ESSAYS ON HEALTH INEQUALITIES, FEMALE LEADERS AND WOMEN'S WELLBEING

By

SAMIRATU WAHAB

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Department of Economics
Birmingham Business School
College of Social Sciences
University of Birmingham
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Abstract

This thesis consists of three chapters that examine the effects of female representation on women's wellbeing and as well as health inequalities among children under age 5.

In the first chapter, we investigate whether the election of female leaders in state legislatures in the districts where they are elected in India has an impact on women's health. Individual-level data from the National Family Health Surveys (NFHS) of India are matched with political data from the Trivedi Centre for Political Data - Indian Elections Dataset (TCPD-IED). We exploit information on close elections and use the fraction of women who win in close elections against men as an instrument for the share of female leaders in the instrumental variable (IV) approach we employ. Our findings from the IV analysis provide some evidence of a positive effect of exposure to female leaders on women's health, measured by Body Mass Index (BMI). Our results show that a one percentage point increase in the share of female leaders is associated with a 0.250 percentage points increase in women's BMI and a 0.159 percentage points increase in BMI for women classified as underweight. In addition, our estimates show that female representation results in a fall in the likelihood of being underweight and severely or moderately underweight. We find that when testing for heterogeneous effects, our results appear to be driven by women with less decision-making power, women with more tolerance for violence, rural women, lower castes women and women with lower levels of education, indicating that female leader policies may affect more marginalised women. A potential channel for the health effect seen is an improvement in the provision of healthcare facilities, health workers and other initiatives that are of importance to women's health as a result of electing female leaders.

The second chapter investigates the role that female leaders have in shaping women's early

birth outcomes and fertility decisions in India. We pool the last three rounds of NFHS cross-sectional data of India for 19 states and merge these with political data from the TCPD-IED. Employing the IV approach to account for the endogeneity of electing female leaders, we find evidence of a significant decline in the likelihood of first birth before age 17, before age 19, and from age 19 to 23. We also find a fall in the likelihood that a woman would desire more children than she actually has. A look into some possible reasons behind these reveal that the effect of female leaders on early birth appears to be driven by a delay in age at first marriage but not by educational attainments or labour market outcomes. Further heterogeneous effects show that Christian and Scheduled Tribes women may be driving the results.

Finally, the third chapter employs the Alkire and Foster approach to multidimensionality and data from the most recent Demographic and Health Surveys of eight Sub-Saharan African countries to examine the nature, variations and sources of health deprivations among under age 5 children in the region. Using equal weights for the four dimensions of health considered including nutrition, morbidity, environment and natal care, we find significant inequalities in health of under-5 children across countries with children from Ethiopia and Congo DR experiencing the largest deprivations. In addition, we find significant differences by child's sex, location and region of residence. Male and rural children exhibit higher deprivations compared to female and urban children respectively. Also, we find that, morbidity contributes the largest whiles nutrition contributes the least to health deprivations in more than half of the countries. Moreover, the ranking of countries is robust to using different weights on all dimensions indicating that such a multidimensional framework is reliable to measuring health deprivations. We conclude that, countries should consider equitable distribution of resources to meet the healthcare requirements of children in the region.

Dedication

To my inspiring parents.

To my loving husband.

We did this.

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CHAPTER 1

Exposure to Female Leaders and Women's Health in India

1.1 Introduction

Globally, the subject of female political representation has received significant attention in recent decades. Women's representation is regarded as a crucial means to address gender disparities and influence societal policy priorities (Beaman et al., 2012). Although disparities persist, some progress has been made worldwide. For instance, women's global parliamentary representation increased from 14.9% in 2006 to about 22.9 % in 2022 (World Economic Forum [WEF], 2022). While much of the debate in the literature has focused on the implications of female leadership for female political empowerment through representation, another aspect centres on whether politically appointed female leaders can impact development.

This debate has spurred a substantial body of empirical literature examining the impact of female leaders on development outcomes, particularly those related to women. For instance, female representation has been linked to higher educational attainments (Clots-Figueras, 2012; Halim et al., 2016), increased parental aspirations for their children, especially girls (Beaman et al., 2012), enhanced women's empowerment through entrepreneurship and labour force participation (Ghani et al., 2014) and greater women's participation in public and private programs (Deininger et al. (2020). However, there appears to be some unwanted negative outcomes linked to female leadership and representation. For example, recently, Anukriti et al. (2022) found that exposure to female representation worsens women's experience of Intimate Partner Violence (IPV), while Amaral et al. (2015) and Iyer et al. (2012) provide evidence of increased reported crimes against women.

Understanding how the political identities of officials influence their constituents' outcomes is an important area of research and the above sheds light on certain important ones. However, little is known about how female leadership affects women's health outcomes. Existing evidence links women's representation and health outcomes through the survival outcomes of children (Bhalotra & Clots-Figueras, 2014) and the use of healthcare services likely promoted by female leaders, such as modern contraception (Anukriti et al., 2022). This suggests that the presence of women in leadership positions may have significant implications for public health outcomes, particularly for women. This chapter contributes to the current literature by investigating the causal effect of exposure to female leaders on women's health outcomes in India, with a focus on Body Mass Index (BMI) and anaemia.

The literature provides conflicting views on the impact of female political representation on women. One perspective suggests that exposure to female leaders could provoke a backlash effect from men, who may perceive female leadership as a challenge to male identity (Anukriti et al., 2022; Iyer et al., 2012). This backlash may lead to increased intrahousehold conflict and other negative male behaviours intended to reassert male dominance, thereby increasing stress and adversely affecting women's well-being. Conversely, the general acceptance of female leaders could reduce negative behaviours towards women and enhance their well-being (Kuipers, 2020; Beaman et al., 2012). Another perspective posits that the gender of policymakers influences policy priorities, potentially leading to direct positive consequences for women's health. Female leaders often prioritize different policies than their male counterparts, focusing on the provision of public goods that benefit and improve the well-being of women and children. These policies typically include investments in health infrastructure, education, sanitation, and water facilities (Wangnerud, 2000; Bhalotra & Clots-Figueras, 2014; Chattopadhyay & Duflo, 2004).

Building on bargaining theories, additional evidence suggests that policies and initiatives implemented by female leaders may create better opportunities for women, such as increased employment and improved educational achievements (Beaman et al., 2012; Halim et al., 2016; Deininger et al., 2020). These opportunities can enhance women's intra-household bargaining power, potentially reducing backlash and violence against them, and subsequently improving their health and well-being (Anukriti et al., 2022; Amaral et al., 2015). However, whether these female-friendly policies that enhance women's bargaining power can successfully improve their lives remains uncertain. This is because, increased bargaining power might inadvertently harm women's well-being by provoking backlash and violence due to perceived threats to male authority (Amaral et al., 2015). Given this lack of consensus, understanding the relationship between the presence of female leaders and women's health in the context of a developing country is crucial, as it has significant implications for policies targeting women's well-being.

In this chapter, we examine how exposure to female political leaders in state assemblies influences their female constituents' health. Trying to identify a causal link between the share of female leaders in the district and women's health outcomes poses several challenges for identification. The primary identification problem is that some unobserved factors may lead to biased estimates of the coefficient of the share of female leaders and consequently incorrect inferences about its effects on health outcomes. For instance, districts that exhibit favourable behaviour towards women are more likely to vote for women and, more likely to invest in women's wellbeing and improve their health. To address this problem, we employ the two-stage least square instrumental variables (hereafter the IV) approach, exploiting the share of female leaders who win in a close election between a man and a woman as an instrument for the share of female leaders in the district.

We employ data from the National Family Health Survey (NFHS) of India which provides individual-level datasets for the years 2015/2016 and 2019/2021. The surveys provide information on women's health including a measure of Body Mass Index (BMI) and Haemoglobin counts (Anaemia) which we use in this study as measures for women's health. Additionally, we employ data from the Trivedi Centre for Political Data-Indian Elections Dataset (TCPD-IED) of India which provides information on assembly elections for each constituency. As the TCPD-IED data is at the constituency level, we aggregate it to the district level and construct a variable, the share of female leaders (winners), which is the fraction of constituencies in the district with female winners in statewide elections. We then match women in the NFHS with their female leaders in the last statewide election before the NFHS years. In addition, we use census data from the Office of the Registrar General & Census Commissioner, India, to obtain information on district characteristics included in our specifications. Moreover, we use the District Level Household and Facility Survey (DLHS) of India for the year 2012/2013 to obtain information on public facilities and public programs to explore the potential policies that female leaders may implement. Female leaders in each district are matched with information on village-level facilities from the DLHS using the last statewide elections before the DLHS survey.

Building on the extant literature this chapter makes several contributions to the literature. First, we examine the impact of female leadership on women's health which to the best of our knowledge has not been done. It is closest to Bhalotra and Clots-Figueras (2014) which examined the impact on child mortality while this chapter focuses on women's health measured by BMI and Anaemia. Second, we provide evidence on how the presence of female leaders may influence women's health with different characteristics such as their level of tolerance for violence, their level of decision-making autonomy in the household and their income level relative to their husbands' incomes. This offers a unique insight regarding the generalisation of the effect of female leaders on women's health. We add to the literature that suggest that the effect of female leaders may vary depending on the social status of women (Anukriti et al., 2022; Liu, 2018). Third, our results support the literature that show that female leaders implement policies that are valued by women by examining the impact of the presence of female leaders on the provision of village level public goods (Bhalotra & Clots Figueras, 2014; Chattopadhyay & Duflo, 2004).

We find evidence which suggests that women's BMI increases with an increasing share of female leaders. We find that increasing the share of seats held by female leaders in a district by one percentage point increases women's Body Mass Index (BMI) by 0.250 percentage points. In other estimations, the presence of female leaders is associated with an increase in BMI for women whose BMI is below 18.5kg/m2 and associated with a decreasing likelihood of women being underweight and moderately/severely underweight. We conclude that female leaders improve women's health through their BMI levels. Our estimates sign do not change when we conduct robustness tests including changes to the cutoff for close elections used as an instrument, addition of political controls, removal of outliers for the share of female leaders and BMI and the inclusion of state-year fixed effects and district trends. In all, no significant results are found in the case of anaemia.

We find evidence that our baseline results are driven by women whose households' traditional structures are strong namely those with less decision-making power and those with a heightened tolerance for violence. In addition, our results are further driven by rural women, lower caste women and women with primary levels of education. Exploring potential channels, we find limited evidence that exposure decreases intimate partner violence and controlling behaviours. Rather, our results show that a potential channel is through an improvement in the provision of healthcare resources and workers such as AYUSH (Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homeopathy) facilities, pharmacies, auxiliary nurses, female doctors and programs and initiatives including non-formal education and national social assistance programme all of which are important for the improvement of women's health.

The remaining sections are organised as follows: Section 1.2 presents the background and relevant literature. Section 1.3 describes the data and presents descriptive statistics of variables used to carry out empirical analysis in this chapter. Section 1.4 shows the identification strategy employed, while section 1.5 discusses the results in addition to a variety of robustness checks, heterogeneous analysis and potential channels. Finally, section 1.6 concludes and presents implications for further research.

1.2 Background and Literature

1.2.1 Background: Female Representation in India

In India, the President and Vice President are elected by electoral colleges consisting of members of parliament and members of the legislative assemblies in states and union territories. The Parliament consists of the Rajya Sabha (upper house of Parliament) and the Lok Sabha (lower house of Parliament). Parliamentary general elections are held every five years through a voting process involving the adult population to elect members of parliament to the lower house, the Lok Sabha, at the national level, focusing on the economy, national development, and foreign policy, to mention a few. At this level, the party that forms the majority after elections determines the prime minister, who is appointed by the president, who also appoints other members of the executive, such as council of ministers (Government of India, 2024).

The Rajya Sabha, elected by members of the legislative assemblies, also represents the states and union territories of India at the national level, providing guidance on legislative matters. There is also the State Legislative Council, known as the Vidhan Parishad, which is the upper house for states that have a bicameral state legislature (Government of India. (2024)[1]. These precede state legislative assemblies, which are responsible for undertaking the administration of the government in their states and specific union territories (Clots-Figueras, 2012) [2]. At this level, elections are also held every five years where adult citizens select their

[1] The lower house of these bicameral state legislatures are the state assemblies.
[2] With the exception of Delhi and Puducherry union territories that have their own legislative assemblies, other union territories have no legislative bodies and are directly governed by the union government of India.

constituency representatives by voting, and winners then represent their states. Although each state has a legislature, governors are selected and given executive powers by the president for a five-year term. Local government bodies, including municipal bodies, which are the urban local bodies, and the panchayats, which are the rural local bodies, follow state assemblies.

This chapter considers women elected from state assemblies. State governments are responsible for allocating money bills, including public expenditure on education, health, and other public infrastructure. Article 246 of the Indian constitution categorically identifies that one of the essential powers of state governments includes allocating government expenditure for public health, sanitation, hospitals and dispensaries in the states (Government of India, 2022). Thus, state legislators have the power to make expenditure decisions on public goods and programs. Evidence exists that female representatives influence policies that are mostly valued by women and children such as investment in health infrastructure and may influence women's health directly through their implementation (Chattopadhyay & Duflo, 2004). Alternatively, female leaders' influence on women's well-being may lie not only in expenditure on health infrastructure but their influence on certain household dynamics.

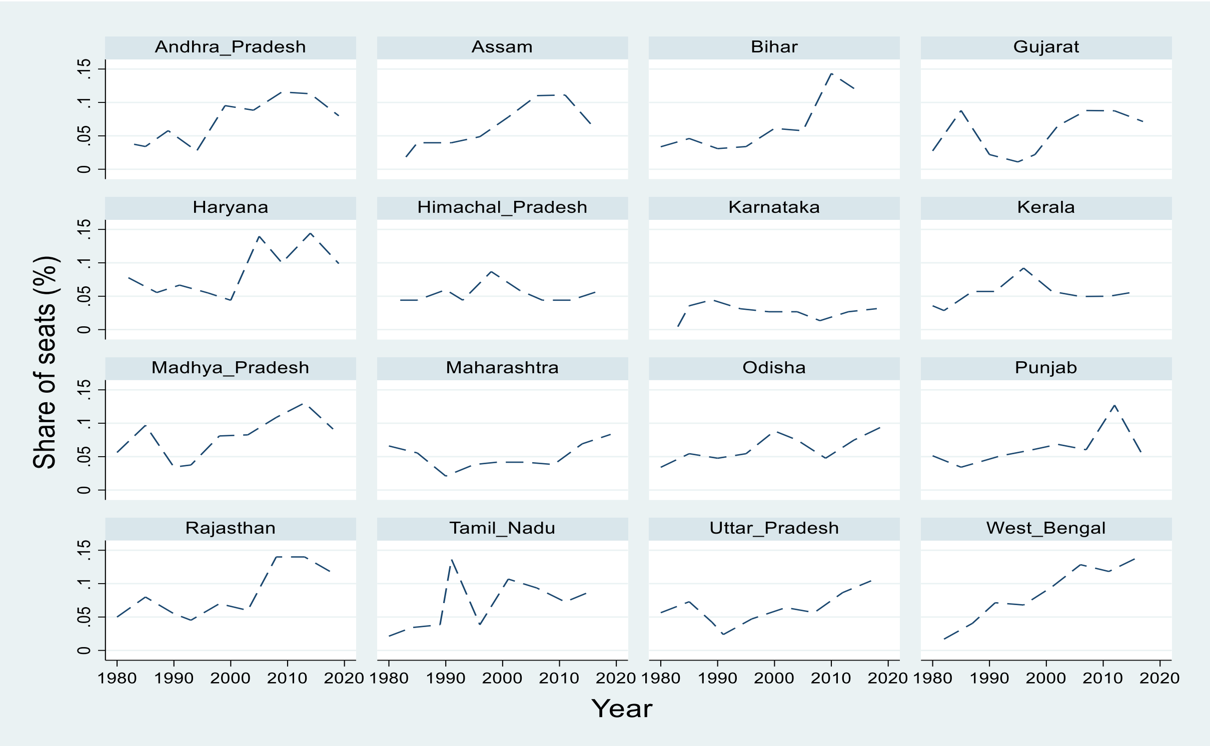
Historically, in India there has been a struggle for women's suffrage, empowerment and reasonable political representation since the British rule (Halim et al., 2016). Like many governments, the Indian government introduced reserved seats for women and lower caste people, the scheduled castes (SC) and scheduled tribes (ST) members at the local level of government in rural villages, the panchayats, and urban municipalities to deal with disparities. Through this system, one-third of seats are mandatorily assigned to SC and ST members, out of which one-third are assigned to SC and ST women. In addition, there is also a one-third reservation for women on overall seats in all areas of the local government. These were achieved after several deliberations, which eventually led to the 73rd and 74th Amendment Acts coming into effect in 1992 and 1993, respectively and serving as a decentralisation tool to bring power to local minorities.

In the 1950s the country introduced reserved seats for SC and ST members in state legislatures proportional to their population in the most recent census before an election (Pande, 2003). However, seats are not reserved for women at the state assembly level, as the parliamentary bill proposing such is yet to reach a consensus. Despite some progress being made in female representation, women in India are underrepresented as they occupy a small percentage of legislators with significant state disparities (Figure 1.1). In Figure 1.1, the fraction of female leaders elected to state assemblies on average does not exceed 15% from 1980 to 2019 for the 16 states[3]. While much of the debate has been focused on female leaders from reserved positions (Beaman et al., 2011; Beaman et al., 2012; Chattopadhyay & Duflo, 2004; Iyer et al., 2012), this study follows Bhalotra and Clots-Figueras (2014) and Anukriti et al. (2022) by examining women elected from these competitively elected seats. The former may be characterized by lower candidate quality and hence may not have the

[3] Bhalotra and Clots-Figueras (2014) show a similar trend from 1970 to 2000 for Indian states. From year 2000 upwards, our graphs show that most states have experienced an increase in the fraction of females elected to political officeholders from assembly elections.

same impact on women as the latter (Bhalotra et al, 2013). In addition, they may not be representative of the common woman's interests given that most elected persons are influenced by elite groups of people in the society (Halim et al., 2016).

Figure 1.1: Share of Assembly Seats Won by Women in 16 States in India (1980 to 2019)



1.2.2 Literature Review

Female Representation, Policy Choices and Women's Wellbeing

In the literature, two previous studies by Bhalotra and Clots-Figueras (2014) and Anukriti et al. (2022) examine some aspects of health. They conclude that the influence of female leaders on wellbeing is through their female-friendly policy choices.

Bhalotra and Clots-Figueras (2014) show that a higher proportion of female leaders elected from state assemblies significantly reduces neonatal and infant mortality. Also, healthseeking behaviours such as antenatal visits, supplement intake and early breastfeeding among mothers were increased. In their study, they employ the 1997/1998 version of the National Family Health Survey (NFHS) of India, matching ever-married women's information including their child survival outcomes with female political leaders in their districts from 1967 to 1998. The main premise of their study is that if female representatives favour policies and initiatives that improve women’s and children’s health, the expectation is that mortality would reduce. Indeed, they find strong evidence that female-friendly policies such as the provision of public goods like primary and community health centres, government hospitals and dispensaries improved while the provision of things like electricity, banks, telephone booths, and post offices declined with more female state legislators in a district. Although this study is influential, it targets a part of women’s health that is related to their children’s survival while the current chapter particularly examines women’s own health outcomes.

Anukriti et al. (2022) find similar results for the provision of village level female friendly public goods. In addition, they find evidence that the implementation of programs such as the Kishori Shakti Yojana, the Janani Shishu Suraksha Yojana, the Balika Samriddhi Yojana and the Janani Suraksha Yojana, the use of contraception (particularly modern contraceptives), and the availability of public health workers like female clinicians, and midwives, all targeting women and adolescent girls’ health were improved with female leaders in a district.

