sex of the child with some of the other potential care seeking determinants, i.e. age, economic class, caste, number of children in the household are is provided.

Initially, the analysis of association between all indicators and seeking care for diarrhoea outside home looking at the independent association of sex and all the other determinants of care seeking. Then, a bivariate and multivariable logistic regression analysis is presented. To further test the hypothesis above a specific model of the association of care seeking with these combined potential determinants is built.

Further to the association analysis of independent effects presented in Chapter 5, an analysis looking at the interaction of the two main determinants (e.g. sex and economic class) is conducted (Model 1).

Then a new model using an interaction term (Model 2) is also fitted. In Model 2, the potential effect of intersections of inequalities in care seeking outcomes for diarrhoea is highlighted. However, besides testing for interaction adding the interaction term in Model 2, I also tested a different model, which I refer to here as "Model 3".

Although the adjusted odds ratios in Model 1 measures the independent association of all sociodemographic characteristics studied, they do not tell us much about how these potential determinants relate to each other when combined together. However, when sex and wealth are combined forming new subcategories in Model 3, it is easier to understand how the combination (or intersection) of gender and wealth could affect care seeking in children, by looking at the associations found. The results of this analysis are discussed further in the discussion chapter.

Chapter 5 provides a description of the subpopulations/subcategories created for Model 3, where the reference group is composed the richest boys group and dummies are created for the other 9 new subcategories.

NFHS4 association analysis approach

Purposeful selection of variables method

Specifically for the logistic regression model built for the NFHS-4 data, the *purposeful selection of variables* method was used (Hosmer Jr et al., 2013c). In this particular algorithm, the analyst makes a variable selection decision at each step of the modelling procedure. At each step, a critical review of all variables included in the model is conducted. The algorithm checks the statistical significance of covariates and also uses the delta-beta-hat-percent ($\triangle \hat{\boldsymbol{\beta}}$ %) to account for confounding (Ibid). One of the advantages of this purposeful selection of variables approach that it has the potential to create a somewhat "richer" model, by retaining important confounding variables (Bursac et al., 2008)..All steps of this algorithm were fully documented using do-files in Stata and Microsoft ®Excel® 2016 spreadsheets.

The *purposeful selection of covariates* algorithm for the final model of the NFHS-4 dataset analysis (i.e., cost of care seeking for diarrhoea) included the following steps (See details in Figure 18):

Step 1: Using univariate analysis, the candidate variables for the first multivariable model were selected. The selection of variables is based on a Wald test from logistic regression and a p-value cut off point of 0.25. Those independent variables with a p-value less than 0.25, or those deemed important according to the literature review and conceptual framework chapters, were retained at this stage

Step 2: In this stage a multivariable model using the variables selected in the previous step were fitted. The importance of each variable was assessed using Wald tests and those variables that do not contribute (using traditional levels of significance) were eliminated. The new model fitted was then compared with the first model fitted in the beginning of this step using the partial likelihood ratio test.

Step 3: At this step, the values of the coefficients in the smaller (constrained) model fitted was compared to the larger model. First, the Wald statistic was used to test if the level of significance for the coefficient of each variable in the constrained model changed. In this case, the Wald test for the variables b4, b8infant, v190, HFS remain all significant the same level and v106 changes from p=0.01 to p=0.03 (i.e., still a p< 0.05). Secondly, the values of the reduce/constrained model with the respective values in the Full Model values. The rule of thumb used to conclude if a variable was needed in the model was if the variable adjusted the effect of another variable with a delta-beta-hat-percent ($\triangle \hat{\boldsymbol{\beta}}$ %) >20 (Hosmer Jr et al., 2013b). None of the variables in the larger model tested had a $\triangle \hat{\boldsymbol{\beta}}$ % bigger than 20 and therefore, the Constrained Model was kept.

Step 4: This step identifies variables that on their own are not significantly related to the outcome but make an important contribution in the present of other variables. It is basically looking for potential confounders. This final model at the end of Step 4 is called "*preliminary main effects model".* In this case, it contains the same independent variables as step 3, i.e., b4,b8infant, v190, v106 and HighFocusSt

Step 5: At this point, since a model with the essential variables has been obtained, each variable in the model is then examined in more detail. Since the model does not contain a continuous variable and the appropriateness of categories have already been addressed, earlier, this step was skipped. The model at the end of this step is referred to as *main effects model*.

Step 6: In this step, interaction among variables was tested. An intersection between two variables means that the effect of each variable is not constant over the levels of the other variable. As with other model building techniques, to include an interaction term in a model , it is important to evaluate if that interaction make sense from a social (or clinical) perspective (Hosmer Jr et al., 2013c). The followed interactions between sex of the child (main independent variable) were tested at this point:

- *sex & infant age (b4*b8infant)*
- *sex & wealth quintile (b4*v190)*
- *sex & High Focus States (b4* HighFocusSt)*
- *High Focus States& wealth quintile (HighFocusSt*v190)*

Again, the interaction terms were tested using a likelihood ratio test, and only consider in this case the statistical significance, and at traditional levels (i.e., 5%, in our case).

At this step, when testing for the interaction of sex with High Focus States, it was noticed that although no interaction was found between these two. However, when the High Focus States was taken out of the model, Mother's level of education (v106) did not show a significant effect in the model.

At the end of this stage the interaction test between High Focus States and Wealth quintile (HighFocusSt*v190) showed not only interaction but also confounding where the univariate model without adjusting High Focus States underestimates wealth quintile by 82.8%.

At the end of this stage the Model is referred to as *preliminary final model and in the case of* this analysis it is called "Main effects Model with interaction term (High Focus States&wealth quintile)"(see flowchart in Figure 18 under for details).

Step 7: For inferential purposes, at this stage the fitness of the Model was checked during this step. The preliminary final model was then tested using the goodness-of-fit testing procedures adequate to test fitness of logistic regression models that use sample survey data, i.e., `svylogitgof` (Archer, 2006). This command estimates the *F*-adjusted mean residual test after `svy: logit` or `svy: logistic`. The test showed a good fit for the data, or at least, showed no violation of assumptions.

Figure 18.Flowchart of steps of Purposeful Selection of variables for NFHS-4 data analysis

	Model name	***Model retained at the end of the step (Stata® commands)***
Step 1:	*Full model*	`svy linearized : logit b4,b8infant, v025, v190,v106,SCT_OBC_by, distance_HCF, HighFocusSt`
Step 2:	*Constrained Model*	`svy linearized : logit POC1_COST b4 b8infant  v190 v106  HighFocusSt`
Step 3:	*Constrained Model*	`svy linearized : logit POC1_COST b4 b8infant  v190 v106  HighFocusSt`
Step 4:	*Preliminary main effects model*	`svy linearized : logit POC1_COST b4 b8infant  v190 v106  HighFocusSt`
Step 5:	*Main effects model*	`svy linearized : logit POC1_COST b4 b8infant  v190 v106  HighFocusSt`
Step 6:	Preliminary final model	`svy linearized : logit POC1_COST b4 b8infant v190 v106 HighFocusSt HighFocusSt _v190`
Step 7:	*Final Model*	`svy linearized : logit POC1_COST b4 b8infant v190 v106 HighFocusSt HighFocusSt _v190`

Notes: Dependent variable: POC1_COST (Costly type of care for diarrhoea); Independent variables: b4 (sex), b8infant (infant age), v025 (rural/urban), v190 (wealth index),v106 ,SCT_OBC_by (Schedule caste or tribe & other backward class), distance (HCF Distance to Health Care facility), HighFocusSt (region of residence, High Focus States or other)

Chapter 5. Gender and poverty and child health care utilisation for diarrhoea-NFHS-3 (2005-06)

Introduction

In line with the research objectives stated in the first chapter, this chapter aims to evaluate the association of gender on health care seeking behaviours for one of the commonest types of infection in children under 5, i.e., diarrhoea. For the analysis presented here, data from the third round of the Indian Demographic and Health Survey (DHS) were used. In India, this survey is as known as the National Family Health Survey (NFHS) and this round, conducted from 2005 to 2006, as the NFHS-3 survey. The care seeking behaviours for diarrhoea studied here are illness perception or reporting, child care seeking outside the house, level and type of health care sought (private doctor, private clinic or hospital versus other types of providers) and use of Oral Rehydration Solution for diarrhoea. The combined effect of gender and wealth on care seeking was assessed using an intersectional approach, using a multivariable logistic regression model adjusting for other potential effect modifiers.

The analyses conducted here take into account the complex survey design used by DHS surveys, including probability weights. The Methods chapter includes further details on the sampling techniques used by DHS, the operationalisation of variables used and data management and analysis techniques. Similarly, the characteristics of the NFHS-3 survey database, a description of the NFHS-3 sample of children U5 and details of the demographics of the children and their families are also provided in the Methods chapter.

Descriptive results

In this chapter, the analysis of diarrhoea and care seeking behaviours presented is restricted to children who were alive at the time of the survey and the unit of the analysis is each child, as described in the Methods Chapter 4. At the time of the survey, 48,679 (93.7%) of the 51,555 children born in the last five years were alive. Of these, 25,301 (52.1%) were boys and 23,378 (47.8%) were girls. For more details

Children under five (U5) reported having Diarrhoea

Of all live children, 9.0% (95%CI 8.5–9.4) were reported to have had diarrhoea in the two weeks preceding the date of the interview.

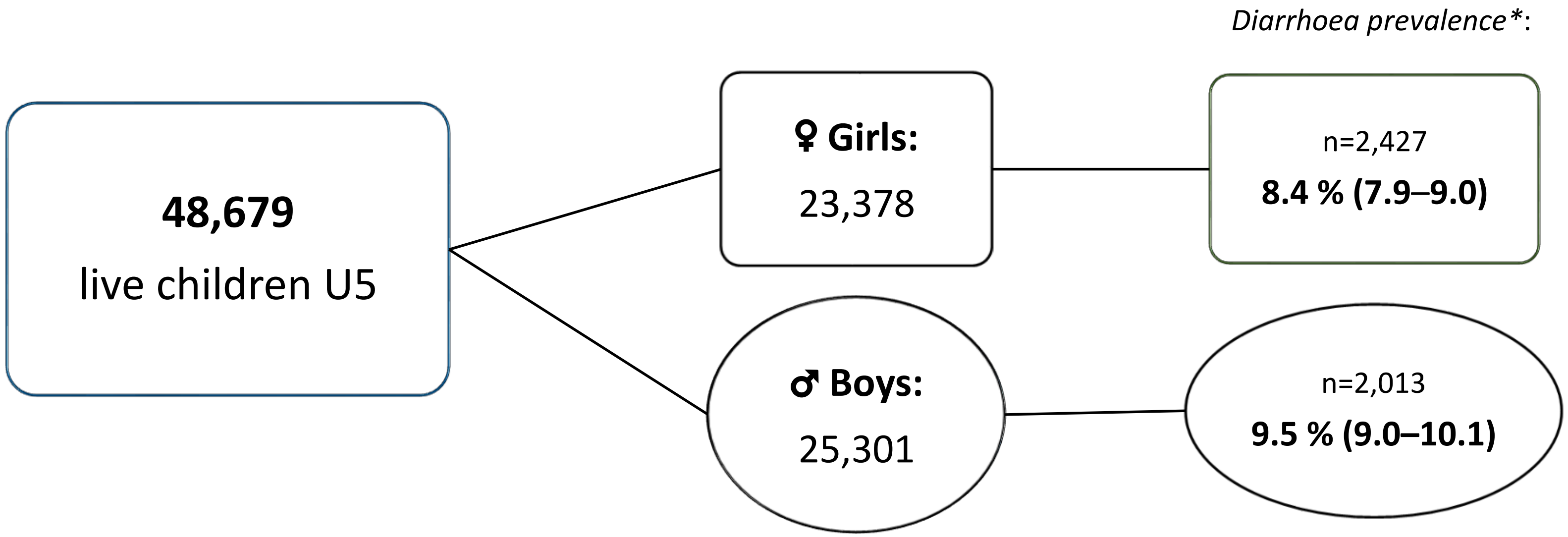
Period prevalences of symptoms and treatment (or careseeking) for symptoms of common infections was calculated according to the Guide to DHS Statistics (Croft T, 2018). Note that all frequency counts presented in this chapter are unweighted and percentages are weighted according to probability weights to account for survey design and sampling, as explained in detail in the Methods Chapter and in the initial analysis plan in Appendix 3**.**

Diarrhoea was reported for 9.5% of the boys and 8.4% of the girls (see Figure 19 for more details).

Demographic characteristics of children under 5 with diarrhoea

For details on the demographics of the sample of children of children under 5 with diarrhoea used in this analysis, please see **Table 14**.

Figure 19. Percentage of children under age 5 with symptoms of diarrhoea in children under 5 years (U5) in the last two weeks – India, NFHS-3 survey, 2005-06.



All frequency counts are unweighted and percentages are weighted according to probability weights to account for survey design and sampling
* As a proportion of alive children according to DHS questionnaire and weigh adjusted;

Table 14. Characteristics of children under 5 with diarrhoea, India, NFHS-3.

		Unweighted	Weighted	
Measure		**Children with diarrhoea (n=4,440)**	**%**	**95% CI**
Sex	girls	2,013	44.7	(42.8 - 46.6)
	boys	2,427	55.3	(53.4 - 57.2)
Young age (years)	< 1	1,377	31.5	(29.7 - 33.3)
	1-4	3,063	68.5	(66.7 - 70.2)
Religion	not Hindu	1,449	24.1	(21.5 - 26.8)
	Hindu	2,987	76.9	(73.1 - 78.5)
Belongs to Scheduled Caste/Tribe or other Backward class (SCT_OBC)?	SCT_OBC	2,982	74	(71.5 - 76.0)
	Don’t belong to SCT_OBC	1,278	26.1	(23.9 - 28.5)
Mother's education level	no formal	1,724	47.2	(44.7 - 49.7)
	primary	657	14.8	(13.4 - 16.4)
	secondary	1,769	33.8	(31.5 - 36.1)
	higher	290	4.1	(3.4 - 5.0)
Wealth quintile	poorest	767	24.5	(22.3 - 26.9)
	poorer	812	22	(20.1 - 24.0)
	middle	968	20.5	(18.8 - 22.5)
	richer	1,028	19.2	(17.4 - 21.2)
	richest	865	13.6	(12.1 - 15.3)
Number of children in household	> 2 children	825	20.8	(19.1 - 22.7)
	2 children	1,784	38.6	(36.7 - 40.6)
	1 child	1,831	40.5	(38.5 - 42.7)
Residence	rural	2,749	74.4	(71.4 - 77.3)
	urban	1,691	25.5	(22.7 - 28.6)
Distance to a Health Care Facility	less of a problem or not a big problem*	3,064	66	(63.4 - 68.4)
	a big problem	1,375	34	(31.6 - 36.6)

All frequency counts are unweighted and percentages are weighted, according to probability weights to account for survey design and sampling. *This DHS question allows three answers, a. not a problem; b. not a big problem; c. a big problem.

Careseeking behaviours in children U5 with Diarrhoea

Period Prevalence of careseeking behaviours for diarrhoea

The weighted prevalence of seven different types of careseeking behaviours for diarrhoea is described in Table 15, for the total number of children and also for boys and girls separately. The weighted prevalences of symptoms reporting was higher for boys than girls (see Figure 1) and so was careseeking outside the home, where 64.6% (95% CI 61.8–67.3) of boys compared to 60.3% (95%CI 57.3–63.2) of girls were taken outside the home for care (see Table *1*). However, neither prevalence of symptoms reporting or the prevalence of care seeking outside home showed a statistically significant difference between boys and girls. Private health care was also more often sought for boys than girls (Table **15**), but there was no statistically significant difference in the prevalence of this care seeking behaviour between boys and girls. Carers offered Oral Rehydration Solution (ORS) to around one-quarter of children with diarrhoea and there was no difference between boys and girls.

Children with diarrhoea who received care outside the home

Seeking care outside the home is an important step in the pathway to access to treatment for infectious diseases like diarrhoea in children. Therefore, this outcome is explored further here. Apart from the sex of the child, other potential determinants for diarrhoea and careseeking outside the home were also studied (Table 3). These were *young age of the child, residence (rural or urban), distance to health care facility, number of children in the household, religion, wealth quintile, mother education and belonging to scheduled caste and tribe and other backward class*. For these, weighted prevalence of careseeking outside the home was lower for those living in rural areas (compared to urban), for those where distance to health care facility was a problem (compared to others), for the poorer, for those children with less-educated mothers and also for those belonging to a scheduled caste or tribe (SCT) or other backward class (OBC). However statistically significant differences between categories were present only for *wealth quintiles, mother* *education and problems with distance to a health care facility* (See Table 16 for more details).

Table 15. Health careseeking behaviours in children under five with diarrhoea - India, NFHS-3 (2005-06).*

	n/N	Weighted (%)	(95% CI)	Sex	n/N	Weighted (%)	(95% CI)
Children with diarrhoea:							
Carers sought advice or treatment outside home	2,682 /4,435	62.7	(60.5 - 64.9)	*Boys*	1,513 /2,425	64.6	(61.8 - 67.3)
				Girls	1,169/2,010	60.3	(57.3 - 63.2)
Carers did not seek advice or treatment outside home	1,456 /4,417	30.8	(28.8 - 33.0)	*Boys*	764 /2,425	29.7	(27.1 - 32.4)
				Girls	692 /2,010	32.3	(29.3 -35.3)
Carers DID NOT administer any treatment	1,879/4,417	43.6	(41.3 - 45.9)	*Boys*	1,044/2,414	44.1	(41.3 - 47.0)
				Girls	835/2,003	43	(39.9 - 46.1)
Carers either administered treatment and or SOUGHT for treatment or advice	1,932/4,424	78.1	(7.6 - 8.0)	*Boys*	1,932/2,422	78.7	(76.2 - 81.0)
				Girls	1,566/2,002	77.4	(74.6 - 79.9)
Carers SOUGHT for treatment in a Private Hospital or Clinic	425 /4,435	9.9	(8.6 - 11.3)	*Boys*	239/2,425	10.6	(9.0 - 12.5)
				Girls	186/2,010	9	(7.5 - 10.9)
Carers consulted with a Private Doctor	1276/4,435	30.6	(28.4 - 32.8)	*Boys*	727/2,425	31.4	(28.8 - 34.2)
				Girls	549/2,010	29.4	(26.7 - 32.3)
Child was given ORS***	1376/ 4,408	26.3	(24.5 - 28.2)	*Boys*	774/2,412	26.5	(24.1 - 28.9)
				Girls	602/1,996	26.2	(23.6 - 28.9)

All frequency counts are unweighted and percentages are weighted, according to probability weights to account for survey design and sampling, missing data excluded. *As a proportion of alive children according to DHS questionnaire;
***Child received a sugar-salt-water solution from a special packet, oral rehydration solution (ORS).

Table 16. Children with diarrhoea: prevalence of care outside the home NFHS-3 (2005-06).*

		care outside the home		
		Unweighted	Weighted	
		N	%	95% CI
Sex	Girls	1,169	60.3	(57.3 - 63.2)
	Boys	1,513	64.6	(61.8 - 67.3)
Young age (years)	< 1	840	60.9	(57.4 - 64.5)
	1-4	1,842	63.5	(60.9 - 66.0)
Religion	not Hindu	806	64.8	(60.3 - 69.1)
	Hindu	1,873	62.0	(59.5 - 64.5)
Belongs to Scheduled Caste/Tribe or other Backward class (SCT_OBC)?	SCT_OBC	1,748	61.3	(58.6 - 63.9)
	Don't belong to any SCT_OBC	821	66.6	(62.8 - 70.3)
Mother's education level	no formal	968	57.6	(54.3 - 61.0)
	primary	363	63.5	(58.2 - 68.5)
	secondary	363	68.0	(64.7 - 71.0)
	higher	221	75.3	(66.3 - 82.6)
Wealth quintile	poorest	385	53.0	(48.5 - 57.3)
	poorer	451	61.0	(56.4 - 65.1)
	middle	561	63.1	(58.4 - 67.5)
	richer	656	67.4	(63.1 - 71.5)
	richest	629	76.0	(71.5 - 80.0)
Number of children in household	*> 2 children*	487	59.9	(55.1 - 64.4)
	2 children	1,057	61.9	(58.5 - 65.1)
	1 child	1,138	64.9	(61.8 - 68.0)
Residence	*rural*	1,597	61.3	(58.6 - 64.0)
	urban	1,085	66.8	(63.1 - 70.2)
Distance to HCF	*less/not a big problem*	1,940	65.1	(62.5 - 68.0)
	a big problem	742	58.0	(54.3 - 61.6)

All frequency counts are unweighted and percentages are weighted, according to probability weights to account for survey design and sampling. Abbreviations: CI, Confidence Intervals; U5, children under 5 years; HFC, Health Care Facility; NFHS-3, National Family Health Survey-third round ;

Prevalence of care outside the home combining sex and other determinants

In the combined descriptive analysis of sex and other determinants of careseeking (Table 17), when age and sex were combined and all subcategories examined, the weighted prevalence of treatment outside the home was either similar for boys and girls or boys were slightly more likely to receive care outside home than girls. However, in households with more than two children, the difference between boys and girls (boys > girls) for care outside the home reached 15% and this difference was a statistically significant difference with non-overlapping confidence intervals (see Table 17 for details).

Sex and economic class and prevalence of careseeking outside the home

In this analysis, as explained in more detail in the Methods chapter, sex of the child and wealth quintile of the family are combined to create ten subcategories for comparison (see Figure 20 for details). Initially, the analysis compares the weighted prevalence (and their 95% Confidence Intervals (CI)) of careseeking outside the home in the ten subcategories.

This comparison of careseeking prevalences between these ten subcategories produced more nuanced results (Table 17 and Figure 21). Richest boys were significantly more likely to receive care outside the home compared to all other subcategories, except richest girls and richer boys. In contrast, richest girls were only more likely to get care outside home when compared with poorest boys and girls. Looking from a different angle, poorest girls, *but not poorest boys*, were significantly less likely to receive care outside home than all the other subcategories. Poorest boys, were worse off in terms of careseeking outside the home *only* compared to richer boys, richest boys and richest girls. In contrast, poorest girls were less likely to receive care outside the home when compared to all six subcategories starting upwards from middle wealth quintile girls.

Compared to poorest girls, richest boys were at least 18% and up to 32% more likely to get care outside the home when diarrhoea is reported (Table 17). Interestingly, richer girls were more similar in terms of the prevalence of careseeking outside the home to poorest boys (no statistically significant difference in proportion) than richer boys were similar to poorest girls. Within each economic class, there were no significant differences between boys and girls.

Figure 20. Dummy variables created to study the combined effect of sex and wealth on care seeking

Subcategory 1*: poorest female*

Subcategory 2: *poorest male*

Subcategory 3: *poorer female*

Subcategory 4: *poorer male*

Subcategory 5: *middle female*

Subcategory 6: *middle male*

Subcategory 7: *richer female*

Subcategory 8: *richer male*

Subcategory 9: *richest female*

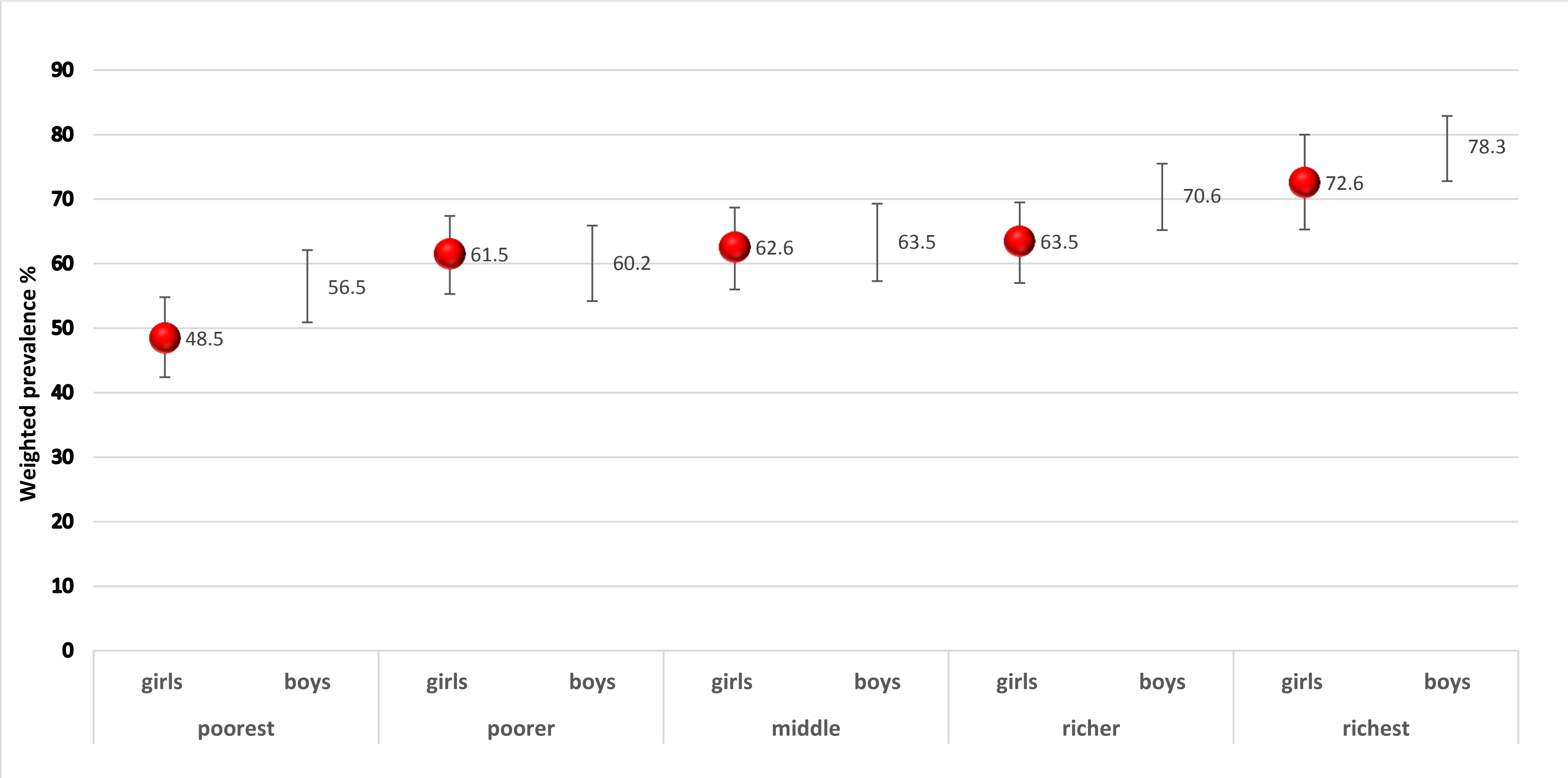
Subcategory 10: *richest male (reference)*

Table 17. Prevalence of diarrhoea and careseeking outside the home by sex and other determinants for children under five in India, NFHS-3 (2005_06).