Previous studies have also evidenced that female leaders may influence women through empowerment policies that may improve women’s intra-household bargaining power (Deininger et al., 2020; Ghani et al., 2014). For instance, Deininger et al. (2020) investigate both short- and longer-term effects of female political power through reservations in Indian villages on women's participation in the National Rural Employment Guarantee Scheme (NREGs) participation.[4] Using the National Council for Applied Economic Research (NCAER) ARIS-REDS datasets for 163 villages in 12 states, they observed that women's participation in the NREGS program as well as participation in social audits and civic and political engagements increased above 50% when political positions were reserved for women in past years.

In addition to this, Ghani et al. (2014) discusses the effect of reservation programs on women’s participation in entrepreneurship in India. They use the timing of state implementation of local-level reservations of political seats for women in India and data from the National Sample Survey Organisation (NSSO) for the years 1994, 2000 and 2005 in their analysis. The results show that, introducing reservations heightens the number of new establishments owned by women and their associated new employment in the unorganised or informal sector. The authors observe that, the presence of female leaders increases women’s access to finance which improves their engagement in entrepreneurship. This suggests that female leaders empower women by removing barriers to finances that may prevent women from establishing their own businesses.

Overall, the above literature lends support to the belief that female leaders support policies that are beneficial to women. In the section that follows, we discuss the literature on female

[4] The NREGS guarantees 100 days of work to every registered household in rural India. The NREGS encouraged more female participation by allocating a third of employment to females from registered households (Amaral et al., 2015).

representation and empowerment and attitudes towards women.

Female Representation and Empowerment and Attitudes Towards Women

Male backlash theories postulate that with exposure to female leadership and empowerment, male partners may use violence when they face threats to their dominance in the household (Bandyopadhyay et al., 2020). On the other hand, bargaining models suggest two opposing views. While improved economic empowerment for women either solely or through their female leaders can increase their bargaining power and eventually reduce negative attitudes like violence against them, in contrast, it may also worsen backlash and other negative attitudes from male partners that are triggered by income shocks that threaten male dominance in the household (Amaral et al., 2015; Bandyopadhyay et al., 2020). In line with these arguments, the literature has provided opposing views on how attitudes towards women are influenced by the election of female officeholders.

On the positive side, Oduro et al. (2015) examined the link between women's wealth and IPV using Ecuador and Ghana as case studies. They find evidence in support of higher bargaining power for women such that it reduces both physical violence in Ecuador and emotional violence in Ghana. In support, Kuipers et al. (2020) find that in Indonesia, both male and female constituents exposed to female leaders agree that women should not be assaulted suggesting a positive change in attitudes towards women when exposed to female leaders. Using a dataset in India, Beaman et al. (2012) found that both parents' and girls' educational aspirations for girls improved with long-term exposure to female leaders. This suggests that a longer time after experiencing female leaders may have generated an attitudinal change such that people develop a positive attitude towards their ability to lead. As a result, they are seen as role models to children, especially girls.

Female representation may influence women’s approach to domestic violence against them by their husbands or other members of their households. For instance, in India, Iyer et al. (2012) document an increase in crime reporting against women following years after mandatory reserved seats for women were initiated. The authors conclude that female leaders in the local Government thus serve as role models to women. As a result, it increases their confidence to report crimes to police officers. Moreover, police officers may become more responsive to women's reporting of crimes against them as female leaders can induce officers to have sympathy towards females. Alternatively, their attitudes may have generally undergone positive changes to how they treat women after being exposed to female leaders. Following the NREGS initiative in India that seeks to empower women through labour force participation and employment, Amaral et al. (2015) find similar increases in reports of gender-based crimes against women, such as rape, kidnappings and sexual harassment and reduced dowry deaths as a result of the increasing participation of women in the program.

While these studies contribute to understanding how attitudes towards women are influenced by the presence of female leaders, they study crime reporting which may not reflect actual crimes against women. The latter is what Anukriti et al. (2022) sought to examine in their work. In their influential paper and contribution to the literature that supports the male backlash effects of exposure to female leaders, Anukriti et al. (2022) show that exposure to female leaders increases the incidence of physical violence against females.

The data they used in their study was taken from the NFHS 2015-16 round where women were asked directly about their experience of domestic violence. Women are observed to experience unintended consequences of pro-women policies implemented by female leaders, the policies that tend to improve their health and fertility choices can generate conflicts. Interestingly, they find that when policies are in favour of women such as family planning policies that control women's fertility, backlash and conflict arise especially among traditional couples where the husbands demand more children and sons. This points to the fact that the impact of female leaders may depend on the household setting which we partly examine in this chapter.

In the Cameroonian context, Guarnieri and Rainer (2021) examined what Cameroon's western territorial borders divided between the British and French colonisers meant for sexual violence against women. The study findings corroborate the male backlash theory as women from the British side which empowered more women than the French side which only focused on the education of a few male administrative elites experienced higher sexual violence. Thus, there is a greater likelihood of experiencing domestic violence, although women are empowered through jobs and higher wages. Employing the National Family Household Survey (NFHS-4) with an interest in urban married women, Dhanaraj and Mahambare (2021) find that women's working status has a significant positive and large effect on IPV when endogeneity is controlled.

1.3 Data

1.3.1 Household Data

We employ data from the National Family Health Surveys (NFHS) of India. The NFHS is a nationwide survey of women, men and children, which collects data on individual characteristics, household characteristics, demographics and economic activities. So far, there has been five repeated cross-sectional surveys from 1992 to 2021. This chapter relies on the last two rounds, NFHS-4 and NFHS-5, conducted in 2015/2016 and 2019/2021, respectively, with similar questionnaires and definitions of variables. For the purpose of matching women surveyed (in the NFHS) with their female leaders (in the political data) in their districts, we needed to identify the districts where women lived, hence, our exclusion of the previous three NFHS surveys as they do not provide information on districts.

We make an analysis in this chapter using a sample of ever-married women from 16 major states.[5] Before the NFHS-5 was conducted, 132 districts were newly created districts; some were either carved out of other districts and made into new districts or merged with other districts. We limit our analysis to only districts that existed before the NFHS-5 and exclude all newly created districts, districts that have been merged and those that have been carved out of older ones. Consequently, when we remove these districts, it leaves us with a total of 74,006 women sampled from 439 districts across 16 states from the pooled NFHS-4 and NFHS-5 datasets and whose information are available for variables used.

From the 2011 census, a little over 90 percent of the entire Indian population lived in these states (Office of the Registrar General & Census Commissioner, India, 2023). We show the location of the States in Appendix Figure 1.A.1. From the figure, the results of this chapter are

[5] We do not include any Union Territory in our analysis. The 16 major states are: Andhra Pradesh, Assam, Bihar, Gujarat, Haryana, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, and West Bengal.

arguably representative of the whole of India given that our sample includes women from states in all sub-regions. Following Durevall and Lindskog (2015), our focus on married women is based on the fact that for those unpartnered, widowed or separated, we find inadequate information about their former partners, which is needed in the analysis. This offers a better scope to understanding how female leaders influence women's outcomes.

We use two key measures of women's health which include Anaemia and BMI. During the surveys, investigators, by consent, collected blood samples from eligible women to obtain their haemoglobin counts in grams/decilitre (g/dl) representing Anaemia. They also collect information on women's height and weight used to compute BMI calculated as weight divided by height in kilogram/meters square (kg/m^2). The summary statistics for these measures are presented in Table 1.1 below. It shows that from the sample haemoglobin counts (anaemia) range from 1.2g/dl to 24 g/dl and on average, women experience mild anaemia (11.56 g/dl)[6]. BMI ranges from 12 kg/m^2 to 59.6 kg/m^2 [7]. Since we mainly use the standardised z-scores in this chapter, we present the z-scores as well in the table. Moreover, 17.2 percent of women are underweight, 24.2 percent are overweight, and 55.7 percent have anaemia.

In addition, we include some control variables primarily suggested in the literature as determinants of women's health. These variables include women, household and partner -

[6] For women, haemoglobin count less than 12g/dl constitutes any Anaemia; mild Anaemia is between 10.0 and 11.9 g/dl; moderate Anaemia ranges from 7.0 and 9.9 g/dl and Severe Anaemia is anything less than 7.0g/dl (Croft et. al., 2018).

[7] A BMI less than 18.5kg/m^2 constitutes underweight (mild: from 17.0kg/m^2 to 18.4kg/m^2; moderate and severe: less than 17.0 kg/m^2). Normal weight ranges from 18.5kg/m^2 to 24.9 while total overweight or obese ranges from 25.0 and above (Croft et al., 2018).

Table 1.1: Descriptive Statistics of Woman's Characteristics

	Mean	Std. Dev.	Min	Max
BMI	22.482	4.375	12.06	59.65
BMI (z-score)	0	1.000	-2.382	8.496
Binary Underweight	0.172	0.378	0	1
Mild underweight	0.106	0.308	0	1
Moderate/severe underweight	0.066	0.248	0	1
Overweight	0.242	0.428	0	1
Anaemia	11.56	1.672	1.2	24.4
Anaemia (z-score)	0	1.000	-6.197	7.68
Binary anaemia	0.557	0.497	0	1
Mild anaemia	0.325	0.468	0	1
Moderate anaemia	0.201	0.401	0	1
Severe anaemia	0.018	0.133	0	1
Age	33.128	8.139	15	49
Woman's education	6.148	5.209	0	20
Religion:				
Hindu	0.856	0.351	0	1
Muslim	0.088	0.284	0	1
Christian	0.017	0.129	0	1
Sikh	0.027	0.163	0	1
Others	0.011	0.106	0	1
Caste:				
Scheduled castes	0.223	0.416	0	1
Scheduled tribes	0.124	0.329	0	1
Other backward castes	0.452	0.498	0	1
Others	0.201	0.401	0	1
Woman works	0.265	0.441	0	1
Husband works	0.911	0.284	0	1
Husband's education	7.733	4.917	0	20
Husband's other wives	0.012	0.122	0	9
Husband's age	37.675	8.721	15	95
Number of under-age 5 children	0.701	0.938	0	9
Wealth status				
Poorest	0.193	0.394	0	1
Poorer	0.207	0.405	0	1
Middle income	0.211	0.408	0	1
Richer	0.200	0.400	0	1
Richest	0.189	0.391	0	1
Woman is Pregnant	0.055	0.227	0	1
Residence				
Rural	0.738	0.44	0	1
Urban	0.262	0.44	0	1
No of observations (N)	74006			

Notes: Data in this table is taken from two rounds of the National Family Health Survey (NFHS) of India, conducted in 2015-16 and 2019-21. The sample includes married women from 16 states in 439 districts.

characteristics. Specifically, they include inter alia women's work status, age, number of years of education, location of residence, pregnancy status, religion and caste; household wealth and number of under 5 year old children; husband's age, education, work status and number of other wives. These are also taken from the NFHS datasets. Table 1.1 provides the summary statistics of these variables. In our sample, the average age of women is 33 years, with about 6 years of education. Almost 27 percent of women engage in work activities. On average, women have at least one child under age 5 living in their households. About 86 percent belong to the Hindu religion and 74 percent live in rural areas. Husbands are relatively older, about 91 percent of them work and appear to be highly monogamous. We also include a dummy variable capturing whether women are pregnant (1) or not (0).

1.3.2 Political Data

The Trivedi Centre for Political Data Indian Elections Dataset (TCPD-IED) covers information on both general and assembly elections in India from 1962 to present. This chapter takes the assembly elections data to obtain information on winners and their runners-up from the last statewide elections that precede the NFHSs. Information on winners includes their names, gender, states, constituency and constituency types, castes, political parties from which they are elected, number of votes and constituency turnouts, among others.

Because we are interested in how female leaders influence women's health, we need to identify the smallest possible level by which female leaders could exert some influence on women who live in the places where they are elected. Since election data from the TCPD-IED are at the constituency level and the NFHS only provides the districts where each woman resides, we aggregate the election data to the district level following Anukriti et al. (2022) and Bhalotra and Clots-Figueras (2014). By doing so, we can match each woman in the NFHS representative sample to their female leaders in the last statewide assembly election at the district level (See Appendix 1.C). Appendix Table 1.B.1 shows the 16 states, and the last election date linked to women from the two rounds of the NFHS. The year of the last statewide elections before the two surveys spans from years 2010 to 2019.

Our main right-hand side variable of concern, the share of female leaders, is calculated as the fraction of seats won by females in the district. From Table 1.2, the average share of female leaders is 8.9 percent in our sampled districts. Moreover, we capitalise on the information about runners-up and vote margins between winners and runners-up in the elections to compute the share of female winners who win in close elections against men. This is used as an instrument in our IV approach which we describe thoroughly in the next section. The instrument has been adopted in the literature examining the effect of female leaders on several outcomes (Anukriti et al., 2022; Bhalotra & Clots-Figueras, 2014; Bhalotra et al., 2013). Like these studies, we define close elections as those in which the top two candidates are of the opposite gender and the margin of victory between them is small. By small we mean less than 2 percent.[8] In Table 1.2 Panel A, about 33.6 percent of districts have experienced close elections between a man and a woman and on average, the share of female leaders that win those close elections is about 15.3 percent.

[8] We use different margins in the robustness analysis.

Table 1.2: Descriptive Statistics of Political and Census Data

Panel A: Political	Obs.	Mean	Std. Dev
Share of female leaders	878	0.089	0.132
z-score	878	0	1
District has at least one female leader	878	0.408	0.492
Whether there has been an election between a man and a woman	878	0.609	0.488
Whether there has been at least one close election between a man and a woman in the district (where the margin of vote < 2%)	878	0.336	0.473
Share of close elections between a man and a woman (where the margin of vote < 2%)	878	0.099	0.148
Share of female leaders that win in close elections against a man (where the margin of vote < 2%)	878	0.153	0.347
Panel B: Census	N	Mean	Std. Dev
Share of female population	439	0.486	0.014
Male literacy rate	439	0.694	0.090
Female literacy rate	439	0.55	0.123
Share of scheduled castes and schedules tribes population	439	0.277	0.158

Notes: Data in this table are taken from Trivedi Centre for Political Data Indian Elections Dataset (TCPD-IED) and the Office of the Registrar General & Census Commissioner of India. Panel A shows descriptives statistics on the major political data obtained from the former and Panel B presents that of district characteristics obtained from the latter.

1.3.3 District Level Data

The third source of data is from the Office of the Registrar General and Census Commissioner, India. Data on district characteristics from the 2011 census including rural population, urban population, and female literacy rates are taken and included as additional controls in our empirical analysis. Table 1.2 Panel B shows that female population is 48.6 percent and scheduled tribe, and scheduled castes population is 27.7 percent. The district male literacy rate of 69.4 percent as expected is greater than the female literacy rate of 55 percent.

1.4 Empirical Strategy

This chapter aims to estimate the causal effect of exposure to female leaders on women's health. It starts with the following baseline model:

$$H_{idst} = \alpha_1 + \beta\, SF_{dt} + \psi X_{idst} + \theta Z_{dt} + \delta_d + \tau_t + \varepsilon_{idst} \qquad (1)$$

In equation (1), H_{isdt} indicates health (Anaemia and BMI) for woman i residing in district *d* in state s in survey year t. SF_{dt} represents the share of female leaders that win assembly constituency seats in the last statewide election before the survey period *t* in district *d* where the woman resides. As mentioned in section 1.3, we include controls for woman, household and partner characteristics represented by the vector X_{isdt}. This includes the woman's work status, age, education, religion, caste, household wealth index and number of the household's under-5 children; husband's work status, husband's number of wives, husband's education and husband's age. Z_{dt} represents district controls comprising the share of female population, share of scheduled caste and scheduled tribes population, male literacy rate and female literacy rate in the district *d*. δ_d represents district fixed effect capturing time invariant district-specific characteristics and τ_t controls for yearly shocks that may affect the woman's health.

The primary coefficient of concern β may suffer from endogeneity bias in our OLS estimations. This is because of unobservable characteristics that may likely correlate with both the election of female leaders (SF_{dt}) and women's health outcomes (H_{idst}). For example, districts that exhibit favourable behaviour towards women will more likely elect women into power and formulate policies that influence women's health. This leaves the SF_{dt} variable correlated with the error term and hence β will be biased.

We address this problem by employing the two-stage least squares instrumental variables (2SLS-IV) approach to causally estimate the effect of exposure to female leaders on women's health. We separate this effect from any impact of the unobservable factors on women's health outcomes. To this end, the share of female leaders that win in a close election against men is used as an instrument for the share of female leaders that win elections in the district. This has been used in the literature by Anukriti et al. (2022), Bhalotra and Clots-Figueras (2014), Bhalotra et al. (2013) and Clots-Figueras (2012). Anukriti et al. (2022) use the share of women who win in close elections as an instrument for the share of female leaders in examining the causal impact of female representation on women's experience of intimate partner violence (IPV) among Indian women. Bhalotra and Clots-Figueras (2014) and Clots-Figueras (2012) use a similar measure in their study of the effect of female representation on child mortality and early life educational attainments respectively. Finally, Bhalotra et al. (2013) use the share of Muslim winners that win in a close election as an instrument for the share of Muslim leaders in estimating the impact of religion and political identity on development outcomes such as education and mortality. In these studies, close elections are defined as those in which the winner and the runner-up are of the opposite genders, and the margin of victory between them ranges from 2% to 3.5%. In the same spirit, we define close elections as one in which the margin of victory is below 2%.[9]

This instrument is valid based on the assumption that the gender of the winner in any close election is random (Bhalotra & Clots-Figueras, 2014). To understand this process, we follow

[9] We use below 1%, 3%, 4% and 5% in subsequent robustness analysis. See the robustness exercise sub-section 1.5.3.

from the literature (see for instance Bhalotra and Clots-Figueras, 2014; Clots-Figueras, 2012; and Anukriti et al., 2022) the regression discontinuity design (RDD) idea plotted in Figure 1.2 below. In the figure, we sample constituencies where the genders of the top two candidates are different. We plot the share of female leaders (SF_{dt}) on the vertical axis against the margin of votes on the horizontal axis, to show the relationship between SF_{dt} and the instrument. The margin of votes is the difference in vote between a woman and a man so that constituencies with positive margins on the RHS of the cutoff have women winning while those with negative margins on the LHS have men winning or women losing.

In India, where elections are first-past-the-post-elections, the probability of winning an election is a function of the vote margin between the winner and the runner-up. From the figure, this function has a discontinuity at the zero cutoff. The reason for this is that, as the vote difference approaches the zero cutoff, constituencies become similar in all characteristics except the gender of the winners. That is, either a woman or a man can win in those constituencies because there is no clear preference for either gender. Hence, when women win in close elections just on the RHS of the zero cutoff, there is a dramatic jump in the share of female leaders that win elections overall. Thus, the causal effect of winning in close elections on the share of female winning overall, is measured by the jump at the zero cutoff, which is the effect of treatment. When women are winning close elections the share of women who win elections generally increases by about 18 percent, a comparable margin to Anukriti et al. (2022).