			Children with diarrhoea (n=4,440)	Weighted %	(95%CI)	Sought treatment outside home (n=2,682)	Weighted %	(95%CI)
Young Age	< 1 year	*girls*	657	13.3	(12.1-14.7)	388	58.5	(53.4-63.3)
		boys	720	15.4	(14.1-16.9)	452	63.1	(58.2-67.8)
	1-4 year olds	*girls*	1,356	7.2	(6.6 - 7.8)	781	61.2	(57.6-64.7)
		boys	1,707	8.2	(7.6 - 8.7)	1,061	65.3	(62.0-68.5)
Wealth quintile	poorest	*girls*	353	9.0	(8.9-9.1)	161	48.5	(42.4–54.8)
		boys	414	9.2	(9.1-9.3)	224	56.5	(50.9-62.1)
	poorer	*girls*	384	9.1	(9.0-9.2)	217	61.5	(55.3-67.4)
		boys	428	9.1	(8.9-9.2)	234	60.2	(54.2-65.9)
	middle	*girls*	442	9.1	(9.1-9.2)	253	62.6	(56.0-68.7)
		boys	526	9.0	(8.9-9.1)	308	63.5	(57.3-69.3)
	richer	*girls*	464	9.1	(8.9-9.2)	281	63.5	(57.0-69.5)
		boys	564	9.0	(8.9 -9.1)	375	70.6	(65.2-75.5)
	richest	*girls*	370	9.3	(9.1 - 9.4)	257	72.6	(65.3-80.0)
		boys	495	9.1	(8.9-9.2)	372	78.3	(72.8-82.9)
Distance to Health Care Facility	is a problem	*girls*	643	9.1	(8.2-10.1)	336	57.1	(52.3-61.8)
		boys	732	10.8	(9.8-11.9)	406	58.7	(53.9-63.3)
	less or no problem	*girls*	1,369	8.1	(7.5-8.8)	833	62.0	(58.3-65.5)
		Boys	1,695	9.0	(8.4-9.6)	1,107	67.7	(64.3-70.9)

			Children with diarrhoea (n=4,440)	Weighted %	(95%CI)	Sought treatment outside home (n=2,682)	Weighted %	(95%CI)
Schedule caste or tribe or other backward class (OBC)	SCT or OBC	*girls*	1,377	8.6	(7.9-9.2)	778	58.7	(55.1-62.2)
		boys	1,605	9.8	(9.2-10.5)	970	63.3	(59.9-66.6)
	other	*girls*	555	8.2	(7.3-9.1)	344	64.8	(59.1-70.2)
		Boys	723	9.0	(8.1-9.9)	477	68.1	(63.2 - 72.7)
Number of children in household	> 2 children	*girls*	370	8.1	7.1-9.2)	189	51.5	(44.7-58.1)
		boys	455	10.2	(9.0-11.5)	198	66.5	(60.7-71.8)
	2 children	*girls*	812	8	(7.2-8.8)	478	61.1	(56.5-65.6)
		boys	972	9.3	(8.5-10.1)	579	62.4	(58.1-66.6)
	1 child	*girls*	831	9.1	(8.3-10.0)	502	63.9	(59.6-68.1)
		boys	1,000	9.5	(8.8-10.3)	636	65.8	(61.7-69.7)

Figure 21. Sex and wealth index* and prevalence of careseeking outside the home, children with diarrhoea, India 2005-2006.



*Wealth quintiles (poorest, poorer, middle, richer, richest)

Sex and mother education level and prevalence of careseeking outside the home

The analysis of mother's education (not shown here) shows a similar pattern. Daughters of mothers with no formal education were less likely be taken outside home for care when compared to both boys and girls of families where mothers had some level of education. However, mother's lack of formal education did not affect care seeking for sons in the same way

Sex and distance to the nearest health care facility and prevalence of careseeking outside the home

For the combination of sex and distance to a health care facility (HCF) the results are as follows. Parents who report distance to HCF as a problem were significantly less likely to take both girls and boys outside the home for care when compared to boys of parents who do not report distance as a problem. However, from the carers who *do not* report distance to HCF as a problem, only boys are more likely to get care outside the home than boys and girls from the parents who report distance as a problem. Boys from families where distance is not a problem, are better off in terms of careseeking outside the home but not girls from the same families (check weighted prevalence and confidence intervals in Table 17).

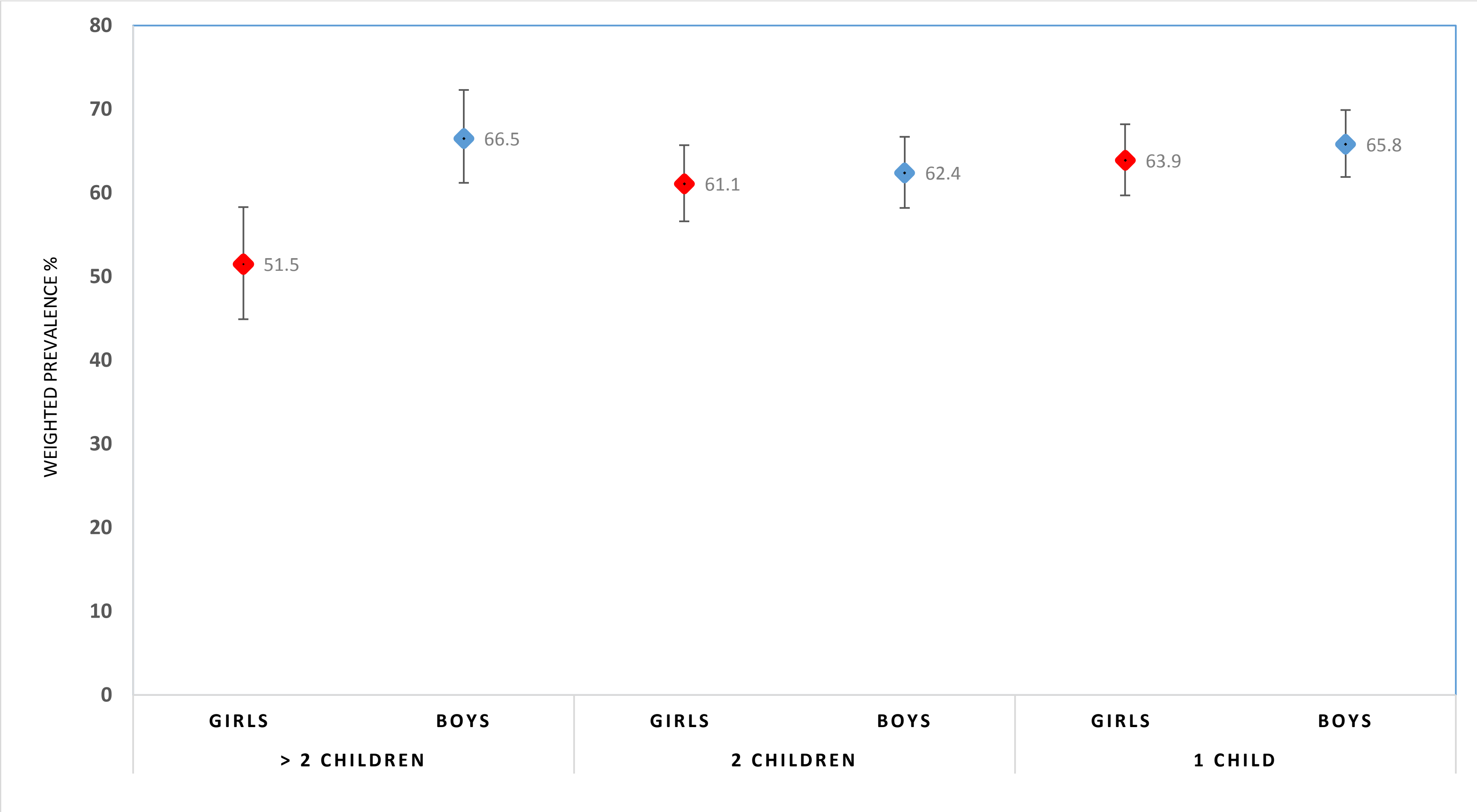
Sex and belonging Scheduled Caste or Tribe or other backwards classes (SCT or OBC) and prevalence of careseeking outside the home

Another combination explored was the sex and whether the child belonged to a Scheduled Caste or Tribe or other backwards classes (SCT or OBC). The results show that girls belonging SCT or OBC had the lowest weighted prevalence of receiving care outside the home for diarrhoea. The same girls were significantly less likely to be taken outside home for care than both boys of families that do not belong to SCT or OBC. However, the same is not the case for the boys belonging to SCT or OBC.

Sex and number of children under five (U5) in the household and prevalence of careseeking outside the home

For the combination of number of children under five (U5) in the household and sex, the results were interesting. Within the three groups, the only difference between boys and girls was in families with more than two children, where girls were significantly less likely than boys to receive care outside the home for diarrhoea. In such larger families, girls were up to 27% less likely to be taken outside the home for care than boys. Moreover, boys in households with more than two children U5 were very similar to other groups, i.e., they were as likely as boys and girls from smaller families to be taken outside home for care. However, girls from families with more than two children were less likely than both boys and girls from families of only one child to be taken outside the home for care (see Table 17 and Figure 22 for more details on prevalence and confidence intervals).

Figure 22. Children with diarrhoea: prevalence of careseeking outside home, sex and number of children in the household, NFHS-3.



Analysis of association using a logistic regression model

Univariate analysis

After the analysis of weighted prevalence, an analysis of association using a logistic regression model was carried out. In the univariate analysis, sex of the child, place of residence (rural or urban), distance to a health care facility (HCF), wealth quintile, mother education and belonging SCT or OBC were associated with the prevalence of careseeking outside the home (Table 18).

Table 18. Careseeking outside home for children with diarrhoea, sex and other determinants: univariate analysis.

		Crude Odds Ratio	(95%CI)	P value
Sex	*boys*	-		
	girls	0.83	(0.71–0.97)	0.021
Age	*1 - 4 y*	-		
	< 1 y	0.9	(0.76–1.06)	0.220
Place of residence	*urban*	-		
	rural	0.79	(0.65–96.0)	0.018
Distance to HCF is a problem	*no*	-		
	yes	0.74	(61.7–88.4)	0.001
Number of children U5 in household	*1 child*	-		
	2 children	0.87	(0.73–1.05)	0.150
	> 2 children	0.8	(0.64–1.01)	0.060
Wealth quintile	*richest*	-		
	richer	0.65	(0.48–0.88)	0.005
	middle	0.54	(0.40–0.73)	<0.001
	poorer	0.49	(0.26–0.48)	<0.001
	poorest	0.35	(0.26–0.48)	<0.001
Mother education	*higher*	-		
	secondary	0.69	(0.44–1.08)	0.117
	primary	0.57	(0.35–0.93)	0.026
	no formal	0.45	(0.28–0.71)	0.001
Schedule caste or tribe (SCT) and other backward class (OBC)	*Other*	-		
	SCT or OBC	0.79	(0.66–0. 96)	0.021
Religion	*other*	-		
	Hindu	0.88	(0.87–1.1)	0.268

Multivariable logistic regression model (Model 1)

Finally, a multivariable logistic regression model was fitted (Figure 19), keeping all the statistically significant independent variables in the univariate analysis, plus the variable age. This model indicates that a lower prevalence of careseeking outside the home for diarrhoea was significantly associated with being a girl (AOR, 0.85; 95% CI, 0.72–0.99), or belonging to a poorer family. The association of careseeking outside the home showed a gradient of association with level of poverty as measured by wealth quintile (richer vs richest: AOR, 0.68; 95% CI, 0.48–0.95; middle vs richest: AOR, 0.57; 95% CI, 0.39–0.83; poorer vs richest: AOR, 0.52; 95% CI, 0.35–0.76; poorest vs richest: AOR, 0.39; 95% CI, 0.26–0.58).

For Stata commands and outputs used to fit the multivariable model 1 presented here, check the Appendix 4.

Table 19. Careseeking outside home for children with diarrhoea, sex and other determinants: multivariable analysis (Model1).

		Adjusted Odds Ratio	(95%CI)	P value*
Sex	*boys*			
	girls	0.85	(0.72–0.99)	0.040
Age	*1 - 4 y*			
	< 1 y	0.87	(0.73–1.04)	0.114
Place of residence	*urban*			
	rural	0.84	(0.67–1.05)	0.131
Distance to HCF is a problem	*no*			
	yes	0.91	(0.75–1.11)	0.370
Wealth quintile:	*richest*			
	richer	0.68	(0.48–0.95)	0.022
	middle	0.57	(0.39–0.83)	0.003
	poorer	0.52	(0.35–0.76)	0.001
	poorest	0.39	(0.26–0.58)	<0.001
Mother education	*higher*			
	secondary	0.90	(0.55–1.47)	0.670
	primary	0.89	(0.51–1.54)	0.670
	no formal	0.77	(0.45–1.30)	0.327
Schedule caste or tribe (SCT) and other backward class (OBC)	*Other*			
	SCT or OBC	0.95	(0.77–1.17)	0.624

* P-value of category compared to base category; values presented here are from factor variables Model.
Model 1: Design df = 9612; F(8, 2006)= 7.86; Prob > F = 0.0000 (Model with non factor variables)
Model 1 using factor variables: Design df = 92013; F(12, 2002)= 5.23; Prob > F = 0.0000

Further association analysis using a model with intersections of inequalities (Model 2)

To further understand the combined association of gender (based on the sex of the child) and socioeconomic level on careseeking another association analysis was performed. This new association analysis uses a heuristic model based on the intersectionality approach described in the Conceptual Framework chapter. Here, this model is referred to as Model 2. In Model 2, the same independent variables used in the multivariable Model 1 (Table 1) are present and in addition, a new dummy variable combining sex and wealth quintile is added. The new dummy variable contains ten categories or subcategories (Box 2). By fitting this new model it is possible to view in more detail the combined effect of gender and wealth on careseeking (Figure 23).

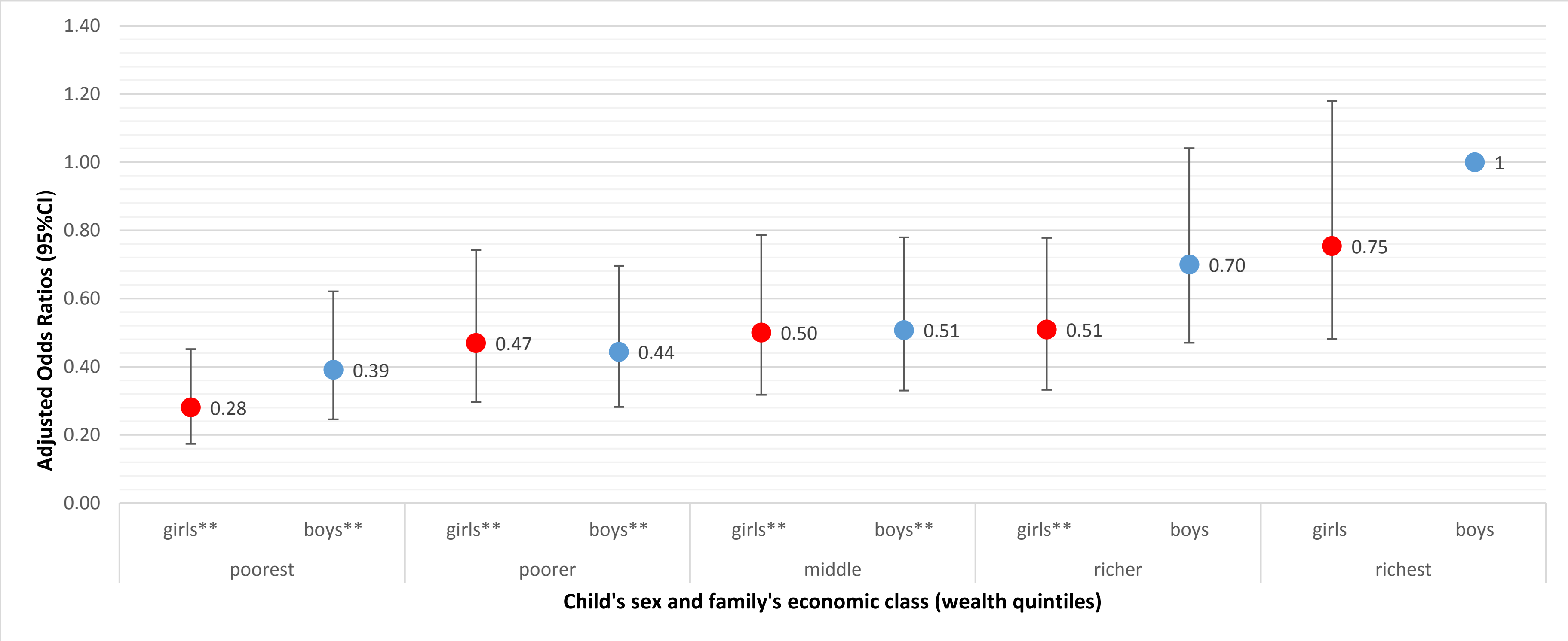
The new model suggests that boys tend to be less affected by family economic status than girls in terms of careseeking. Boys in the richest quintile are the reference category. Boys in the richest quintile are the reference category and were significantly more likely to receive care outside the home compared to all other subcategories, except for the richest girls and the richer boys. Girls in the poorest quintile were significantly less likely to receive appropriate careseeking than boys in the richest quintile, with AOR of 0.28 (95%CI 0.17–0.45). In contrast, for poorest boys this difference, although still significant, is smaller, with AOR of 0.39 (95%CI 0.25–0.62). Similarly, when compared to richest boys, girls in the richer quintile were significantly less likely to get the same level of careseeking with AOR 0.51 (95%CI 0.33–0.78), whilst for boys in the same richer quintile this difference was not only smaller but also not significant (AOR 0.70 (95%CI 0.47–1.04)). It is interesting to notice as well that the odds ratio and 95% confidence interval for careseeking in richer girls is nearly the same to that of the boys in the middle wealth quintile.

In the next chapter, a similar analysis is conducted the most recent National Family Health Survey in India, NFHS-4. The association between gender and careseeking for common infections in children under 5 (U5) focusing on diarrhoea again. However, for the NFHS-4 data, the analysis aims to determine whether careseeking for girls are of different standard than that provided to boys with regards to cost of care.

Furthermore, it aims to explain if and how gender intersects with other social inequalities leading to the disadvantage of girls, in relation to careseeking behaviours.

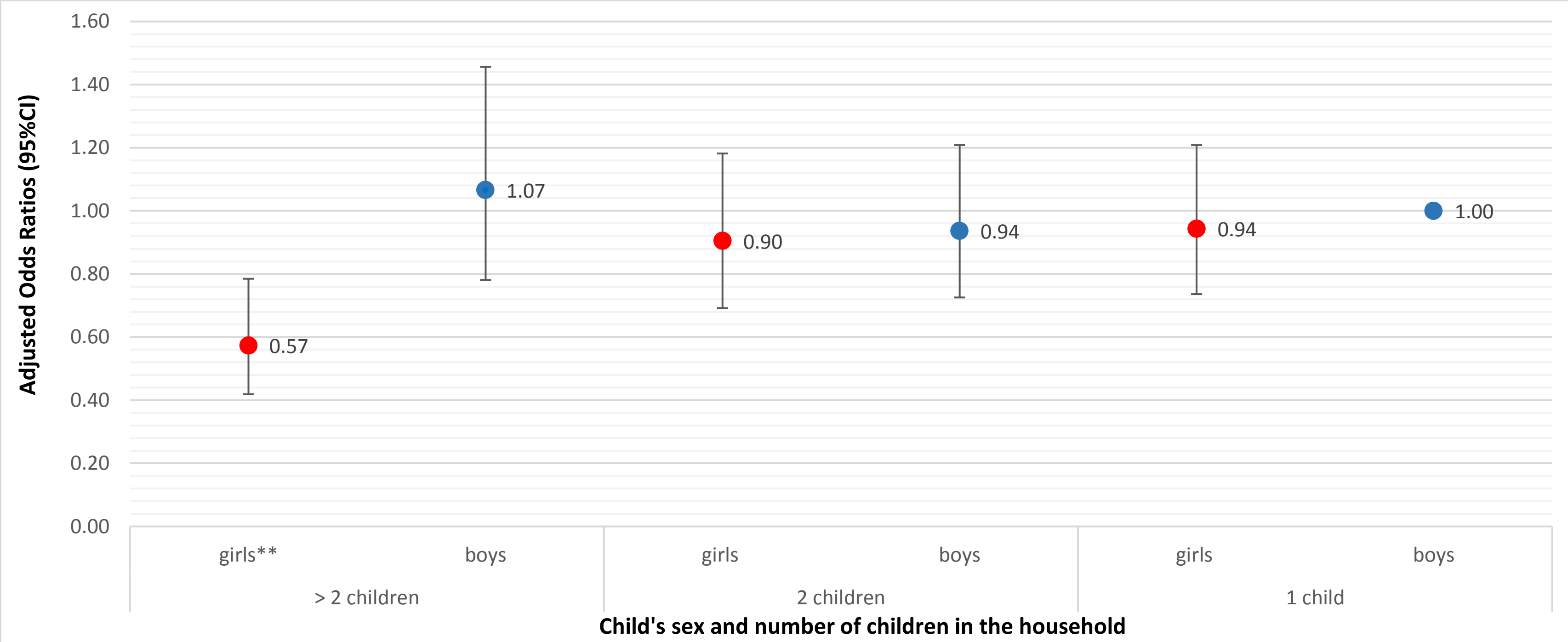
Following from the analysis of Sex and number of children under five (U5) in the household and prevalence of careseeking outside the home using weighted prevalences, an analysis of association for children with diarrhoea according to sex and number of siblings was performed (Model 3). The results appear in and confirm the weighted prevalence results.

Figure 23. Children with diarrhoea: associations of sex and economic class on careseeking outside the home (Model 2).



*Adjusted for age, place of residence, distance to health care facility, number of children in the household, mother education and caste.
**Significantly less likely to received care outside home when compared to reference class, i.e. richest boys.

Figure 24. Careseeking outside the home for children with diarrhoea according to sex and number of siblings: adjusted* odds ratios, confidence intervals (Model 3).



*Adjusted for age, place of residence, distance to health care facility, economic class, mother education and caste. **Girls with two or more siblings are significantly less likely to received care outside home when compared to reference class, i.e. boys with no siblings.

Chapter 6. Gender inequalities in child careseeking behaviours (2015-16)

Introduction

In this chapter, the association between gender and careseeking for common infections in children under 5 (U5) is explored. Similarly, this chapter seeks to determine whether careseeking behaviours for girls are of a different standard than that provided to boys. Furthermore, it aims to explain if and how gender intersects with other social inequalities leading to the disadvantage of girls, in relation to careseeking behaviours. After exploring several different careseeking behaviours for diarrhoea, the chapter will focus on cost of care for diarrhoea and the association with gender.

The aim of the chapter is to address the research question detailed in Chapter 1: Introduction, of this thesis and described below (in italics):

In India, does gender, depending on the sex of the child (U5), have an effect on:

Different types of health careseeking behaviours (across the severity spectrum), including:

- *Illness perception or reporting*
- *Treatment delay*
- *Utilization of any type of health care treatment (either modern or traditional)*
- *Use of health care facility for treatment and level of care sought (primary care, secondary care or tertiary care)*
- *Choice of provider used (likelihood to see a better qualified practitioner)*
- *Distance travelled for boys compared to girls to reach treatment centre*
- *Expenditure on health care for boys versus girls*

Other potential behaviours are: the number of health care providers seen during illness, referrals for further treatment followed by action from parents, use of modern treatment, and use of antibiotics or Oral Rehydration Solution (ORS).

The NFHS-4 sample of children

The sample of children used in the analysis presented here comes from the most recent, i.e. the fourth round of the India Demographic and Health Survey, conducted between 2015 and 2016. In India, this survey is commonly referred as the National Family Health Survey- 4 (NFHS-4).

A detailed description of the NFHS-4 sample of children U5 and their families is provided in the Methods Chapter. It contains the initial description of the sample selection for analysis, demographics, and the prevalence of the main variables used in the analysis. The Methods Chapter 4 also contains other preliminary explanation about the NFHS survey and about each round of the NFHS survey studied. Similarly, the Methods Chapter 4 provides a detailed description of the methodology and methods used, including the models used to examine the associations between careseeking behaviours for diarrhoea and other common infections.

Descriptive results

Children under five (U5) reported having ARI, Fever or Diarrhoea

More details on the methods used in this descriptive section, including a full demographic description of the sample is provided in the Methods Chapter 4. Of the 230,538 children in the sample, girls made up 47.9% (95%CI = 47.6-48.2), which corresponds to an U5 sex ratio (U5SR) of 925 females /1000 males (95%CI =905 to 945).

Symptoms in all children under five

Of the selected sample of 230,538 children U5, 9.1 % were reported having diarrhoea in the last two weeks preceding the survey. Equally, 12.9% of children were reported to have had fever and 2.7% had symptoms compatible with ARI. For all children U5, reporting of diarrhoea, fever and symptoms compatible with ARI were slightly more frequent for boys than for girls (Table 20). For a more detailed explanation on how the ARI was constructed, please refer to the Methods chapter.

Symptoms in infants (< 1 year old)

Here, a subsample of infants is selected, i.e. all children < 1 year (N=43,406). In this group, 14.0% of children were reported having diarrhoea in the last two weeks preceding the survey. In addition, 15.1% were reported to have had fever and 3.4% had symptoms compatible with ARI. Reporting of diarrhoea, fever and ARI was similar for boys and girls (Table 20).

Symptoms in children between 1 and 5 years old

From the same sample of children under 5, all children older than 1 year (N=187,132) were selected. In this group of older children, 8.0% of children were reported having diarrhoea in the last two weeks preceding the survey. In addition, 12.4% were reported to have had fever and 2.6% had symptoms compatible with ARI. Similar to the whole sample of children under five, in this group, reporting of diarrhoea, fever and ARI were slightly more frequent for boys than girls (Table *20*).

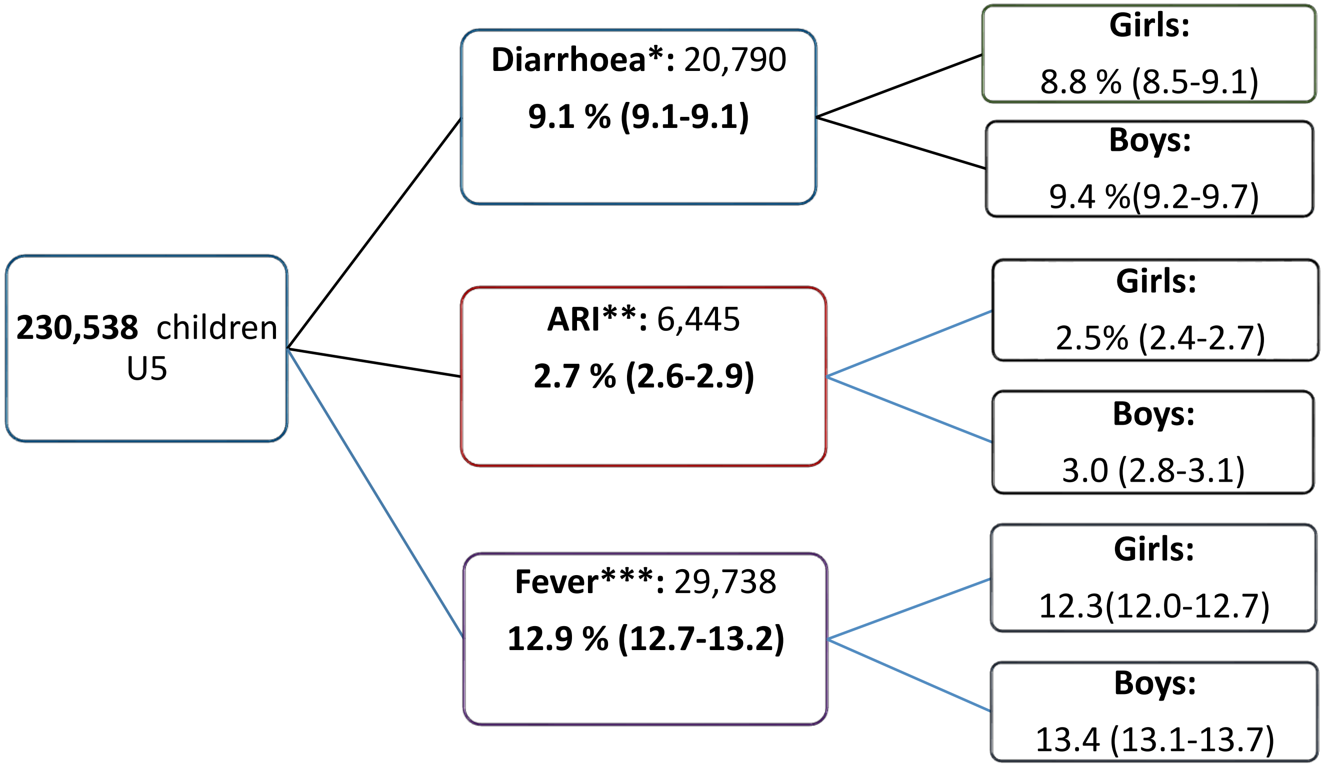
In summary, for the whole group of children U5, carers reporting of diarrhoea, fever and ARI were slightly more frequent for boys than girls (Figure 25). The same pattern is true for the group of older children (1 to 4 years of age) but not true for the group of children under 1 year old (infants).