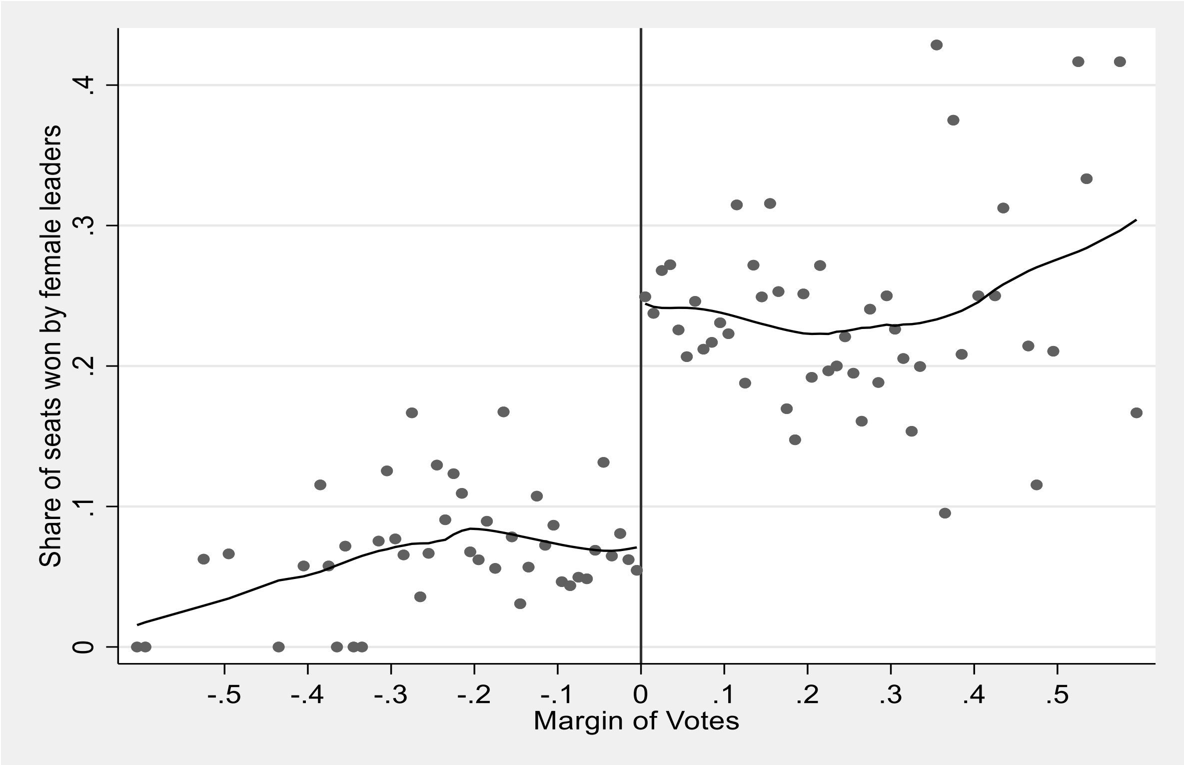
Using the instrument, we first regress SF_{dt} on the instrument such that our first and second stage specifications are:

$$SF_{dt} = \alpha_2 + \rho\, SFC_{dt} + \omega PC_{dt} + \eta X_{idst} + \pi Z_{dt} + \gamma_d + \varphi_t + \mu_{idst} \quad (2)$$

$$H_{idst} = \alpha_1 + \beta\, \widehat{SF_{dt}} + \sigma PC_{dt} + \psi X_{idst} + \theta Z_{dt} + \delta_d + \tau_t + \varepsilon_{idst} \quad (3)$$

Where SFC_{dt} is the instrument, share of female leaders that win in a close election against a man in the district *d* at time t. The remaining variables are as explained above. Based on the predicted endogenous covariates from equation (2) which is the first stage of our IV approach, we estimate the true coefficient β, our primary coefficient in the second stage regression in equation (3). In this IV setup, β as the coefficient of interest now depicts the causal effect of exposure to female leaders on women's health. We include a vector PC_{dt} for other political controls in both the first and second stage specifications. These include the share of close elections between a man and a woman in the district as the existence of this type of election may not be random (Bhalotra & Clots-Figueras, 2014). It may depend on several factors including voter preference and the share of female candidates in the district. In addition, standard errors are clustered at the district level as observations in the same area could be correlated and are robust to arbitrary forms of heteroskedasticity.

Figure 1.2: First Stage Using Regression Discontinuity Design (RDD)



Notes*:* Sample includes all elections where the top two candidates are of the opposite gender in the district. Positive margin of votes indicates women victory and negative margin indicate loses.

1.4.1 Validity of Instruments

Two tests to show the validity of the RDD have been proposed by Imbens and Lemieux (2008). First is the McCrary (2008) density test. RDD requires that the chances of winning in close elections be the same for both genders so that the jump indicated in Figure 1.2 can be attributed to women winning in close elections. This is not possible if candidates self-select by adjusting or manipulating their votes such that they win in close elections, creating a bias in the outcome of close elections. If this manipulation bias is not prevented, RDD will be flawed. To check whether any manipulation exist or not, we employ the McCrary (2008) density test[10]. In the context of this paper, this tests for whether female leaders win close elections disproportionately. If there were any disproportionate wins in close elections for female leaders around the cutoff of zero, the running variable (vote margin) would be discontinuous. This is illustrated in Figure 1.A.2 in the Appendix. With a null hypothesis of no discontinuities, a p-value of 0.938 indicates that the margin of votes is continuous and hence there is no evidence of manipulation in this case.

The second test is to check that individual characteristics are continuous and vary smoothly around the cutoff. Individuals in households found in places where women win in close elections must be similar in all characteristics to individuals in households where men win except the gender of the winner (treatment). To ensure that we are comparing similar individual characteristics, we regress individual characteristics on the share of female leaders instrumented by the share of female leaders in close elections in Table 1.B.2. Our results confirm that individual characteristics do not vary by the gender of winners in close elections.

In addition, we check for whether constituencies, where women win in close elections, are similar to those where men win except the gender of the winner. If constituency characteristics are discontinuous around the cutoff and are not similar, then our results may be capturing the effect of these other characteristics other than the gender of the winner in close elections. This is illustrated in Table 1.B.3.[11] In the table, incumbency, overall voter turnout and winner voter turnouts are not significantly different for the constituencies with

[10] We utilise the rddensity command in Stata by Cattaneo et al. (2018)
[11] We use ttest in Stata to check for differences in means of the constituency characteristics between constituencies where women win and those where men win in close elections.

different winner genders. This is the same with the number of candidates and the type of party affiliation.[12]

1.5 Results

1.5.1 The Effect of Exposure to Female Leaders on Women's Health

Baseline results for the estimates are shown in Tables 1.3, 1.4 and 1.5 below. We are interested in the coefficient of the main right-hand side variable (RHS), the share of female leaders elected in the district. Table 1.3 specifically presents the OLS results. We consider coefficients in the richest specifications where we include both state trends and some political controls[13]. These are depicted in columns 4 and 8 for Anaemia and BMI respectively. The coefficients show that the share of female leaders is positively associated with BMI. This OLS coefficient must be interpreted with caution due to the potential endogeneity bias described above.

In Tables 1.4 and 1.5, we report the IV results for the effect of exposure to female leaders on health outcomes, anaemia and BMI. Table 1.4 presents the first stage regression of the share of female leaders on the share of female leaders that win in a close election against a man. We find a positive and statistically significant relationship between the share of female leaders and the share of female leaders in a close election against a man as we would expect. This result is consistent with other studies that employed the latter as an instrument for the former (Bhalotra & Clots Figueras, 2014; Clots-Figueras, 2012; Anukriti et al., 2022). We

[12] Nevertheless, we include the two major political party affiliations as additional political controls in the robustness checks.

[13] Table 1.B.4 in the appendix shows the full results for all variables.

consider regressions results in column 4 where we include both district and year FEs, state trends and some political controls. As shown in column 4, a one s.d increase in the share of -

Table 1.3: OLS: Exposure to Female Leaders and Women's Health

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable:	Anaemia				BMI			
share of female leaders	-0.002	0.007	0.001	0.005	0.009	0.010	0.015**	0.016**
	(0.008)	(0.011)	(0.011)	(0.012)	(0.008)	(0.007)	(0.007)	(0.007)
Observations	74,006	74,006	74,006	74,006	74,006	74,006	74,006	74,006
R-squared	0.025	0.058	0.061	0.061	0.174	0.207	0.208	0.208
District FE	no	yes	yes	yes	no	yes	yes	yes
year FE	no	yes	yes	yes	no	yes	yes	yes
State trends	no	no	yes	yes	no	no	yes	yes
political controls	no	no	no	yes	no	no	no	yes

Notes: Robust standard errors clustered at the district level in parentheses. ***, ** and * represent significance at 1 percent, 5 percent and 10 percent levels respectively. All regressions control for woman, husband, household and district characteristics. Woman characteristics include education, religion, caste, location of residence, age, pregnancy and work status. Husband characteristics include age, education, work status and number of wives. Household characteristics include household wealth status and number of children under age 5. District characteristics include the share of female population, the share of scheduled castes and scheduled tribes' population, the male literacy rate and the female literacy rate. The political controls included in columns 4 and 8 are the share of close elections in the district and whether there has been a man versus woman elections in the district. The coefficients of these additional variables are not included for brevity. (See Appendix 1.B.4).

female leaders in a close election is associated with a 0.411 s.d. increase in the share of female leaders overall. The first stage F-statistics associated with the estimates are large depicting that the instrument is valid. This offers an assurance that the share of women who win in a close election against men is not a weak instrument for the share of female leaders who win elections in the district.

Next is the second stage regression results from the 2SLS procedure presented in Table 1.5. Columns 1 to 4 show results for Anaemia, while columns 5 to 8 show that of BMI. Beginning with anaemia, we find that exposure to female leaders has a negative relationship with Anaemia but not significant. In the case of BMI, columns 5 to 8 show that, BMI increases with exposure to female

Table 1.4: IV First Stage: Exposure to Female Leaders and Women's Health

Dependent variable: Share of female leaders	Share of female leaders			
	(1)	(2)	(3)	(4)
share of female leaders in close elections against men	0.531***	0.426***	0.433***	0.411***
	(0.031)	(0.041)	(0.042)	(0.046)
Observations	74,006	74,006	74,006	74,006
First stage F-stat	290.8	107.5	109.1	81.45
District FE	no	yes	yes	yes
year FE	no	yes	yes	yes
State trends	no	no	yes	yes
political controls	no	no	no	yes

Notes: Robust standard errors clustered at the district level in parentheses. ***, ** and * represent significance at 1 percent, 5 percent and 10 percent levels respectively. The main variable of interest, share of female leaders in the district is the outcome is this table instrumented by the share of female leaders in close elections against men. The predicted share of female leaders is used in the second stage specifications in Table 1.5 below. Other right-hand side variables include woman, husband, household and district characteristics.

leaders. In the chosen specification in column 8, the coefficient is 0.033. This shows that a one percentage point increase in exposure to female leaders is associated with a 0.25 percentage points increase in women's BMI. Putting this into context, since the median number of seats (constituencies) in a district in the sample is 5 seats and the median share of seats held by females is 0, electing an additional woman implies the median number of seats for women and the share of seats for women increases from 0 to 1 and from 0 to 1/5 or 0.2 respectively.

Hence, an increase in the share of female leaders by 0.2 percentage points (increase by 1 additionl woman), corresponds to an increase in women's BMI by 0.049 percentage points. Overall, this result suggest that the election of female leaders is indeed positive for women's BMI levels.

In general, the estimated 2SLS coefficients are larger in magnitude than the OLS coefficients and are statistically significant in the case of BMI as the dependent variable. The coefficients in the OLS specifications are downward biased, caused by for instance districts voting women into power due to their favourable stance for female leaders which may also have an impact on women's health outcomes. The IV table (Table 1.5) also depicts how the coefficients-

Table 1.5: IV Second Stage: Exposure to Female Leaders and Women's Health

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable:	Anaemia				BMI			
share of female leaders	-0.007	-0.013	-0.016	-0.007	0.010	0.032**	0.032**	0.033**
	(0.015)	(0.024)	(0.022)	(0.027)	(0.012)	(0.015)	(0.014)	(0.016)
Observations	74,006	74,006	74,006	74,006	74,006	74,006	74,006	74,006
District FE	no	yes	yes	yes	no	yes	yes	yes
year FE	no	yes	yes	yes	no	yes	yes	yes
State trends	no	no	yes	yes	no	no	yes	yes
political controls	no	no	no	yes	no	no	no	yes

Notes: Robust standard errors clustered at the district level in parentheses. ***, ** and * represent significance at 1 percent, 5 percent and 10 percent levels respectively. The outcome is Anaemia in columns 1 to 4 and BMI in columns 5 to 8. All regressions controls for woman, husband, household and district characteristics. Woman characteristics include education, religion, caste, location of residence, age, pregnancy and work status. Husband characteristics include age, education, work status and number of wives. Household characteristics include household wealth status and number of under age 5 children. District characteristics include the share of female population, share of scheduled castes and scheduled tribes' population, male literacy rate and female literacy rate. The political controls included in columns 4 and 8 are the fraction of close elections in the district and whether there has been a man versus woman election in the district. The coefficients of these additional variables are not included for brevity. (See Appendix 1.B.5).

evolve by enriching the specifications to improve identification. The signs of the coefficient of the share of female leaders when the dependent variable is Anaemia do not change, as we control for district and year fixed effect (column 2), state trends (column 3) and some political variables (column 4) although they are not significant. The estimate shows an increasing BMI in column 5. Controlling for both district and year fixed effects in column 6 makes a significant changes to the coefficient from 0.010 to 0.032. The magnitude of the coefficient remains the same in column 7 when state specific trends which is meant to capture unobserved factors like the status of women in the state that evolve overtime. Also, the magnitude of the coefficient only increases slightly when we introduce some political controls in column 8. Notice that we report only coefficients for the variables of interest. Tables 1.B.5 in the Appendix show full results for all variables included in the specifications in Table 1.5.

1.5.2 Heterogeneities

By Levels and Categories of BMI and Anaemia

Since an increasing BMI could mean either positive or negative health outcomes for women depending on their existing BMIs, we first examine whether different levels of BMI and Anaemia (Table 1.6) and second, whether different categories of BMI and Anaemia (Table 1.7) change the pattern of our estimates in Table 1.5.[14] In Table 1.6, we find that exposure to female leaders increases the BMI for women whose BMIs fall below 18.5 kg/m². Specifically,

[14] A person whose BMI is below 18.5 kg/m² is classified as underweight; a person whose BMI is between 18.5 and 24.9 kg/m² is classified as normal weight and a person whose BMI is above 24.9 kg/m² classified as overweight/obese.

Table 1.6: Levels of BMI and Anaemia.

Outcome	(1) BMI	(2) BMI	(3) BMI	(4) Anaemia	(5) Anaemia
Sample: women with BMI:	<18.5 kg/m²	>18.5 and <=24.9 kg/m²	>24.9 kg/m²	<12g/dl	>=12g/dl
share of female leaders	0.021**	0.004	-0.003	-0.017	0.011
	(0.009)	(0.008)	(0.024)	(0.018)	(0.013)
Observations	12,744	42,905	18,299	41,222	32,784
first-stage F-stat	70.85	73.98	86.99	82.15	75.66
district FE	yes	yes	yes	yes	yes
year FE	yes	yes	yes	yes	yes
state trends	yes	yes	yes	yes	yes

Notes: Robust standard errors clustered at the district level in parentheses. ***, ** and * represent significance at 1 percent, 5 percent and 10 percent levels respectively. Column 1 includes women whose BMI is below 18.5kg/m², column 2 women with BMI between 18.5kg/m² and 24.9 kg/m² and column 3 those with BMI above 24.9 kg/m². In column 4, we include women with Haemoglobin counts below 12g/dl and in column 5 include women with counts equal to and above 12g/dl. All regressions control for woman, husband, household and district characteristics as in Table 1.5.

Table 1.7: Categories of BMI and Anaemia

Panel A: Other BMI indicators Outcome:	(1) Underweight	(2) Mild underweight	(3) Moderate/severe Underweight	(4) Normal weight	(5) Overweight
share of female leaders	-0.011*	-0.002	-0.009**	0.001	0.009
	(0.006)	(0.005)	(0.004)	(0.008)	(0.007)
Observations	74,006	74,006	74,006	74,006	74,006
first-stage F-stat	81.45	81.45	81.45	81.45	81.45
Panel A: Other Anaemia indicators	(1)	(2)	(3)	(4)	
Outcome:	Anaemia	Mild anaemia	Moderate anaemia	Severe anaemia	
share of female leaders	0.001	-0.007	0.005	-0.000	
	(0.012)	(0.008)	(0.008)	(0.002)	
Observations	74,006	74,006	74,006	74,006	
first-stage F-stat	81.45	81.45	81.45	81.45	
district FE	yes	yes	yes	yes	
year FE	yes	yes	yes	yes	
state trends	yes	yes	yes	yes	

Notes: Robust standard errors clustered at the district level in parentheses. ***, ** and * represent significance at 1 percent, 5 percent and 10 percent levels respectively. A woman is underweight if her BMI is below 18.5kg/m², she is mildly underweight if her BMI is between 17 and 18.5kg/m² and is moderately or severely underweight if her BMI falls below 17. Normal weight characterizes BMI between 18.5 and 24.9kg/m² and overweight includes those with BMI above 24.9kg/m². All regressions control for woman, husband, household and district characteristics as in Table 1.5.

a one percentage point increase in the share of female leaders is associated with a 0.159 percentage points increase in BMI for women classified as underweight. When we use a sample of women who fall between the normal BMI levels (18.5 to 24.9 kg/m²) and those above 24.9 kg/m², the estimates are not significant. Again, there is no significant effect of female leaders on Anaemia whether haemoglobin levels fall below 12g/dl or equal to and above 12g/dl (columns 4 and 5). In Table 1.7, we find that the share of female leaders is negatively associated with the likelihood that a woman will be underweight in column 1. In column 3, women are less likely to be moderately and severely underweight with exposure to female leaders. The likelihood of Anaemia, mild anaemia, moderate and severe anaemia in Panel B does not change with female leaders. Overall, these estimates point out that female representation is associated with only women's BMI. The results suggest that increased levels of elected women raise women's BMI but only for those who are classified as underweight and also reduces the likelihood of women being underweight and moderately or severely underweight.

Given these results, we interpret our baseline estimates as an improvement in women's health as women's BMI is found to increase with increasing female representation. In subsequent sections, we explore further heterogeneous effects.

Socio Economic Backgrounds

In this section, we examine whether female leaders target certain groups of women by inferring from our analysis of women with different socio-economic backgrounds. While some studies have shown that female representation in India influences IPV among rural women (Anukriti et al., 2022), others have shown that female representatives influence urban constituents' educational outcomes (Clots-Figueras, 2012). If poor health is common among vulnerable women, we expect that, for instance, female-friendly policies will target these women, hence the impact of exposure to female leaders will be stronger on their BMI. Such vulnerable women may include women with less autonomy in household decision-making, women with more tolerance for violence, women with lower relative income than their husbands, rural, less educated and lower castes/tribes' women. We examine heterogeneity in the effect of exposure to female leaders by 1) whether the woman has higher autonomy in household decision-making or not 2) whether she is more likely accepting of violence or not 3) whether she earns more income, less income or the same income relative to the husband's income or she is the sole earner. 4) rural-urban residency status, educational levels and whether she belongs to the lower castes/tribes or other castes/tribes.

Decision-making Autonomy

To differentiate between women based on their decision-making power in the household, we take advantage of six questions asked to women about who is involved in household decision-making. The six questions ask about the person who usually decides 1) how to spend the respondent's earnings; 2) on the respondent's healthcare; 3) on large household purchases; 4) on family visits; 5) what to do with money the husband earns; and 6) on contraception.

Responses to these questions include whether decisions are made by 1) husband only; 2) wife only; 3) both husband and wife; and 4) some other household members.[15] If the woman's response is 2 or 3, we assign a value of 1 and 0 otherwise. We sum the responses for all 6 questions and take a z-score of the total which represents the autonomy score for each woman. Next, we construct two sub-samples of women; the first group constitutes women who fall below the 75th percentile autonomy score (0.691) and the second group of women whose score is at least at the 75th percentile score. We describe the former as those women who have less autonomy and the latter as those with more autonomy in decision-making.