Table 20. Prevalence of common infections in children under 5, India, 2015-16

Age (years)		Girls % (95% CI)	Boys % (95% CI)	All children % (95% CI)	P - value*
All under 5	**Diarrhoea**	8.8 (8.5-9.1)	9.4 (9.2-9.7)	9.1 (9.1-9.1)	0.0001
	ARI	2.5 (2.4-2.7)	3.0 (2.8-3.1)	2.7 (2.6-2.9)	0.0000
	Fever	12.3 (12.0-12.7)	13.4 (13.1-13.7)	12.9 (12.7-13.2)	0.0000
	N	110,780	119,758	230,538	
Infants (< 1)	**Diarrhoea**	14.0 (13.3-14.7)	14.1 (13.4-14.7)	14.0 (13.5-14.5)	0.8863
	ARI	3.1 (2.8-3.5)	3.6 (3.3-3.9)	3.4 (3.1 -3.6)	0.0437
	Fever	14.7 (14.0-15.4)	15.4 (14.7-16.1)	15.1 (14.6-15.6)	0.1463
	N	20,733	22,673	43,406	
1 to 5	**Diarrhoea**	7.6 (7.4-7.9)	8.4 (8.1-8.7)	8.0 (7.8-8.2)	0.0000
	ARI	2.4 (2.2-2.5)	2.8 (2.7-3.0)	2.6 (2.5-2.7)	0.0000
	Fever	11.8 (11.5-12.1)	13.0 (12.6-13.3)	12.4 (12.2-12.7)	0.0000
	N	90,047	97,085	18,7132	

All frequency counts are unweighted and percentages are weighted, according to probability weights to account for survey design and sampling.
*P-values (boys versus girls) and 95% confidence intervals (CI) based on Rao Scott 2nd order corrected Pearson F statistic.

Figure 25. Prevalence of common infections in children for children under 5 in the last two weeks before the survey, India, 2015-16.



Note: All frequency counts are unweighted and percentages are weighted according to probability weights to account for survey design and sampling. Weighted proportions exclude missing and "don't know" responses.
* P= 0.0001; ** P = 0.0000; *** P = 0.0000 (P -values reflect comparisons between boys and girls. P- values and 95% confidence intervals (CI) based on Rao Scott 2nd order corrected Pearson F statistic.

Careseeking behaviours in children U5 with Diarrhoea or ARI or Fever

As explained in the Methods Chapter 4, in DHS surveys, for children with diarrhoea, fever or ARI, carers are asked questions concerning careseeking behaviours. The prevalence of different types of careseeking behaviours in both boys and girls are provided in this section.

Careseeking behaviours and treatment given for children with diarrhoea

Careseeking behaviours adopted for children who presented diarrhoea are described here. As with the prevalence of symptoms, the prevalence of careseeking behaviours is presented separately for all under 5, infants (< 1 year old), for older children (1 to 4 year olds) and for infants (<1 year old).

These nine types of careseeking behaviours can be measured (see Table 21, Table 22, Table 23) and these behaviours highlight the three following aspects of careseeking or carers' actions when their child had diarrhoea:

- **Type** of treatment provided
- **Place** where care was sought
- **Delay** in seeking care
- **First point** of careseeking
- **Level and cost of care** sought

The prevalence of nine different types of careseeking behaviours for children with diarrhoea are presented (see Table 21,Table 22,Table 23). Some of these variables are a summary of different individual questions asked about careseeking, as explained in the Methods Chapter 4.

Treatment given for diarrhoea

In the whole group of children under 5, boys received slightly more Oral Rehydration Solution (ORS) or Recommended Home Fluids (RHF) than girls. The results were similar for older children (1 to 4 year olds), but no difference in ORS AND RHF treatment given to boys and girls in the infant group was found.

For all children under 5 with diarrhoea, in 43.4 % of all cases parents did not administer any treatment. A similar proportion of boys and girls in the under 5 year olds and in the two subgroups were likely to receive NO treatment from carers (Table 21 Table 22 Table 23).

Summary variables (summary of treatment given and place sought for care)

Seeking treatment for diarrhoea outside the home

For the overall group of under 5s with diarrhoea, and consistently for the two age subgroups (older children and infants), carers were more likely to seek *treatment outside the home* for boys than for girls. The average difference between boys and girls in the overall under 5s was 3.4% with similar results for the subgroups of older children (1 to 5 year olds) and infants (Table 23). These results are consistent with the previous results presented in chapter 5, where data from the previous NFHS survey (i.e., NFHS-3, 2005_06) were used.

Carers were also more likely ***not to seek*** *advice or treatment anywhere* for Girls compared to boys. The average difference between girls and boys (in the whole group of under 5s) was 2.4% (Table 21).

For the summary variable “Carers either *administered* some treatment AND/OR *sought* for treatment or advice somewhere”, again, boys were more likely to get more treatment or be taken somewhere for treatment than girls. The average difference between boys and girls for this variable was 1.9% (Table 21).

Careseeking delay for diarrhoea

There was no significant difference in careseeking delay when comparing boys and girls (Table 21,Table 22,Table 23).

First Point of Care sought for diarrhoea

Carers used private doctors as their first point of care for diarrhoea more often for boys than for girls in the overall group of under 5 children, with an average difference between boys and girls of 3.4%. A similar pattern is found in the older children and infant subgroups. The first point of care sought for diarrhoea will be discussed in detail next.

Table 21.Careseeking behaviours in all children under five with diarrhoea, India, 2015-16.

Children with diarrhoea		Girls	Boys	All	P-value**
		% (95% CI)	% (95% CI)	n (%)	
Treatment given	Carers gave Oral Rehydration Solution (ORS)	49.9 (48.45-51.4)	51.9 (50.5-53.2)	11,012 (51)	0.0476
	Carers gave ORS or Recommended Home Fluids (RHF)	56.5 (55.0-58.0)	58.9 (57.6-60.2)	12,269 (57.8)	0.0125
	Carers DID NOT administer any treatment	44.5 (43.0-46.0)	42.4 (41.1-43.8)	8,713 (43.4)	0.0592
Summary of care	Carers sought advice or treatment outside home*	66.0 (64.6-67.4)	69.4 (68.1-70.6)	13,740 (67.8)	0.0001
	Carers *did not seek* advice or treatment anywhere	24.0 (22.7-25.2)	21.6 (20.5-22.7)	5,070 (22.7)	0.0027
	Carers either ADMINISTERED some treatment AND/OR SOUGHT for treatment or advice somewhere	87.7 (86.8-88.6)	89.6 (88.8-90.3)	18,371 (88.7)	0.0009
Careseeking delay	Carers sought advice/treatment within 48 hours of start	71.4 (69.9-72.8)	70.3 (68.9 - 71.6)	15,685 (70.8)	0.2438
First Point of Care sought	Carers either SOUGHT for treatment in a Private Hospital or Clinic	12.6 (11.5-13.8)	13.7 (12.6-14.7)	2,094 (13.2)	0.1681
	Carers either SOUGHT for treatment with a Private Doctor	31.0 (29.6 - 32.3)	34.4 (33.1-35.7)	6,430 (32.8)	0.0001

*Variable h12z= Sought advice or treatment outside home (h12z); Note: All frequency counts are unweighted and percentages are weighted, according to probability weights to account for survey design and sampling.
**P-values reflect comparisons between boys and girls. P values and 95% confidence intervals (CI) based on Rao Scott second-order corrected Pearson F statistic (accounts for the complex survey design).

Table 22. Careseeking behaviours for infants (< 1 year old) with diarrhoea, India, 2015-16.

Children with diarrhoea		Girls	Boys	All	P-value**
		% (95% CI)	% (95% CI)	n (%)	
Treatment given	Carers gave Oral Rehydration Solution (ORS)	41.4 (38.9 -44.0)	41.3 (39.0-43.7)	2,493 (41.4)	0.9536
	Carers gave ORS or Recommended Home Fluids(RHF)	45.0 (42.4-47.6)	41.3 (39.0-43.7)	1,350 (45.6)	0.5165
	Carers DID NOT administer any treatment	44.7 (42.2-47.2)	41.5 (39.1-43.9)	2,473 (43.0)	0.0322
Summary variables	Carers sought advice or treatment outside home	67.3 (64.8-69.7)	70.8 (68.6-72.9)	3,936 (69.1)	0.0346
	Carers *did not seek* advice or treatment anywhere	24.3 (22.1-26.6)	21.9 (20.0-23.9)	1,437 (23.0)	0.1217
	Carers either ADMINISTERED some treatment AND/OR SOUGHT for treatment or advice somewhere	84.3 (82.5-86.0)	86.0 (84.3-87.6)	4,943 (85.2)	0.1550
Careseeking delay	Carers sought advice/treatment within 48 hours of start	71.5 (69.7-73.2)	70.8 (69.2-72.3)	11,299 (71.1)	0.52
First Point of Care sought	Carers SOUGHT for treatment in a Private Hospital or Clinic	15.1 (13.2-17.3)	14.8 (13.2-16.7)	702 (15.0)	0.8305
	Carers SOUGHT for treatment with a Private Doctor	32.6 (30.3-35.0)	36.7 (34.3-39.1)	1,966 (34.7)	0.0124

Note: All frequency counts are unweighted and percentages are weighted, according to probability weights to account for survey design and sampling.
**P-values reflect comparisons between boys and girls. P values and 95% confidence intervals (CI) based on Rao Scott second-order corrected Pearson F statistic (accounts for the complex survey design).

Table 23. Careseeking behaviours in children between 1 and 5 years old with diarrhoea, India, 2015-16.

Children with diarrhoea		Girls	Boys	All	P-value**
		% (95% CI)	% (95% CI)	n (%)	
Treatment given	Carers gave Oral Rehydration Solution (ORS)	53.4 (51.7-55.2)	55.9 (54.3-57.4)	8,519 (54.8)	0.0339
	Carers gave ORS or Recommended Home Fluids(RHF)	61.3 (59.5-62.9)	63.76 (62.3-65.2)	9,527 (62.6)	0.0223
	Carers DID NOT administer any treatment	44.4 (42.7 - 46.2)	42.8 (41.3- 44.4)	6,240 (54.8)	0.3316
Summary variables	Carers sought advice or treatment outside home	65.4 (63.7 - 67.1)	68.8 (67.4-70.2)	9,804 (67.8)	0.0012
	Carers *did not seek* advice or treatment anywhere	23.8 (22.4 - 25.3)	21.4 (20.2-22.7)	3,633 (22.5)	0.0102
	Carers either ADMINISTERED some treatment AND/OR SOUGHT for treatment or advice somewhere	44.4 (42.7 - 46.2)	42.8 (41.3-44.4)	6,240 (43.6)	0.3316
Careseeking delay	Carers sought advice/treatment within 48 hours of start	71.5 (69.7-73.2)	70.8 (69.2-72.3)	11,299 (71.1)	0.52
First Point of Care sought	Carers either SOUGHT for treatment in a Private Hospital or Clinic	11.6 (10.3 - 13.0)	13.2 (12.0-14.5)	1,392 (12.5)	0.0601
	Carers SOUGHT for treatment with a Private Doctor	30.3 (28.7 - 31.9)	33.6 (32.1-35.0)	4,464 (32.1)	0.0016

Note: All frequency counts are unweighted and percentages are weighted, according to probability weights to account for survey design and sampling.
**P-values reflect comparisons between boys and girls. P values and 95% confidence intervals (CI) based on Rao Scott second-order corrected Pearson F statistic (accounts for the complex survey design).

Gender and other determinants and cost of care sought

First point of care sought

This section explores the variables relating to the "*first point of care sought for diarrhoea"* (variable h44a) in more detail. It starts with a descriptive analysis and subsequently an association analysis is presented. These variables are important because they highlight not only the level of care sought for diarrhoea, but also the cost paid by children's carers when seeking for care. A full explanation on the DHS variable h44a and all the COST related variables created from it, is provided in the Methods chapter.

Cost and level of care provided

The first comparison for the first point of care sought for diarrhoea, includes various levels of care, i.e., from community to referral and private and public (**Figure 24**). Most (46.1%) of the carers used private primary level care as their first point of call for diarrhoea and secondly, they used private secondary or tertiary care (17.1%). For both of these two levels of care, carers tended to use private care more often for boys than for girls.

When comparing the use private services against other types of care (Table 25), carers tended to use private care more often for boys than for girls.

Finally, when the costliest type of care (i.e., private hospital/doctor/clinic) is compared to other types of care, boys tended to receive the most costly type of care more often than girls (Table 25).

Table 24. First point of care sought for children U5 with diarrhoea, India, 2015-16.

First point of care sought by carers (DIARR_POC1)			
	Girls	**Boys**	**All children**
	% (95% CI)	**% (95% CI)**	**% (95% CI)**
Public: community level	5.5 (4.9-6.2)	4.5 (3.9-5.1)	4.6 (4.1-5.1)
Public: primary level	5.9 (5.2-6.8)	5.4 (4.8-6.1)	6.6 (6.0-7.2)
Public: secondary or tertiary level	13.8 (12.7-15.0)	13.5 (12.5-14.6)	13.6 (12.8-14.5)
Private: community level (drugstore/pharmacy)	5.9 (5.2-6.7)	5.1 (4.5-5.7)	5.4 (5.0-6.0)
Private: primary level	44.6 (42.8-46.3)	47.4 (45.8-48.9)	46.1 (44.8-47.3)
Private: secondary or tertiary level	16.7 (15.3-18.2)	17.3 (16.1-18.7)	17.1 (16.0-18.1)
Non-medical	3.7 (3.1-4.3)	3.5 (3.0-4.1)	3.6 (3.2-4.0)
Other	3.9 (3.3 -4.6)	3.3 (2.8-3.8)	3.6 (3.2-4.0)
Sample size			15,720

*P-value = 0.0104 (comparing boys and girls and including all categories of care sought above)

Table 25. Careseeking behaviours according to cost in children under 5 with diarrhoea, India, 2015-16.

	Girls	Boys	All	P-value*
	% (95% CI)	% (95% CI)	% (95% CI)	
Private care against other types of care				
All private services	66.7 (65.1-68.3)	69.3 (67.9-70.7)	68.1 (67.0-69.2)	0.0104
Public services/others	33.3 (31.7-34.9)	30.7 (29.3-32.1)	31.9 (30.8-33.0)	
Costliest type of care (private hospital/doctor/clinic) versus others				
Private hospital/doctor/clinic	56.1 (54.4-57.8)	60.0 (58.5-61.5)	58.24 (57.0-59.4)	0.0003
Others (incl. public)	43.9 (42.2-45.6)	40.0 (38.5-41.5)	41.76 (40.6-43.0)	
Sample size				15,720

Note: All frequency counts are unweighted and percentages are weighted, according to probability weights to account for survey design and sampling. Percentages are calculated excluding missing/don't know answers.
* P-values reflect comparisons between boys and girls. P values and 95% confidence intervals (CI) based on Rao Scott second-order corrected Pearson F statistic (accounts for the complex survey design).

Cost of care provided for diarrhoea: regional patterns

To assess how the cost of care for diarrhoea varied in different regions of India, five different macro-regions of India were compared (Table *26*).The children under 5 sample sizes varied according to region for this specific analysis for diarrhoea, where the Central region is the most populous (n= 6,996) and the Western region the least populous (n=1,057).

The average difference between boys and girls according to region varied from nearly null in the Northeast region to over 6% in the Western region.

Table 26. Children with diarrhoea: use of costliest type of care*

	Girls	Boys	Boys-Girls	P-value**
	% (95% CI)	% (95% CI)	%	
Region*				
Northeast	24.0 (17.9 - 31.4)	23.8 (18.3 - 30.3)	-0.2	0.964
East	47.4 (43.9 -50.9)	49.4 (46.1 - 52.7)	2.0	0.393
Central	62.6 (60.3 - 64.8)	66.3 (64.4 - 68.1)	3.7	0.007
Northern	54.1 (50.1 - 58.1)	59.7 (55.9 - 63.5)	5.6	0.042
Western	62.5 (55.8 - 68.9)	68.6 (62.8 - 73.8)	6.1	0.157
South	52.2 (46.3 -58.0)	56.5 50.97,61.83)	4.3	0.243

*Regional sample sizes for this variable: Northeast (n=1,071); East (3,025); Central (n=6,996); Northern (n=2,492); Western (1,057); South (n=1,079);
Note: All frequency counts are unweighted and percentages are weighted, according to probability weights to account for survey design and sampling. ** P-values reflect comparisons between boys and girls. P values and 95% confidence intervals (CI) based on Rao Scott second-order corrected Pearson F statistic (accounts for the complex survey design).

Further, to that, an analysis using a binary variable and comparing the four largest states in northern India to the rest of the states is performed (Table *27*). These states, i.e., Uttar Pradesh, Bihar, Rajasthan and Madhya Pradesh, are part of the nine “High Focus States” of India, which report a persistent poor performance in child health and mortality, as reported in the literature (Guilmoto, Kumar,2012, Bora 2019). More details on the rationale and construction of the variables used in regional analysis are presented in the Methods Chapter 4.

Table 27. Children with diarrhoea, first point of care sought: costliest type of care.

	Girls	Boys	Boys-Girls	P-value*
	% (95% CI)	% (95% CI)	%	
Region*				
High Focus States	59.0 (57.0,61.1)	63.0 (61.4,64.8)	4.0	0.0018
Others states together	52.7 (49.9,55.5)	56.4 (53.8,58.9)	3.7	0.05

Total population of children 0-6 years old (Census of India): HFS (n= 93,816(boys= 49,167; girls= 44,649); Other states (n= 136,722 (boys= 70,591; girls= 66,131)

Note: All frequency counts are unweighted and percentages are weighted, according to probability weights to account for survey design and sampling.

* P-values reflect comparisons between boys and girls. P values and 95% confidence intervals (CI) based on Rao Scott second-order corrected Pearson F statistic (accounts for the complex survey design).

Sex and other determinants and use of costliest type of care for diarrhoea: bivariate descriptive analysis

The relationship of sex and other determinants of child health and the use the cost of care for diarrhoea is illustrated in (Table *28*), using the comparator of weighted prevalences. The results show that boys were more likely to receive the costliest type of care compared to girls (average difference of 3.9%), as were younger children (younger than one 1 year old) when compared to older children. Urban children (when compared to rural ones), wealthier children and children from more educated mothers were also more likely to receive the costliest type of care when compared to other children. In terms of regional prevalences, children living in the selected four most populous High Focus States (Uttar Pradesh, Bihar, Rajasthan and Madhya Pradesh) were also more likely to receive the costliest type of care for diarrhoea when compared to children living in other states.

Other potential determinants of use of costliest care studied were the number of children in the household, belonging to a Scheduled Caste or Tribe (SCT) & Backward Class, religion, and reporting distance to the nearest health care facility as a problem. None of these four factors was associated with the prevalence of use of the costliest type of care for diarrhoea.

Table 28. Costliest type of care for children with diarrhoea, sex and other determinants, bivariate analysis

		% (95%CI)	P value
Sex	male	60.0 (58.5-61.5)	0.0003
	female	56.1 (54.4–57.8)	
Age	1 - 4 y	56.3 (54.8-57.7)	0.0000
	< 1 y	63.3 (61.3–65.2)	
Place of residence	urban	65.3 (62.7–67.9)	0.0000
	rural	55.7 (54.4–57.0)	
Number of children U5 in household	1 child	58.8 (57.0–60.5)	0.363
	2 children	57.3 (55.6–59.1)	
	> 2 children	59.1 (56.5–61.6)	
Wealth quintile	richest	74.6 (71.6–77.4)	0.0000
	richer	63.0 (60.3–65.7)	
	middle	58.7 (56.2-61.1)	
	poorer	52.6 (50.3-54.8)	
	poorest	50.9 (48.9-53.0)	
Mother education	higher	71.6 (68.2–74.8)	0.0000
	secondary	59.2 (57.4-60.9)	
	primary	53.7 (50.9-56.6)	
	no formal	54.9 (52.9–56.8)	
Schedule caste or tribe (SCT) & backward class	Other	60.5 (57.8–63.0)	0.047
	SCT or OBC	57.6 (56.2–58.9)	
Religion	other	58.3 (56.9–59.6)	0.913
	Hindu	58.1 (55.5–60.7)	
Region: High Focus States (HFS)$	other states	54.7 (52.7–56.7)	0.0000
	HFS	61.2 (59.8–62.7)	
Distance to HCF is a problem	no	59.1 (57.6–60.5)	0.056
	yes	56.8 (54.9–58.7)	

$ Bihar, Madhya Pradesh, Rajasthan, Uttar Pradesh.
Note: All frequency counts are unweighted and percentages are weighted, according to probability weights to account for survey design and sampling.

Binary logistic regression

To further study the association between sex of the child and the cost of care for diarrhoea while accounting for these other determinants using the data from the NFHS-4 a binary logistic regression model was constructed and tested. The main dependent variable specified was a dichotomous one, i.e., the “use of costliest type of care (private hospital/doctor/clinic) versus other types of care”. A more detailed explanation of the binary logistic regression model construction, estimation and post–estimation statistics is presented in the Methods Chapter 4. The explanation includes the full list of potential exposures and the variables, both dependent and independent, used in the modelling.

Univariate analysis: exploring the association of cost of care for diarrhoea in boys and girls under 5

In this section, the univariate logistic regression is presented. Odds Ratios are estimated in relation to each exposure, i.e., sex of the child and other potential determinants.

The results of the univariate logistic regression (Table *29*) follow the same pattern of the bivariate statistics using weighted percentages presented early. Girls had *lower odds* of receiving the costliest type of care for diarrhoea than boys (OR=0.85, 95%CI =0.78–0.93). Similarly, children older than 1 year, those living in rural areas and the ones who belonged to the poorer wealth quintiles were less likely than their counterparts to receive the costliest type of care.

In terms of regional, patterns, as in the weighted prevalence results, children living in the four selected High Focus States (i.e., Bihar, Madhya Pradesh, Rajasthan, Uttar Pradesh) were more likely to receive the costliest type of care for diarrhoea.

Table 29. Use of costliest type of care for children with diarrhoea, sex and other determinants: univariate analysis.

		Crude Odds Ratio (95%CI)	P value*
Sex	male	-	
	female	0.85 (0.78–0.93)	0.000
Age	< 1 y	1.0	
	1 - 4 y	0.75 (0.68–0.82)	0.000
Place of residence	urban		
	rural	0.67 (0.59–0.76)	0.000
Number of children U5 in household	1 child	1	
	2 children	0.94 (0.86–1.04)	0.226
	> 2 children	1.01 (0.89–1.14)	0.862
Wealth quintile	richest	1	
	richer	0.58 (0.48–0.70)	0.000
	middle	0.48 (0.40–0.58)	0.000
	poorer	0.38 (0.42–0.45)	0.000
	poorest	0.35 (0.30–0.42)	0.000
Mother education	higher	1	
	secondary	0.57 (0.48–0.68)	0.000
	primary	0.46 (0.38–0.56)	0.000
	no formal	0.48 (0.40–0.57)	0.000
Scheduled caste or tribe (SCT) & backward class£	Other	1	
	SCT or OBC	0.89 (0.79–1.0)	0.047
Religion	other	1	
	Hindu	0.99 (0.88–1.12)	0.913
Region: High Focus States (HFS)$	HFS	1	
	Other states	0.76 (0.71–0.85)	0.000
Distance to HCF is a problem	no	1	
	yes	0.91 (0.83–1.0)	0.056

* P-value of category compared to base category;
For the variables sex, age, place of residence, wealth quintile, mother education and Region (HFS) the p-value of the univariate model was < 0.000. For the variable Caste, the same whole model p-value was borderline (0.047) and the other were non-significant at 0.05.
£ This variable excludes all values coded as don't know (1493(0.65% total) values I don't know).
$ Bihar, Madhya Pradesh, Rajasthan, Uttar Pradesh.
Note: P values and 95% confidence intervals (CI)are based on the recommended Rao Scott second-order corrected Pearson F statistic, which accounts for the complex survey design.

Multivariable analysis

A multivariate logistic regression model adjusting for covariates was the method chosen to examine the association between sex of child and cost of care for diarrhoea. As explained in more detail in the Methods Chapter 4, the purposeful selection of covariates approach was employed, as proposed by Hosmer and Lemeshow (Hosmer et al., 2013). As part of the same approach, an exploratory analysis of potential effect modifiers of gender inequalities using interaction terms was conducted to assess the effect of the intersection of inequalities in the studied outcome. The interaction terms were tested after the main effects model was fitted. To choose the referred final Model, consideration was given to the fitness of the model, the parsimony principle and plausibility of its components.

The Main Effects Model (Table 30) and the Final Model (Table 31) are presented here with their corresponding post-estimation values. The intermediate models and further statistics are presented either in the Methods Chapter 4 or in the Appendix of this thesis.

The variables mother's education level, and wealth quintiles have respectively four and five categories each. A close assessment suggests that the categories for these two variables could be collapsed when reporting Odds Ratios and therefore, some of the tables and graphs presented here have fewer categories.

Main effects model

The Main Effects Model (Table 30) should contain the essential variables to explain the probability of using the costliest type of care for diarrhoea. In this case, the essential variables are *sex, age (infant), wealth, mother's education level, region of residence (High Focus States or not).* All of these variables were predictors of costliest type of care for diarrhoea in children. The Model F statistics (F= 31.90, 10 df) and the associated p value corresponds to a high prediction probability.

Table 30. Use of costliest type of care for children with diarrhoea, sex and other determinants: multivariable analysis (*Main Effects Model*-not final).