The results are presented in Table 1.8. Columns 1 and 2 show coefficients for women with less autonomy and columns 3 and 4 show the case of women with more autonomy. We find that women who are less likely involved in decision-making have increasing BMI with exposure to female leaders. Column 2 thus shows that increasing the share of female leaders by one percentage point is associated with an increasing BMI status by 0.288 percentage point which is not very different from our baseline estimate. When compared to women with more autonomy in columns 3 and 4, the coefficients under the latter are positive and smaller but are not significantly so[16]. The results in this section show the importance of considering the women's socio-economic environment in understanding how female leaders impact their BMI, and it explains how female leaders may benefit vulnerable women such as women with less power in the household through for instance their policies.

[15] The descriptive statistics of these variables together with indicators for tolerance for violence and relative income are shown in Appendix Table 1.B.6

[16] We also conduct a similar analysis using the 50th percentile scores in Table 1.B.7 and the results are similar.

Table 1.8: Heterogeneities: Level of Autonomy in Household Decision Making

Dependent variable: BMI	(1)	(2)	(3)	(4)
Sample:	<75th percentile autonomy score		>= 75th percentile autonomy score	
share of female leaders	0.034**	0.038**	0.012	0.005
	(0.015)	(0.017)	(0.039)	(0.042)
Observations	66,015	66,015	7,991	7,991
first-stage F-stat	109.3	80.88	84.27	67.09
District FE	yes	yes	yes	yes
year FE	yes	yes	yes	yes
State trends	yes	yes	yes	yes
political controls	no	yes	no	yes

Notes: Robust standard errors clustered at the district level in parentheses. ***, ** and * represent significance at 1 percent, 5 percent and 10 percent levels respectively. The outcome is BMI in all regressions. All regressions include woman, husband, household and district characteristics; see Table 1.5. All columns use 2 percent cutoff for close elections. Columns 1 and 2 restrict the sample to women whose autonomy z-score is below the 75th percentile score (0.691) and columns 3 and 4 those above or equal to the 75th percentile score.

Tolerance for violence

On the degree of tolerance for violence, women were asked questions about whether they justify acts of violence carried out by their husbands in the NFHS. They were asked about whether beating a wife by the husband is justified if 1) the wife goes out without the husband's permission, 2) the wife neglects the children 3) the wife argues with the husband 4) the wife refuses to have sex with the husband 5) the wife does not cook properly. Responses were simple "yes" and "no" with values 1 and 0 respectively. We take the total score for the five questions for each woman and construct a z-score representing the tolerance score for each woman. Just as is done in the case of autonomy, we also consider the 75th percentile score. Women whose scores fall below the 75th percentile score are -

Table 1.9: Heterogeneities: Level of Tolerance for Intimate Partner Violence

Dependent variable: BMI	(1)	(2)	(3)	(4)
	<75h percentile tolerance score		>=75h percentile tolerance score	
share of female leaders	0.027	0.023	0.058***	0.076***
	(0.017)	(0.020)	(0.022)	(0.027)
Observations	51,983	51,983	22,023	22,023
first-stage F-stat	98.31	74.14	97.73	72.49
District FE	yes	yes	yes	yes
year FE	yes	yes	yes	yes
State trends	yes	yes	yes	yes
political controls	no	yes	no	yes

Notes: Robust standard errors clustered at the district level in parentheses. ***, ** and * represent significance at 1 percent, 5 percent and 10 percent levels respectively. The outcome is BMI in all regressions. All regressions include woman, husband, household and district characteristics; see Table 1.5. All columns use 2 percent cutoff for close elections. Columns 1 and 2 restrict the sample to women whose tolerance for violence z-scores are below the 75th percentile score (0.569) and columns 3 and 4 for those above or equal to the 75th percentile score.

classified as less likely to accept violence and those above or equal to the 75th percentile score are classified as more likely accepting of violence.

Results of this analysis are presented in Table 1.9 with columns 1 and 2 showing the effect of exposure on BMI for women who are less likely to accept violence and columns 3 and 4 showing for those more likely accepting of violence. The estimates are positive and not significant for less tolerant women in column 2 but positive and significant for women more likely to tolerate violence in column 4. A one percentage point increase in the share of female leaders is associated with a 0.576 percentage point increase in BMI. This suggests that, for women who are more likely to accept violence, exposure to female leaders is associated with an improvement in their health status. This further supports the assertion that marginalised women are the most targeted of woman-friendly policies that female leaders may prioritise.

Relative Income

We present the results of heterogeneities by women's income relative to their husbands' income in Table 1.10. In the NFHS, women answer questions about their income positions relative to their husbands'. In columns 1 and 2 we show coefficients for the share of female leaders for a subsample of women who say they earn less than their husbands. This is followed by women who earn the same income as their husbands in columns 3 and 4 and those who earn more than their husbands in columns 5 and 6. Finally, columns 7 and 8 present coefficients for women who are sole earners. Our estimated coefficients mostly show that the share of female leaders is positively associated with BMI for women who earn less, or more than their husbands and for sole earners and negatively associated with BMI for women who earn the same as their husbands. The coefficients are however not significant indicating that our baseline results are not driven by women's relative income positions in the household.

Place of Residence, Castes/tribes and education

The heterogeneous effects of female representation on women's health by residential status, educational levels and caste type are shown in Table 1.11. From the Table, female leaders influence the BMI of women from rural locations, women with primary education and lower castes women. This further confirms that policies of female leaders that improve women's well-being may benefit marginalised women hence higher levels of treatability for these women.

Table 1.10: Heterogeneities: Income Relative to Husband's Income

Dependent variable: BMI	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Earns less than husband		Earns the same as husband		Earns more than husband		Woman is the Sole earner	
share of female leaders	0.047	0.037	-0.042	-0.045	0.078	0.078	0.227	0.178
	(0.028)	(0.031)	(0.056)	(0.058)	(0.059)	(0.068)	(0.143)	(0.223)
Observations	10,184	10,184	4,206	4,206	3,604	3,604	830	830
District FE	yes	yes	yes	yes	yes	yes	yes	yes
year FE	yes	yes	yes	yes	yes	yes	yes	yes
State trends	yes	yes	yes	yes	yes	yes	yes	yes
political controls	no	yes	yes	yes	no	yes	yes	yes
first-stage F-stat	77.62	66.55	68.90	56.19	75.52	55.85	14.18	5.955

Notes: Robust standard errors clustered at the district level in parentheses. ***, ** and * represent significance at 1 percent, 5 percent and 10 percent levels respectively. The outcome is BMI in all regressions. All regressions include woman, husband, household and district characteristics; see Table 1.5. All columns use 2 percent cutoff for close elections. Columns 1 and 2 restrict sample to women who answer they earn less than their husband, columns 3 and 4 those who earn about the same as husbands, columns 5 and 6 those who earn more than husbands and columns 7 and 8 those who are sole earners.

Table 1.11: Heterogeneities: Residence, Education and Castes/tribes

Outcome: BMI	(1) Rural	(2) Urban	(3) No education	(4) Primary education	(5) Secondary education	(6) Higher education	(7) Lower castes/tribes	(8) Higher castes/tribes
share of female leaders	0.037**	0.045	0.020	0.091**	0.029	-0.009	0.033**	0.018
	(0.017)	(0.040)	(0.023)	(0.037)	(0.023)	(0.054)	(0.016)	(0.038)
Observations	54,580	19,426	23,663	10,874	32,201	7,268	59,095	14,911
first-stage F-stat	77.28	73.35	54.96	73.86	86.48	74.08	72.72	77.11
district FE	yes	yes	yes	yes	yes	yes	yes	yes
year FE	yes	yes	yes	yes	yes	yes	yes	yes
state trends	yes	yes	yes	yes	yes	yes	yes	yes
political controls	yes	yes	yes	yes	yes	yes	yes	yes

Notes: Robust standard errors clustered at the district level in parentheses. ***, ** and * represent significance at 1 percent, 5 percent and 10 percent levels respectively. The outcome is BMI in all regressions. All regressions include woman, husband, household and district characteristics; see Table 1.5. All columns use below 2 percent cutoff for close elections. Columns 1 and 2 group women by residence status, columns 3 to 6 by educational levels attained, and columns 7 and 8 by their castes/tribes.

1.5.3 Robustness Checks

So far, we have defined close elections as those in which a woman and a man are the top two candidates, and the vote difference is less than 2 percent. The arbitrary nature of our threshold choice for close elections could make our results less credible if coefficients depend on the choice of threshold. We investigate in our robustness analysis whether the results are sensitive to changes in the threshold. This modification is in line with studies showing consistent results when the close election instrument is altered up to a margin of 5% (Bhalotra & Clots-Figueras, 2014; Clots-Figueras, 2012; Anukriti et al., 2022). Columns 1 to 4 in Table 1.12 indicate results for Anaemia as the outcome while columns 5 to 8 show results in the case of BMI as the outcome using a 1%, 3%, 4% and 5% margin of votes respectively. The

Table 1.12: Robustness Checks: Changes in the Close Election Threshold

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable	Anaemia				BMI			
Robustness: cutoff:	1%	3%	4%	5%	1%	3%	4%	5%
share of female leaders	0.085	-0.016	-0.021	-0.023	0.041	0.043***	0.034***	0.028**
	(0.101)	(0.023)	(0.021)	(0.019)	(0.063)	(0.014)	(0.013)	(0.011)
Observations	74,006	74,006	74,006	74,006	74,006	74,006	74,006	74,006
first-stage F-stat	5.584	108.4	135	167.2	5.584	108.4	135	167.2
District FE	yes	yes	yes	yes	yes	yes	yes	yes
year FE	yes	yes	yes	yes	yes	yes	yes	yes
State trends	yes	yes	yes	yes	yes	yes	yes	yes
political controls	yes	yes	yes	yes	yes	yes	yes	yes

Notes: Robust standard errors clustered at the district level in parentheses. ***, ** and * represent significance at 1 percent, 5 percent and 10 percent levels respectively. The outcome is Anaemia in columns 1 to 4 and BMI in columns 5 to 8. All regressions include woman, husband, household and district characteristics; see Table 1.5. Columns 1 and 5 use below 1 percent cutoff for close elections, columns 2 and 6 use below 3 percent, 3 and 7 use below 4 percent and 4 and 8 use below 5 percent cutoff.

coefficient of the share of female leaders are robust to changing the close elections definition to less than 1%, 3%, 4% and 5%. It however remains consistently insignificant in the case of

Anaemia. The coefficients are significant in most cases under BMI except when the margin of vote is narrowed to 1%. A 1%, 3% and 4% threshold results in slightly larger estimates compared to the baseline, increasing it to 5% results in a slightly smaller estimate. Overall, we conclude the results are not sensitive to the choice of bandwidth for close election.

Secondly, we include some political controls, of which the coefficients are shown in Table 1.13. These controls include the proportion of winners from the two main political parties and the number of seats reserved for scheduled castes and tribes' members[17]. As with the former, major political parties may strategically elect female leaders and influence women's health (Bhalotra & Clots-Figueras, 2014). The latter controls for the possibility that females differ from males in competing for reserved seats (Bhalotra & Clots-Figueras, 2014). If these were not controlled, the results may be capturing the effects of these variables. In Panel A column 1, the coefficients are robust to these additions when BMI is the outcome variable. In addition, we remove outliers by narrowing our sample to only women whose share of female leaders is below the 90th percentile share of 0.25 or 25%. The sample size is reduced to 66,830 and the coefficient is robust in sign but increases to 0.064 in column 2. The coefficients under Anaemia remain insignificant in Panel B in the two cases above (columns 1 and 2).

We further remove outliers from the outcome variables in columns 3 and 4. In column 3 we limit the sample to only women whose BMI (Anaemia) equals or falls below the 75th percentile

[17] The two parties included are the Bharatiya Janata Party (BJP) and the Indian National Congress (INC).

Table 1.13: Robustness Checks: Others

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Dependent variable:	BMI	BMI	BMI	BMI	BMI	BMI
Robustness:	*Political controls*	*Removal of outliers (SF > the 90th percentile= 0.25)*	*Removal of outliers (BMI>the 75th percentile= 24.86)*	*Removal of outliers (BMI>the 90th percentile= 28.25)*	*District trends*	*State-year FE*
share of female leaders	0.032*	0.064**	0.019*	0.025*	0.347	0.030*
	(0.016)	(0.030)	(0.011)	(0.013)	(0.259)	(0.016)
Observations	74,006	66,830	55,482	66,622	74,006	74,006
first-stage F-stat	82.75	57.11	74.82	79.13	8.532	83.49
	(1)	(2)	(3)	(4)	(5)	(6)
Panel B: Dependent variable:	Anaemia	Anaemia	Anaemia	Anaemia	Anaemia	Anaemia
Robustness:	*Political controls*	*Removal of outliers (SF > the 90th percentile= 0.25)*	*Removal of outliers (Anaemia> the 75th percentile= 12.7)*	*Removal of outliers (Anaemia >the 90th percentile= 13.5)*	*District trends*	*State-year FE*
share of female leaders	-0.010	-0.019	-0.020	-0.007	-0.014	-0.001
	(0.027)	(0.044)	(0.019)	(0.021)	(0.710)	(0.026)
Observations	74,006	66,830	56,926	67,266	74,006	74,006
first-stage F-stat	82.75	57.11	83.31	84.22	8.532	83.49
District FE	yes	yes	yes	yes	yes	yes
year FE	yes	yes	yes	yes	yes	yes
State trends	yes	yes	yes	yes	yes	yes

Notes: Robust standard errors clustered at the district level in parentheses. ***, ** and * represent significance at 1 percent, 5 percent and 10 percent levels respectively. The outcome is BMI in Panel A and Anaemia in Panel B. All regressions include woman, husband, household and district characteristics; see Table 1.5. All columns use 2 percent cutoff for close elections. Column 1 includes more political controls including the number of seats reserved for scheduled castes and tribes' members and whether the winner belongs to the two main political parties, BJP and INC. Column 2 removes women from districts where the share of female leaders is above the 90th percentile (0.25 or 25 percent or more share of female leaders). Coefficients are robust when we consider only women below the mean share of female leaders of approximately 9%. Column 3 removes outliers; women whose outcomes are above the 75th percentile (BMI >24.86kg/m2 and Anaemia > 12.7g/dl). Again, outliers are removed in column 4; women whose outcomes are above the 90th percentile (BMI >28.25 kg/m2 and Anaemia > 13.5g/dl) In column 5 we control for district trends instead of state trends. In column 6, we include state-year-specific fixed effects.

BMI (Anaemia) of 24.86kg/m2 (12.7 g/dl) and do the same for the 90th percentile BMI (Anaemia) of 28.25 kg/m2 (13.5g/dl) in column 4[18]. The signs of the estimates remain the same. We replace state trends with district trends, as individual districts may exhibit trends in women's health and our estimated results may be capturing this trend. The coefficient is again positive as shown in column 5 under BMI but not significant. The inclusion of state-year FE also does not change the sign of our estimate in column 6. We further confirm that female leaders may not influence women's anaemia.

1.5.4 Extension

Following the election of female leaders, it is anticipated that women's health outcomes will improve due to the implementation of new policies by the female leaders in their districts. Ideally, we would want to assess women's health before and after these elections to accurately measure the impact of these policies. However, the repeated cross-sectional data used in this chapter does not allow for this direct comparison as the same women are not surveyed across different years. Consequently, we lack information on the health status of women before the survey year. To address this limitation, we utilize the available data on children aged five and below, including their birth histories and their prenatal and postnatal conditions. We take advantage of the timing of birth information and compare the effects of female leaders on the health outcomes of children born before and children born after the election of female leaders in their districts. Thus, although we cannot directly measure the

[18] 24.86 is close to the BMI of 24.9 above which a person is considered obese.

impact on women's health before these leaders took office, we can infer potential effects through the health outcomes of their children. This is supported by studies indicating that female leaders tend to prioritize the welfare of both women and children (Beaman et al., 2012; Kumar & Prakash, 2017).

To eliminate the potential advantage of incumbency, we limit our analysis to female leaders who were not elected in the previous election cycles before the ones matched to the survey years. We split our sample based on the timing of childbirth, categorizing children as born either before or after the general election year in their respective district (state). This allows us to infer whether increased access to female leaders before birth has an impact on prenatal and postnatal health outcomes. Consistent with our earlier analyses, we utilize the proportion of female leaders elected before the survey years and include control variables accounting for individual and district characteristics. For Models 2 and 3, we employ the same share of close elections as an instrumental variable, in line with our baseline estimates. Here our outcome variables are prenatal, postnatal and nutritional health outcomes.

The results are presented in Table 1.14. In this table, we analyse the impact of female leaders on prenatal, postnatal, and nutritional health outcomes by comparing children born before and after these leaders were elected in their districts. In Panel A, columns 1 and 2 use the outcome variable prenatal blood test. Column 1 reveals that the election of female politicians significantly increases the likelihood of prenatal checks for children born after the election of female leaders. Conversely, for children born before the election (column 2), female representation does not affect prenatal blood test. Similar results are observed in columns 3, 5, and 7. Female politicians positively influence the likelihood of births occurring in improved-

Table 1.14: Using the Health Outcomes of Children Under 5 Years Old

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A:	Prenatal blood test		Place of delivery is improved		Postnatal checks		Birth by a health professional	
Sample: Born	After	Before	After	Before	After	Before	After	Before
Share of female leaders	0.082***	0.021	0.045***	0.049**	0.024	0.002	0.037***	0.025
	(0.018)	(0.023)	(0.017)	(0.020)	(0.017)	(0.034)	(0.013)	(0.022)
Observations	145,859	57,637	206,944	109,077	168,399	64,048	206,992	109,127
first-stage F-stat	3761	1110	3487	1613	3967	1240	3488	1613
district FE	yes	yes	yes	yes	yes	yes	yes	yes
mother cohort FE	yes	yes	yes	yes	yes	yes	yes	yes
other controls	yes	yes	yes	yes	yes	yes	yes	yes

	(1)	(2)	(3)	(4)	(5)	(6)
Panel B	Stunting		Wasting		Underweight	
Sample: Born	After	Before	After	Before	After	Before
Share of female leaders	-0.041***	-0.003	-0.048***	-0.010	0.000	0.007
	(0.013)	(0.022)	(0.013)	(0.024)	(0.013)	(0.026)
Observations	206,992	109,127	206,992	109,127	206,992	109,127
first-stage F-stat	3488	1613	3488	1613	3488	1613
district FE	yes	yes	yes	yes	yes	yes
mother cohort FE	yes	yes	yes	yes	yes	yes
other controls	yes	yes	yes	yes	yes	yes

Notes: Robust standard errors clustered at the district level in parenthesis. ***, ** and * represent significance at 1 percent, 5 percent and 10 percent levels respectively. Like in previous tables, the dependent variables are in z-scores for the sample used. A child has a prenatal blood test coded “1” if their mother states that they took a blood test, or their blood pressure was taken during pregnancy. Place of delivery is “1” if a child’s birth occurred in a public or private health facility such as a government hospital, dispensary, private hospital, etc. Postnatal checks is “1” if there were postnatal checks within 2 months of the child’s birth and finally, a child’s birth is attended by a health professional if the person is a doctor, a midwife, a nurse, or a community health worker. All regressions include individual and district characteristics. Individual characteristics include place of residence, religion, caste, child sex and birth order. District characteristics include the share of female population, the share of scheduled castes and scheduled tribes’ population, the male literacy rate and the female literacy rate. All regressions also include district and mother cohort fixed effects and the fraction of closed elections in the district.

health facilities (column 3), births attended by a health professional (column 7), and children undergoing postnatal checks (column 5, although not significant) for children born after the election. Specifically, the coefficients indicate that a one percentage point increase in female representation increases the likelihood of a prenatal blood test, a birth in an improved facility, and birth attended by a health professional by 1.156, 0.635, and 0.521 percentage points, respectively. For children born before the election, the coefficients are not significant, except for column 4, where we find a positive and significant effect on births occurring in improved facilities.

Although we do not know precisely when nutritional deficiencies may have occurred, previous studies have shown that female leaders tend to be more concerned about the health outcomes of newborn children and mothers at risk of conception, and they promote policies aimed at improving their health such as those that promote better nutrition and vaccination (Bhalotra & Clots-Figueras, 2014). Consequently, they are likely to focus on newly born children after their appointments. In Panel B, we analyse the likelihood of stunting, wasting, and being underweight by comparing children born before and after the election of female representatives. As in previous analyses, female representatives have no significant effect on children born before their election (columns 2, 4, and 6). However, columns 1 and 3 show that a one percentage point increase in exposure to female leaders reduces the likelihood of stunting (by 0.578 percentage points) and underweight (by 0.677 percentage points) among children born after the election of these politicians. Overall, the results in Table 1.14 are reassuring, as they allow us to infer from children's health outcomes that the election of female leaders positively influences women's BMI as policies implemented by female leaders most likely favour women and children's health.

1.5.5 Potential Channels

In this section, we investigate some potential channels that may underlie the positive effect of female leadership on women's BMI and decrease in the likelihood of underweight and moderate/severe underweight among women. Specifically, we test whether female leaders can positively influence intimate partner violence and controlling behaviours from the husband; women's access to public goods or facilities and distress behaviours such as drinking and smoking habits. We also assess whether female leaders may influence village level public health infrastructure, availability of health workers and initiatives that are of relevance to women's health.

Intimate Partner Violence

In this sub-section, we investigated the effect of female representation on intimate partner violence which may impact women's health and well-being. Exposure to female leaders can increase the risk of intimate partner violence against women as predicted by the theory of male backlash (Bandyopadhyay et al., 2020) as male partners may resort to violence to assert their dominance. This may happen in a way that affects women's health negatively (Adhikari, et al., 2020; Ellsberg & Emmelin, 2014; Ferdos and Rahman, 2018, Ferreira Mde et al., 2015). However, it may reduce violence among couples if there is a general acceptance of female leaders (Anukriti et al., 2022) and their abilities which can be translated into how husbands treat their wives (Beaman et al., 2012). This is what we would expect given that exposure to female leaders in our study has a positive impact on women's health.

Considering the sample of women who respond to questions on domestic violence, in Table 1.B.8, we do not find any significant effect of exposure to female leaders on overall IPV in column 1. If IPV were an underlying effect, exposure may rather influence the multiple types of violence against the woman separately. Hence, we consider all types of violence including physical, sexual and emotional violence. Exposure to female leaders has no significant effect on physical, sexual and emotional violence, however, as shown in columns 2, 3 and 4 respectively.

In Table 1.B.9, we further consider the heterogeneous effect by the level of decision-making autonomy and tolerance for violence. The share of female leaders in the district is not significantly associated with IPV for women with less autonomy (column 1). This explains that less autonomous women are not less likely to experience domestic violence when exposed to female leaders. Contrary to that, when we consider women with more autonomy in column 2 the coefficient is negative and statistically significant. This shows that increasing the share of female leaders in a district is associated with a decline in IPV against women with more decision-making power in the household. Similar results for the overall IPV are found in the case of physical violence and emotional IPV in columns 4 and 8.[19] Interestingly, it is only among women with less decision-making autonomy that exposure to female leaders results

[19] We conduct a similar heterogeneous analysis by residence, education and caste and find no impact by any category. Results are available upon request.

in an increase in BMI as shown in Table 1.8. The coefficient is not significant regardless of women's tolerance level for violence in panel B.

Also, breaking down physical IPV into severe and less severe physical IPV in Table 1.B.10, we find similar results. The coefficients remain insignificant under tolerance for violence. Overall, the results do not offer a direct link between exposure to female leaders and IPV experienced by women with less power and hence we reject a dominant role of this channel.

Controlling Behaviours of Husband.

Like the case of IPV, controlling behaviours by husbands which indicate some form of emotional and or psychological abuse towards their wives (Stojetz & Brück, 2023) may reduce due to the presence of female officeholders. If this channel should help explain our results, then we expect these attitudes by husbands against their wives to reduce. We take a z-score of the total indicators for controlling behaviours which include whether the woman has permission to meet friends, the woman has contact with family, the husband accuses the wife of promiscuity, the husband demands to know the whereabouts of the wife and whether the husband trusts wife with money. In column 1 of Table 1.B.11, we consider the effect of exposure on overall controlling behaviour and consider heterogeneities by autonomy and tolerance levels in columns 2 to 5. We mostly find positive coefficients, but they are not significant, suggesting that our BMI and underweight results cannot be explained by changes in the husband's controlling behaviours towards the wife.[20]

[20] Similar results are found in other heterogeneous analysis. Results are available upon request.

Visit to Hospital and Public vs Private Hospital.

Previous studies have shown that female leaders improve the provision of public health services that improve women's well-being (Chattopadhyay & Duflo, 2004; Anukriti et al., 2022; Bhalotra & Clots-Figueras, 2014). Women may have unrestricted access to these services when faced with female leaders. In addition, information about women's healthcare and proper eating habits may be provided in public facilities where female legislators may channel their activism and initiatives that favour women's health. In this section, we investigate whether women visit health facilities and if they do whether they visit more public than private ones when exposed to female leaders.

In Appendix Table 1.B.12 the outcome is whether the woman visited any health facility in the last 3 months in columns 1 to 5 and whether she visits public against private health facilities in columns 6 to 10. We show the coefficients for the overall sample of women in columns 1 and 6 which are not significant. We show heterogeneities by whether the woman has more or less autonomy (columns 2, 3, 7 and 8) and by whether she has more or less tolerance for violence (columns 4, 5, 9 and 10). The estimated coefficients show that female leaders do not influence women's visits or the type of facility visited. We conclude that this channel does not explain our baseline results.

Addictions: Smoking and Drinking

In addition, we investigate whether female representation can influence certain addictive behaviours amongst women. If the presence of female leaders improves women's health, this channel suggests that female leaders may serve as role models against negative behaviours such as smoking and drinking. They may also invest in educational programmes that educate women on the negative effects of these behaviours. The results are shown in Table 1.B.13. We find negative coefficients for the women overall, and the different sub-samples of women regarding alcohol consumption in columns 1 to 5. In addition, positive coefficients are observed when smoking is the outcome in columns 6 to 10. Although these coefficients are sizable, they are not significant. Hence this may not play a dominant role in explaining our results.

Healthcare Facilities, Initiatives and Programs

We examine whether female leaders influence the provision of public health facilities and programs or initiatives. Earlier studies have shown that female leaders invest resources into making better infrastructure and policy programs that align with the preferences of those they represent, especially women (Beaman et al., 2012; Chattopadhyay & Duflo, 2004). If female leaders promote these policies and initiatives, we expect that a positive effect on women's health is a result of the investment in these female-friendly policies.

We exploit the fourth round of the District Level Households and Facility Survey (DLHS-4) dataset conducted between 2012 and 2014. We capitalise on village level data that has information on infrastructure and match each village to their district female leaders from the TCPD-IED, as is done when matching women in the NFHS sample to their district female legislators. We limit the sample to villages in 6 states whose elections happened before the DLHS survey dates[21]. That is to say, since the interview years for the DLHS-4 were 2012, 2013

[21] The states include Himachal Pradesh, Karnataka, Kerala, Punjab, Tamil Nadu and West Bengal.

and 2014, we only consider places that held elections just prior to these DLHS dates. For instance, the state assembly elections in Himachal Pradesh conducted in 2012 is matched with DLHS-4 information with the interview year being 2013. Here, the election years precede the DLHS years, so that for any effects that we find, we can say that female leaders elected from the election prior to the DLHS may have an influence on the availability of these facilities.

The sample contains 2671 villages surveyed[22]. We run the regressions in equations 4 and 5 below instrumenting the share of female leaders in the district with the share of female leaders that win in close elections in the district as follows:

$$SF_{dt} = \alpha_2 + \rho . SFC_{dt} + \omega PC_{dt} + \pi Z_{dt} + \gamma_s + \varphi_t + \mu_{vdst} \quad (4)$$

$$PG_{vdst} = \alpha_1 + \beta . \widehat{SF_{dt}} + \sigma PC_{dt} + \theta Z_{dt} + \delta_s + \tau_t + \varepsilon_{vdst} \quad (5)$$

Where *PG* represents outcomes for some public goods, programs and initiatives in village *v* in district *d* in state *s* in year *t.* The other variables are the same as explained in equations 2 and 3. The results are shown in Table 1.15 below. In panel A column 1, although the share of female leaders is associated with an increase in the provision of healthcare resources, the estimates are not significant.

[22] Table 1.B.14 shows the summary statistics of village facilities and election data covered by the combined DLHS-TCPD-IED sample.

Table 1.15: Village Level Healthcare Facilities, Initiatives and Programs

Panel A:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Outcome:	Healthcare resources	AYUSH	Village health guide	ASHA	Registered medical practitioner	Auxiliary nurse	Female doctor
share of female leaders	0.298	0.076*	0.016	0.020	0.067	0.069*	0.062*
	(0.206)	(0.045)	(0.035)	(0.036)	(0.052)	(0.041)	(0.033)
p-value	0.148	0.090	0.635	0.573	0.196	0.093	0.063
Observations	2,671	2,667	2,669	2,669	2,668	2,667	2,666
Panel B:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Outcome:	Non-formal education	National social assistance programme	Sanitation programme	Rajiv Gandhi National Drinking Water Mission	Swarnjayanti Gram Swarozgar Yojana	Minimum Needs Programme	Pharmacy
share of female leaders	0.030**	0.051**	-0.003	0.035	-0.020	0.034	0.065**
	(0.013)	(0.024)	(0.044)	(0.034)	(0.031)	(0.036)	(0.031)
p-value	0.022	0.038	0.949	0.310	0.514	0.350	0.035
Observations	2,669	2,668	2,668	2,669	2,669	2,669	2,668
state FE	yes	yes	yes	yes	yes	yes	yes
year FE	yes	yes	yes	yes	yes	yes	yes

Notes: Robust standard errors clustered at the district level in parentheses. ***, ** and * represent significance at 1 percent, 5 percent and 10 percent levels respectively. All estimates include district level controls including the share of female population, share of scheduled castes and scheduled tribes' population, male literacy rate and female literacy rate. Non-formal education is a dummy for whether there is a government non-formal education in the village. Ayush is dummy for whether there is an AYUSH (Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homeopathy) facility in the village. Village health guide is for the availability of a health guide in the village. Healthcare resources is z-score of a sum of healthcare resources including public health centre, sub-centre, community health centre, block public health centre, district hospital and government dispensary in the village. National social assistance programme, Sanitation programme, Rajiv Gandhi National Drinking, Swarnjayanti Gram Swarozgar Yojana and Minimum Needs Programme are all dummies for whether these programs existed. Pharmacy is also a dummy for whether there is a pharmacy in the village.

We find a positive coefficient for the availability of an Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homeopathy (AYUSH) facility with the presence of female leaders in column 2. The availability of a female doctor and auxiliary nurse also increases as shown in columns 7 and 6 respectively. These estimates are similar to what is found in Anukriti et al. (2022). In addition to Anukriti et al. (2022), we include other health infrastructure such as village health guides and health workers including Accredited Social Health Activist (ASHA) and Registered Medical Practitioner (RMP) columns 3, 4 and 5. Although the estimates are positive, they are not significant.

In Panel B, initiatives and programs that may help improve women's health are considered. Non-formal Education (NFE), and National Social Assistance Programmes (NSAP) increase with female leaders. In addition, the provision of pharmacies also has a positive and significant association with female leaders. These results corroborate Chattopadhyay and Duflo (2004), Anukriti et al., (2022) and Bhalotra and Clots Figueras, (2014) suggesting that indeed female leaders improve the availability of female-friendly policies and programs when appointed. Although in the previous section, we do not find an effect on women's visits and type of public facilities visited, the results here provides an assurance that female leaders may have prioritised public initiatives like non-formal education where information about women's nutritional and other healthy habits are shared. The results here are further supported by evidence in Table 1.15, which shows that female leaders' after their appointment may influence policies and initiatives such as NFE, etc., that also positively impact children's health hence supporting the assertion that they target women's and children's health concerns.

1.6 Conclusions

Increasing the number of females in political positions is seen as a powerful tool to reducing gender inequalities and shaping societal policy priorities. While the literature has identified the importance of female representation not just for political empowerment but also issues of development, little is known about its impact on women's health. This chapter presents empirical evidence that the presence of female leaders influences women's BMI and underweight outcomes.

In particular, we use data from the National Family Health Surveys (NFHSs) of India, the Trivedi centre for Political Data Indian Elections Dataset (TCPD-IED) of India, Census data and the District Level Household Survey (DLHS) of India. The difficulty that arises in establishing the causal impact of female leaders on women's health is that district preferences could be correlated with both the election of female leaders and women's health outcomes, thus potentially biasing our findings and ultimately leading to flawed inferences if not addressed. Using the datasets that provide information of winners and their runners-up, we are able to examine the causal effect by exploiting close elections between a man and a woman as an instrument for the share of female leaders in our IV specifications.

The IV estimates show that the presence of female leaders has an increasing effect on women's overall BMI. However, when we divide the overall BMI into its standardised classifications, we find that raising the election of female leaders results in an increase in the BMI for women classified as underweight. In addition, female representation is also associated with a decreasing effect on the likelihood of underweight and moderate/severe underweight. In particular, the coefficients show that a one percentage point increase in exposure to female leaders is associated with a 0.250 percentage points increase in women's BMI and a 0.159 percentage points increase in BMI for women classified as underweight. We also find that female representation results in a fall in the likelihood of being underweight and severely or moderately underweight. We find no effect on Anaemia outcomes suggesting that the effect of female leaders may be specific to certain health outcomes. The results are quite robust to some checks such as using different bandwidth for the share of female leaders in close elections used as an instrument, including some political controls, removing some outliers and the inclusion of state-year fixed effects and district trends. We conclude that, increasing the number of female representatives is important and contributes to a better representation of female needs.

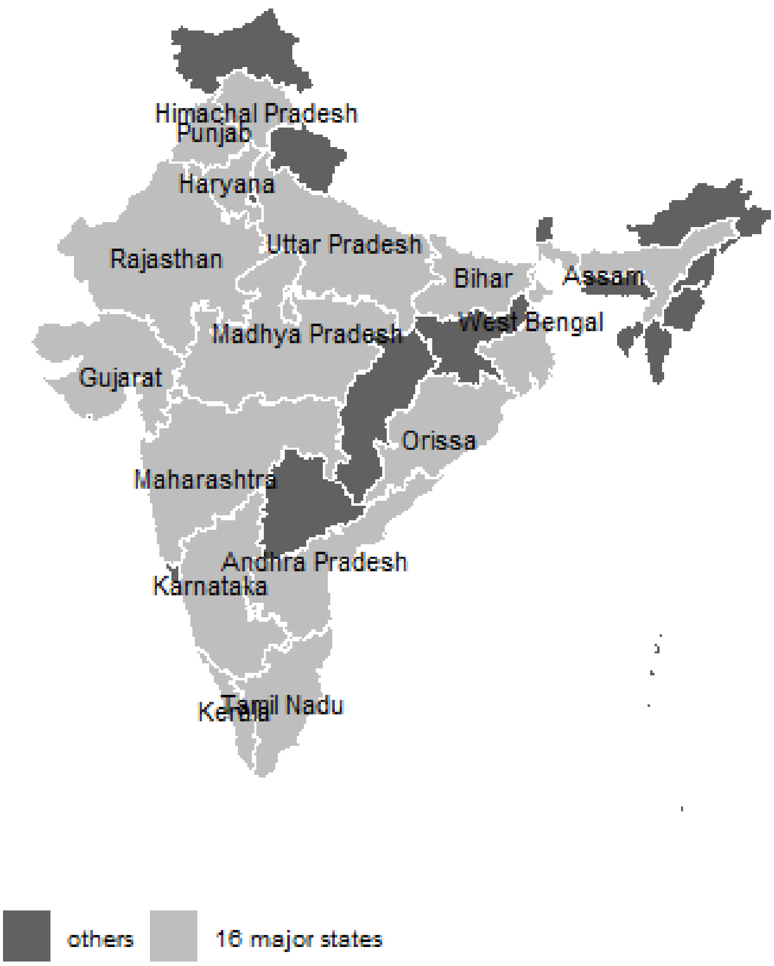
Given that female leaders' policies may target specific groups of women, an extensive heterogeneity analysis shows that the increase in BMI is mostly found among marginalised women particularly women with stronger traditional norms including those with less autonomy in household decision making and those with more tolerance for violence. In addition, we find that less educated, lower castes and rural women also drive the results. Exploring potential channels, we find some evidence of improvement in the provision of public health facilities and workers, and implementation of initiatives and programs that are important to women's health in the presence of female leaders. These highlight the importance of electing female representatives as they contribute to public health improvement in developing countries like India particularly targeting the most vulnerable groups of people.

Although our paper makes relevant contributions in understanding how female leaders can influence women's health, we recognise some limitations. First, is the use of a repeated cross-sectional data which does not allow a continuous follow-up of each woman in our sample to examine how women's health evolve when exposed to female leaders. Also, we cannot distinguish between whether women focused on overall health enhancing programmes or women's health in particular. Further research may examine whether female leaders could influence the health of both women and men or all their constituents. However, addressing this comment will require a substantial amount of additional analysis including information on men's health outcomes (i.e. BMI and Haemoglobin counts) which are not available in the women's dataset we have used. They are also not available in the MR recode (men's data). One would need to use the PR (i.e. household) recode which contains information on all household members, and merge with the original data and this has been left for future work. Additional research could also examine whether male leaders may influence some of the policies and initiatives explored in this chapter and the influence of women's political affiliation. Nonetheless, this chapter provides causal evidence that female representation matters for women's health, although we cannot say if overall population health is also affected.

Appendix 1

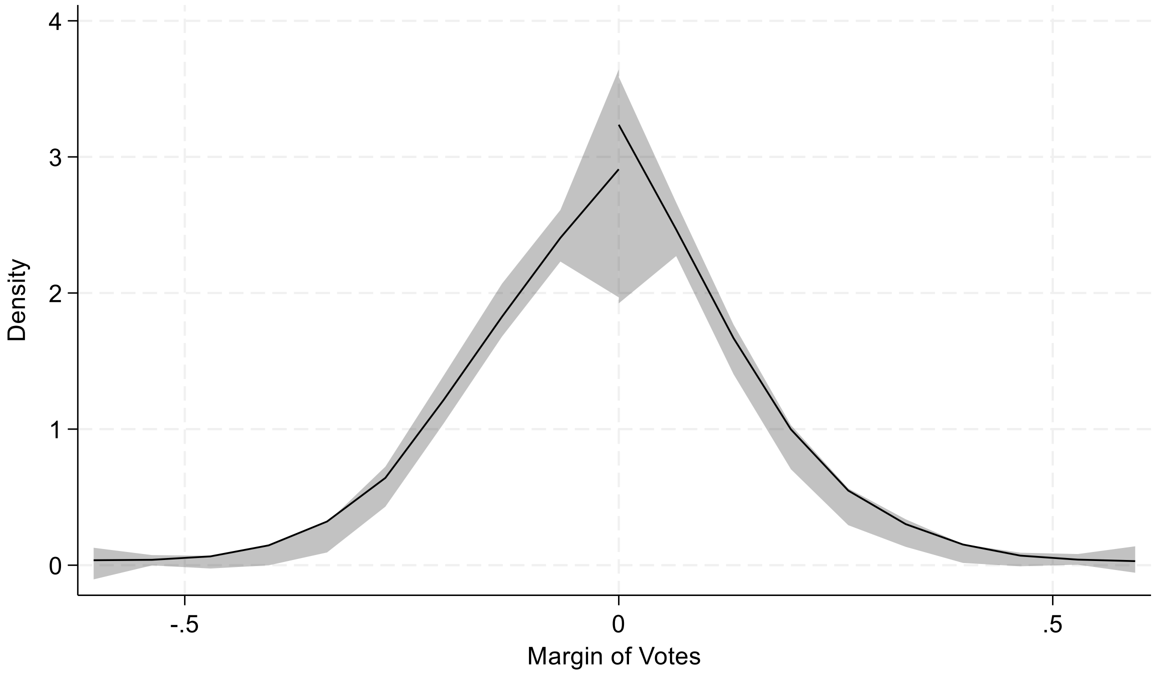
1.A Figures

Figure 1.A.1: Map of India Showing 16 Major States by Population



Notes: The map shows the 16 states considered in the empirical analysis.