		Adjusted Odds Ratio (95%CI)	**P value**
Sex	male	ref	0.001
	female	0.86 (0.78–0.94)	
Age	< 1 y		0.000
	1 to 4 y	0.78 (0.71–0.87)	
Wealth quintile Mother education level	richest	ref	
	richer	0.61 (0.50–0.74)	0.000
	Middle	0.51 (0.42–0.62)	0.000
	poorer	0.38 (0.31–0.46)	0.000
	poorest	0.33 (0.27–0.41)	0.000
Mother education level	higher	ref	
	secondary	0.78 (0.64–0.94)	0.004
	primary	0.69 (0.56–0.86)	0.001
	no formal	0.74 (0.60-0.91)	0.008
Region: High Focus States (HFS)$	HFS	ref	
	Other states	0.62 (0.56–0.68)	0.000

$ Bihar, Madhya Pradesh, Rajasthan, Uttar Pradesh. N=15,720
Main Effects Model: Design df = 9612; F(10, 9603)= 31.90; Prob > F=0.0000

Final Model

To reach the Final Model, all relevant interactions were tested using the variables from the Main effects Model and the adequacy and fitness of the model were assessed. The interaction terms included child sex with wealth, child sex with age, mother's education level with region (High Focus States), wealth with region (High Focus States). More details on these procedures, i.e., step 6 and 7 of Hosmer and Lemeshow purposeful selection of covariates are explained in the Methods Chapter 4.

Table *31* displays the results of the final multivariable logistic regression model regarding the relationship between sex and other potential determinants (i.e., independent variables) and the use of costliest type of care for children with diarrhoea (i.e., dependent variable).

In the Final Model, five independent variables remained associated with the cost of care outcome studied:

- sex (being a girl)
- age (being older than 1)
- wealth quintile (poorer quintiles)
- mother education (not having higher degree of education)
- Region of residence (*not living* the four High Focus States of Bihar, Madhya Pradesh, Rajasthan, Uttar Pradesh)

Moreover, a significant interaction effect between wealth quintiles and region of residence, i.e., being a resident of the four populous High Focus States was detected.

The results show that sex remained a significant independent variable in the Final Model, where girls were on average 14% less likely to receive the costliest type of care for diarrhoea when compared to boys (Odds Ratio 0.86 (95%CI 0.78–0.94)). Older children were also more likely to receive the costliest type of care compared to infants (under 1 year old). Wealth was a significant predictor of cost of care received for diarrhoea as well. Compared to the richest children in the sample, all other children in the lower wealth quintiles were less likely to receive the costliest type of care, with children in the poorest quintile being the ones less likely to get costly care (Odds Ratio 0.33). Children in households where mothers had higher education level were also more likely to receive the costliest type of care for diarrhoea, especially when compared to those with primary education or no formal education at all. Surprisingly, children living ***outside*** the High Focus States (i.e., Bihar, Madhya Pradesh, Rajasthan, Uttar Pradesh) were much less likely to receive the costliest type of care (Odds Ratio 0.60 (95%CI 0.54–0.66)) when compared to those living in those four states. This effect modification is reported separately.

The F statistics for the Final Model (F= 30.73, 11 df), and the associated p-value associated with this F value is very small (0.0000) suggests a good prediction probability, even with one more term added to it compared to the previous model (Table 31). The F-adjusted mean residual goodness-of-fit test applied to the final Model with the interaction term suggested no evidence of lack of fit.

Table 31. Use of costliest type of care for children with diarrhoea, sex and other determinants: final multivariable logistic model.

		Adjusted Odds Ratio (95%CI)	P value
Sex	male	ref	0.000
	female	0.86 (0.78–0.94)	
Age	< 1 y	ref	0.000
	1 to 4 y	0.78 (0.71–0.86)	
Wealth quintile Mother education level	richest	ref	
	richer	0.58 (0.48–0.70)	0.000
	Middle	0.45 (0.37–0.55	0.000
	poorer	0.31 (0.24–0.38)	0.000
	poorest	0.23 (0.18–0.30)	0.000
Mother education level	higher	ref	
	secondary	0.78 (0.65–0.94	0.003
	primary	0.70 (0.57–0.87	0.001
	no formal	0.74 (0.60–0.90)	0.008
Region: High Focus States (HFS)$	HFS		
	Other states	0.38 (0.31–0.48)	0.000
HFS x Wealth*		-	0.000

$ Bihar, Madhya Pradesh, Rajasthan, Uttar Pradesh. N=15,720
*The effects of region of residence is reported separately.
1. Design df = 9612; F-statistics: F(11, 9602)=30.73; Prob > F=0.0000
2. Goodness-of-fit test: F (9, 9604)=0.46; Prob > F = 0.9017 (Pearson goodness-of-fit test or Hosmer-Lemeshow).

Final Model equation for Cost of care probability

The list of variables names and definitions for the final Model logistic regression equation is presented (Table *32*).

Table 32. Names*, definitions of NFHS-4 variables used in the logistic regression analysis equations

`DiarrCost`	Costliest type of care (i.e., private hospital/doctor/clinic) is provided for diarrhoea
`Sex`	Sex of the child
`Infant`	Is the child an infant, i.e., younger than 1 year old
`Rural`	Place of residence (rural or urban)
`Wealth`	Wealth quintile (richest, richer, middle, poorer, poorest)
`MotherEd`	Mother' education level (no education, primary, secondary, higher)
`Religion`	Belongs to a Hindu family or not
`ChildrenU5hh`	Number of children Under 5 in household (1,2 3or more)
`CasteTribe`	Belonging to a Caste, Tribe & Backward class
`DistHCF`	Distance to a Health Care Facility is a problem or not
`HighFocusSt`	Being a resident in the *High Focus States (*i.e., Bihar, Madhya Pradesh, Rajasthan, Uttar Pradesh.)

Finally, Equation 1 shows the formula representing the final Model for the binomial logistic regression analysis (in a logit form). It represents the modelling of the probability of using the costliest type of care for diarrhoea as opposed to other types of care.

Equation 1. Logit model equation showing the relationship of sex and other determinants and the cost of care for Diarrhoea in children

$$\mathrm{logit}(\Pr(\mathrm{DiarrCost} = 1)) = \beta 0 + \beta 1\mathrm{Sex} + \beta 2\mathrm{Infant} + \beta 3\mathrm{Wealth} + \beta 4\mathrm{motherEd} + \beta 5\mathrm{HFocu} + \beta\ \mathrm{HFocusSt} \times \mathrm{Wealth}$$

Cost of care provided for diarrhoea: interactions and regional patterns

As part of the Model building strategy, tests for relevant interactions were conducted, always taking in account the conceptual framework constructed based on the literature review.

In the main Final Model (see Table 31), only one interaction term was included, i.e., Wealth with High Focus States and using a traditional level of significance, i.e., $p<0.05$, and taking into account the contribution for the predictability of the model. However, because interaction effects are easy to be overlooked, we report here some other interactions with a using a more sensitive significance level ($P \leq 0.15$).

The first stratum-specific Odds Ratios reported highlight the interaction between sex and wealth quintile (Table 33). In this case, the overall Wald test for this interaction term was not very strong, but still significant. Although this interaction term was not added to the final model, it is reported here.

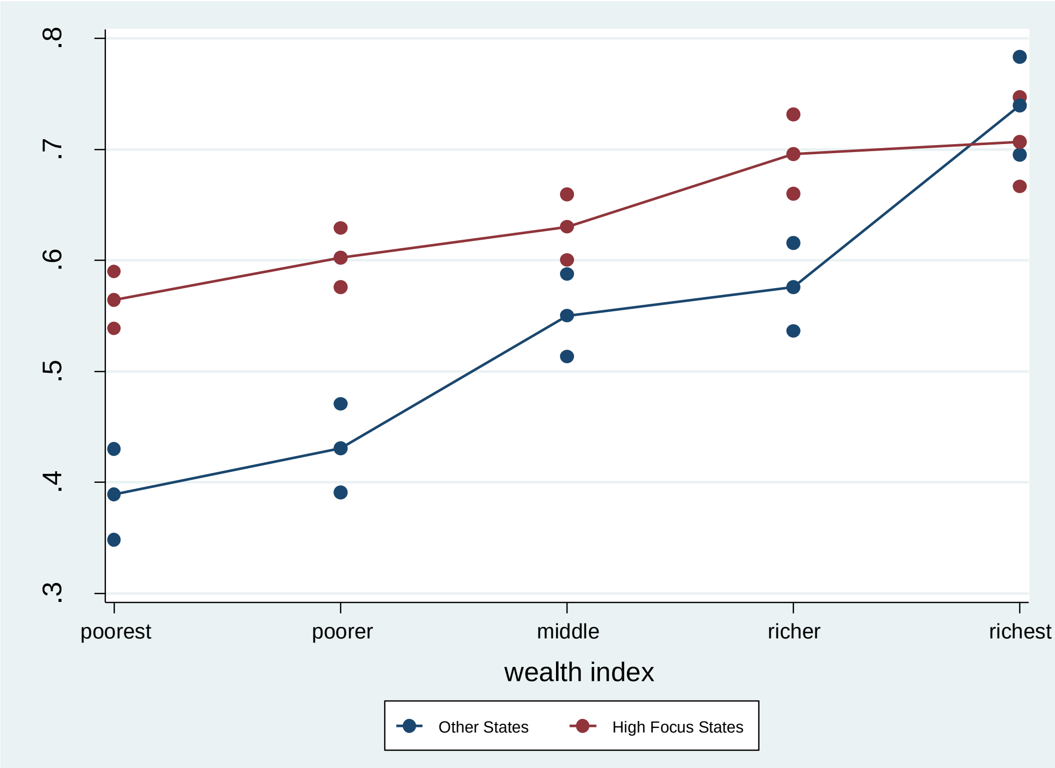
The strongest interaction, however, was detected between wealth index and region of residence, i.e., living or not in the four selected High Focus States (Table 33). In this case, the pattern of effect of wealth index on cost of care for diarrhoea are not only stronger in the Non–High Focus States Regions but appears somewhat different in pattern across the wealth quintiles (See Figure 26).

Table 33. Sex and other determinants and receipt of costliest type of care for diarrhoea: stratum specific associations

Interaction	Main effect	Costliest type of care for diarrhoea	
		Adjusted Odds Ratio (95%CI)	P value*
Sex x Wealth			
poorest	Girls x boys	0.96 (0.82–1.12)	0.617
poorer	Girls x boys	0.80 (0.67–0.96)	0.016
middle	Girls x boys	0.87 (0.72–1.07)	0.186
richer	Girls x boys	0.84 (0.66–1.06)	0.133
richest	Girls x boys	0.72 (0.53–0.97)	0.032
High Focus States(HFS) x wealth			
High Focus States	poorest	0.57 (0.45–0.71)	0.000
	poorer	0.65 (0.52–0.83)	0.000
	middle	0.73 (0.58–0.92)	0.0080
	richer	0.97 (0.76–1.24)	0.8070
Other States	poorest	0.21 (0.15–0.28)	0.000
	poorer	0.25 (0.19–0.34)	0.000
	middle	0.42 (0.32–0.55)	0.000
	richer	0.47 (0.36-0.61)	0.000

Interactions were tested using the Main Effects Model. Interactions terms were tested using the Wald test and reported if P value was < 15. The P value for sex*wealth (P =0.14) and for High Focus States (HFS) x wealth (P < 0.000).
P-values and 95% CI intervals are from binary logistics regression using complex survey analysis techniques, including probability weights.

Figure 26. Predictive Margins of effect of region of residence on wealth quintiles, for cost of care for diarrhoea in children, India 2015-16.



In fact, two quite different patterns of effects were found when the final logistic regression model for costliest care for diarrhoea was run separately for the two different subpopulations of these regions (results are not shown here). The analysis of subpopulations in the two distinct regions show:

- That wealth inequality for costliest type of care is more pronounced for the states other than the four selected High Focus States.
- For the four High Focus States, use of costly type of care differs between sexes but not for the other states.
- The impact of mother's level of education in the four High Focus States is significant but not in the other states.

A discussion of these findings is provided in the next chapter. Please, check Appendix 5 for the Correlation matrix for variables for the univariate analysis and in the final Model and further commands in Stata.

Chapter 7. Discussion

Overview

The results of the research conducted for this thesis were presented in the previous chapters. In the current chapter, a short introduction to gender and health careseeking is provided first, then a summary of the main findings of the study. A discussion of these findings is then provided, focusing on their relevance for both public health and further research in the field.

Gender and child health careseeking

The success of child survival initiatives depends on an adequate coverage of health care services and also on acceptance and uptake of these services by families in need (Andersen, 1995). Therefore, appropriate careseeking behaviour by families plays an essential role in guaranteeing that every sick child has access to life-saving interventions. Not seeking care outside the home, delaying seeking care, or using low-quality health care services can have significant health consequences for sick children in developing countries (Källander et al., 2011). Several deterrent factors for seeking care outside the home for childhood diseases in poor settings have been recognised. They are socioeconomic factors, include poor recognition of symptoms, distance to health care facility and difficulties with transport, prior use of traditional medicine, place of residence (where rural is worse than urban), severity of illness, equity indicators like gender inequality (Geldsetzer et al., 2014b, Diaz et al., 2013, Källander et al., 2011). The pathway to care for sick children involves a movement from inside to outside the home (Colvin et al., 2013) and entails a series of steps. The first step is the recognition of disease by carers, and the final step is reaching the health care facility with the child to access medical care. Still, the full reasons behind the patterns and delays in careseeking for childhood diseases are not fully understood. For severe diseases, the delay that occurs inside the home, or the so-called "first delay" (Källander et al., 2011), is usually due to lack of caretaker recognition of symptoms and also household practices, including household decision making arrangements. In low resource settings, families develop different strategies in order to accommodate the health care needs of its members. These strategies are usually aligned with the existing power relations, including gender-based power relations, within the household (Sen and Östlin, 2008). The impact of such power relations in health care can be amplified in times of financial crisis. Both poverty and traditional norms and practices (independent form economic factors) can result in gender bias against women and girls (Iyer et al., 2007). In the first situation, when resources become scarce, gender bias (as in gender discrimination) takes a rationing form, i.e., rationing bias. In the second case, however, pervasive beliefs, values, or traditions independent of economic resources lead to gender discrimination regardless of resource constraints, the so-called "pure" gender bias or discrimination (ibid). In most situations, it is a challenge for health researchers to be able to isolate both types of gender bias or discrimination.

The work of this thesis aimed to evaluate the relationship of gender (as per the sex of the child) on health careseeking for common infections. The focus of this study was South Asia broadly, and India, more specifically. Moreover, it aimed to evaluate the impact of other biological, cultural, and socioeconomic factors in these inequities. In the next section, a discussion of the key findings of this thesis is provided.

Systematic review of the literature

The findings of the systematic literature review and meta-analysis show that gender inequality was present for all three types of health service utilization—careseeking, admissions, and in-hospital case fatality. In South Asian studies, compared to boys, girls were less likely to receive appropriate careseeking and were also less likely to be admitted to hospital for the treatment of common infections.

Compared to boys of the same age, girls in South Asia were one third less likely than to receive appropriate careseeking for commons infections (OR 0.71, 95% CI: 0.64-0.79). Apart from the studies collected in our review, other studies in South Asia, not specifically for infections, show similar results (Pokhrel et al., 2005).

Just as observed for health care seeking, there is about a 30% chance that a boy would be admitted or treated for common childhood infections compared to girls (OR 1.27, 95% CI: 1.18-36). When other regions were considered in the analysis, inequality towards girls was indeed highest in South Asia (OR 1.5) and Asia (OR 1.3).

A recent sizeable hospital-based study conducted in Bangladesh (Naheed et al., 2019) looked at admissions and in-hospital case-fatality rates for pneumonia. The authors report that girls admitted were more likely to have severe or very severe pneumonia when compared to boys and were also more likely to die when compared to boys with the same severity of the disease. They noted that girls and boys received the same level of care when admitted to the hospital.

In the systematic review conducted in this thesis, across the six Asian studies reporting on in-hospital case-fatality rates for all common infections, girls had a 60% higher risk of in-hospital death compared to boys (OR 1.64, 1.33-2.03). This is an issue worth exploring further across South Asia, as the chances of a girl dying in hospital from diarrhoea are, in fact, about 130% higher compared to boys (OR 2.26, 1.66-3.08).

The literature review has some limitations. First, not all studies reported odds ratios, as this was calculated from available data when given. In some instances, the incidence rate ratio was used, which limits pooling and comparisons. Second, there were limited studies from South Asia. For example, the fifteen careseeking studies selected reported on three South Asian countries only (i.e., Bangladesh, India, and Pakistan). Similarly, 14 out of 19 studies (74%) on admission rates were conducted outside South Asia.

For the outcome care seeking, although the initial searches yielded quite a number of studies, only 15 studies were selected. That suggest that the search strategy was broad and quite comprehensive aiming to retrieve as many relevant studies as possible. There was some duplication between the databases searched but in tandem with the scope of the search and the number of databases. The search strategy also included admissions and no language restrictions were applied. It also initially included malaria, but later not eligible malaria studies in this region were selected. Because the focus of this thesis was on South Asia, care seeking studies in this region were selected. Only few studies have really examined this outcome in the detail and measurement accuracy required to properly compare boys and girls and that resulted in few careseeking studies selected. The criteria used were not too strict, but rather aimed to provide a sound comparison between boys and girls. In addition, several studies were rejected due to poor study designs, including very small sample. The body of evidence from the social sciences and also from mortality studies with regards to gender discrimination against women and girls in South Asia is quite substantial and therefore, it is surprising that the health care literature has not published more studies of care seeking comparing boys and girls in the region.

Notwithstanding, this review provided insights into gender inequalities in health care utilization suffered by girls in the South Asia region.

NFHS-3 analysis results

The analysis presented in chapter five was based on the data provided by the third round of the National Family Health Survey in India (NFHS-3), conducted in 2005-06. The primary variable studied was a summary variable, i.e., careseeking outside home for diarrhoea.

The analysis detected an association between sex of the child and careseeking outside the home for children. It also identified a strong association between wealth (or wealth index) and the careseeking outside home. Although the population impact of gender alone on this particular outcome was not significant when weighted percentages were calculated, its impact became more evident when other important social determinants like economic class were combined with the sex of the child.

Examining each independent variable separately can mask the impact of essential interactions and have implications if data is supposed to be used for the implementation of policies and programs. Thus, by combining gender and other potential determinants (Independent variables), the intersectional approach used in this analysis provided a more nuanced view. It allows visualizing the potential effect of gender (according to the sex of the chid) through other inequalities, i.e., economic class and family size. The results suggest that not only rationing but also pure gender bias (or discrimination) against girls might be present in India (Iyer et al., 2007). They also suggest that girls tended to benefit less from economic advantage when compared to boys. The descriptive findings, using weighted prevalences, was confirmed by the association analysis conducted. The use of subcategories combining sex of the child and economic class helped to visualize the odds ratios for the careseeking outcome not only for girls and boys but also for girls and boys in each economic class. The intersectional approach used provided more insight into the potential impact of combined inequalities (i.e., being a girl and belonging to more impoverished families) on the careseeking outcome.

The analysis also suggests that the number of siblings can have a negative impact on careseeking for girls but not for boys. Previously, others have (Raj et al., 2015b, Pande, 2003) explored the effect of sibling numbers and sex composition on the risk of malnutrition for girls under five in South Asia. Raj and colleagues (Raj et al., 2015b), for example, looking at DHS data from India, Bangladesh and Nepal, found that the risk of acute malnutrition was significantly higher for girls with brothers and the risk of chronic malnutrition was higher in girls with multiple sisters, whilst boy's nutritional status was less affected by siblings. In contrast, more recently, Rajan and Morgan (Rajan and Morgan, 2018), using data from the NFHS survey, studied the effect of sex of the child and sibling composition on various health outcomes, including treatment for acute respiratory infections(ari), vaccination and nutrition. They conclude that parents in India, at a specific parity, will discriminate against all daughters compared to sons. They also conclude that for these care seeking outcomes, as opposed to selective abortions, this discrimination is generalized discrimination, i.e., independent of the birth order of the daughter and the sibling composition. In the case of sex-selective abortions, "redundant" daughters tend to be aborted, which is called selective gender discrimination (Hesketh et al., 2011).

Previous research (Källander et al., 2011, Rheingans et al., 2012, Pande, 2003, Malhotra and Upadhyay, 2013, Colvin et al., 2013, Raj et al., 2015a, Johri et al., 2015) highlights the importance of young age, distance to health care facility and difficulties with transport, place of residence, number of children in the household, religion/ethnicity and mother's education and empowerment level as potential determinants of health care utilisation and health status for children in developing countries, including in South Asia. However, in this analysis, these factors were not independently associated with careseeking outside the home in the association analysis. These results warrant further investigation. For the variables religion and caste and tribe allocation, a more sophisticated categorization might be necessary.

NFHS-4 analysis results

The NFHS-4 analysis conducted in this thesis looked at different aspects of careseeking with a focus in diarrhoea. Specifically for diarrhoea, the descriptive analysis compared boys and girls and looked at five different aspects of careseeking behaviours, i.e., type of treatment given, type of place where care sought, delay in seeking care, the first point of care sought and the level and cost of care sought for children.

Overall, the analysis showed that a higher percentage of boys received *protective careseeking* behaviours from carers compared to girls. This small and yet significant difference was consistent across most of the protective careseeking behaviours, including the use of Oral Rehydration Solution (ORS) and seeking care outside the home. For careseeking delay, in contrast, there was no statistically significant difference in careseeking between boys and girls.

The most crucial difference benefiting boys was for seeking care outside the home and using a private doctor for care. These differences were not specific for the infant group (children under one year old). It is important to note this because at least for respiratory infections, boys could present with more severe clinical disease.

In the descriptive analysis, a regional pattern of differences in gender inequality in careseeking for diarrhoea was also noticed. States from the Central region (i.e., Madhya Pradesh, Chhattisgarh , Uttarakhand, Uttar Pradesh) and the Northern Region (Delhi, Chandigarh, Haryana, Himachal Pradesh, Jammu and Kashmir, Punjab, Rajasthan) and also the state of Bihar (East) showed the most marked and statistically significant gender differences benefitting boys. Then a different analytical approach was taken, and the four more populous states in Northern India (Uttar Pradesh, Bihar, Rajasthan, and Madhya Pradesh were compared with the rest of India. These four are part of the nine “High Focus States”(Sharma, 2015) and have higher mortality and fertility rates. For this new comparison, the gender disparities in careseeking behaviour for diarrhoea remained. The child population and sample sizes for the 4 High Focus States (HFS) and the rest of the states are equally significant (93,816 and 136,722).

Apart from the sex of the child and region of residence, significant differences in the prevalence of use of costlier care for diarrhoea were noticed for other covariates. Wealthier children, those with more educated mothers, younger children (< 1 year old), and urban children, had a higher prevalence of use of costlier care for diarrhoea than their counterparts. Most of these were expected results; however, unexpectedly, no significant difference in prevalence for this type of careseeking behaviour was noticed for families from Scheduled Caste, Tribe, or other Backward classes and those with a higher number of young children at home.

The association analysis confirmed that most of the findings described so far and revealed other patterns. The results confirm that gender inequities in care seeking for diarrhoea still persist in India, with girls having lower odds than boys to receive curative care, especially for diarrhoea. Girls were 16% less likely to receive the costliest type of care for diarrhoea than boys, even when other covariates were controlled for in the analysis.

Further than gender, other determinants of child health care seeking, in general, have shown an essential association with the cost of care for diarrhoea in this study.

Infants (i.e., children under one year old) were also more likely to receive a costlier type of care than older children (ages 1- 4 years). This is an expected result since infants could be seen as more vulnerable than older children.

Poverty is an important barrier for careseeking in children, especially in LMICs like India (Vilms et al., 2017). In the NFHS-4 analysis, the wealth quintile was a significant predictor of the use of costly care for diarrhoea as well. Children in the most deprived quintile were nearly three times less likely to receive a costlier type of care than those in the richest quintile.

The findings suggest that wealth modified the effect of gender in care seeking for diarrhoea but only for poorer and in the richest wealth quintile, where girls were significantly less likely to receive costly care than boys.

When the analysis of subpopulations, comparing the four High Focus States (Uttar Pradesh, Bihar, Rajasthan, and Madhya Pradesh) to other states in India, an interaction was noticed. However, an important interaction between sex and wealth quintile was noticed where a different effect of poverty on careseeking was found for these four High Focus States (Uttar Pradesh, Bihar, Rajasthan, and Madhya Pradesh) compared to other states of India. This suggests that the potential impact of poverty on the use of costly care seeking for diarrhoea is more pronounced for states other than the High Focus States. One possible explanation for this finding is that because the use of private services in the Highs Focus States is higher than on the rest of India, the impact of poverty might not be as extreme for these states.

Maternal education level was also a predictor of use of costlier careseeking behaviour for diarrhoea, but not for the four High Focus States in question. This finding calls for further investigation.

The analysis of subpopulations conducted showed that the association of gender with the use of a costlier type of careseeking is driven by these four populous High Focus States (Uttar Pradesh, Bihar, Rajasthan, and Madhya Pradesh). This suggests that girls living in these states and maybe in other Northern similar states are more at risk of neglect compared to those living in other regions of India.

These results suggest that, in India, gender inequality for careseeking for diarrhoea can be strongly influenced by regional factors, where a stronger clustering of gender differences in careseeking are concentrated in the northern part of India, particularly in the four most populous High Focus States of Uttar Pradesh, Bihar, Rajasthan, and Madhya Pradesh. These findings agree with recent spatial analysis looking at excess under-5 female mortality across India and using census data (Guilmoto et al., 2018). In this study, Guilmoto and colleagues report a strong spatial clustering of excess female deaths and suggest that postnatal sex discrimination in India is currently concentrated in the northern districts. More importantly, this geographical distribution is not the same as the distribution of skewed sex ratios at birth (i.e., high prevalence of pre-natal gender discrimination), which is a common assumption. Similarly, using the same data as this thesis, i.e., NFHS-4, Bora, and Saikia (Bora and Saikia, 2018), also report the concentration of higher rates of under-five and neonatal mortality rates in the north-central and eastern districts of India. In the same study, these two authors (Bora and Saikia, 2018) argue that the rates of under-five mortality suggest potential gender discrimination of girls in India, especially concerning nutrition and health care investment.

Nine of the Northern states of India are classified as low epidemiological transition level (ETL) where high mortality rates are combined with high fertility rates. Such states(Bihar, Jharkhand, Uttar Pradesh, Rajasthan, Meghalaya, Assam, Chhattisgarh, Madhya Pradesh, and Odisha) carry the most significant burden of diarrhoea, lower respiratory, and other common infectious diseases in children (Dandona et al., 2017). These are also very populous states with a total population of 626 million people in 2016, nearly half of the population of India. In these nine states, the

majority of the population rely on private healthcare for their ailments (Kumar and Singh, 2016), despite a vast network of public health services. Similarly, the socioeconomic disparities in these northern states are higher than in the rest of India (Singh et al., 2011). Socially and culturally, compared to the rest of India, the northern states tend to be more patriarchal in terms of kinship (Dyson and Moore, 1983), with less female autonomy, when compared to the rest of India.
Relying on private healthcare services increases inequalities in health care, including gender inequalities. In India, a high percentage of households experience catastrophic health expenditures because of high out-of-pocket payment for health care (Pandey et al., 2018). Families who need to seek care from private providers either because they do not trust the public health service or because there are not enough public outlets will have to use more mechanisms to ration the use of health services, which could mean that girls will be likely to suffer in terms of careseeking.

As others have reported earlier (Nasrin et al., 2013), in low-resource settings like India, the cost is an important deterrent for seeking care for children with diarrhoea and other infections. These “costs” also include opportunity costs, like time and resources spent to reach the health care facility.

In India, high out of pocket expenditure in Health (NNSO) means that families are very cautious in the way they manage the use of private care for their children.

These findings on cost agree with the findings of other researchers (Dongre, 2010, Ganatra & Hirve, 1994 Pandey, 2002 Nuruddin, 2009; Modern Treatment: (Larson, 2006); Provider type (Pandey, 2002) Facility. Similarly, studying similar data from India, others have argued that gender inequalities in the use of health care services, especially costly type of care like hospitalisation, are exacerbated by poverty (Asfaw et al., 2010).

Limitations of NFHS-3 and NFHS-4 data analysis

This analysis has limitations. The assumption of causality using cross-sectional data is not warranted. Although the period of recall for childhood diseases in DHS is short (two weeks), differential social desirability and recall bias cannot be excluded. Previous research on sex and disease in the region, suggest that perception and reporting of illness for girls is lower than for boys (Pokhrel,2005; Willis, 2009; Nuruddin, 2009).

Moreover, although quality control for data collection, data entry, and quality control procedures in DHS surveys are very well established, field problems relating to interviewers training and supervision are recognised as a problem in DHS and MICS surveys (Arnold, 2013).

Whilst some argue that maternal reporting for child illness is a valid measure of careseeking (Carter et al., 2018a), severity of disease is a not always picked up by carers, especially in developing countries. Hospital based studies, using health care professionals to evaluate clinical symptoms in children, are superior to DHS reports of symptoms and signs of common infections in children. Therefore, reporting accuracy on disease (including severity of disease) in DHS data is not ideal.

No analysis of sibling composition was performed. Using data from the NFHS-3 and studying child survival, Chamarbagwala (Chamarbagwala, 2011) reports an association of sibling composition (older siblings) and suggests that sibling composition might be a determinant daughter's survival disadvantage in that context. In contrast, Rajan and Morgan (Rajan and Morgan, 2018), using data from the first three rounds of the NFHS in India , studied the impact of sibling composition and birth order on vaccination coverage, careseeking for acute respiratory infection (ARI), breastfeeding length and nutrition. They conclude that compared to sons, daughters in India are discriminated against independently of sibling composition and birth order. They argue that, at least for these outcomes, the evidence of generalized discrimination (i.e., affects all daughters compared to sons) is stronger than for selective discrimination (affecting daughters with older sisters).

Similarly, the fact that there was no difference in gender disparity for careseeking between families from Scheduled Caste, Tribe, or other Backward classes and others could be attributed to the current classification of this variable in the DHS questionnaire. Although others have reported increased gender discrimination in households with a higher number of children, our analysis did not confirm this. This further warrant investigation.

Chapter 8. Conclusions and final recommendations

Summary findings

The research of this thesis based both on a systematic review of the literature and the analysis of demographic and health surveys highlighted important issues and patterns relative to child health careseeking in India and more broadly in South Asia. For children under five suffering from frequent infections and especially those suffering from diarrhoea. Box 3 shows the summary of findings.

Box 3. Thesis summary findings

- ✓ Gender inequality in child health careseeking is still present in South Asia and India and puts girls in a vulnerable position in terms of health and wellbeing
- ✓ In India, the intersection of gender and poverty means that girls in India are worse off than boys in terms of child health care. However, poorer girls are much worse off because girls ten to benefit less from economic advantage when compared to boys
- ✓ There is an association between the sex of the child and careseeking patterns outside the home
- ✓ Gender inequality in child careseeking is an Indian phenomenon with a strong clustering in the Northern part of India;
- ✓ Mother education is associated with child careseeking, where children from more educated mothers tend to receive better health care
- ✓ Rural children are still lagging in terms of careseeking;
- ✓ Where data comparisons with other regions of the world in the same stage of development were performed, South Asian countries seem to concentrate more on gender inequality in child health care. This suggests that gender inequalities in child healthcare utilisation in South Asia are both a development and a cultural issue
- ✓ Gender discrimination in India is associated with structural inequalities potentially due to development issues such as rural residence and living in a less developed region. However, it is also associated with household specificities like wealth index and mothers' level of education (e.g., poorer families are more likely to discriminate against girls in intra-household food allocation and expenditures in health care)
- ✓ Moreover, this analysis highlighted the usefulness of using intersectionality as a research tool in the study of gender and other social inequalities in health from the conceptualization, questions design, data analysis through the interpretation of results.
- ✓ In line with previous social and economic research, the findings from this thesis highlight that son preference is still a prevalent phenomenon in India and other parts of South Asia (Das Gupta et al., 2003, Edmeades et al., 2012, Pande, 2003).

Recommendations

Recommendations for research

Gender is not only a determinant of health but also a driver of health behaviours and a shaper of health systems responses (Manandhar et al., 2018). The relationship between health and gender, leading to health inequities, is complicated, and it affects child health. Better analysis, both quantitative and qualitative, aimed at unpacking how disparities in sex-disaggregated indicators are drive-by gender norms are still required.

The results of the systematic review conducted suggest that there is still a gap in evidence on gender inequalities in access to health services for common childhood diseases in the region. Researchers working in South Asia should look more in-depth into this important issue whilst using appropriate methods to allow comparisons between boys and girls.

Similarly, the importance of collaboration amongst different disciplines is still needed. One of the aspects of this thesis is that it is engaged with conceptualization in order to provide not only a "bridge " between a social phenomenon and the data provided by quantitative research but also a foundation for refinement of research questions. Moreover, engaging with theory helped to shape the design of the analysis and better interpret its findings. More research of the same kind should be fostered (Weber et al., 2019).

Gender discrimination affecting health is a complex phenomenon. In developing countries like India, the availability of quality data, and more statistical evidence for mortality rates is scarce (Guilmoto et al., 2018).

The findings, especially from the analysis of the NFHS survey data, have strong external validity and can be generalized to the population of India (Lavrakas P, 2008). India as a good case study for the impact of gender on careseeking behaviours in a South Asian country, especially considering the combined effect with poverty and other axes of inequality. However, to what extent the findings in this thesis could be generalized to the rest of South Asia, it is not clear, but further similar research in other South Asian countries should explore that.

Similarly, more studies using an intersectional approach and adding qualitative data should be beneficial. Girls who are poorer and live in the northern states of India will still be at higher risk of gender discrimination even if this effect is not on a multiplicative scale.

Recommendations for public health

Addressing gender inequalities in child health relates to two critical sustainable development goals (SDGs), SDG3 and SDG5Resource limited countries face a considerable challenge while trying to achieve the targets for both SDG3 (*i.e., "Ensure healthy lives and promote wellbeing for all at all ages")* and SDG5 (i.e., *"Achieving gender equality and empowering all women and girls").* Although progress has been made, both child mortality and morbidity and gender inequality are still a significant problem in India and other South Asian countries. Interventions aiming to address gender health inequities require an understanding of the complex relationship among different social determinants of health.

The findings presented in this thesis suggest that more efforts in planning for interventions for common childhood infections in the region to reduce gender inequalities in child health care are still needed. However, in order to address this issue, the kind of action needed must be interdisciplinary, multisectoral, and involve not only government sectors but other stakeholders like civil society, private sector, and academia (Manandhar et al., 2018).

Similar efforts should help mainstream gender as an important determinant of health and improve accountability of public health stakeholders, governments, and agencies in relation to such an important public health issue.

Gender is about power relations between different groups of people. Furthermore, power, or lack of it, is a potent health determinant (George et al., 2019). Similarly, the other structural factors, such as laws, labour markets, and structure and macroeconomic policies, are both influenced and influencers of gender norms. Therefore, effectively addressing gender health inequalities depend on addressing the structural factors that also influence gender inequality. Needless to say that this cannot be achieved by the health sector working alone.

Conclusion

Reducing the impact of gender inequalities in child health in India or elsewhere is a huge task, which requires adequate and also innovative types of action (Darmstadt et al., 2019). Full recognition of the extent of the impact of gender in child health care in the region is the first step only. However, transformative actions will only be achieved by understanding how gender intersects with other inequalities to the detriment of girls in South Asia (Weber et al., 2019).

There have been recent attempts to study gender and other inequalities in health care seeking using nationally representative data from demographic and health surveys. Although these efforts are commendable, they shed very little light on the contextual factors leading to these inequalities (Calu et al., 2017). This type of work provides baseline evidence for further inquiries into the complex system of contextual drivers of gender inequalities in different regions, countries, and intra country regions. By using a theoretical framework, including the intersectionality theoretical perspective, the research conducted in this thesis has enabled a more nuanced and in-depth view of the findings with regards to inequalities in health, especially for gender and child careseeking in India.

Finally, if India is to meet the targets for both SDG3 and 5, access to child life-saving interventions should be made available for all children and not only those in the most advantaged groups. Understanding the relationship of different axes of inequalities in access to child health care is likely to improve child health policies and programmes and therefore benefit more children in India and South Asia.

The work of this thesis and similar ones can contribute to the crucial knowledge necessary for engagement with transformative actions to address gender inequality in child health in India and other similar settings. If this kind of knowledge is translated into effective policies and actions by government and civil society, it can enable a healthier, happier and longer life for all girls and women in South Asia allowing them to achieve their full human potential.

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Appendices

Appendix 1. Systematic review - supplementary material

Appendix 1.1 Search strategies for other databases (apart from PubMed)

EMBASE

1. mortality/ or exp childhood mortality/ or exp infant mortality/ or exp child death/ or exp Cause of Death/
2. exp incidence/ or exp prevalence/ or morbidity/ or hospitalized child/ or hospitalized infant/ or (care seeking or care-seeking).mp. or burden.mp.
3. gender/ or gender bias/ or boy/ or girl/ or sex factors.mp. or boy.mp. or girl.mp. or gender.mp. or sex.mp.
4. exp lower respiratory tract infection/ or exp respiratory tract infection/ or pneumonia/ or acute chest syndrome/ or bronchopneumonia/ or infectious pneumonia/
5. exp malaria/
6. exp diarrhea/ or diarrhoea.mp.
7. 1 or 2
8. 4 or 5 or 6
9. 3 and 7 and 8
10. limit 9 to (human and yr="1990 -Current" and (preschool child <1 to 6 years> or school child <7 to 12 years> or adolescent <13 to 17 years>))

LILACS

(tw:(diarr$ OR pneumonia OR neumonia OR malaria))
AND
(tw:(death OR mort$ OR muert$ OR incidenc$ OR prevalenc$ OR morbi$ OR admission$ OR interna$ OR hospital$))
AND
(tw:(gender OR genero OR sex$ OR male OR female OR boy$ OR menin$ OR girl$ OR nin$ OR crianc$))
AND
(tw:(child$ OR paediat$ OR pediat$)) (da:(da:201$ OR da:201$ OR da:199$)) AND (limit:("humans" OR "female" OR "male" OR "preschool" OR "infant" OR "child" OR "newborn" OR "adolescent"))
AND (instance:"regional") AND (db:("LILACS") AND limit:("humans"))

WHOLIS

[Words] diarr$ OR pneumonia OR malaria
AND
[Words] death OR mort$ OR incidenc$ OR prevalenc$ OR morbi$ OR admission$ OR hospital$
AND
[Country, publication year] PD 200$ OR PD201$ OR PD 199$

PAHO

[Words] (diarr$ OR pneumonia OR neumonia OR malaria) [Words]
AND
[Words] Death OR mort$ OR muert$ OR incidenc$ OR prevalenc$ OR morbi$ OR admission$ OR interna$ OR hospital$ [Words]
AND
[Words] gender OR genero OR sex$ OR male OR female OR boy$ OR menin$ OR girl$ OR nin$ OR crianc$
AND
[Country, publication year] PD 200$ OR PD201$ OR PD 199$

WHO Global library portal search strategy

AIM (AFRO)

(diarr$ OR pneumonia OR malaria) AND (child$ paediat$ OR pediat$) AND (da:200$ OR da:201$ OR da:199$)

IMEMR (EMRO)

(diarr$ OR pneumonia OR malaria) AND (Death OR mort$ OR incidenc$ OR prevalenc$ OR morbi$ OR admission$ OR hospital$) AND (child$ OR paediat$ OR pediat$) AND (da:200$ OR da:201$ OR da:199$)

IMSEAR (SEARO)

(diarr$ OR pneumonia OR malaria) AND (Death OR mort$ OR incidenc$ OR prevalenc$ OR morbi$ OR admission$ OR hospital$) AND (child$ OR paediat$ OR pediat$) AND (da:200$ OR da:201$ OR da:199$)

WPRIM (WPRO)

(diarr$ OR pneumonia OR malaria) AND (Death OR mort$ OR incidenc$ OR prevalenc$ OR morbi$ OR admission$ OR hospital$) AND (child$ OR paediat$ OR pediat$) AND (da:200$ OR da:201$ OR da:199$)

Global Health Cabi

1. exp malaria/
2. exp diarrhea/ or diarrhoea.mp.
3. exp pneumonia/ or (respiratory diseases or lower respiratory tract infectios).sh.
4. (girl* or boy* or gender or female or male).mp. [mp=abstract, title, original title, broad terms, heading words]
5. (child* or pedia* or paedia* or infant).mp. [mp=abstract, title, original title, broad terms, heading words]
6. (care seeking or care-seeking).mp. or ambulatory care/ or hospitalization/ or "length of stay"/ or patient admission/ or burden.mp. or exp Morbidity/
7. exp mortality/ or exp infant mortality/ or exp Death/
8. 1 or 2 or 3
9. 6 or 7
10. 8 and 9
11. 4 and 8 and 9
12. 4 and 5 and 8 and 9

SIGLE: (200314)

(Diarr* OR pneumonia OR malaria) AND (child* OR paediat* OR pediat* OR infant*)

Ind Med

(Diarrhea OR Diarrhoea OR pneumonia OR malaria) AND (child OR childhood OR children OR paediatric OR pediatric OR infant)

WEB of Science

TITLE=(Diarrhea OR Diarrhoea OR pneumonia OR malaria OR acute respiratory infections)
AND
TOPIC: *(children)*
AND
TOPIC=(gender or boy or girl or female or male)
Timespan=1900-2014

Chinese databases:

CNKI

Topic: respiratory infection or pneumonia (vague)

Or Topic: bronchiolitis or malaria (vague)

Or Topic: diarrhoea (vague)

And Topic: incidence or death (vague)

And Topic: child (vague)

And All: male or female (vague)

Publication time: 1st Jan 1990 – 20th Mar 2014

Wanfang

All (vague): male or

All (vague): female and

All (vague): pneumonia and

All (vague): incidence and

All (vague): child

Time: 1990 – 2014

CQVIP (138+58+7=203 results)

Title/key word: incidence

Or Title/key word: death

And Title/key word: pneumonia

And Title/key word: child

Time: 1990 – 2014

Appendix 1.2 Asian studies reporting on Admissions only

	Author, year (disease)*	Age	Admission ratio (M:F) and 95%CI	Age group population ratio (M:F) $	Country
South Asian countries:					
1	Chansoria, 1990[12] (MD)	< 14 y	1966-68: **2.64 (2.36,2.96);** 1977-81: **1.65 (1.59,1.72)**	1.05 (1991)$$$ 1.08 (2011) $$$	India
2	Butler,1991 (D)	0-59 mo 60-120 mo	0-59mo: 1.14 (0.85,1.53); 60-120 mo: 2.75(1.79,4.22)	0-59mo: 1.04 60-120 mo: 104	Bangladesh
3	Mitra,2000[9] (D)	0-59 mo	1.77 (1.47,2.1)	1.04	Bangladesh
4	Baqui,2007 (P)	0-59 mo	1.71 (1.52,1.92)	1.04	Bangladesh
5	Tiewsoh, 2009 (SP)	0-59 mo	1.35 (0.95, 1.92)	1.13	India
6	Borade, 2010 (D)	0-59mo	1.56 (1.21-2.0)	1.13	India
7	Kumar, 2011 (P)	0-59 mo	1.27 (0.86,1.88)	1.05$$	India
8	Ali Junejo, 2012 (M)	3 mo - <12y	1.77 (1.40.2.24)	1.13	Pakistan
9	Colombara, 2013 (D)	< 5 y	1.53 (1.31-1.40)	1.03	Bangladesh
10	Banstola, 2013 (P)	0-59 mo	1.46 (1.27,1.69)	1.05	Nepal
Other Asian countries:					
1	Swanjutha, 1994[13] (P)	0-59 mo	2.0 (1.55,2.6)	1.05	Thailand
2	Lee, 1999 (D)	< 16 y	1.43 (1.35,1.52)	1.01	Malaysia
3	Djelantik,2003 (SP)	0-23 mo	1.55 (1.46,1.65)	1.05	Indonesia
4	Nguyen, 2004 (D)	< 5 y	1.94 (1.51-2.49)	1.11	Vietnam
5	Yang, 2005 (D)	< 14 y	1.34 (1.11,1.60)	1.17 - 1.34	China
6	You, 2006 (D)	< 12y	1.39 (1.17,1.65)	1.15 - 1.33	China
7	Lupisan, 2007 (SP)	2-59 mo	1.39 (1.25,1.56)	1.05	Philippines
8	Poo, 2007 (D)	2 mo - <12y	1.10 (0.90,1.34)	1.06	Malaysia
9	Yang, 2010 (SP)	1 mo to <12y	2.28 (1.76,2.94)	1.12 - 1.19	China
10	Nanda, 2010 (M)	Children, no age specified	1.77 (1.40.2.24)	1.13	India
11	Chea, 2011 (D)	< 12y	1.29 (1.0,1.67)	1.04***	Borneo
12	Shieh, 2013 (D)	< 6 y	1.77 (1.47,2.14)	1.11	Vietnam
13	Li, 2012 (D)	< 5 y	2.21 (2.0,2.45)	1.22 - 1.29	China

*D=Diarrhoea; P=Pneumonia; SP=Severe Pneumonia; M=Malaria; MD=Mixed diseases; MI=Mixed infections ;**In Butler study it is only Typhoid fever and diarrhoea; ** *See other findings of this study. Of the 5 studies, Lupisan and Butler are the studies where CFR is similar for boys and girls, although one probably would expect higher mortality rates for boys;

Appendix 1.3 Review of South Asian studies reporting on Immunisation and Nutrition

Narrative synthesis

Of the 12 articles reporting on child care, two studies reported on both outcomes, four reported on immunisation coverage only and six studies on nutrition only (Table 1 in Appendix 1). All of them used data from India, either national data or from specific regions or states. Data from Bangladesh and Nepal is reported together with data from India in one of the studies and in another study, data from Pakistan is also reported. Findings of all six articles reporting on immunisation suggest that girls are less likely to receive full immunisation compared to boys, and also less timely immunisation. This gender disparity is likely to be intensified by the presence of older siblings (e.g. girl with girls with 2+ older surviving sisters). For studies reporting on nutrition outcomes, the results are more nuanced. In seven out of eight studies, findings are suggestive of gender bias in nutrition outcomes benefitting boys. In one of them (Corsi et al., 2015) no female disadvantage in anthropometric measures is detected. And in another study, looking at intra households allocation of food (Aurino, 2016), no significant gender disparity in dietary diversity is detected for 5, 8 or 12 years old children but a pro-boy gap emerged at 15 years of age. Moreover, three studies reporting on breastfeeding suggest that girls were breastfed for shorter periods than boys and this effect is intensified by birth order and sibling composition. In a recent study reporting on national data from India, Bangladesh and Nepal (Raj, 2014), girls who had brothers were at increased risk for acute malnutrition. Conversely, in the same study, girls were at increased risk of chronic malnutrition if they had sisters and in contrast, boy's malnutrition seemed less affected by siblings. Surprisingly, gender disparities were not always worse for children belonging from families in the lower socioeconomic classes.

Table S1. South Asian studies reporting on gender inequality in child care (immunisation and nutrition).

Author, year	Country	Outcomes		Suggests gender bias? Yes (Y), No (N), Inconclusive (I)	Comments
		Immunisation	Nutrition		
1. Pande, 2003(Pande and Yazbeck, 2003)	India (national)	✓		Y	Gender inequalities persisting in in most states, even in the South. They seem to be unrelated to other inequalities including immunisation coverage
2. Boroaah, 2004(Borooah, 2004)	India (16 major States)	✓	✓	Y	Econometric analysis, rural households, children between 1-2 years: Likelihood of girls being fully vaccinated, after adjusting for other variables, was 5 percentage points lower than that for boys. Nutritious diet: the treatment of girls depended mother's literacy. For illiterate mother was worse. Father's literacy did not affect the gender gap.
3. Rammohan, 2014(Rammohan et al., 2014)	India (national)	✓		Y	2008 DHLS girls significantly less likely to be vaccinated at all and also timely vaccinated.
4. Prusty and Kumar, 2014(Prusty and Kumar, 2014)	India (national)	✓		Y	Gender disparity (GD) in full immunization coverage slightly more in rural compared to urban areas. GD narrowed in the North region but increased in the West and South regions (son preference?). Contrary to expected, girls of poorer wealth quintile were more likely to be immunized even after adjusting for other factors. GD highest among Muslims followed by Hindus. GD among middle and upper middle classes has increased over the study period (1992–2006).
5. Singh, 2014(Singh and Parsuraman, 2014)	India and Pakistan (national)	✓		Y	For both countries: boys and girls with either no older surviving siblings or with surviving siblings of the opposite sex more likely to be fully immunized compared to other sibling compositions. In India, this bias was more intense. During the period, the least increase in coverage were in girls with 2+ older surviving sisters or with

Author, year	Country	Outcomes		Suggests gender bias? Yes (Y), No (N), Inconclusive (I)	Comments
		Immunisation	Nutrition		
					1+ older surviving brothers and sisters. Additionally, the highest increase in coverage was evident in boys with 2+ surviving older sisters.
6. DasGupta, 1987(Gupta, 1987)	India (Ludhiana District, Punjab, India)		✓	**Y**	Although infant girls receive similar caloric intake as boys, girls tend to be fed more cereals whilst boys are fed more milk and fats.
7. Jayachandran, 2009(Jayachandran and Kuziemko, 2009)	India (national)		✓	**Y**	Model of breastfeeding (BF) under son-biased fertility preferences using 1992, 1998 and 2005 NFHS waves, national: • Breastfeeding duration increases with birth order (esp. near target family size) • Lowest for daughters and children without older brothers (parents try again for a son?) • Largest GD near target family size, when gender is most predictive of subsequent fertility. • Child-mortality patterns mirror (impact of birth order and ideal family size) • Results suggest that gender gap in BF explains 14 % of excess female child mortality in India (≡ 22,000 "missing girls"/year)
8. Fledderjohan, 2014(Fledderjohann et al., 2014)	India (national)		✓	**Y**	NFHS 2005–06, national: Indian girls are breastfed for shorter periods than boys and consume less milk with increased probability to die
9. Raj, 2014(Raj et al., 2015b)	Bangladesh, India and Nepal (national)		✓	**Y**	Sibling effect: For girls, having brothers increases the risk for acute malnutrition (wasting) and having multiple sisters increases the risk for chronic malnutrition (stunting/underweight). In contrast, boy malnutrition is less affected by siblings.

Author, year	**Country**	**Outcomes**		**Suggests gender bias? Yes (Y), No (N), Inconclusive (I)**	**Comments**
		Immunisation	**Nutrition**		
10. Barcellos, 2014*(Barcellos et al., 2014)	India (six states, rural)	✓	✓	**Y**	Indian Time Use Survey (1998-99): effect of gender on parental investments are likely to be biased due to the fact that girls systematically end up in larger families. Boys receive significantly more and better quality care time than girls. Boys are more likely to be breastfed longer, and to be given vaccinations and vitamin supplementation. This suggests that this differential treatment is neither due to their greater needs nor to the effect of anticipated family size.
11. Corsi, 2015	India (national)		✓	**N**	No female disadvantage (anthropometric measures) 1992-93 and 2005_06 in terms of stunting in under 5s.
12. Aurino, 2016(Aurino, 2016)	Andhra Pradesh and Telangana (India)		✓	**Y**	Three rounds of Young lives survey, intra-household allocation of food during childhood: • No important GD in dietary diversity 5, 8 or 12 years old. A pro-boy gap emerged at 15 years. • Boys' advantage in dietary quality: mostly higher consumption of protein- and vitamin-rich foods (adjusted results). • These GD between adolescents were robust when puberty onset, time use and dietary behaviours were controlled for • GD dietary quality in mid-adolescence did not vary by maternal education, poverty or place of residence. • GD with pro-boy bias marked amongst adolescents with 'academically aspiring

*immunisation, nutrition and child care

Appendix 2. Conceptual Framework - supplementary material

Appendix 2.1.

Individual's position and health advantage: the importance of looking into "middle groups" or positionality and health inequity

The concept of "middle groups" in this chapter, draws from the work conducted by Sen and Iyer (Sen and Iyer, 2012). They used household sur*vey* data from Karnataka, India, and looked at health-seeking for long-term ailments and explored how different axes of advantage and disadvantage intersect with each other and can affect the entitlement to treatment for long-term illness. In my data analysis, I will be using a similar approach and therefore it is useful to clarify the concept of "middle groups" or the non extreme groups.

If we assume that an individual "position" in society depend on various things and has an impact on their access to health care. For each individual considered, this "position" will depend both **on the position of his/her household** (e.g. wealth and income, background, ethnicity, race, Caste) and also on the **individual's position within his/her household** (e.g. gender, age, marital status, birth order, personal income). From an intersectional point of view, it is important to consider as many different axes of oppression as possible when looking at inequity. To make it easier to understand, I will consider two axes of oppression only, gender and wealth (using social class as a measure of wealth). If we consider both of these characteristics as dichotomies, we have then poor and non poor and men and women. The full range of subclasses created are:

- non poor men (extreme advantage)
- non poor women (middle group 1)
- poor men (middle group 2)
- poor women (extreme disadvantage)

In a patriarchal society in South Asia (for example), it is fairly plausible to assume that the biggest difference in social and health advantages is between non poor men compared to poor women, the two extreme groups. However, the “middle groups”, i.e., the non poor women and the poor men, have a combination of one advantage and one disadvantage and how do they compare to each other? As Sen and Iyer (ibid) explain, non poor women have an economic advantage and a gender disadvantage, whilst poor men have the opposite. The implication of this approach of looking at the middle groups in terms of care seeking and access to treatment is that one can understand in more details how different types of advantage work through another. As the authors argue, this focus in a multi-dimensional social ordering allows more insight on how different axes of oppression/advantage intercept and with each other affecting health access and outcomes. In their particular research in Karnataka, India, the authors found that whilst both gender and class affected access to treatment, having a gender advantage whilst belonging to a middle group might be more beneficial than having economic advantage. As the authors also explain, in order to access health treatment, individuals who belong to the middle groups can ***leverage*** their disadvantage by using their advantages. In the Sen and Iyer words: *“Leveraging occurs as groups use their advantages along some dimensions to compensate for disadvantages along others”.* In their particular research both gender and class are leveraged to secure access, however, gender as an advantage is more powerful than class as a lever when looking at middle groups. Exploring health inequalities using this approach have important policy implications.