Figure 1.A.2: Manipulation Test for the Running Variable (Margin of Votes)



Notes: Sample includes all elections where the top two candidates are of the opposite gender in the district. The p-value for the McCrary density test is 0.938.

1.B Tables

Table 1.B.1: Statewide Constituency Assembly Election Dates

#	State	Election dates pre NFHS IV	Election dates pre NFHS V
1	Andhra Pradesh	2014	2019
2	Assam	2011	2016
3	Bihar	2010	2015
4	Gujarat	2012	2017
5	Haryana	2014	2019
6	Himachal Pradesh	2012	2017
7	Karnataka	2013	2018
8	Kerala	2011	2016
9	Madhya Pradesh	2013	2018
10	Maharashtra	2014	2019
11	Orissa	2014	2019
12	Punjab	2012	2017
13	Rajasthan	2013	2018
14	Tamil Nadu	2011	2016
15	Uttar Pradesh	2012	2017
16	West Bengal	2011	2016

Notes: Information is taken from the TCPD-IED.

Table 1.B.2: Proof that Individual Characteristics do not vary

Outcome	(1) Age	(2) Woman educ.	(3) Religion	(4) Caste	(5) Woman work status	(6) Hus. work status	(7) Hus. Educ.	(8) Hus. other wives	(9) Hus. age	(10) No. of children under age 5	(11) Wealth index
share of female leaders	-0.020	-0.116	-0.008	0.004	0.008	-0.006	-0.099	-0.000	-0.048	0.001	0.002
	(0.108)	(0.090)	(0.011)	(0.020)	(0.008)	(0.005)	(0.084)	(0.002)	(0.113)	(0.016)	(0.022)
Obs.	74,006	74,006	74,006	74,006	74,006	74,006	74,006	74,006	74,006	74,006	74,006
first-stage F-stat	109	109	109	109	109	109	109	109	109	109	109

Notes: Robust standard errors in parentheses, clustered at the district level. ***, ** and * represent significance at 1 percent, 5 percent and 10 percent levels respectively. We include district fixed effect, year fixed effect and state trends in all regressions.

Table 1.B.3: Proof that Constituency and Candidate Characteristics do not vary

Variable		**Winner is a woman in close election (n=195)**	**Winner is a man in close election (n=230)**	**Difference**
Winner is the incumbent	Mean	0.267	0.348	0.081
	Std. error	(0.032)	(0.031)	(0.045)
Number of winner votes	Mean	73258.66	71287.1	-1971.556
	Std. error	(1843.08)	(1283.236)	(2195.848)
Total number of constituency valid votes	Mean	162883.2	158352.6	-4530.628
	Std. error	(3747.883)	(2114.041)	(4144.547)
Total number of constituency candidates	Mean	11.256	11.048	-0.209
	Std. error	(0.348)	(0.346)	(0.493)
Turnout percentage	Mean	71.378	71.879	0.501
	Std. error	(1.317)	(0.764)	(1.470)
BJP	Mean	0.323	0.309	-0.014
	Std. error	(0.034)	(0.031)	(0.045)
INC	Mean	0.195	0.174	-0.021
	Std. error	(0.028)	(0.025)	(0.038)
National Parties	Mean	0.544	0.539	-0.004
	Std. error	(0.035)	(0.033)	(0.049)
State Parties	Mean	0.421	0.426	0.006
	Std. error	(0.035)	(0.033)	(0.048)
Independents	Mean	0.010	0.017	0.007
	Std. error	(0.007)	(0.009)	(0.012)
Local parties	Mean	0.015	0.017	0.002
	Std. error	(0.009)	(0.009)	(0.012)

Notes: We restrict the sample to constituencies where the top two candidates ae of different genders and the margin of votes is less than 2 percent. ***, ** and * depict the difference is significant at 1, 5 and 10 percent respectively. We use a simple ttest to check whether differences are significant.

Table 1.B.4: OLS for the Effect of Exposure to Female Leaders on Women's Health (Table 1.3)

Outcome:	(1) Anaemia	(2) Anaemia	(3) Anaemia	(4) Anaemia	(5) BMI	(6) BMI	(7) BMI	(8) BMI
share of female leaders	-0.002	0.006	0.000	0.005	0.008	0.010	0.015**	0.016**
	(0.008)	(0.011)	(0.011)	(0.012)	(0.008)	(0.007)	(0.007)	(0.007)
age	0.003**	0.003***	0.003***	0.003***	0.016***	0.016***	0.016***	0.016***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Woman's education	0.004***	0.003***	0.003***	0.003***	0.007***	0.007***	0.007***	0.007***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Religion: Hindu								
Muslim	0.059***	0.049***	0.050***	0.051***	0.124***	0.124***	0.126***	0.126***
	(0.019)	(0.016)	(0.016)	(0.016)	(0.015)	(0.015)	(0.015)	(0.015)
Christian	0.103***	0.049	0.043	0.044	0.017	0.017	0.020	0.020
	(0.038)	(0.032)	(0.031)	(0.031)	(0.030)	(0.030)	(0.030)	(0.030)
Sikh	-0.060	-0.033	-0.033	-0.033	0.115***	0.115***	0.113***	0.113***
	(0.037)	(0.037)	(0.036)	(0.036)	(0.034)	(0.034)	(0.033)	(0.033)
Others	-0.138	-0.068	-0.069	-0.070	0.063*	0.063*	0.064*	0.064*
	(0.113)	(0.060)	(0.056)	(0.057)	(0.033)	(0.033)	(0.033)	(0.033)
Caste: Scheduled castes								
Scheduled tribes	-0.074***	-0.080***	-0.081***	-0.081***	-0.044***	-0.044***	-0.043***	-0.043***
	(0.020)	(0.018)	(0.018)	(0.018)	(0.016)	(0.016)	(0.016)	(0.016)
Other backward castes	0.066***	0.058***	0.056***	0.056***	0.030***	0.030***	0.031***	0.031***
	(0.012)	(0.011)	(0.011)	(0.011)	(0.009)	(0.009)	(0.009)	(0.009)
Others	0.056***	0.051***	0.048***	0.048***	0.064***	0.064***	0.064***	0.064***
	(0.015)	(0.014)	(0.014)	(0.014)	(0.012)	(0.012)	(0.012)	(0.012)
Woman works	-0.013	-0.020**	-0.018*	-0.019*	-0.052***	-0.052***	-0.052***	-0.052***
	(0.011)	(0.010)	(0.010)	(0.010)	(0.008)	(0.008)	(0.008)	(0.008)
Husband works	0.007	0.021	0.022	0.022	0.031***	0.031***	0.034***	0.034***
	(0.014)	(0.014)	(0.013)	(0.013)	(0.012)	(0.012)	(0.012)	(0.012)
Husband's education	0.004***	0.003***	0.003***	0.003***	0.008***	0.008***	0.008***	0.008***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Husband's other wives	0.010	0.025	0.026	0.026	-0.074***	-0.074***	-0.073***	-0.073***
	(0.035)	(0.035)	(0.035)	(0.035)	(0.026)	(0.026)	(0.026)	(0.026)
Husband's age	-0.002*	-0.003**	-0.003**	-0.003**	0.009***	0.009***	0.009***	0.009***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Number of under 5 children	-0.053***	-0.056***	-0.055***	-0.055***	-0.046***	-0.046***	-0.046***	-0.046***
	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Wealth Index: Poorest								
Poorer	0.027*	0.030**	0.027**	0.027**	0.125***	0.125***	0.126***	0.126***
	(0.014)	(0.013)	(0.013)	(0.013)	(0.011)	(0.011)	(0.011)	(0.011)
Middle	0.037**	0.044***	0.041***	0.041***	0.277***	0.277***	0.280***	0.280***
	(0.017)	(0.015)	(0.015)	(0.015)	(0.012)	(0.012)	(0.013)	(0.013)
Richer	0.032*	0.045***	0.045***	0.044***	0.454***	0.454***	0.456***	0.456***
	(0.019)	(0.016)	(0.016)	(0.016)	(0.015)	(0.015)	(0.015)	(0.015)
Richest	0.101***	0.124***	0.124***	0.124***	0.615***	0.615***	0.616***	0.616***
	(0.023)	(0.019)	(0.019)	(0.019)	(0.018)	(0.018)	(0.018)	(0.018)
District female population	-0.315	0.398***	38.108	40.303	0.686***	0.686***	-4.441	-8.546
	(0.240)	(0.036)	(45.600)	(45.879)	(0.031)	(0.031)	(35.629)	(35.096)

District SC & ST population	-0.097	1.233***	635.660	675.540	-0.193***	-0.193***	-86.375	-153.589
	(0.069)	(0.094)	(767.257)	(772.017)	(0.066)	(0.066)	(599.437)	(590.392)
District Male literacy rate	0.328	-2.258***	-269.081	-285.099	-5.583***	-5.583***	30.716	59.477
	(0.271)	(0.166)	(322.633)	(324.622)	(0.133)	(0.133)	(252.075)	(248.292)
District literacy rate	-0.250	1.782***	131.093	138.509	4.348***	4.348***	-13.261	-27.428
	(0.199)	(0.140)	(156.329)	(157.287)	(0.116)	(0.116)	(122.146)	(120.324)
Pregnancy status	-0.496***	-0.496***	-0.494***	-0.494***	0.116***	0.116***	0.116***	0.116***
	(0.018)	(0.018)	(0.018)	(0.018)	(0.014)	(0.014)	(0.014)	(0.014)
Location of residence	0.020	0.023**	0.022*	0.022*	0.133***	0.133***	0.133***	0.133***
	(0.013)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
Observations	74,006	74,006	74,006	74,006	74,006	74,006	74,006	74,006
R-squared	0.027	0.059	0.062	0.062	0.208	0.208	0.209	0.209

Notes: Robust standard errors clustered at the district level in parentheses. ***, ** and * represent significance at 1 percent, 5 percent and 10 percent levels respectively. Columns 2 and 6 include both district and year fixed effects (FE), columns 3 and 7 include state trends and columns 4 and 8 include some political controls. These political controls are whether there has been a male female close election in the district and the share or fraction of close elections in the district.

Table 1.B.5: IV for the Effect of Exposure to Female Leaders on Women's Health (Table 1.5)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Outcome:	Anaemia	Anaemia	Anaemia	Anaemia	BMI	BMI	BMI	BMI
share of female leaders	-0.007	-0.013	-0.016	-0.007	0.010	0.032**	0.032**	0.033**
	(0.015)	(0.024)	(0.022)	(0.027)	(0.012)	(0.015)	(0.014)	(0.016)
age	0.004***	0.003***	0.003***	0.003***	0.016***	0.016***	0.016***	0.016***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Woman's education	0.003**	0.003***	0.003***	0.003***	0.010***	0.007***	0.007***	0.007***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Religion	-0.001	0.002	0.002	0.002	0.044***	0.040***	0.040***	0.040***
	(0.013)	(0.008)	(0.008)	(0.008)	(0.007)	(0.006)	(0.006)	(0.006)
Caste	0.032***	0.028***	0.027***	0.027***	0.015***	0.027***	0.027***	0.027***
	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Woman works	-0.021**	-0.022**	-0.020**	-0.021**	-0.056***	-0.056***	-0.056***	-0.056***
	(0.011)	(0.010)	(0.010)	(0.010)	(0.009)	(0.008)	(0.008)	(0.008)
Husband works	0.013	0.022	0.023*	0.023*	0.028**	0.032***	0.034***	0.035***
	(0.014)	(0.014)	(0.013)	(0.013)	(0.012)	(0.012)	(0.012)	(0.012)
Husband's education	0.004***	0.003***	0.003***	0.003***	0.006***	0.007***	0.007***	0.007***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Husband's other wives	0.005	0.024	0.024	0.025	-0.069**	-0.074***	-0.074***	-0.074***
	(0.035)	(0.035)	(0.035)	(0.035)	(0.027)	(0.026)	(0.026)	(0.026)
Husband's age	-0.003**	-0.003**	-0.003**	-0.002**	0.009***	0.009***	0.009***	0.009***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Number of under 5 children	-0.048***	-0.055***	-0.055***	-0.055***	-0.047***	-0.045***	-0.045***	-0.045***
	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Wealth index	0.023***	0.029***	0.030***	0.030***	0.167***	0.159***	0.159***	0.159***
	(0.006)	(0.005)	(0.004)	(0.004)	(0.005)	(0.004)	(0.004)	(0.004)
District female population	1.835**	52.618***	10,467.996	11,364.056	0.875	12.677**	-219.139	-1,220.989
	(0.743)	(9.724)	(12,454.687)	(12,585.950)	(0.660)	(6.258)	(10,288.556)	(10,160.566)
District SC & ST population	-0.242***	0.825***	525.811	570.901	-0.288***	-0.460***	-12.251	-63.082
	(0.073)	(0.080)	(627.884)	(634.501)	(0.054)	(0.056)	(518.649)	(512.212)
District Male literacy rate	0.610**	-17.636***	-1,799.231	-1,950.955	-0.774***	-4.637***	34.806	208.028
	(0.287)	(2.707)	(2,130.205)	(2,152.451)	(0.216)	(1.741)	(1,759.791)	(1,737.933)
District literacy rate	-0.529**	8.122***	554.614	600.571	0.787***	3.344***	-8.707	-62.553
	(0.206)	(1.146)	(653.349)	(660.097)	(0.164)	(0.741)	(539.765)	(533.075)
Pregnancy status	-0.487***	-0.494***	-0.492***	-0.492***	0.111***	0.119***	0.118***	0.118***
	(0.018)	(0.018)	(0.018)	(0.018)	(0.014)	(0.014)	(0.014)	(0.014)
Location of residence	0.033***	0.032***	0.031***	0.031***	0.124***	0.146***	0.145***	0.145***
	(0.012)	(0.011)	(0.011)	(0.011)	(0.013)	(0.011)	(0.011)	(0.011)

Observations	74,006	74,006	74,006	74,006	74,006	74,006	74,006	74,006
first-stage F-stat	290.8	107.5	109.1	81.45	290.8	107.5	109.1	81.45

Notes: Robust standard errors clustered at the district level in parentheses. ***, ** and * represent significance at 1 percent, 5 percent and 10 percent levels respectively. Columns 2 and 6 include both district and year fixed effects (FE), columns 3 and 7 include state trends and columns 4 and 8 include some political controls. These political controls are whether there has been a male female close election in the district and the share or fraction of close elections in the district.

Table 1.B.6: Other Women Characteristics

Variable	Obs.	Mean	Std. Dev.	Min	Max
Relative income: wife earns					
less than husband	18824	0.541	0.498	0	1
about the same as husband	18824	0.223	0.417	0	1
more than husband	18824	0.191	0.393	0	1
sole earner	18824	0.044	0.205	0	1
Autonomy: Wife is involved in decision making:	74006	3.813	1.717	0	6
Overall z-score		0	1	-2.221	1.274
Contraception decision	48220	0.915	0.278	0	1
Own earnings decision	74006	0.212	0.409	0	1
Family visits decision	74006	0.766	0.423	0	1
healthcare decision	74006	0.768	0.422	0	1
Household purchases decision	74006	0.75	0.433	0	1
Husband earnings decision	74006	0.72	0.449	0	1
Beating justified by wife if wife:	74006	1.096	1.589	0	5
Overall z-score	74006	0	1	-0.69	2.457
Goes out without permission	73846	0.233	0.423	0	1
Neglects children	73844	0.289	0.453	0	1
Argues with husband	73794	0.268	0.443	0	1
Refuses sex	73637	0.129	0.335	0	1
Does not cook properly	73832	0.180	0.384	0	1

Notes: This table presents summary statistics of women's characteristics used in subsequent analysis. Specifically, information on women's income relative to husbands' income, women's involvement or autonomy in decision making and women's level of tolerance for intimate partner violence.

Table 1.B.7: Heterogeneity by Autonomy Score

Dependent variable: BMI	(1)	(2)	(3)	(4)
	<50^{h} percentile autonomy score		>=50^{h} percentile autonomy score	
share of female leaders	0.047**	0.057**	0.016	0.007
	(0.019)	(0.023)	(0.017)	(0.020)
Observations	40,640	40,640	33,366	33,366
first-stage F-stat	103	74.57	107.9	83.75
District FE	yes	yes	yes	yes
year FE	yes	yes	yes	yes
State trends	yes	yes	yes	yes
political controls	yes	yes	no	yes

Notes: Robust standard errors clustered at the district level in parentheses. ***, ** and * represent significance at 1 percent, 5 percent and 10 percent levels respectively. The outcome is BMI in all regressions. All regressions include woman, husband, household and district characteristics; see Table 1.5. All columns use 2 percent cutoff for close elections. Columns 1 and 2 restrict the sample to women whose autonomy z-score is below the 50th percentile score and columns 3 and 4 those above or equal to the 50th percentile score. Autonomy score is the z-score from the sum of woman's response on decision-making power on woman's earnings, healthcare, large household purchases, visits to family, husband earnings and contraception.

Table 1.B.8: Female Leaders and Intimate Partner Violence.

Dependent variable:	(1) IPV	(2) Physical IPV	(3) Sexual IPV	(4) Emotional IPV
share of female leaders	-0.010	0.002	0.010	0.006
	(0.018)	(0.017)	(0.019)	(0.016)
Observations	56,617	56,617	56,617	56,617
first-stage F-stat	109.2	143.5	109.2	143.5
district FE	yes	yes	yes	yes
year FE	yes	yes	yes	yes
state trends	yes	yes	yes	yes
political controls	yes	yes	yes	yes

Notes: Robust standard errors clustered at the district level in parentheses. ***, ** and * represent significance at 1 percent, 5 percent and 10 percent levels respectively. The outcome is BMI in all regressions. All regressions include woman, husband, household and district characteristics; see Table 1.5. The sample is limited to women who answer questions on domestic violence. All columns use 2 percent cutoff for close elections.

Table 1.B.9: Female Leaders and Intimate Partner Violence: Heterogeneities

Panel A:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sample:	Less auto.	More auto.	Less auto.	More auto.	Less auto.	More auto.	Less auto.	More auto.
Outcome	IPV		Physical IPV		Sexual IPV		Emotional IPV	
share of female leaders	0.006	-0.136***	-0.006	-0.164***	0.013	-0.009	0.018	-0.096**
	(0.019)	(0.052)	(0.017)	(0.050)	(0.019)	(0.053)	(0.016)	(0.046)
Observations	50,264	6,353	50,264	6,353	50,264	6,353	50,264	6,353
first-stage F-stat	108.4	87.74	108.4	87.74	108.4	87.74	144	106.8
Panel B:			(1)	(2)	(3)	(4)	(5)	(6)
Sample:	Less tole.	More tole.	Less tole	More tole.	Less tole	More tole.	Less tole	More tole.
share of female leaders	0.003	-0.004	0.013	-0.003	0.009	0.051	0.019	-0.008
	(0.020)	(0.039)	(0.018)	(0.035)	(0.021)	(0.038)	(0.019)	(0.035)
Observations	39,875	16,742	39,875	16,742	39,875	16,742	39,875	16,742
first-stage F-stat	98.16	92.20	126.7	123.7	98.16	92.20	126.7	123.7
district FE	yes	yes	yes	yes	yes	yes	yes	yes
year FE	yes	yes	yes	yes	yes	yes	yes	yes
state trends	yes	yes	yes	yes	yes	yes	yes	yes
political controls	yes	yes	yes	yes	yes	yes	yes	yes

Notes: Robust standard errors clustered at the district level in parentheses. ***, ** and * represent significance at 1 percent, 5 percent and 10 percent levels respectively. The outcome is BMI in all regressions. All regressions include woman, husband, household and district characteristics; see Table 1.5. The sample is limited to women who answer questions on domestic violence. All columns use 2 percent cutoff for close elections. Panel A considers heterogeneities by level of decision-making autonomy and Panel B by the level of tolerance for violence.