Table S2. South Asian studies reporting on hospital admission rates and case fatality rates for common childhood infections (used in developing Conceptual Framework)

Author, year	Country	Outcomes		Suggests gender bias? Y, N, I,	Comments
		Admission Rates (AR)	Case Fatality Rates (CFR)		
Faveau, 1991(Fauveau et al., 1991)	Bangladesh	✓	✓	**Y**	
Mitra, 2000(Mitra et al., 2000)	Bangladesh		✓	**Y**	Suggest delay in seeking care for girls and also more boys than girls admitted, especially in intensive care
Butler, 1991(Butler et al., 1991)	Bangladesh		✓	**Y**	Authors argue that combined results suggest delay in admissions for girls
Bahn, 2005 (Bhan et al., 2005)	India	✓		**Y**	Results adjusted for age, maternal and paternal education, socioeconomic status(SES) and family size
Nuruddin, 2009 (Nuruddin et al., 2009b)	Pakistan	✓		**I**	
Nair, 2013 (Nair et al., 2013a)	Multicountry	✓		Y	South Asia mainly. 7 South Asian sites (India (n=4), Bangladesh (n=3)) and 2 South East Asian. Compares AR from Asia with global rates (meta-analysis).

Yes (Y), No (Y), Inconclusive(I)

Table S4. South Asian studies on care seeking behaviours for common childhood infections in boys versus girls.

Care seeking behaviour	Author, year	Country	Suggests* gender bias? Yes (Y), No (N), Inconclusive (I)
Illness perception or reporting	Pokhrel, 2005(Pokhrel et al., 2005)	Nepal	**Y**
	Nuruddin, 2009 (Nuruddin et al., 2009b)	Pakistan	**I&**
	Willis, 2009 (Willis et al., 2009)	India	**Y**
Treatment delay	Mitra,2000 (Mitra et al., 2000)	Bangladesh	**Y**
	Pandey,2002 (Pandey et al., 2002)	India	**Y**
	Pandey, 2009 (Pandey et al., 2009)	Nepal	**N**
	Malhotra, 2013 (Malhotra and Upadhyay, 2013)	India	**Y**
Utilization of any health care treatment	Hussain, 1999 (Hussain et al., 1999)	Bangladesh	**Y**
	Tambe, 1999 (Tambe et al., 1999)	India	**Y£**
	Hasan, 2000 (Hasan and Khanum, 2000)	Pakistan	**Y£**
	Thind, 2004 (Thind, 2004)	India	**Y**
	Pokhrel, 2005 (Pokhrel et al., 2005)	Nepal	**Y**
Using a health care facility for treatment	Nuruddin, 2009 (Nuruddin et al., 2009b)	Pakistan	**N**
	Malhotra, 2013 (Malhotra and Upadhyay, 2013)	India	**I**
	Quadri, 2013 (Quadri et al., 2013)	Pakistan	**N**
Number of health care providers used	Faveau, 1991 (Fauveau et al., 1991)	Bangladesh	**Y**
Choice of health care provider used	Faveau, 1991 (Fauveau et al., 1991)	Bangladesh	**Y£**
	Ganatra and Hirve, 1994 (Ganatra and Hirve, 1994)	India	**Y££**
	Pandey,2002 (Pandey et al., 2002)	India	**Y**
	Larson, 2006 (Larson et al., 2006)	Bangladesh	**Y£££**
	Pokhrel, 2005 (Pokhrel et al., 2005)	Nepal	**Y**
Use of modern€ treatment	Hussain,1999 (Hussain et al., 1999)	Bangladesh	**Y$**
	El Arifeen, 2004 (El Arifeen et al., 2004)	Bangladesh	**N**
Distance travelled to treatment centre	Ganatra and Hirve, 1994 (Ganatra and Hirve, 1994)	India	**Y£**
	Pandey,2002 (Pandey et al., 2002)	India	**Y£**

Expenditure in health care	Ganatra and Hirve, 1994 (Ganatra and Hirve, 1994)	India	**Y**
	Pandey,2002 (Pandey et al., 2002)	India	**Y**
	Willis, 2009 (Willis et al., 2009)	India	**Y£**
	Dongre, 2010 (Dongre et al., 2010)	India	**N£**
	Nuruddin, 2009 (Nuruddin et al., 2009b)	Pakistan	**I&**
Use of antibiotics	Larson, 2006 (Larson et al., 2006)	Bangladesh	**Y¥**
Referrals for further treatment followed	Ganatra and Hirve, 1994 (Ganatra and Hirve, 1994)	India	**I**

*Study show statistically significant difference between boys and girls. Unless stated, adjusted for other effect modifiers; €: Modern treatment includes govt. health facilities, pharmacy or school physicians. Conversely, traditional treatment includes kabiraji (ayurvedic treatment), hekimi (herbal medical treatment), quack, homeopathy and religious healers; & Authors argue that the study did not have enough power to detect differences in boys compared to girls once adjusted for other effect modifiers; £: Only unadjusted ratio provided; ££ Adjusted for severity of illness only; £££: Gender bias detected mainly in urban households; $: Adjusted for household income only, bias detected in poorer households only; ¥: Bias detected in rural households and city corporation(non-slum) type settings;

Appendix 2.3 Ecosocial theory and implications for this conceptual framework: glossary and explanatory text

Glossary

Gender: a social construct based on social roles and relating to power and authority[1] & female biological sex of child.

Gendered expressions of biology:** where, according to Krieger (Krieger, 2003) gendered expressions of biology could be erroneously invoked to explain biologic expressions of gender.

Biological expression of gender discrimination*: i.e., embodiment, includes pre-natal experiences;

Understanding embodiment

In Figure 2 and 3 (main manuscript) we present a diagram depicting the embodiment of gender inequality, and the two main pathways through which this happens. In figure 3, we list examples of inappropriate care of girls compared to boys in South Asia, and the potential consequences to health and wellbeing of young girls. Girls have a biological advantage at survival than boys in the first year of life. However, the embodiment of gender discrimination by young girls render them relatively frail compared to boys, leading to the ***biological expression of gender discrimination*** (Figure2, a core construct of the Ecosocial theory. This frailty might render girls less able to cope with the challenge of important acute infections like diarrhoea or pneumonia. The biological absorption or the **embodiment** of this material and social reality in which South Asian girls live in lead to gender based child health inequity phenomenon in this region. These health inequities includes excess mortality of girls.

Understanding the ***biological expression of gender discrimination*** (letter **b** in the figure 2), or, the ***embodiment***, is crucial to anyone attempting to look at the impact of gender discrimination on health outcomes or health care use for girls in South Asia.

Reference:

Krieger N. Genders, sexes, and health: what are the connections—and why does it matter? International journal of epidemiology. 2003;32(4):652-7

Appendix 3. Methods - supplementary material

Appendix 3.1- Form: Centre for Population Health Sciences Research Ethics criteria for level 1 self-audit Review for PGR projects

University of Edinburgh,
Centre for Population Health Sciences
RESEARCH ETHICS SUBGROUP

Self-Audit Checklist for Level 1 Ethical Review <u>for PGR projects</u>

See **Intra** website for further information: http://www.cphs.mvm.ed.ac.uk/intra/research/ethicalReview.php

NOTE to student: *Completion of this form should be under the* ***oversight*** *of your supervisor. A good strategy would be to complete a draft as best you can, then discuss with your supervisor before completing a final copy for your supervisor to sign.*

Proposed Project (State research question and topic area, and <u>briefly</u> describe method/ data. Specify also <u>countries</u> in which data will be collected.):

Title: "Common childhood infections and gender inequalities in care seeking and mortality in low and middle income-countries."

Aim: We aim to estimate care seeking (across severity spectrum i.e. type of care sought (no care, homecare or primary, secondary or pharmacy), type of health care provider (medically trained or not), purchase of over-the-counter medication in pharmacy, outpatient attendance and hospitalisation) and mortality by gender.

Methods: I will conduct a comprehensive systematic literature review to identify studies reporting data (by gender) on hospitalisations and mortality for the three leading causes of child mortality, i.e. pneumonia, diarrhoea and malaria. To gather unpublished data I will use networks already in collaboration with the CPHS and will also identify leading researchers on childhood pneumonia, diarrhoea and malaria working in developing countries who are likely to have unpublished data and set up broad-based working group collaborations. To add to this evidence, I will conduct an analysis of Demographic Health Surveys (DHS), Multiple Indicator Cluster Survey (MICS) and other national household surveys databases from developing countries looking at differences in care seeking and mortality by gender in children under five. I also intend to look at Verbal Autopsy(VA) data from the INDEPTH network when these become publically available. Although all data used for this review will be secondary in nature I have already applied for DHS database clearance and got approval. I also have an agreement with UNICEF to collaborate and conduct MICS data analysis and will apply for data clearance from the INDEPTH network to use their data on VA in children once these data has been publically available.

1. Bringing the University into disrepute

Is there any aspect of the proposed research which might bring the University into disrepute? ~~YES~~/ NO

2. Data protection and consent

Are there any issues of DATA PROTECTION or CONSENT which are NOT adequately dealt with via established procedures? ~~YES~~/ NO

These include well-established sets of undertakings. For example, a 'No' answer is justified *<u>only if</u>*:

(a) There is compliance with the University of Edinburgh's Data Protection procedures (see www.recordsmanagement.ed.ac.uk);

(b) Respondents give consent regarding the collection, storage and, if appropriate, archiving and destruction of data;

(c) Identifying information (eg consent forms) is held separately from data;

(d) There is Caldicott Guardian approval for (or approval will be obtained prior to) obtaining/ analysing NHS patient-data.

(e) There are no other special issues arising about confidentiality/consent.

3. Study participants

a) Will a study researcher be in direct contact with participants to collect data, whether face-to-face, or by telephone, electronic means or post, or by observation? (eg interviews, focus groups, questionnaires, assessments) ~~YES~~/ NO

b) **Answer this <u>only if</u> qu. 3 above = 'YES':**
In ethical terms, could any participants in the research be considered to be ***'vulnerable'***?
e.g. children & young people under age of 16, people who are in custody or care (incl. school), a marginalised/stigmatised group
Please tick one: 'vulnerable' ☐ not 'vulnerable' ☐

4. Moral issues and Researcher/Institutional Conflicts of Interest

Are there any SPECIAL MORAL ISSUES/CONFLICTS OF INTEREST? ~~YES~~/ NO

(a) An example of conflict of interest for a researcher would be a financial or non-financial benefit for him/herself or for a relative of friend.

(b) Particular moral issues or concerns could arise, for example where the purposes of research are concealed, where respondents are unable to provide informed consent, or where research findings could impinge negatively/ differentially upon the interests of participants.

(c) Where there is a dual relationship between researcher and participant (eg where research is undertaken by practitioners so that the participant might be unclear as to the distinction between 'care' and research)

5. Protection of research subject confidentiality

Are there any issues of CONFIDENTIALITY which are NOT adequately handled by normal tenets of confidentiality for academic research? ~~YES~~/

NO These include well-established sets of undertakings that should be agreed with collaborating and participating individuals/organisations. For example, a 'No' answer is justified *only if*:

(a) There will be no attribution of individual responses;

(b) Individuals (and, where appropriate, organisations) are anonymised in stored data, publications and presentation;

(c) There has been specific agreement with respondents regarding feedback to collaborators and publication.

6. Potential physical or psychological harm, discomfort or stress

(a) Is there a FORSEEABLE POTENTIAL for PSYCHOLOGICAL HARM or STRESS for participants? ~~YES~~/NO

(b) Is there a FORSEEABLE POTENTIAL for PHYSICAL HARM or DISCOMFORT for participants? ~~YES~~/ NO

(c) Is there a FORSEEABLE RISK to the researcher? ~~YES~~/ NO

Examples of issues/ topics that have the potential to cause psychological harm, discomfort or distress and should lead you to answer 'yes' to this question include, but are not limited to:

relationship breakdown; bullying; bereavement; mental health difficulties; trauma / PTSD; violence or sexual violence; physical, sexual or emotional abuse in either children or adults.

7. Duty to disseminate research findings

Are there issues which will prevent all relevant stakeholders having access to a clear, understandable and accurate summary of the research findings if they wish?* ~~YES~~/
NO

** If, and only if, you answered 'yes' to 3 above, 'stakeholders' includes the participants in the research*

Overall assessment

- If every answer above is a definite NO, the self-audit has been conducted and confirms the *ABSENCE OF REASONABLY FORESEEABLE ETHICAL RISKS – please tick box* [X]

  This means that regarding this study, as currently self-audited, no further ethical review actions are required within CPHS. However, if in the coming weeks/months there is any change to the research plan envisaged now (and outlined above), the study should be re-audited against a Level 1 form, because it may be that the change made negates the absence of ethical risks signed off here.

- If one or more answers are YES, then risks have been identified and prior to commencing any data collection **formal ethical review is required** - either:
  - by NHS REC (NB copy of ethics application and decision letter to be sent to CPHS Ethics); or
  - if not to be formally reviewed by NHS REC, then CPHS level 2/3 ethical review required. *[If either 4 is 'yes' or 3b is 'vulnerable' then it is possible level 3 review is required.]*

Two copies of this form should be taken for inclusion in the final dissertation/thesis and the original should be returned to the CPHS Ethics administrator.

Luciana M.G. Brondi	Dr. Harish Nair
Student Name	Supervisor Name
Student Signature	Supervisor Signature *

* **NOTE to supervisor:** *The CPHS Ethics Subgroup will not check this form (the light touch Level 1 form means we have insufficient detail to do so). By counter-signing this check-list as truly warranting all 'No' answers, you are taking responsibility, on behalf of CPHS and UoE, that the research proposed truly poses <u>no</u> potential ethical risks. Therefore, if there is any doubt on any issue, it would be a wise precaution to mark it as 'uncertain' and contact the Ethics Subgroup as to whether a level 2 form might be required as well. (See Intra Ethics website – URL at top of form)*

25 March 2014

Appendix3.2-Construction of common infections and care seeking behaviour variables using NFHS4 child recode dataset

Building up care seeking variables for common infections (acute respiratory infection, diarrhoea and fever) using NFHS4 questionnaire

ARI (acute respiratory infection)

Based on the Guide to DHS Statistics (Croft, 2018a), I created a new variable for acute respiratory infection ("**ari**") to be used in the calculations of care seeking behaviours. The sequence of steps used to build this new variable were based both on information contained on section 10 (10.13) of the Guide to DHS Statistics (Croft, 2018a), and also the fact that NFHS4 questionnaires were based on recode version VI of the DHS questionnaires (see definition under). On the child health section of the woman's questionnaire, the mother is asked about if her child had symptoms of acute respiratory infection and diarrhoea and fever at any time in the two weeks previous to the interview (Table 1 under for respiratory symptom's questions).
Therefore, the definition of a child under five with **ari** in this thesis is the one recommended by DHS, and according to the recode VI of the questionnaire:
"Any child who was ill in with a cough accompanied by short, rapid breathing which was chest-related and/or by difficult breathing which was chest-related"
To recode the new variable, we used the following DHS-VI recode original variables:

Table 34.Questions on acute respiratory symptoms in the Child Health Section of the woman's questionnaire (NFHS-4)

Variable*	Question asked	values
h31	Has the child had an illness with cough in last two weeks?	0 “no”; 2 “yes”; 8 “don’t know”
h31b	When the child had a cough illness, did (he/she) breathe faster than usual with short, rapid breaths or have difficulty breathing?	0 “no”; 2 “yes”; 8 “don’t know”
h31c	Was the fast or difficult breathing due to a problem in the chest or to\z a blocked or runny nose?	1 “chest only”; 2 “nose only”; 3 “both”; 6 “other; 8 “don’t know”

*Variable/question h31c is asked only to those who answered “yes”. Question/variable h31b is only asked to those who said “yes“ to question h31.

The detailed Stata codes used to create the new recoded variable “**ari”** are presented in Figure Y under.

Figure Y. Stata codes for new recoded variable ari (acute respiratory infection)

```
gen ari=0
replace ari=1 if h31==2 & (h31b = 1 & h31c==3/1)
replace ari=8 if h31==8/h31b=8/h31c==8
label define ari label 0 "No" 1 "Yes" 8 “Don’t
```

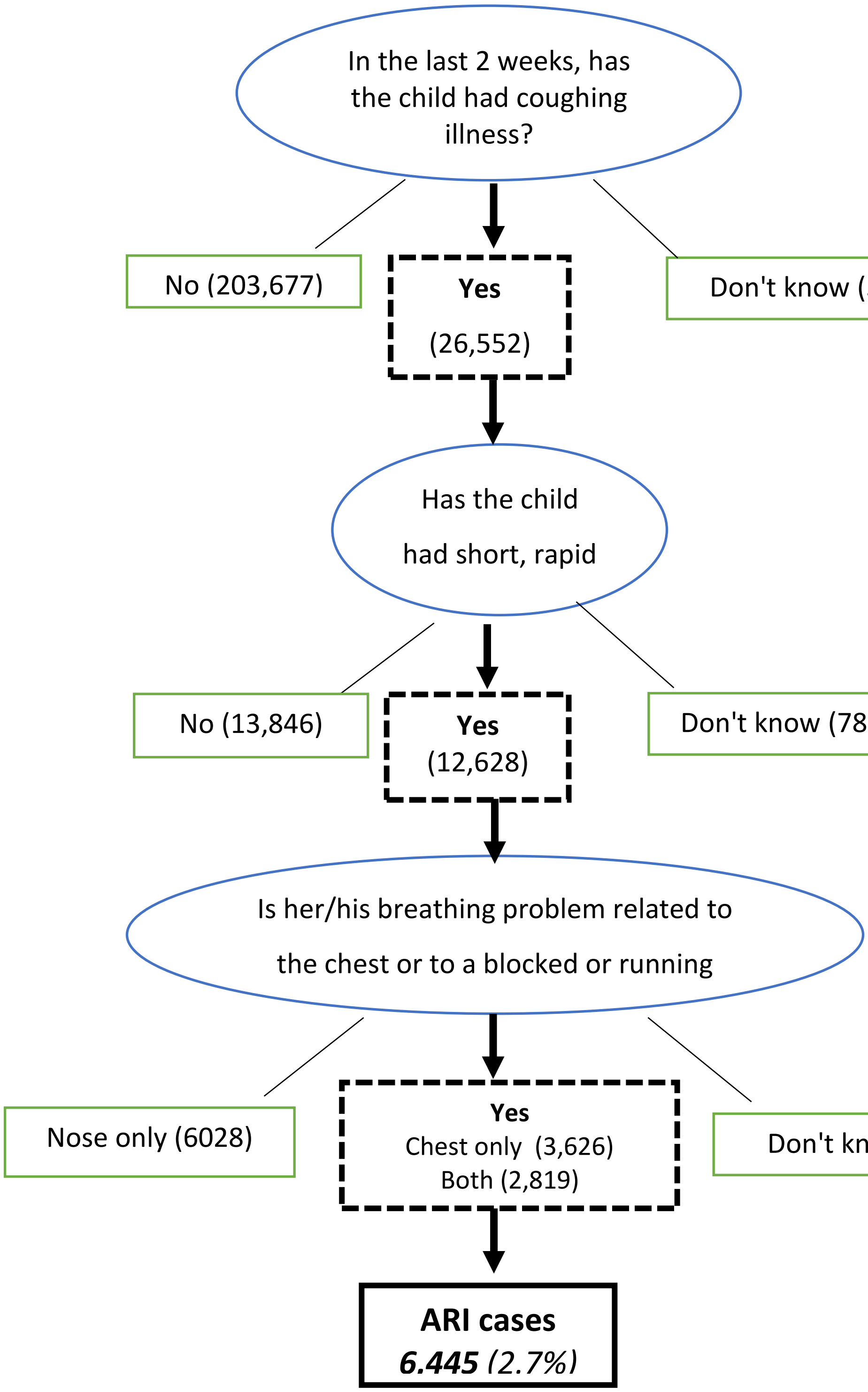
A Flowchart depicting the steps used to create the ARI variable is provided (Flowchart 1).

Because to create this variable, I had to use 3 other variables which are subsets of each other (see note under Table 1 above), the missing answers for each individual original question had to be added to calculate the number of missing information for my final “ari” variable (Figure X for more details). Therefore, for the variable **ari**, there were in total, no missing answers, but 527 don’t know answers, which amount to 0.02% (unweighted) of all children.

Diarrhoea and fever

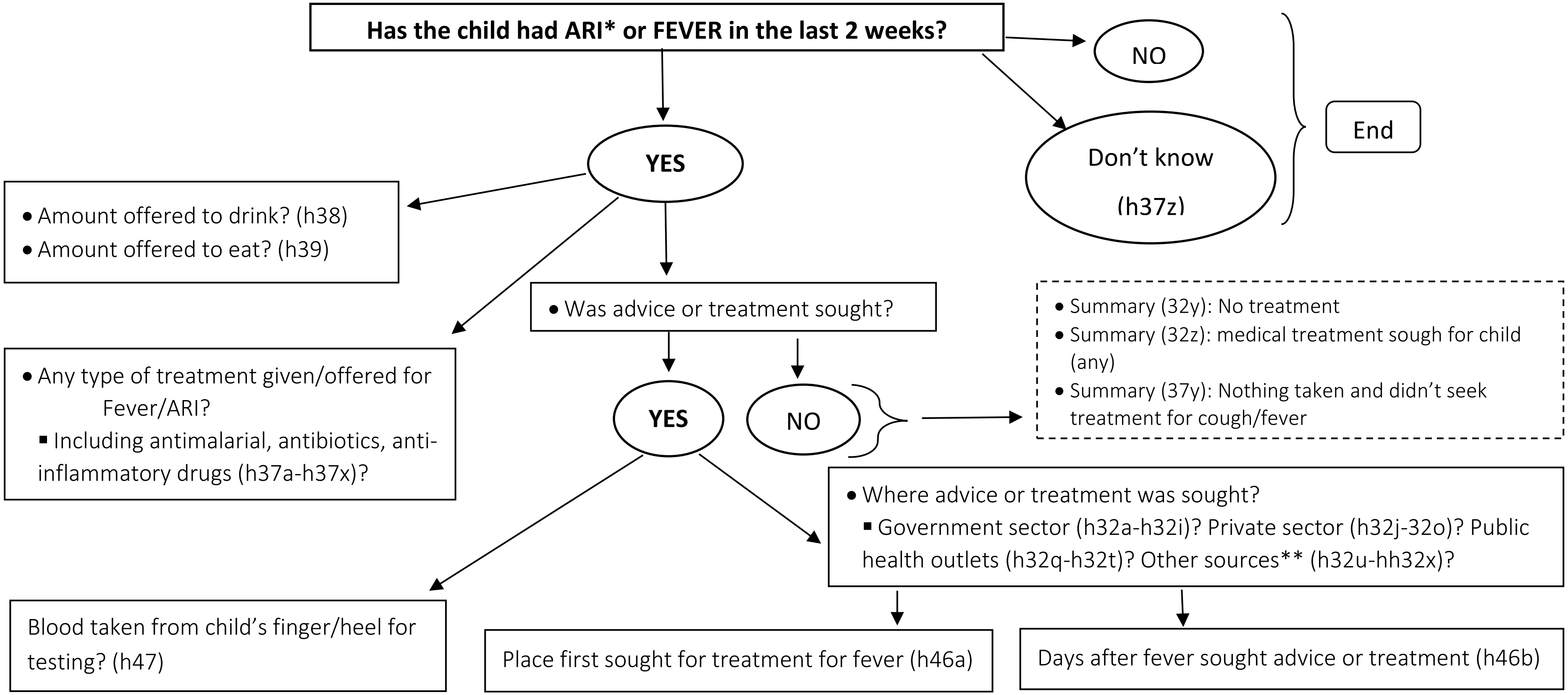
For Diarrhoea and Fever, the same principle was used to reach the care seeking behaviour variables (Flowchart 2 under), except that it involved only one original variable about symptoms.

Flowchart 1. Using restricted sample to create new acute respiratory infection variable[2] (ARI)



[2] The **ari** variable has no missing answers, and 527 "don't know" answers (0.18 % of total children, weighted). Frequency counts are unweighted and proportions are weighted.

Flowchart 1. ARI[3] and fever: Care seeking behaviour variables construction steps using child health section of the NFHS4 questionnaires:



[3] ARI (Acute Respiratory Infection) is a recoded variable constructed using NFHS4 variables h31,h31b and h31c and according to the following definition: "Any child who was ill with a cough accompanied by short, rapid breathing which was chest-related and/or by difficult breathing which was chest-related". *The care seeking questions above are asked in NFHS-4in relation to any child with cough or fever, but in this thesis I selected only the ones who had ARI and fever.
**Other sources included Shop, Friend/relative, other.
37y is the summary variable for any place outside home where parents administer any treatment or sought for any treatment outside the house. (a summary of 2" variables)
The main summary variable is h21 only in children live and with diarrhoea; h21 is a summary of h12A to h12Z, h13, h14, h15 to h15m and h20 : whether care was sought-ANY PLACE or Any TREAT give- sick child

Appendix 3.3-Regional division of India and NFHS-4 data:

For this thesis, I used the macro region division where the States have been grouped into six zones having an Advisory among these States. Such Zonal Councils, were set up in 1956, as part of the States Reorganization Act (Part III) (WIKIPEDIA, 2019, India, 1956). From the web page:

> The present composition of each of these Zonal Councils is as under:
>
> **Northern Zonal Council**: Chandigarh, Delhi, Haryana, Himachal Pradesh, Jammu and Kashmir, Punjab, and Rajasthan;
>
> **North-Eastern Zonal Council**: Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland and Tripura; The State of Sikkim has also been included in the North Eastern Council vide North Eastern Council (Amendment) Act, 2002 notified on 23 December 2002.[4]
>
> **Central Zonal Council:** comprising the States of Chhattisgarh, Madhya Pradesh, Uttarakhand and Uttar Pradesh;
>
> **Eastern Zonal Council:** Bihar, Jharkhand, Odisha, and West Bengal;
>
> **Western Zonal Council:** Dadra and Nagar Haveli, Daman and Diu, Goa, Gujarat, and Maharashtra:

Similarly, two recent articles which looked at U5 mortality in India are considered. The first article, by Guilmoto and colleagues (Guilmoto et al., 2018) used the Indian 2011 Census data to study U5 female excess deaths across the country. The other paper, published by Bora and Saikita (Bora and Saikia, 2018) used NFHS-4 (2015-16) survey data and studied both U5 mortality rates and Neonatal mortality rates (NMR) across India in relation to the Sustainable Development Goal 3. Based on the findings of Guilmoto's study, most of the excess U5 mortality for girls is clustered in districts belonging to four largest northern states in India, i.e., Uttar Pradesh, Bihar, Rajasthana and Madhya Pradesh. For U5MR, the Bora and Saikita's study suggests that the states that have the highest percentage of districts which are not likely to meet the target for females U5MR are Uttar Pradesh; Uttarakhand, Mizoram, Haryana, Chhattisgarh and Delhi. Whilst for NMR, the districts where female NMR SDG target are unlikely to be achieved are clustered in the north-central and eastern belt of the country.

According to Guilmoto and colleagues, excess female U5 deaths are concentrated in areas of north central India with high population density and fertility, the same region of the BIMARU states. The acronym BIMARU, coined by Ashish Bose in the 80s, is used to designate a group of states, i.e. , Bihar, Madhya Pradesh, Rajasthan, and Uttar Pradesh. Bose, a demographer, after analyzing selected demographic indicators, found that these states lagged behind the rest of the states in India, whilst accounting for around 40% of the total population of the country. The word “bimar” in Hindi means “sick”, and Bose argued that these states were demographically sick, especially if compared with the better-performing states of the South, i.e. Kerala, Tamil, Nadu, Andhra Pradesh, and Karnataka.

Using both studies I tested two different regional variables, which I called regional1 and regional2. The states included variable regional1, based on Guilmoto and colleagues’ findings, are the BIMARU states.

Variable regional 1= Uttar Pradesh, Bihar, Rajasthan and Madhya Pradesh X others (Already significant)

Variable regional 2= Uttar Pradesh, Bihar, Rajasthan and Madhya Pradesh, Uttarakhand, Mizoram, Haryana, Chhattisgarh and Delhi, X others

Table 35. Cluster of excess or high mortality rates for U5 and neonatal female children in India.

Author, year	Indicator	Cluster	Results
Guilmoto C., 2018	Excess female deaths in U5s in India	Uttar Pradesh, Bihar Rajasthan and Madhya Pradesh	Uttar Pradesh (32.1%), Bihar (17.8%), Rajasthan (8.8%) and Madhya Pradesh (8.1%) –These four states account for 66.8% of all excess female deaths.
Bora and Saikita,	NMR and U5MR	Uttar Pradesh; Uttarakhand, Mizoram, Haryana, Chattisgarh and Delhi.	Districts where female NMR SDG target unlikely to be achieved in north-central and eastern belt of the country. For the U5MR, the states that have the highest percentage of districts which are not likely to meet the target for females are Uttar Pradesh; Uttarakhand, Mizoram, Haryana, Chattisgarh and Delhi.

*NMR: Neonatal mortality rate **U5MR: Under five (U5) mortality rate;

	High Risk states according to different indicators			variable
State	**Excess female deaths U5s**	**NMR* SDG targets**	**U5MR SDG targets**	**Regional1**
Andhra Pradesh		X		
Bihar	X	X		✓
Chhattisgarh		X	X	
Delhi		X	X	
Haryana		X	X	
Jammu & Kashmir		X		
Rajasthan	X			
Madhya Pradesh	X	X		✓
Manipur		X		
Mizoram			X	
Odisha		X		
Punjab		X		
Rajasthan	X			✓
Uttar Pradesh	X	X		✓
Uttarakhand		X		

*I only included as high-risk when at least 40% of the districts are not likely to reach the target

Six Macro regions India

Region code (Stata)	Region	states	estate code	6_regionletter
0	**Central**	***Madhya Pradesh***	19	A
		Chhattirsgarh	7	A
		Uttarakhand	34	A
		Uttar Pradesh	33	A
1	**East**	***Bihar***	5	B
		Jharkhand	15	B
		West Bengal	35	B
		Odisha	26	B
2	**Northern**	***Delhi***[CT]	25	C
		Chandigarh[T]	6	C
		Haryana	12	C
		Himachal Pradesh	13	C
		Jammu and Kashmir	14	C
		Punjab	28	C
		Rajasthan	29	C
3	**Northeast**	***Arunachal Pradesh***	3	D
		Assam	4	D
		Manipur	21	D
		Meghalaya	22	D
		Mizoram	23	D
		Nagaland	24	D
		Sikkim	30	D
		Tripura	32	D
4	**South**	***Andhra Pradesh***	2	E
		Karnataka	16	E
		Tamil Nadu	31	E
		Telangana	36	E
		Lakshadweep[T]	18	E
		Kerala	17	E
		Puducherry[T]	27	E
		Andaman and Nicobar Islands[T]	1	
5	**Western**	***Goa***	10	F
		Gujarat	11	F
		Maharastra	20	F
		Dadra and Nagar Haveli[T]	8	F
		Daman and Diu[T]	9	F

Source: https://ipfs.io/ipfs/QmXoypizjW3WknFiJnKLwHCnL72vedxjQkDDP1mXWo6uco/wiki/Divisions_of_India.html

T: Union territory; CT: Capital territory

Appendix 3.4 Initial Data Analysis Plan for this thesis

Background

Understanding health care utilisation is a crucial step in the design of strategies to improve access to life-saving interventions for young children. This is particularly important for developing countries where the number of young children who die as a consequence of common infections (i.e., diarrhoea, pneumonia and malaria) is still high (Liu et al., 2015) . The body of evidence for excess mortality of girls in South Asia is compelling. However, evidence showing gender based inequities affecting health care utilisation in South Asia is not so compelling and is also divided between the social and medical sciences.

Purpose and structure

This document aims describe the plan for analysis of the large-scale national household surveys databases, specifically the USAID funded Demographic Health Surveys (DHS) datasets. My main analysis approach has been informed by the literature review conducted and the conceptual framework described earlier in my thesis. Although the main objective of this document is to describe data management and analysis steps to be used, I first recap the aims and objectives of my PhD project emphasizing research questions to be answered using data from household surveys. I also provide a description of DHS surveys and data sets.

All data management and analyses described here are conducted using STATA 13 (StataCorp, College Station, TX).

Main goals of the PhD

I aim to document gender inequities in child healthcare seeking behaviours and hospitalisations (including in-hospital mortality) for children under five (U5) living in South and South East Asia. I will also evaluate the impact of other biological, cultural and socio-economic factors in these inequities with a focus in South Asia (i.e. Bangladesh, India, Pakistan and Nepal). In my research I use data from both published literature and *large scale national household surveys*. In line with my goals, I have proposed eight research objectives, as follows, where some of them will be achieved through DHS dataset analysis.

PhD research objectives (in bold, the objectives relating to DHS data analysis)

- I aim to estimate the effect of gender (depending on the sex of the child) on:

1. Hospital admissions and in-hospital case fatality ratio for common causes of deaths in this age group (e.g. pneumonia, diarrhoea and malaria), with a focus in South and South East Asia

2. Different types of *health care seeking* behaviours (across the severity spectrum) in South Asian countries. Some examples include:

- Illness perception or reporting
- Treatment delay
- Utilization of any type of health care treatment (either modern or traditional)
- Use of health care facility for treatment and level of care sought (primary care, secondary care or tertiary care)
- Number of health care providers seen during illness
- Choice of provider used (likelihood to see a better qualified practitioner)
- Use of modern treatment
- Distance travelled for boys compared to girls to reach treatment centre
- Expenditure on health care for boys versus girls
- Use of antibiotics
- Referrals for further treatment followed by action from parents

3. Uptake of *preventive measures* (children under 5 sleeping under insecticide treated net (ITNs) for malaria, and measles immunisation)

4. Type of treatment given for symptoms of Acute Respiratory Infections (ARI) and diarrhoea and diagnostic usage and type of treatment given for suspected malaria (where malaria is prevalent)

I also aim to:

5. Where the data allows, assess whether and how other factors (such as household income/wealth index, maternal and paternal education and occupation, women's autonomy, child's age, family size, birth order, sex distribution of siblings, regions within countries, setting (rural or urban), religion and caste/tribe modify the effect of gender on *care seeking, preventive measures, diagnostic usage and adequate treatment for* common causes of death in young children (i.e. children under five).

6. Evaluate time trends for sex differences in *health care seeking* (across severity spectrum) comparing results of surveys conducted since 1990

7. Provide policy context summary looking at government gender anti-discrimination policies and initiatives for health implemented in the last two decades in the four countries studied

8. Build a conceptual framework to explain the role of gender in care seeking behaviours and hospitalizations for pneumonia, diarrhoea and malaria in South Asia using data from published literature.

When looking at the impact of gender in care seeking behaviours, I will explore whether and how other explanatory variables modify the effect of gender in care seeking, preventive measures, diagnostic usage and adequate treatment in young children.

These other explanatory variables are: household income/wealth index, maternal and paternal education and occupation, women's autonomy, child's age, family size, birth order of index child, sex distribution of siblings (i.e. number of living brothers and number of living sisters), regions within countries, setting (rural or urban), religion and caste/tribe.

Time trends versus analysis of explanatory variables

Initially, one of the research objectives household survey data was to evaluate time trends for sex differences in *health care seeking* behaviours comparing results of surveys conducted since 1990. However, as this PhD evolved and I proposed a conceptual framework to explain the differences in care seeking behaviours and considering the time frame for completion of the work, the data analysis main emphasis has changed. Now, instead of focusing on trends over time, the focus will be on the explanatory variables, of which gender is the main one. This approach will give more depth to the analysis rather than breadth and provide more insight on the impact of gender issues on care seeking for child in the region.

Review of research objectives in line with data available

I explored the potential of databases to answer the research questions posed. The main characteristics of DHS data which make them suitable to this study include its data content (availability of data on morbidity for under-fives and other sociodemographic information, and also information on parents), the geographical scope (data on South Asian countries chosen) and the comparability across different surveys.

Using materials provided by the DHS Program on DHS general methodology and also materials pertaining to each particular survey I collected information on methods and the how the specific survey was carried out. Checking each relevant dataset also helped.

The following were carried out:

- Checking how the relevant rounds of DHS surveys were carried out in each of the four countries and documenting it
- Download and review of datasets, recode manuals, survey report
- Checking and documenting different rounds, field work dates, name of file, relevant variables included, consistency between rounds, sample size, recode version, structure of data files, coding standards, etc.
- Reading final survey reports produced in each country

Important information obtained:

- DHS surveys are nationally representative surveys
- The sample size of the under 5 population and their caregivers in the surveys are adequate to answer my research questions
- General demographic characteristics of the sample reflect the characteristics of the population it has been drawn from (gender, age, setting(rural/urban), education, socioeconomic status);

- The extent to which each survey represents the local under 5 and caregiver population
- The consistency between rounds of DHS (e.g. Do the child morbidity questions refer to children under 5 in all DHS rounds?)

One important step was to get acquainted with the questionnaires in different rounds and check how well data from the surveys databases match my research questions.

Relevant DHS data sets available in the country chosen

In this step, all relevant datasets available were checked for suitability for this research project.
This is an overall assessment of the potential uses of the survey data before getting into more detailed data checks. Changes in the various rounds of DHS Surveys conducted in South Asia means that not all datasets are suitable for analysis. My focus will be in South Asia and specifically in India, Nepal, Bangladesh and Pakistan and in the most recent DHS survey data available for these countries. Eight datasets

Table S5. Most recent DHS datasets available per country

Country	Database	Recode version	Field work year	Children Sample size*
India	DHS (NFHS-3)	V	November 2005 - August 2006	*51,555*
India	DHS (NFHS-2)	III	November 1998 - Dec 1999	*30,372 ***
Pakistan	DHS	VI	October 2012 - April 2013	*11,763*
Pakistan	DHS	V	September 2006 - February 2007	*9,177*
Nepal	DHS	VI	January 2011 - June 2011	*5,306*
Nepal	DHS	V	February 2006 - August 2006	*5,783*

Bangladesh	DHS	VI	July 2011 - December 2011	*8,753*
Bangladesh	DHS	V	March 2007 - August 2007	*6,058 ****

*Total sample size, not weighed (***except Bangladesh DHS conducted in 2007) and before cleaning of variables;
** Under 36 months and the questions on diarrhoea, fever, and symptoms of acute respiratory infection were based on 29,864 children age 1-35 months

Information to be obtained at this stage:

- How many rounds of DHS were conducted in a specific country of interest?
- Are data of all of the rounds available for use an in a suitable format for data analysis
- What is the consistency of the data (including variables, format, quality, population, etc.) if trend analysis is to be conducted?

Example: In my initial data analysis of Indian datasets I carried out an analysis of consistency looking at variables of the Child Health questionnaire between two rounds DHS surveys, the DHS 2005_06 and the DHS 1998_99. This initial exploratory analysis showed important differences in this two survey databases and I decided not to use the older survey, especially for the trend analysis. More details of this consistency analysis can be found in the Logbook for DHS data management and analysis document.

After deciding on the suitability of the available datasets, these were downloaded and stored securely. To keep a record of the data management and analysis processes and files describe here, I created a word document called “Logbook for DHS data management and analysis”. In this logbook, the name, location, format and dates of files used both for data management and analysis are recorded for further reference. The logbook includes either information or where to find the files containing information on databases, variable dictionary, log files and do-files and a brief description of the content of these files with relevant comments. See an example in Table S6 under.

Table S6. Stata DHS original data sets used in the PhD thesis

Dataset description	Original file name	Format	Recode	Path	Last update (from DHS)
India DHS 2005_06 (child recode file)- All India	IAKR52FL. dta	Stata	VI	Gender inequality project\DATA ANALYSIS\DHS\STATA_files\India DHS Stata files\DHS2005_06	27/08/2010
India DHS 98_99 (child recode file)- All India	IAKR42FL. dta	Stata	IV	\cmvm.datastore.ed.ac.uk\cmvm\smgphs\users\s1272067\Gender inequality project\DATA ANALYSIS\DHS\STATA_files\India DHS Stata files\DHS98_99	20/07/2006

Main care seeking outcomes

The main outcome and explanatory variables chosen for the analysis are described in tables below, according to the research question asked. A full list containing the description of each variable relating to diarrhoea, fever and pneumonia is presented in Appendix 2.
For the descriptive analysis, most of the variables included in tables 3 and 4 will be used to describe the care seeking behaviours for each of the conditions, i.e., diarrhoea, pneumonia and fever. Some of these variables will also be used in the association analysis, depending on their suitability (see criteria for inclusion earlier in this subsection).

To be able to answer each question, one or various variables have to be combined together and cleaned and recoded sometimes. I will give an example of this using question D2, which refers to the ***Place*** where treatment or advice was sought for diarrhoea.

Table S7. Research questions/objectives and main outcome variables used to answer them, diarrhoea.

Research question/objective**	Outcome variable*	Description	Type
Effect of gender on:			
D1. Illness perception or reporting	**h11 :**	whether the child had diarrhoea in the last 24 hours or in the last two weeks	0
	h11a:	whether there was any blood in the stools	0
D2.***Place*** where treatment or advice was sought (private or public and level of complexity) *and*	**h12a-l:**	use of public sector medical services(various levels, including country specific)	0
D3. Choice of ***provider*** used***	**h12j-x:**	use of private sector (various levels, including shop, traditional practitioner and country specific outlet)	0
	h12y:	Identifies whether no care or advice was sought for the child during the current episode of diarrhoea	1
	h12z:	Identifies whether the child had been taken to a medical facility for treatment of the current episode of diarrhoea	1
	h12t:	whether the child was taken to a traditional practitioner	0
D4.Type of treatment ***administered*** to the child	**h13-15m:**	different types of treatment offered to the child during the episode of diarrhoea including country specific treatment	0
	h13:	whether child was given oral rehydration using a sugar and salt solution from a special packet(ORS)	0
	h13b:	whether child was given a pre-packaged ORS liquid	0
	h15:	whether child was given antibiotic pills or syrups	0
	h15e:	whether child was given zinc	0
	h20:	whether the child received any other treatment	0
	h21$^{\$}$:	whether the child received any treatment or whether advice or treatment was sought	1
	h21a:	whether the child received no treatment	1
D5.Treatment delay and options	**h44:**	days after diarrhoea sought advice or treatment	0
	h44a	place first sought treatment for diarrhoea	0

* Variables coding as in the DHS recode V and this is the variable in its original form; **Questions/objectives were broken into sub-objectives to facilitate the matching; *** And the likelihood to see a better qualified practitioner;
Codes: 1=summary variable, and some of these are used in final reports; 0=non-summary variable $: This is a summary of the preceding variables H12A to H12Z, H13, H14, H15 to H15M and H20.

Table S8. Research questions/objectives and main outcome variables used to answer them, fever or cough.

Research question/objective**	Outcome variable*	Description	Type
Effect of gender on:			
P1. Illness perception or reporting ***£	**h22:**	whether the child had fever in last two weeks	0
	h31:	whether the child had suffered from a cough in the last two weeks or in the last 24 hours	0
	h31b:	whether the child had suffered from rapid breathing when he/she had the cough	0
P2. ***Place*** where treatment was sought (private or public and level of complexity) *and*	**h32a-32i**	Use of public sector medical services (various levels, including country specific)	0
	h32j-32x	Use of private sector (various levels, including shop, traditional practitioner and country specific)	0
P3. Choice of ***provider*** used****	**h32y :**	Identifies whether no care or advice was sought for the child during the current episode	1
	h32z:	Identifies whether the child had been taken to a medical facility for treatment of the current episode	1
P4.Type of treatment ***administered*** to the child	**h37a-37z :**	which treatment taken for fever/cough (from antimalarials to nothing)	0
	h37a:	whether the child received Fansidar	0
	h37e	whether the child received combination with Artemisin	0
	h37n[££]:	country specific treatment	0
	h31c:	amount offered to child to drink	0
P5.Treatment delay and options	**h46a :**	place first sought treatment for fever	1
	h46 b:	days after fever sought advice or treatment	0

* Variables coding as in the DHS recode V and this is the variable in its original form; **Questions/objectives were broken into sub-objectives to facilitate the matching;
****And the likelihood to see a better qualified practitioner; $:This is a summary of the preceding variables ; £: Standard definition for possible pneumonia in DHS and MICS surveys id defined as cough with or without fever and difficulty breathing due to a problem in the chest (Diaz et al., 2013); Codes:1=summary variable used n final report; 0=non-summary variable
££: In DHS recode V, this question, h37n asks "did the child received an antibiotic drug for this episode?", however, in DHS VI there is an specific question on use of antibiotics for fever/cough.

Table S9. Research questions/objectives and main outcome variables used to answer them, preventive measures.

Research question/objective**	Outcome variable*	Description	Type
Effect of gender on:			
Pr1. Uptake of preventive measures : measles vaccination	**h1:**	whether the respondent has a health card for the child and whether she could produce it	0
	h9:	measles vaccination	0
Pr2. Uptake of preventive measures : children under 5 sleeping under insecticide treated net (ITNs)	**v459:**	have bed net for sleeping (hh report)	0
	v460:	children under 5 slept under bed net last night (hh report)	0

* Variables coding as in the DHS recode V and this is the variable in its original form; **Questions/objectives were broken into sub-objectives to facilitate the matching; Codes:1=summary variable used n final report; 0=non-summary variable

Table S10. Research questions/objectives and main effect modifiers of sex as a determinant for care seeking outcomes.

Research question/objective**	Variable*	Description
How other factors modify the effect of gender on different care seeking outcomes:		
EM1. Young age of child	**b8:**	age of child
EM2.Residence	**v025:**	type of place of residence, rural or urban
EM3.Distance to HCF	**v467d*** **	distance to the health facility
EM4.Number of children in the household	**v137******	number of children resident in the household and aged 5 and under.
EM5.Religion	**v130**	religion of the respondent
EM6. Wealth	**v190**	Wealth index (divided into quintiles)
EM7.Women education level$	**v106**	Mother education
EM8. Caste and tribe	**s118**	type of caste and tribe and other backward classes

* Variables coding as in the DHS recode V and this is the variable in its original form; **Questions/objectives were broken into sub-objectives to facilitate the matching; ***Visiting children are not included; ****Both the question and the codes are country-specific. $: As a proxy measure of women's empowerment

Data Management

Validation of variables and checking data quality levels

As explained before, numerous procedures to check and clean data are conducted by the DHS program team before releasing the final datasets. For my data validation and checks, I rely on the creation of do-files and log files for data management procedures.

Guidelines suggest that checks for data quality should measure the following aspects in a dataset:

- Accuracy
- Consistency
- Completeness
- Duplicates
- Rules
- Usability of data

Fortunately, for most of these aspects of the data quality the DHS program cleaning, editing and inputting procedures are very thorough and the quality of most variables in the datasets is very good when the data is made publicly available. Others who used DHS data previously have reported on that (Gabrysch, 2010) and I confirmed this during my data checks.

Typical validation procedures should include:

- Continuous variables: check of minimum and maximum value, mean and the median
- Categorical variables: frequency checks observing each category and results (do they make sense?)

Other exploratory data analysis, both numerical and graphical methods are also helpful. Tabulating frequencies of variable or doing a cross tabulation using logical routines can detect problems in the dataset.

The use of the command **codebook** in Stata can be very helpful at this stage. For the outcome variables in this analysis, it is important to note that the questions asked in the Child Health section refer only to live children and therefore, before checking for missing data, the data should be filtered to exclude children who are dead (i.e. variable b5=0).

Conducting the procedures inform about the quality and potential of different variables intended for use in this analysis. Some desired characteristics for each variable include:

1. Importance as an outcome for my analysis
2. Consistency between recodes
3. Easy to use (no need or minimal need to clean or recode)
4. Less missing data

Data cleaning and management

During this step the datasets should be prepared for final analysis. For each of the steps conducted here it is recommended that a do-file type program should be written. It is also important that log files documenting the main results are created. For the descriptive analysis, I use do-files to apply filters and cleaning and recoding routines to conduct specific analysis depending on the outcomes instead of creating new datasets for each outcome analysis. After creating the routines, accuracy test should be performed before saving the do-file and producing the result logs. For further analysis, new datasets should be created, depending on the necessity.

Statistical analysis

To facilitate the understanding of the analysis steps proposed here, I will be referring to the analysis presented in the draft report attached to this Plan (Brondi, 2015). In this report I presented an initial analysis looking at the impact of gender and poverty on care seeking behaviours for diarrhoea in India, using data from the DHS India 2005_06.

Considering weights in the analysis

As explained earlier, DHS surveys have use a complex sampling framework. There seems to be a consensus that use of weights in descriptive analysis of survey data make the sample analysis more representative of the target population (Hancioglu and Arnold, 2013). However, for the analysis of association, there is less clarity on the use of weights (Measure DHS, 2003, Deaton, 1997). Those who recommend the use of weights for association data analysis advise that data needs to be adjusted considering the specific weights to correct the estimates according to sampling probability. Using weights in analysis of association can correct for heteroscedasticity and achieve more precise estimates and delineate average partial effect when the effect is heterogeneous (Solon et al., 2015). Therefore, I decided to conduct all my analysis using weight correction, like other have conducting similar research done in the past (Raj et al., 2015b, Diaz et al., 2013). In Stata, correction of standard errors for DHS survey data should be carried out using the survey commands i.e., SVY and svyset. These commands weight observations according to their over or under-representation in the national survey. The data has to be "declared" survey data before any analysis is conducted. Survey design variables are identified by the "svyset" command and the "svy:" command executes further commands taking accounting of the survey settings identified by the "svyset" command. I used the national women's weight as the weight unit (v005) and the cluster number as the primary sampling unit (see figure 1 for details). A complete case analysis approach was used given the small number of missing values.

Figure S6. Command used in Stata to set DHS data as survey data

```
svyset v001 [pweight=v005], vce(linearized) singleunit(missing)
```

Descriptive statistics

The analysis of diarrhoea and care seeking behaviours to be carried out is restricted to children who were alive at the time of the survey since for children who have died the child health history not applicable. The unit of the analysis is each child.

For each dataset analysed I will provide tables containing the weighted prevalence of different types of care seeking behaviours for diarrhoea by sex (see Table 1 in (Brondi, 2015)).

The weighted prevalence of care seeking behaviours according to sex and other potential biological and socio demographic determinants will also be presented (see Table 2 in (Brondi, 2015)). These determinants include place of residence, distance to health care facility, wealth quintile, religion, belonging to schedule caste or tribe and other backward classes, mother education, young age of child and number of children living in the household.

To further understand the impact of intersections of inequalities affecting care seeking behaviours I will combine sex and other inequalities into subcategories/subpopulations (see an example of the subcategories created by combining sex and wealth in Figure 1 under). I will then present the weighted prevalence of care seeking behaviours in each subcategory (see Table 3 in (Brondi, 2015)) . Further, I will provide graphs using subcategories to improve understanding (see Appendix 2 in (Brondi, 2015)).

Figure S7. Model 3 dummy variables to study the interaction of sex and wealth effects on

Subpopulation 1: poorest female
Subpopulation 2: poorest male
Subpopulation 3: poorer female
Subpopulation 4: poorer male
Subpopulation 5: middle female
Subpopulation 6: middle male
Subpopulation 7: richer female
Subpopulation 8: richer male
Subpopulation 9: richest female
Subpopulation 10: richest male (reference)

Association analysis

Analysis of association between all explanatory variables and care seeking for diarrhoea, pneumonia and fever will be carried out using bivariate and multivariable logistic regression.

Univariate analysis

I will conduct bivariate analyses and produce frequency distributions and crude odds ratios to estimate the association between the sex of the child, care seeking outcomes and the other explanatory variables, i.e. place of residence, distance to health care facility, wealth quintile, religion, belonging to schedule caste or tribe and other backward classes, mother education, young age of child and number of children living in the household.

Multivariable analysis

Model 1

To assess the independent effect of sex and other determinants on care seeking behaviours I will create a model retaining age, sex and all the other explanatory variables that show an statistically significant association (i.e. $p < 0.05$) with the care seeking behaviour in question. I call this model “Model 1”. An example of a prototype of Model 1 is presented in Table 4 of the report aforementioned (Brondi, 2015). Please, note that in this particular case I retained all variables studied (even those who did not show a statistically significant association with the outcome) in the final Model until I further refine the analysis.

Model 2 and Model 3: looking at how other factors might modify the effect of sex

I will explore this in two ways. First, I will consider all potential effect modifiers of the effect of gender in care seeking according to the empirical and social literature review conducted and the conceptual framework proposed. Potential effect modifiers in this case are age of the child, place of residence, distance to health care facility, wealth quintile, religion, belonging to schedule caste or tribe and other backward classes, mother education, young age of child and number of children living in the household. To look at the interaction between sex and all these other factors (e.g. sex and economic class) I will add interaction terms to a final Model 1 combining sex of the child with each of the potential effect modifiers.

I will refer to this new model with an interaction term as “Model 2” (not described here). Model 2 highlights the effect of intersections of inequalities in care seeking outcomes for diarrhoea. However, besides testing for interaction adding the interaction term in Model 2, I will also create a different model, which I refer to here as “Model 3” in my previous report on care seeking for diarrhoea in India (Brondi, 2015).

Although the adjusted odds ratios in Model 1 measures the independent effect of all sociodemographic characteristics studied, they do not tell us much about how these potential determinants relate to each other when combined together. However, when sex and wealth are combined forming new subcategories (or subpopulations) in Model 3, it is easier to understand how the combined effect of gender and wealth affect care seeking in children. This heuristic model will add an intersectionality dimension to the analysis. I use the new subpopulations created earlier (see figure 1 above), where the reference group is composed the richest boys group and dummies are created for the other 9 new categories. With Model 3 it is possible to compare the impact of gender and economic class and calculate odds ratios of care seeking prevalence for each one of my new subpopulations (e.g. richest females versus richest males, richer female versus poor females, etc.) (see Appendix 2 in (Brondi, 2015)).

Model Fitness

Different models, including models with interaction effects will be tested against the original model, using the command “svylogitgof” in Stata. This command tests for goodness-of-fit for a logistic regression model fitted using survey sample data (Archer, 2006).

Multicollinearity

In addition to the analysis described here I intend to test for multicollinearity of different independent variables in my logistic regression models. If other women autonomy variables apart from mother’s education level are to be added to this model, this will be desirable.