Table 1.B.10: Female Leaders and Severe/Less Severe Physical Violence: Heterogeneities

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Outcome:	Severe physical IPV	Severe physical IPV	Less severe physical IPV	Less severe physical IPV	Severe physical IPV	Severe physical IPV	Less severe physical IPV	Less severe physical IPV
	Less auto.	More auto.	Less auto.	More auto.	Less tole	More tole.	Less tole	More tole.
share of female leaders	-0.016	-0.131**	-0.006	-0.135***	-0.019	-0.016	-0.014	-0.022
	(0.018)	(0.060)	(0.023)	(0.052)	(0.019)	(0.039)	(0.026)	(0.035)
Observations	50,264	6,353	50,264	6,353	39,875	16,742	39,875	16,742
first-stage F-stat	108.4	87.74	108.4	87.74	98.16	92.20	98.16	92.20
district FE	yes	yes	yes	yes	yes	yes	yes	yes
year FE	yes	yes	yes	yes	yes	yes	yes	yes
state trends	yes	yes	yes	yes	yes	yes	yes	yes
political controls	yes	yes	yes	yes	yes	yes	yes	yes

Notes: Robust standard errors clustered at the district level in parentheses. ***, ** and * represent significance at 1 percent, 5 percent and 10 percent levels respectively. The outcome is BMI in all regressions. All regressions include woman, husband, household and district characteristics; see Table 1.5. The sample is limited to women who answer questions on domestic violence. All columns use 2 percent cutoff for close elections. Columns 1 to 4 considers heterogeneities by the level of decision-making autonomy and columns 5 to 8 by the level of tolerance for violence.

Table 1.B.11: Female Leaders and Controlling Behaviours: Heterogeneities.

	(1)	(2)	(3)	(4)	(5)
Sample:	All	Less auto.	More auto.	Less tole	More tole.
Outcome:	Control beh.	Control beh.	Control beh.	Control beh.	Control beh.
share of female leaders	-0.008	0.022	0.006	0.003	0.075
	(0.036)	(0.031)	(0.046)	(0.030)	(0.051)
Observations	56,617	50,264	6,353	39,875	16,742
first-stage F-stat	143.5	81.09	72.30	74.40	72.38
district FE	yes	yes	yes	yes	yes
year FE	yes	yes	yes	yes	yes
state trends	yes	yes	yes	yes	yes
political controls	yes	yes	yes	yes	yes

Notes: Robust standard errors clustered at the district level in parentheses. ***, ** and * represent significance at 1 percent, 5 percent and 10 percent levels respectively. The outcome is BMI in all regressions. All regressions include woman, husband, household and district characteristics; see Table 1.5. The sample is limited to women who answer questions on domestic violence. All columns use 2 percent cutoff for close elections. Columns 1 considers the full sample of women who answer questions on controlling behaviour, columns 2 and 3 considers heterogeneities by the level of decision-making autonomy and columns 4 and 5 by the level of tolerance for violence.

Table 1.B.12: Female Leaders and Visit and Type of Health Facility Visited: Heterogeneities.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Outcome:		Visit to health facility in the last 3 months					Visit to public vs private hospital in the last 3 months			
Sample:	Overall	Less auto.	more auto.	Less tole	More tole.	Overall	Less auto.	more auto.	Less tole	More tole.
share of female leaders	0.021	0.029	-0.005	0.027	-0.010	-0.011	-0.002	-0.019	-0.012	-0.034
	(0.030)	(0.034)	(0.044)	(0.031)	(0.058)	(0.035)	(0.040)	(0.051)	(0.034)	(0.083)
Observations	62,693	44,076	18,617	55,897	6,796	28,295	19,875	8,420	25,200	3,095
first-stage F-stat	79.70	73.03	67.77	78.63	66.77	80.84	76	62.14	79.79	58.29
district FE	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
year FE	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
state trends	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
political controls	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes

Notes: Robust standard errors clustered at the district level in parentheses. ***, ** and * represent significance at 1 percent, 5 percent and 10 percent levels respectively. The outcome is BMI in all regressions. All regressions include woman, husband, household and district characteristics; see Table 1.5. The sample is limited to women who answer questions on domestic violence. All columns use 2 percent cutoff for close elections. The dependent variable in columns 1 to 5 is a dummy where 1 indicates whether the woman visited a health facility in the last 3 months, and it is also a dummy in columns 6 to 10 where 1 is for whether the visit was to a public facility. Columns 1 and 5 considers the full sample of women, columns 2 to 4 and 7 to 10 considers the different sub-samples of women by the level of decision-making autonomy and by the level of tolerance for violence.

Table 1.B.13: Female Leaders and Smoking and Drinking Behaviours: Heterogeneities

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Outcome:	Woman drinks alcohol					Woman smokes cigars/cigarettes				
Sample:	Overall	Less auto.	more auto.	Less tole	More tole.	Overall	Less auto.	more auto.	Less tole	More tole.
share of female leaders	-0.049	-0.054	-0.023	-0.045	-0.022	0.023	0.030	0.018	0.021	0.037
	(0.067)	(0.066)	(0.065)	(0.061)	(0.084)	(0.030)	(0.030)	(0.046)	(0.028)	(0.080)
Observations	74,006	51,983	22,023	66,015	7,991	74,006	51,983	22,023	66,015	7,991
first-stage F-stat	81.45	74.14	72.49	80.88	67.09	81.45	74.14	72.49	80.88	67.09
district FE	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
year FE	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
state trends	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
political controls	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes

Notes: Robust standard errors clustered at the district level in parentheses. ***, ** and * represent significance at 1 percent, 5 percent and 10 percent levels respectively. The outcome is BMI in all regressions. All regressions include woman, husband, household and district characteristics; see Table 1.5. The sample is limited to women who answer questions on domestic violence. All columns use 2 percent cutoff for close elections. The dependent variable in columns 1 to 5 is a dummy where 1 indicates whether the woman drinks alcohol, and it is also a dummy in columns 6 to 10 where 1 is for whether the woman smokes cigars or cigarettes. Columns 1 and 5 considers the full sample of women, columns 2 to 4 and 7 to 10 considers the different sub-samples of women by the level of decision-making autonomy and by the level of tolerance for violence.

Table 1.B.14: Public Health Infrastructure, Political and District Characteristics

Panel A: Facilities, programs and initiatives	Obs.	Mean	SD	Min	Max
Number of Healthcare Resources	2671	1.398	1.386	0	6
Pharmacy	2668	0.519	0.500	0	1
AYUSH	2667	0.141	0.348	0	1
Village health guide	2669	0.516	0.500	0	1
ASHA	2669	0.579	0.494	0	1
Registered medical practitioner	2668	0.221	0.415	0	1
Auxiliary nurse	2667	0.522	0.500	0	1
Female doctor	2666	0.265	0.441	0	1
Non-formal education	2669	0.066	0.248	0	1
National Social Assistance Programme	2668	0.172	0.378	0	1
Sanitation programme	2668	0.518	0.500	0	1
Rajiv Gandhi National Drinking Water Mission	2669	0.208	0.406	0	1
Swarnjayanti Gram Swarozgar Yojana	2669	0.211	0.408	0	1
Minimum Needs Programme	2669	0.236	0.424	0	1
Panel B: Political and district characteristics					
Share of female leaders	2671	0	1	-.741	2.615
Share of female leaders than win in close elections against a man	2671	0	1	-.364	2.906
Whether there has been an election between a man and a woman	2671	0.652	0.476	0	1
Share of close elections between a man and a woman (Margin of vote < 2%)	2671	0.071	0.104	0	.375
Share of female population	2671	0.493	0.017	.45	.532
Male literacy rate	2671	0.757	0.073	.55	.89
Female literacy rate	2671	0.657	0.098	.435	.886

Notes: This table presents summary statistics of village-level public health infrastructure from the District Level Household and Facility Survey (DLHS) dataset in Panel A. In Panel B, political data and district characteristics that are merged to the village level data is presented. Political data is taken from the Trivedi centre for Political Data Indian Elections Dataset (TCPD-IED) and while district characteristics data is from the Office of the Registrar general & Census Commissioner of India. The sample includes only 6 states with elections occurring before the DLHS survey.

1.C Data

Elections data is taken from the Trivedi Centre for Political Data Indian Elections Dataset (TCPD-IED). The datasets used in this chapter range from the year 2010 to 2019, as indicated in Table 1.B.1. The original dataset is at the constituency level. But in this chapter, we aggregate it to the district level. First, we considered only districts that were available when the NFHS-4 was conducted. We only include districts that remained intact since the NFHS-4 through the NFHS-5, leaving us with 439 districts across 16 states. Second, we take all constituencies in each district and compute the total number of seats and the total number of seats won by women in the district. Finally, we compute the share of female leaders in each district using the total number of seats won by women divided by the total number of seats in the district.

We finally merge the election data with the individual-level data using the district where the woman lives and the year of the election. As female leaders needed to have been in power to influence women's outcomes, we match each woman to her female leaders in the election that happened prior to the woman being interviewed in the NFHS survey. For instance, if a woman who lives in the state of Gujarat is interviewed during the NFHS-4 in the year 2015, we match her with the share of female leaders from her district in Gujarat to which assembly elections occurred in 2012. For a woman interviewed in the NFHS-5 in the years 2019-2021, we match her with the female leaders in her district from the 2017 elections.

CHAPTER 2

When Women Lead: Early Birth and Fertility Choices Among Women in India.

2.1 Introduction

The main objective of this chapter is to examine how female political representatives can influence early birth and fertility choices of women, with a specific focus on young age outcomes. This study is motivated by various factors.

First, tackling early birth among girls is particularly essential for a country's development, as childbirth in adolescence poses health risks for both mothers and their newborns as well as financial strain on disadvantaged households (Winter & Nambiath, 2016). Young age pregnancies come with their own complications during and after the pregnancy (United Nations Development Programme [UNDP], 2024). It is one of the causes of health problems and adolescent deaths, in part because young mothers are less likely to seek medical care (Castilla, 2018). Together with early marriages, early pregnancies can create vulnerabilities as they may result in school drop-out and consequently reduced opportunities to develop social networks that can jeopardise their income-earning potential (Castilla, 2018). In light of this, one way in which Goal 3 of the Sustainable Development Goals, which seeks to "ensure healthy lives and promote well-being for all at all ages," is to reduce the adolescent birth rate by 2030 (United Nations [UN], 2015). In 2022, the adolescent birth rate, births per 1000 women ages 15 to 19 years in India, was estimated to be 16.3 (UNDP, 2024). While this figure is lower than the South Asian rate of 27.9 and the world's rate at 41.9 per 1000 births, it is an important issue to address as teenage pregnancy has negative social and economic consequences for both the mother and child (Castilla, 2018).

Second, given the rise in concerns about female leadership in developing countries, it has become increasingly important to further study whether female representatives in government can make a difference to women's wellbeing. There are reasons for expecting that the presence of female leaders can make a difference to birth and fertility choices. One is that the direct effects of their policies can create economic opportunities for young children, especially girls, by increasing their desire for better opportunities for their future. The priorities of female politicians more often have been family, women and children oriented (Thomas, 1991). More than men, they are more likely to focus on legislation that may concern, for example, childcare, girls' education, teenage pregnancies, child marriages, and domestic violence (Thomas, 1991). In the context of India, women have favoured primary, middle, and secondary school policies (Clots-Figueras, 2011), with both girls and boys having attained at least primary education in urban areas (Clots-Figueras, 2012). Female legislators have easily raised policy issues relating to healthcare (Chattopadhyay & Duflo, 2004) and invested in health infrastructure like primary health centres and government hospitals (Bhalotra & Clots-Figueras, 2014; Anukriti et. al., 2022).

The other reason is that role models formed out of female leaders can lower gender stereotypes and improve girls' ideas of what is possible to achieve as a woman. Beaman et al. (2012) argue that female officeholders are not only role models for girls and women but also, for men, their stereotypical beliefs concerning women's contributions to society may change. Role models can reduce the number of child brides and the age at first marriage and gauna[23] (Castilla, 2018), can cause families to reduce the practice of sex selection allowing girls to be born (Kalsi, 2017), and when visible and viable, can improve girls' participation in politics (Campbell & Wolbrecht, 2006).

[23] In India, the gauna ceremony represents the consummation of marriage if one partner entered into the relationship before the legal age of consent. In such a case, the marriage ceremony would have been held earlier and that partner continuous to stay with their parents or guardian. After the gauna ceremony takes place when they become adults, they are allowed to move in with their partner and consummate the marriage (Castilla, 2018).

To examine the impact of exposure to female leaders on women's birth and fertility outcomes, we address the issue of endogeneity of politician's gender by employing the Instrumental Variable (IV) approach using the share of female leaders that win in close elections as an instrument for the share of female leaders. This method and type of instrument have been widely used (see, for instance, Bhalotra & Clots Figueras, 2014; Anukriti et al., 2022). We employ data from the National Family Health Survey (NFHS) and match women with their female leaders using state assembly political data from the Trivedi Centre for Political Data-Indian Elections Dataset (TCPD-IED). Because we examine early birth outcomes for women between ages 13 to 18, we compute the share of female leaders for these women in their states from years before age 13. We construct our main explanatory variable, using the average share of female leaders for the first 12 years of life at the state level. We also construct the close election instrument using the same number of years. In some specifications where we examine births beyond this age, age 13 to 18 averages are instead used.

This chapter contributes to a large empirical literature that examines the impact of female representation, whether or not from being elected through quotas or reservations.[24] Unlike other studies that analyse different outcomes as discussed in the literature section and also in the previous chapter, we examine the implications of electing female leaders for individuals' decision making around fertility and childbirth. This paper also relates to the literature on the determinants of children's and women's wellbeing from a developing

[24] Liu (2018) and Kuipers (2020) on political role models in East and Southeast Asia and Indonesia, respectively, Iyer et. al. (2012) on crimes, Chattopadhyaya and Duflo (2004) on female-leader policies in Rajasthan and West Bengal (states in India), Deininger et. al. (2020) on economic empowerment of women in India, and Ghani et. al. (2014) on entrepreneurship of women in India.

country perspective.[25] Additionally, although some studies have examined women's fertility outcomes, the ability to examine the effects on women's birth from a younger age makes our paper different, as there is a scarcity of literature examining how female leaders may have influenced individuals' outcomes at a younger age. Finally, our study also investigates some potential channels, such as early marriage, the labour market, and educational attainments, through which women may delay first birth and make decisions on their overall fertility when exposed to female leaders.

Our results show that an increase in female representation is associated with a decline in the likelihood that women have their first births early. Specifically, we find a decline in the likelihood of first births before age 17, before age 19, and between age 19 and 23. In addition, our overall fertility regressions show that women's desire for more children also declines. In our heterogeneous effects analysis, this latter result appears to be driven by Christian and Scheduled Tribes (ST) women. Moreover, our attempt to explore potential channels shows that education and labour market outcomes do not vary with female representation. Rather, we find that women are not likely to be married at a younger age, suggesting that late marriage appears to explain our results for the delay in first birth outcomes. Our results are robust to using alternative close election thresholds and using shorter time periods for the construction of our main explanatory variable.

The remainder of the chapter is as follows: Section 2.2 presents a review of relevant literature. In Section 2.3, we outline the description of data and descriptive statistics. Section 2.4

[25] Castilla (2018) on child marriage, Halim et. al. (2016) on education, Kalsi (2017) on sex selection, Bhalotra and Clots-Figueras (2014) on child mortality.

presents the empirical strategy while Section 2.5 presents our empirical estimates of the effect of female representation on the outcomes of interest and finally, Section 2.6 concludes.

2.2 Literature Review: Evidence of the Role Model Effect

Even if female political representation in state government is low, there is ample evidence that female officeholders in state legislatures influence certain policy decisions, especially those that pertain to women and children (Beaman et al., 2011; Beaman et al., 2012; Bhalotra & Clots-Figueras, 2014). As they play a major role in developing health policies, and health is a salient issue, the question of whether their policies specifically target women's fertility is imperative. Theoretically, the gender of politicians might not matter in determining the type of policies implemented. As Downs (1957) put it, if politicians are concerned with sticking to policies pledged to electorates and care about winning elections, the policies enacted will solely reflect electorates' preferences, and politicians' gender will be irrelevant. In the absence of such obligations and promises made to electorates, gender will play a role, since increased office holdings of a certain group with a particular identity can affect their policy decisions related to that group (Besley & Coate, 1997). As a result, female legislators in this context can influence policy affecting women and children.

Chapter one summarises empirical research on women's policy influence. To summarise, evidence has shown that female leaders influence the provision of female-friendly public goods such as primary and community health centres, government hospitals, and dispensaries (Bhalotra & Clots-Figueras, 2014; Anukriti et al., 2022), influence women's participation in the labour market through initiatives such as the National Rural Employment Guarantee Scheme (Deininger et al., 2020), and improve access to finance for female entrepreneurs (Ghani et al., 2014). In the United States, Thomas (1991) discovers that women are more inclined to favour legislation addressing women, children, and family issues. In addition, they find that these are improved, and women are easily able to pass such legislation in states with the highest proportion of female representatives in the statehouse than in those with fewer representatives, as the former receives more support not only from women but also from their male counterparts when such issues are raised.

While women's descriptive and substantive representation in politics are important and have often been studied in the literature, their symbolic representation has often been overlooked. Proponents of female leadership have argued that female representation signals to women and young girls that leadership is not only a man's game and as well signals to them about what is possible to achieve (Campbell & Wolbrecht, 2006; Liu, 2018). Female leaders thus become symbolic figures or role models to look up to, enabling them to envision themselves as equal to their male counterparts (Liu, 2018).

The majority of studies in this area have been focused on how quotas that reserve seats for women generate role models. Kalsi (2017) documents a reduction in sex selection favouring girls following the passage if India's 73rd constitutional amendment act, which reserved local seats for women. In their difference-in-difference analysis, the likelihood that a child born after reservations is a male declines. They observe that the mechanism is women's increased status through the appointment of female chairpersons in local elections who are seen as role models, rather than the expectation of improvements in infrastructure that help in the survival of children or by restrictions on access to sex detection technologies, which may reduce infanticides. While this study is important, Kalsi (2017) does not particularly address early birth choices in her study.

Corroborating Kalsi (2017), Campbell and Wolbrecht (2006) argue that the visibility and viability of female leaders play a role in how young women respond to finding role models. Using a US sample, they find that having visible female candidates, those who compete in high-profile political offices, and having viable female candidates, those who win races or achieve a margin of 10 points closer to the winner in an election, results in adolescent young girls having a high potential for political involvement. These are further enhanced by the level of socialisation in their families. Another available piece of evidence by Ghani et al. (2014) suggests that reservation of political seats for women enhances women's engagement in informal sector firms through heightened access to finance and also provides inspiration for entrepreneurs through existing female establishments.

Role models may also improve a whole society's stereotypical beliefs surrounding women and girls. Beaman et al. (2012) evidence this by examining the effect of reservations on parental and children's aspirations for children. They find declining gender gaps in career and educational aspirations in West Bengal after reservations were implemented twice in local elections. Both men and women, including their daughters have higher aspirations for the girl child than for the boy child.