Weights

Figure S8. Simplified representation of calculation of household weight in DHS surveys

$$\text{Household weight}^{*} = \frac{1}{\text{household selection probability}} \times \frac{1}{\text{household response rate}^{**}}$$

* For a particular household

** Of its household response rate group

Figure S9. Simplified representation of calculation individual weight in DHS surveys

$$\text{Individual weight}^{*} = \text{Household weight} \times \frac{1}{\text{Individual response rate}^{**}}$$

* Of a respondent case

** Of her(woman) individual response rate group

DHS variables with potential relevance to this analysis

Note: All codes according to DHS recode V

Identification and stratification variables

Table S10. DHS indexation and stratification variable relevant to this analysis

Variable	Description
caseid	child unique identifier
v000	country code and phase
v001	PSU(primary sampling unit-national)
v002	household number

Outcome variables for child morbidity section of DHS survey questionnaire

Table S11. DHS outcome variables relating to common infections in children, h11 to h12z

Variable	Description
h11	had diarrhoea recently
h12a	diarrhoea: Government Hospital.
h12b	diarrhoea: Government Health Centre
h12c	diarrhoea: Government Health Post
h12d	diarrhoea: govt. mobile clinic
h12e	diarrhoea: Community Health Worker.

h12f	diarrhoea: Country-specific public sector
h12g	diarrhoea: Country-specific public sector
h12h	diarrhoea: Country-specific public sector
h12i	diarrhoea: other public medical sector
h12j	diarrhoea: private hospital or Clinic
h12k	diarrhoea: pharmacy/drugstore
h12l	diarrhoea: private doctor
h12m	diarrhoea: private mobile clinic
h12n	diarrhoea: community health worker
h12o	diarrhoea: country-specific medical private sector
h12p	diarrhoea: country-specific medical private sector
h12q	diarrhoea: country-specific medical private sector
h12r	diarrhoea: country-specific medical private sector
h12s	diarrhoea: shop
h12t	diarrhoea: traditional practitioner
h12u	diarrhoea: country-specific medical private sector
h12v	diarrhoea: country-specific medical private sector
h12w	diarrhoea: country-specific medical private sector
h12x	diarrhoea: other

h12y	diarrhoea: no medical treatment or advice sought
h12z	diarrhoea: whether child was taken to medical facility for treatment

Table S12. DHS outcome variables relating to common infections in children, h13 to h21

Variable	Description
h13	diarrhoea: child was given oral rehydration using a sugar and salt solution from a special packet (ORS)
h13b	diarrhoea: given pre-packaged ORS liquid
h14	diarrhoea: given recommended home solution
h15	diarrhoea: given antibiotic pills or syrups
h15a	diarrhoea: given antimotility
h15b	diarrhoea: given antibiotic injection
h15c	diarrhoea: given intravenous feeding (iv)
h15d	diarrhoea: given home remedy, herbal medicine
h15e	diarrhoea: given zinc
h15f	diarrhoea: given other (not antibiotic, antimotility, zinc)
h15g	diarrhoea: given unknown pill or syrup
h15h	diarrhoea: given non-antibiotic injection
h15i	diarrhoea: given unknown injection
h15j-m	diarrhoea: country specific other treatments

h20	diarrhoea: whether the child received any other treatment
h21a	diarrhoea: given no treatment
h21	diarrhoea: child received any treatment or whether advice or treatment was sought for the child

Table S13. DHS outcome variables relating to common infections in children, h22 to h32z

Variable	Description
h22$^{\$}$	had fever in last two weeks
h31	had cough in last two weeks
h31b	short, rapid breaths
h31c	problem in the chest or blocked or running nose
h31d	fever/cough in last 2 weeks: amount offered to drink
h31e	fever/cough in last 2 weeks: amount offered to eat
h32a	fever/cough: government hospital
h32b	fever/cough: government health center
h32c	fever/cough: government health post
h32d	fever/cough: government mobile clinic
h32e	fever/cough: community health worker
h32f	fever/cough: country-specific public sector
h32g	fever/cough: country-specific public sector
h32h	fever/cough: country-specific public sector

h32i	fever/cough: other public medical sector
h32j	fever/cough: private hospital or clinic
h32k	fever/cough: pharmacy/drugstore
h32l	fever/cough: private doctor
h32m	fever/cough: private mobile clinic
h32n	fever/cough: comm.health worker
h32o	fever/cough: country-specific medical private sector
h32p	fever/cough: country-specific medical private sector
h32q	fever/cough: country-specific medical private sector
h32r	fever/cough: other private medical sector
h32s	fever/cough: shop
h32t	fever/cough: traditional practitioner
h32u	fever/cough: friend/relative
h32v	fever/cough: anganwadi/icds centre
h32w	fever/cough: country-specific medical private sector
h32x	fever/cough: other
h32y	fever/cough: no treatment or advice sought
h32z	fever/cough: whether child was taken to medical facility for treatment

Table S14. DHS outcome variables relating to common infections in children, h37a to h46b

Variable	Description
h37a	fever/cough: Fansidar
h37b	fever/cough: Chloroquine
h37c	fever/cough: Amodiaquine
h37d	fever/cough: Quinine
h37e	fever/cough: Combination with artemisinin
h37f	fever/cough: Country specific antimalarial
h37g	fever/cough: Country specific antimalarial
h37h	fever/cough: Other antimalarial
h37i	fever/cough: pills/syrup
h37j	fever/cough: injection
h37k	fever/cough: aspirin
h37l	fever/cough: Acetaminophen
h37m	fever/cough: ibuprofen
h37n	fever/cough: country specific

h37o	fever/cough: country specific
h37p	fever/cough: country specific
h37x	fever/cough: other
h37y	fever/cough: nothing
h37z	fever/cough: don't know or if was taken
h38	diarrhoea: amount offered to drink
h39	diarrhoea: amount offered to eat
h44a	diarrhoea: first place sought treatment
h44b*	diarrhoea: days after start of episode sought advice or treatment
h44c*	still has diarrhoea
h46a	fever: first place sought treatment
h46b*	fever: days after start of episode sought advice or treatment

*Important: these questions are no longer part of the core DHS questionnaire in DHS round 6 but the variables are kept in the DHS VI recode;
$ A new variable was added to fever in DHS VI (h47:Blood taken from child's finger/heel for testing)

Explanatory variables

The ***sex*** of the child is the **main** exposure (or explanatory) variable.

Table S13. DHS main explanatory variable, sex of child

Variable	Description
b4	sex of the child

Other explanatory variables-effect modifiers

Table S14.Other DHS explanatory variables apart from the sex of child

Variable	Description
hidx/midx	index to birth history child
b8	current age of child
b11	preceding birth interval (months)
b12	succeeding birth interval (months)
b16	child's line number in household
v024	region
v025	type of place of residence, rural or urban
v107	mother highest year of education
v130	religion
v131	ethnicity[$] (woman)
v137	number of children 5 and under in household (de jure)
v190	wealth index
v191	wealth index factor score (5 decimals)
v202	sons at home
v203	daughters at home
V218	number of living children
v447a	woman's age in years

v716	respondent's occupation
V701	husband/partner's education level
v701	husband/partner's education level
v704	husband/partner's occupation

$ The caste and tribe of the family will be looked at for countries where this entry exists

Women empowerment and exposure variables

Apart from mother education, other variables in DHS surveys measure empowerment of women and gender norms and perceptions. There is potential to use them in the analysis as well.

Table S15. Woman empowerment and exposure variables

Variable	Description
v151	sex of household head
v157	frequency of reading newspaper or magazine, woman
v158	frequency of listening radio
v159	frequency watching tv
v206	sons who have died
v207	daughters who have died
v627	Ideal number of boys
v628	Ideal number of girls

v743a	person who usually decides on respondent's health care
v743b	person who usually decides on large household purchases

---------------------END OF ANALISYS PLAN-------------------------

Appendix 4. NFHS-3 results-supplementary material

Model 1- factor variables (STATA commands and output)

<u>**Independent variables**</u>**: Sex, age, residence, distance, siblings, mother_ed, caste**

```
svy linearized: logistic h12z_livenonmiss b4 b8infant v025 distance lowcaste_tribe ib(last).v190 ib(last).v10
Survey: Logistic regression
Number of strata  =      1            Number of obs     =      4254
Number of PSUs    =   2014            Population size   =  4617113721
                                      Design df         =      2013
                                      F(  12,   2002)   =      5.23
                                      Prob > F          =    0.0000
                                   |    Linearized
h12z_livenonmiss | Odds Ratio   Std. Err.      t    P>|t|     [95% Conf. Interval]
-----------------+------------------------------------------------------------
              b4 |  .8459266   .0688049   -2.06   0.040     .7212022    .9922208
        b8infant |  8658574   .0788925   -1.58   0.114     .7241734    1.035262
            v025 |  1.192247   .1388937    1.51   0.131     .9487328    1.498265
        distance |  .9134319    .092335   -0.90   0.370     .7491695      1.1137
  lowcaste_tribe |  .9488981   .1014054   -0.49   0.624     .7694846    1.170144
            v190 |
         poorest |  .3853267   .0804291   -4.57   0.000     .2558887    .5802392
          poorer |   .517358   .1029691   -3.31   0.001     .3501673    .7643754
          middle |  .5710989   .1073828   -2.98   0.003     .3949709    .8257671
          richer |  .6764317   .1154909   -2.29   0.022     .4839564    .9454569
            v106 |
    no education |  .7665778   .2079062   -0.98   0.327     .4503602    1.304826
         primary |  .8865332   .2503904   -0.43   0.670     .5094939    1.542592
       secondary |  .8986938   .2253216   -0.43   0.670     .5496283    1.469449
           _cons |  3.798655   1.132668    4.48   0.000     2.116748    6.816957
```

Appendix 5. NFHS-4 results-supplementary material

Appendix 5.1-Correlation matrix for variables for the univariate analysis and in the final Model

corr POC1_COST b4 b8infant v190 v106 BIMARU_STATES

(obs=15720[a])

	POC1_COST	b4	b8infant	v190	v106	BIMARU~STATES
POC1_COST	1.0000[b]					
b4	-0.0282[d]	1.0000				
b8infant	0.0806[c]	0.0140	1.0000			
v190	0.1493	-0.0099	0.0444	1.0000		
v106	0.0729	-0.0192	0.0477	0.4960	1.0000	
BIMARU_STATES	0.1612	-0.0187	0.0575	-0.1902	-0.2284	1.0000

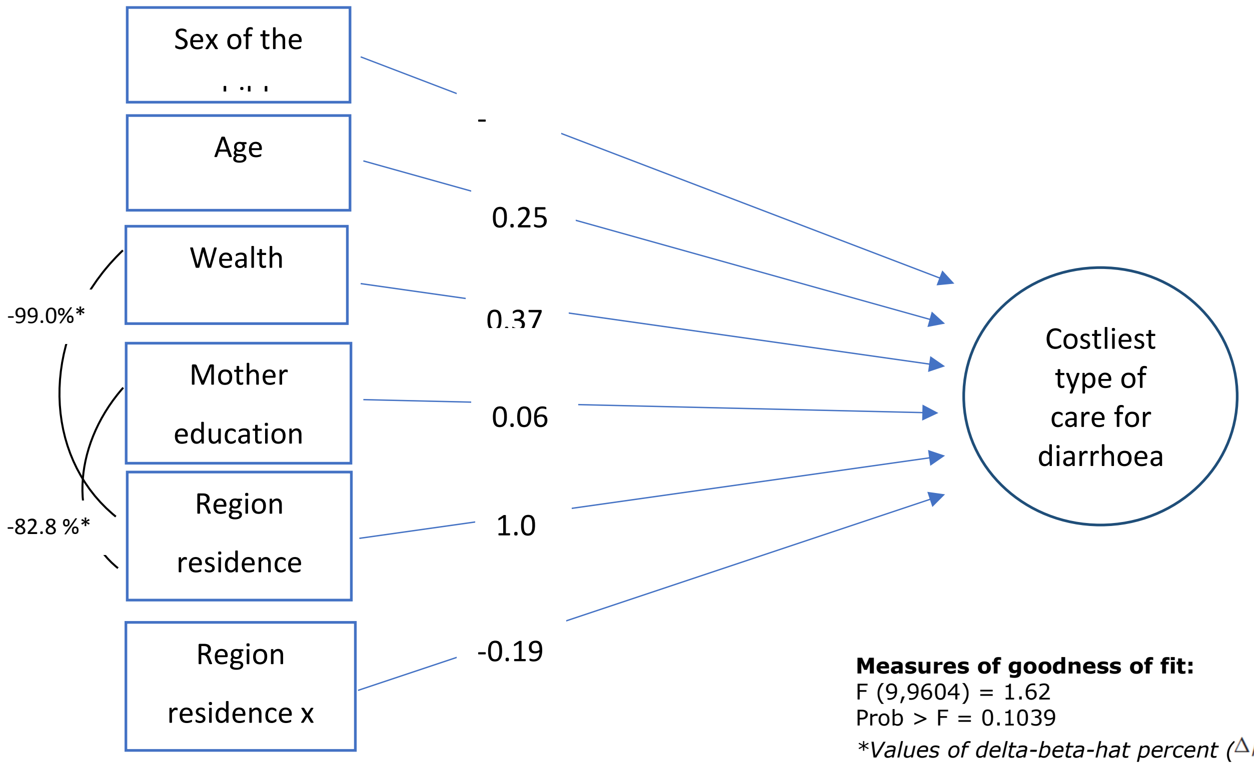
a. Number of observations that were used in the correlations on the table above. All correlations are based on all 15,720 observations.

b. This is the correlation between **PCO1_COST** and **PCO1_COST**. Since the correlation between any variable and itself is always 1, it is no surprise. PCO1_COST (costliest type of care =1; other type of care=0)

c. Correlation between **b8infant**, i.e., being an infant or not with (1=younger than 1 year; 0=1 year or older) and **POC1_COST**. A positive correlation means that as one variable increases, so does the other. A perfect positive correlation equals -1 and a perfect positive correlation, +1.

d. Correlation between **b4** (boy=1; girl=2) and **POC1_COST.** It is negative, indicating that as one score decreases, the other increases.

Appendix 5.2- Final Cost of care for diarrhoea model (statistically significant parameter estimates shown), NFHS-4.

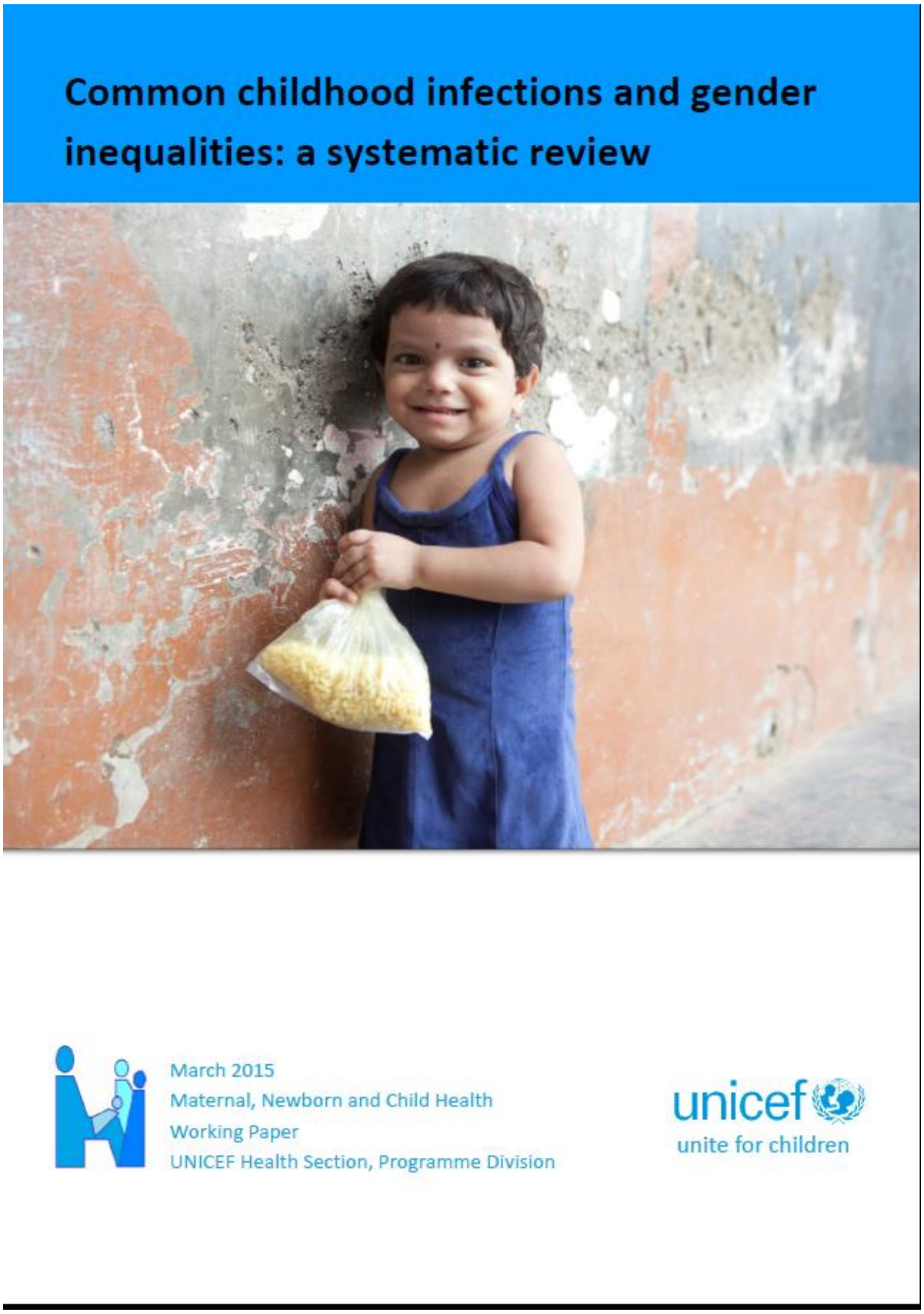


Measures of goodness of fit:
F (9,9604) = 1.62
Prob > F = 0.1039
**Values of delta-beta-hat percent* ($\Delta\hat{\beta}\%$) *suggests confounding*

Appendix 6. Publications

UNICEF Working Paper:

NAIR, H., CAMPBELL, H., PARK, J. J., BRONDI, L., SHI, T., OLSSON, S., HAKIM, S., HSI, T., RUDAN, I. & KIROLOS, A. 2015. Common childhood infections and gender inequalities: a systematic review. New York: UNICEF (United Nations Children's Fund) (UNICEF).



Article:

Park, J.J. and Brondi, L., 2015. Why are girls still dying unnecessarily? The need to address gender inequity in child health in the post–2015 development agenda. *Journal of global health*, *5*(2).

VIEWPOINTS

Why are girls still dying unnecessarily?
The need to address gender inequity in child health in the post–2015 development agenda

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The 40–year anniversary of the United Nations 'International Women's Day,' was celebrated on 8 March 2015. As we approach the end of the Millennium Development Goals (MDGs), we reflect on the gender debate that has arose amidst tackling MDG4 and highlight the need for greater gender equality in measuring child health outcomes in the post–MDG era in line with MDG 3 (see **Box 1**).

NEED TO PROFILE GENDER AS A DETERMINANT OF CHILD HEALTH INEQUITY

In recent years, several key UN reports and articles have begun to articulate the gender gap that exists in child health outcomes [1–3]. Indeed, it has been the UN which has taken a lead in promoting gender equality internationally by requiring all UN entities to mainstream gender and promote gender equality as mandated by the Beijing Platform for Action (1995) and ECOSOC resolutions 1996, 1997, 2006 and consolidated by the quadrennial comprehensive policy review 2012 (General Assembly Resolution 67/226). According to the 2012 World Development Report, gender equality is at the heart of development and "...too many girls and women are still dying in childhood and in the reproductive ages" [4]. Perhaps it is a reflection on the relative success of MDG 3 and 4 (despite it not being likely that the numerical targets will be achieved in time) that it has helped to raise the issue of gender in child health and the need for more equitable goals in the future.

Leading international organisations have developed organisation specific gender action plans, policies or guidelines in the past two decades in order to tackle gender imbalance issues in its organisational activities (see **Box 2**).

The authors congratulate recent efforts to collect gender disaggregated child health outcomes data by Inter-Agency Group for Child Mortality Estimation (IGME) and Countdown 2015 as the first step to enable the profiling of gender as a determinant of child health inequity. Nevertheless, if gender is to be mainstreamed as a determinant of child health, future country achievement profiles should require nations to highlight sex disparities in coverage of life saving interventions, especially in countries where girls are known to be subject to discrimination in health care access and outcomes. In other words, it should become the norm, rather than the exception, to report sex–differentiated data for child health indicators. In addition, reporting health interventions

> There is need for better quality evidence on the role of gender in child health achievements both globally and regionally.

Poster:

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'Ten shades of grey': an intersectional analysis of gender and poverty on child health care utilisation in India.

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Background

In South Asia, gender based discrimination might affect child health care utilisation, including care seeking behaviours for potential fatal infections. I aimed to determine whether gender and poverty affected care seeking for diarrhoea in children in India.

Methods

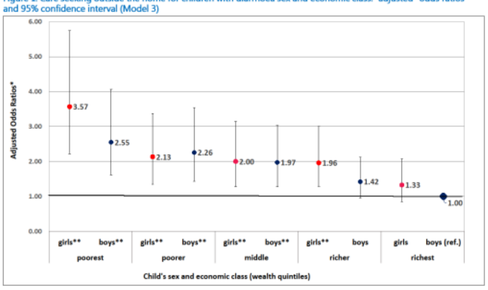
Data from the latest Indian Demographic and Health Survey (DHS 2005–06) was used. The combined effect of gender and wealth on care seeking was assessed using an intersectional approach, using a multivariable logistic regression model adjusting for other potential effect modifiers.

Results

The analysis included 4,440 children with diarrhoea, where lower prevalence of care seeking outside the home for diarrhoea was significantly associated with being a girl (AOR, 0.84; 95% CI, 0.72 – 0.99), or belonging to a poorer family.

(P values varying from 0.024 richer vs. richest to 0.000 poorest vs. richest). Further association analysis using a heuristic intersectional model suggests that boys tend to be less affected by family economic status than girls in terms of care seeking. Boys in the richest quintile were significantly more likely to receive appropriate care seeking than girls in the poorest quintile, with AOR of 3.57 (95% CI 2.21 – 5.75). However, when compared to poorest boys this difference, although still significant, is smaller, with AOR of 2.55 (95%CI 1.61 – 4.07). Similarly, when compared to richest boys, girls in the richer quintile were significantly less likely to get appropriate care seeking with AOR 1.96 (95% CI 1.28 – 3.01), whilst for boys in the same richer quintile this difference was not significant (AOR 1.42 (95%CI 0.96 – 2.13)).

Figure 1. Care seeking outside the home for children with diarrhoea sex and economic class: adjusted* odds ratios and 95% confidence interval (Model 3)



*Adjusted for age, place of residence, distance to health care facility, number of children in the household, mother education and caste.
**Significantly less likely to received care outside home when compared to reference class, i.e. richest boys.

Table 1. Factors associated with seeking care outside home for children with diarrhoea in India, DHS 2005–06 (Model 1).

Factors		Adjusted Odds Ratio	(95%CI)
Sex	*male*		
	female	0.84*	(0.72 - 0.99)
Age	*1 - 4 y*		
	< 1 y	0.87	(0.73 - 1.04)
Place of residence	*urban*		
	rural	1.22	(0.96 - 1.52)
Distance to HCF is a problem	*no*		
	yes	0.91	(0.75 - 1.11)
Number of children U5 in household	*1 child*	-	
	2 children	0.95	(0.78 - 1.15)
	> 2 children	0.83	(0.66 - 1.04)
Wealth quintile:	*richest*		
	richer	0.68*	(0.49 - 0.95)
	middle	0.57**	(0.39 - 0.82)
	poorer	0.51**	(0.35 - 0.75)
	poorest	0.38***	(0.25 - 0.57)
Mother education:	*higher*		
	secondary	0.89	(0.54 - 1.46)
	primary	0.88	(0.51 - 1.54)
	no formal	0.76	(0.45 - 1.31)
Schedule caste or tribe (SCT) & other backward class	*Other*		
	SCT or OBC	0.99	(0.80 - 1.22)
Religion	*other*		
	Hindu	0.87	(0.67 - 1.11)

* p<0.05, ** p<0.01, *** p<0.001

Conclusions

These results suggest that in terms of care seeking for diarrhoea, girls tended to benefit less from economic advantage when compared to boys. In South Asia poverty effects on health inequality might be influenced by gender. In such settings, data analysis and policy initiatives targeting access to health care should be gender sensitive.

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Article:

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PAPERS

Linking household and facility data for better coverage measures in reproductive, maternal, newborn, and child health care: systematic review

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Background Currently many measures of intervention coverage obtained from household surveys do not measure actual health intervention/service delivery, resulting in a need for linking reports of care–seeking with assessments of the service environment in order to improve measurements. This systematic review aims to identify evidence of different methods used to link household surveys and service provision assessments, with a focus on reproductive, maternal, newborn and child health care, in low– and middle–income countries.

Methods Using pre–defined search terms, articles published in peer–reviewed journals and the grey literature after 1990 were identified, their reference lists scanned and linking methods synthesized.

Findings A total of 59 articles and conference presentations were carefully reviewed and categorized into two groups based on the linking method used: 1) indirect/ecological linking that included studies in which health care–seeking behavior was linked to all or the nearest facilities or providers of certain types within a geographical area, and 2) direct linking/exact matching where individuals were linked with the exact provider or facility where they sought care. The former approach was employed in 51 of 59 included studies, and was particularly common among studies that were based on independent sources of household and facility data that were nationally representative. Only eight of the 59 reviewed studies employed direct linking methods, which were typically done at the sub–national level (eg, district level) and often in rural areas, where the number of providers was more limited compared to urban areas.

Conclusions Different linking methods have been reported in the literature, each category has its own set of advantages and limitations, in terms of both methodology and practicality for scale–up. Future studies that link household and provider/facility data should also take into account factors such as sources of data, the timing of surveys, the temporality of data points, the type of services and interventions, and the scale of the study in order to produce valid and reliable results.

Conference Paper:

Brondi, L. “We will pay the extra rupee to treat our son” - a conceptual framework explaining gender inequity in child health care utilisation in South Asia.” Paper presented at the 10th European PhD workshop in South Asian Studies, European Association for South Asian Studies (EASAS), Lisbon, Portugal. June, 2016.

Title: “We will pay the extra rupee to treat our son”- a conceptual framework explaining gender inequity in child health care and health care utilisation in South Asia.

"Washing one's hands of the conflict between the powerful and the powerless means to side with the powerful, not to be neutral".
Paulo Freire (Freire, 1985)

Introduction

Immunisations, medical treatment for infections and hospital care are some of the available life-saving interventions health care services can provide for children in need, especially children under 5 (U5). Although the coverage of these interventions has increased substantially in the last two decades in low and middle income countries (LMICs), not all children benefit equally from this increase (Barros and Victora, 2013). The most obvious group of vulnerable children in these countries are those living in the poorest, less educated and more rural communities. However, in South Asia, another group of children is added to these more obvious ones, the girls. In the patriarchal societies of South Asia, son preference is still the norm putting girls at a social and health disadvantage (Hill and Upchurch, 1995, World_Bank, 2011). In these societies, girls should be treated as a vulnerable group of children as well. A recent study in India, shows that not only the “missing girls” phenomena due to prenatal sex determination (Jha et al.) is still present in the country and it increased substantially in the last decade . Additionally, a recent analysis (Alkema et al., 2014) five of the ten countries with the highest excess female mortality for children under-five (U5) are in South Asia (i.e. India, Pakistan, Bangladesh, Afghanistan and Nepal).
In this context, understanding the role and dynamics of gender inequities in child health care utilization is vital (Park and Brondi, 2015). Because, different health care practices might