Castilla (2018) finds that child marriage declines when women are exposed to female leaders via the quota system. Women who have political role models are more likely to marry or have their gauna later in life, and are less likely to become child brides. The author argues that this is possible if stereotypes about women and existing gender norms are modified in favour of women. Since one way women can have early birth is by getting married at an early age, the fact that women marry at a later age could be translated into having births at a later date. This channel is explored in this chapter.

According to Liu (2018), the role model effect may be context specific and influenced by social structures. They argue that, for example, whereas much of East and Southeast Asia (ESA) has experienced an improvement in women's political power, this has not been matched by an increase in women's social power. This indicates to women that their place in society is not improved. As a result, even in areas where women's political empowerment has improved, the role model effect may not be experienced since social norms still remain unfavourable to women. Using a sample of 13 ESA countries, they indeed find that female representation decreases women's political involvement, including political discussions, voting behaviour, and campaign and protest activities.

While these studies are imperative, they have not been able to address whether female leaders can influence women's early birth and fertility decisions.

2.3 Data and Descriptive Statistics

We employ two sources of data. The National Family Health Survey (NFHS), which provides us with information on women's health and fertility and other demographics, and the Trivedi Centre for Political Data-Indian Elections Dataset (TCPD-IED), which provides political data in India from the 1960's to date.

The NFHS

We restrict our analysis to the last three rounds of the NFHS of India conducted in years 2005/2006, 2015/2016, and 2019/2021. We use the ever-married women's sample and include women who have ever given birth from 19 major states in India[26]. Because our electoral data starts in 1961, we include only women born in and after 1961 and women born

[26] These states include Andhra Pradesh, Assam, Bihar, Chhattisgarh, Gujarat, Haryana, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Meghalaya, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, Uttarakhand and West Bengal.

before 2003. Hence, women in our sample are aged 19 to 49 years old, born between 1961 and 2002. Using the year 2002 as the last year women are born in our sample is important, as the last survey period 2019/2021 ensures that we can observe a woman's fertility outcomes during her teenage years if she was born in 2002 and is sampled from this survey. Because we study births around the teenage years, we further drop some women who have had births before age 13, a total of which are about 5000 women.

A few women living in some states, including Chhattisgarh, Jharkhand, Uttarakhand, Haryana, and Meghalaya, were born before the states were formed. For these states, we include only women born after the states were formed. These states were carved out of other states at the time they were formed.[27] This is to ensure that we have state-level assembly election political data for all women from the time they were born. We also restrict the sample to women who have lived all their lives in their current place of residence. This is to ensure that we match women with their state's female leaders, as movement would mean that they are exposed to different leaders and possibly a different political environment. We finally obtained almost 40000 women in our sample (see Appendix 2.C).

Our early birth outcome variable is 1 if a woman had her first birth during her teenage years and 0 otherwise. Teenage years are defined as any first birth occurring between ages 13 and 18. In other regressions, we observe other fertility outcomes, including first birth occurring from 13 to 16 years old and from 19 to 23 years old. Table 2.1 presents the descriptive statistics for the NFHS data. The sample consists of more than 30, 000 women from 19 states in India. Roughly 17 percent belong to a scheduled caste, while 32 percent belong to a

[27] Chhattisgarh and Jharkhand were part of Madhya Pradesh and Bihar, respectively, until the year 2000. Uttarakhand was also cut from Uttar Pradesh in 2000. Haryana was part of the northern part of Punjab until 1966. Meghalaya was formed in 1972 by carving out 2 districts from Assam.

scheduled tribe (ST). About 79 percent of women in the sample reside in rural areas. Around 24 percent are the poorest, and 68 percent and 9 percent are Hindus and Muslims, respectively. On average, women have their first births at age 20. About 12 percent have their first births before 17 and about 31 percent before age 19. First births between 19 and 23 years old are the highest at 49 percent.

Further descriptive statistics are shown in the appendix. Figure 2.A.1 shows that the age at first birth usually peaked at around age 20 for women in almost all states. [28] Age at first birth has also increased over the years, as shown in Figure 2.A.2, which plots the fraction of women in each five-year cohort bin giving birth to their firstborn at specific ages. For instance, the year of birth 1971 represents women born from 1971 to 1975. All points above 1971 denote the fraction of women from the 1971 cohort having their first birth before age 16 (8%), before age 19 (29%), between 19 and 23 years (46%), and before age 24 (75%). We observe that the fraction of women having their first birth by these ages drops by younger cohorts. While women seem to have their first births by at least age 24, a lower fraction of younger cohorts born from 1991 to 2001 (2003) have their first births before this age. The stark differences show that, for instance, compared to women born in 1961, of which about 80 percent have their first births by age 24, only about 15 percent of women born in the 2001 cohort have their first birth before age 24.

The TCPD-IED

We use state assembly political data from the Trivedi Centre for Political Data—Indian Elections Dataset (TCPD-IED), which contains information on all elected candidates in all constituencies across all states. We again utilise legislative assembly election results in this

[28] We use the sample of data for 19 states in India used in this study.

chapter. Because we want to examine the impact of female leaders in the state where women were born on their fertility outcomes during teenage years, we needed to use the share of female leaders they have been exposed to before their adolescent years since only female leaders they have been exposed to before those years can influence their behaviour during those years. Hence, we calculate the average share of female leaders in a woman's birth state throughout the first 12 years after she was born. First, because the data only includes results at the constituency level, we aggregate the gender of winners from the constituency to the state level. Second, we compute the share of female leaders by state and year. Finally, we compute the average share of female leaders for the 12 years. We then match women in the NFHS with their female leaders using their state and year of birth (see Appendix 2.C).

Appendix Table 2.B.1 shows an example of how this is computed. Take, for instance, woman C who was born in 2000 and has lived in State 3 since she was born. She would have turned 12 in 2012. This means that female politicians that could have had an influence on her fertility decisions before she becomes a teenager are female leaders elected from 2000 to 2012. Given that there have been three statewide elections within this period, we take the average of the three, including 2000, 2004 and 2009. This gives an average of 0.20, or 20 percent, as shown in the last column. In some other regressions, we use longer and shorter time periods, including 13- to 18-year averages, averages from age 6 to 12, and so on.

Similar to Chapter one, the share of female leaders in close elections is used as an instrument for the share of female leaders that win elections generally. Hence, we follow a similar approach as is done above to compute the share of female leaders that win close elections against a man by computing 12-year, 13- to 18-year, and other shorter-year averages. In the section that follows, we explain the instrument, its validity in detail, and its usefulness.

Table 2.1: Descriptive statistics of Individual and Political Data

Panel A: Individual variables	N	Mean	Std. Dev.
Age at first birth	36149	20.593	3.882
First birth before age 17	36149	0.124	0.329
First birth before age 19	36149	0.307	0.461
First birth from ages 19 to 23	33070	0.491	0.500
Caste			
SC	36149	0.173	0.378
ST	36149	0.322	0.467
OBC	36149	0.358	0.479
Others	36149	0.147	0.354
Religion			
Hindu	36149	0.676	0.468
Muslim	36149	0.085	0.279
Christian	36149	0.214	0.410
Sikh	36149	0.005	0.072
Others	36149	0.020	0.138
Wealth Quantile			
Poorest	36149	0.235	0.424
Poorer	36149	0.258	0.437
Middle	36149	0.229	0.420
Richer	36149	0.171	0.377
Richest	36149	0.107	0.309
Residence			
Rural	36149	0.786	0.410
Urban	36149	0.214	0.410
Sec education	36149	0.520	0.500
Married before 17	33068	0.265	0.441
Married before 19	33068	0.382	0.486
Married from ages 19 to 23	13,530	0.766	0.423
Number of children	20931	2.319	1.378
Ever had a child	30238	1.000	0.000
ideal number of children	20430	2.362	1.245
Ideal – actual number of children	20931	0.363	0.481
Panel B: Political Variables			
Share of female leaders (12 years average)	36149	0.060	0.059
Share of close elections (12 years average)	36149	0.009	0.017
Share of female leaders in close elections (12 years average)	36149	0.506	0.362
Share of female leaders (13 to 18 years average)	33070	0.095	0.110
Share of close elections (13 to 18 years average)	33070	0.014	0.035
Share of female leaders in close elections (13 to 18 years average	33070	0.571	0.375

Notes: Data on Individual variables is taken from the NFHS while political data is taken from the TCPD-IED. The threshold for close elections is 2%. 12-year average indicates averages computed for the first 12 years. 13 to 18 years average used in some regressions indicates averages computed from age 13 to age 18.

From the descriptive statistics in Table 2.1, the share of female leaders between 1961 and 2020, when the last woman born in 2002 would have turned 18, averaged 6 percent. This was computed from the 12-year average from the year of birth to age 12 for each woman. Similarly, about 0.9 percent of elections are close elections between a man and a woman, with women winning about half of those elections.

2.4 Empirical Strategy

In this chapter, our first outcome of interest *F* is early birth outcomes. The effects of female representation on these outcomes are measured through 3 outcome variables. The first variable is an indicator that equals 1 if a woman *i* born in state s at time *t* gave birth to her first child from ages 13 to 18 years old and equals 0 for first birth happening at 19 years or later. Second, we construct a dummy variable for first birth from ages 13 to 16 and lastly from ages 19 to 23. The next outcome of interest measures women's fertility outcomes. For this we use total number of children, ideal number of children and women's desire for more children. We estimate the following two-stage least squares instrumental variable model:

$$F_{ist} = \delta_s + \tau_t + \beta\, SF_{st} + \theta PC_{st} + \pi X_{ist} + \varepsilon_{ist} \qquad (1)$$

$$SF_{st} = \gamma_s + \varphi_t + \rho\, SFC_{st} + \sigma PC_{st} + \omega X_{ist} + \mu_{ist} \qquad (2)$$

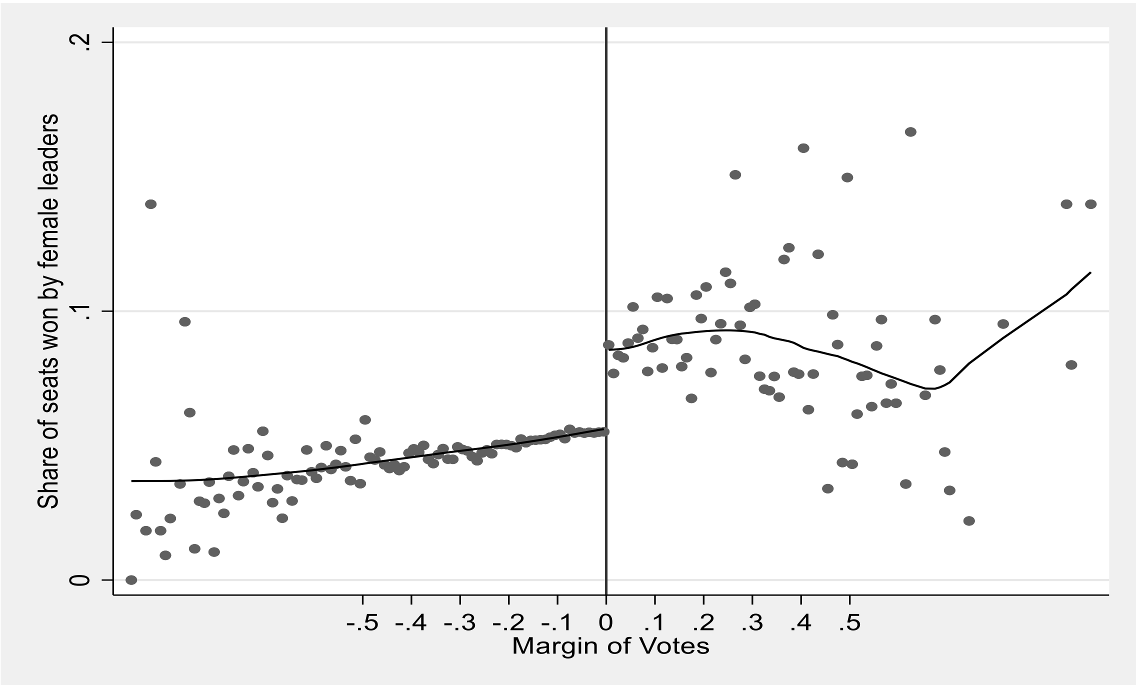
δ_s and τ_t denote a set of state and woman's cohort of birth fixed effects, respectively. State-specific time trends capturing gradually evolving trends by state are included in some specifications. SF_{st} captures the average share of female leaders for all elections exposed to a woman in state *s* within the first 12 years of life. This is instrumented by the average share of female leaders that win in close elections against a man, SFC_{st} in state *s* in equation 2. All regressions include the average proportion of close elections PC_{st} and other individual characteristics X_{ist} which include dummies for castes (SC, ST, OBC and Others), religion

(Hindu, Sikh, Muslim, Christian and Others), wealth quantiles (poorest, poorer, middle, richer, and richest), residence in a rural area, and finally secondary educational attainment. We have implemented a double clustering method and clustered standard errors at the state-year level.

The coefficient of interest β measures the likelihood of early birth or fertility. As SF_{st} may be correlated with both the outcome variable F_{ist} and ε_{ist} through for instance unobserved state characteristics, we use the same IV method and instrument for SF_{st} with SFC_{st} in Chapter one. This gives us predicted values of SF_{st} in equation 2, which is then used in estimating the coefficient of interest β in equation 1. F_{ist} must be correlated with SFC_{st} only through SF_{st}, hence, a need to check the whether SFC_{st} is a valid instrument.

In an RDD setup, as explained by Imbens and Lemieux (2008), we would like to see whether the effect of treatment, which in this case is women winning close elections, can be seen by a sudden jump in the outcome (women winning elections in general) around the cutoff (the point where women barely win close elections). We show a simple graph that plots the margin of victory against the share of female leaders that win elections in Figure 2.1. The data used spans from 1961 to 2020, when the youngest women in the sample would have been 18 years old. We use raw election results to sketch this figure. From the figure, the right-hand side of 0 on the margin of vote axis is when women win in close elections between a man and a woman, while the left-hand side showing negative margins is when women lose or when men win. As soon as women start to win in a man-woman election, just after the 0 cutoff, we see a jump in the share of female leaders that win elections in general, which is about 3 percentage points. This indicates that winning in close elections is positively associated with the share of female leaders in general. Notice that, although we use the average share of female leaders in our main regressions as stated in specifications (1) and (2), we do not use it here in this graph but rather use the raw values from each constituency assembly election. Using the raw values allows us to group the margins of victory into 1 percentage point bins and assess the effect of individual close elections on the share of female leaders that win elections in general.

Figure 2.1: RDD for First Stage



Notes: This graph plots the raw values of the share of female leaders from each election year in each state using data from the TCP-IED. All points have been put into 1 percentage point bins. Elections here include only male-female elections.

Validity of the Instrument

The validity of the instrument is shown by the McCrary (2008) test in Figure 2.A.3, which tests whether the running variable, the vote margin, is discontinuous at the zero threshold. Any discontinuity would indicate the invalidity of the RDD, as that shows that the discontinuity with the share of female leaders may not have been caused by women winning in close elections but may have been caused by, for instance, politicians' manipulation of their margins of vote, which leaves the share of female leaders also discontinuous. The whole idea of the RDD will be invalidated because the jump would not have been caused by women winning close elections. In Figure 2.A.3 with a p-value of 0.603, we find no evidence of any discontinuity in the density of the forcing variable (margin of votes) around the cutoff, proving that the RDD design is valid and the share of female leaders that wins in close elections can be used as an instrument for the share of female leaders that win elections in general.

Additionally, we test that other constituency characteristics do not differ for women and men who win in close elections. This is to ensure that we do not mistakenly attribute the impacts of these other characteristics to the gender of winners. We do this using the same t-tests run in chapter one, comparing constituency characteristics of women who win in close elections against men who win in close elections. The results are depicted in Table 2.B.2. I test for whether a winner was the incumbent, number of winner votes, number of constituency valid votes, number of constituency candidates, turnout, and finally belonging to independent parties, local parties, national parties, state parties, and other parties. Men and women who win in close elections do so in places where they do not differ by these characteristics except in terms of party types. Since we are interested in capturing the gender of politicians and not party affiliations, we control for the fraction of winners from these parties in our robustness analysis.[29]

Lastly, we check whether individuals vary in characteristics other than the gender of the winner in close elections. Since we use the share of female leaders from 0 to 12 years and from 13 to 18 years in our baseline regressions for early birth and fertility, respectively, we report results for using these two to verify individual characteristics in Tables 2.B.3 and 2.B.4. In the tables, we regress individual characteristics such as rural residency, caste, religion, and secondary school attainment on the share of female leaders while instrumenting it with the share of female winners in close elections. In Table 2.B.3, using 0 to 12 year averages, we show that individual characteristics are not significantly predicted by the share of female leaders that win in close elections. In the same vein, using 13 to 18-year averages in Table 2.B.4 further proofs individual characteristics are not different.

2.5 Results

2.5.1 Effects on Birth Outcomes

Table 2.2 presents the OLS estimates. The OLS estimates show in most cases a negative and significant effect of female representation on the likelihood of first birth before age 19, before age 17, and from age 19 to 23. The OLS coefficients are lower than the IV estimates as will be shown in subsequent tables, hence proven to be downward biased.

Table 2.3 presents the estimates for the effects of female representation on early birth outcomes using specifications 1 and 2 and the data from the NFHS and TCPD-IED.[30] The

[29] Bhalotra et al. (2013) similarly control for the fraction of winners from the BJP and INC parties, as their tests demonstrate a statistically significant difference in party ideology between Muslim and non-Muslim leaders.

[30] We present the full list of covariates in the Appendix.

Table 2.2: OLS: Effects of Female Representation on Early Birth Outcomes

	(1)	(2)	(3)	(4)	(5)	(6)
Outcome variable:	=1 if first birth before age 19		=1 if first birth before age 17		=1 if first birth from age 19 to 23	
SF: Average share of female leaders (age 0 to 12)	-0.328***	-0.330***	-0.235***	-0.237***		
	(0.067)	(0.068)	(0.050)	(0.050)		
SF: Average share of female leaders (age 13 to 18)					-0.035	-0.035
					(0.030)	(0.030)
N	39,333	39,333	39,333	39,333	39,329	39,329
R-squared	0.068	0.068	0.044	0.044	0.026	0.026
state FE	yes	no	yes	no	yes	no
cohort FE	yes	yes	yes	yes	yes	yes
state trends	no	yes	no	yes	no	yes
Controls	yes	yes	yes	yes	yes	yes

Notes: Robust standard errors clustered at the state-year level in parenthesis. ***, ** and * represent significance at 1 percent, 5 percent and 10 percent respectively. The outcome variable is first birth before 19 in columns (1) and (2), first birth before age 17 in columns (3) and (4) and first birth from age 19 to 23 in columns (5) and (6). In columns (5) and (6), the share of female leaders is computed as the average share of female leaders from age 13 to age 18 and the share of female leaders that win in close elections are also computed using same period averages. Columns (1), (3) and (5) control for state fixed effects and cohort fixed effects while columns (2), (4) and (6) control for cohort and state trends. Individual controls include religion, rural-urban residency, castes, wealth index and secondary school attainment. We also control for the share of close elections between a man and a woman in the state. Full regression results are shown in Appendix Table 2.B.5.

sample is restricted to women from 19 major states in India, aged 19 and above, who have lived in the same state since their birth. In columns (1) to (3), the outcome variable is an indicator that equals 1 if the woman had her first birth before age 19. In columns (4) to (6), it is equal to 1 if the woman had her first birth before age 17. Columns (1), (2), (4), and (5) include fixed effects for state and birth cohort, while columns (3) and (6) replace state FE with state trends. Columns (2), (3), (5), and (6) also control for individual covariates (religion, wealth quantiles, castes, rural residency, and secondary education attainment). The coefficient of *SF*, the share of female leaders, β, is negative and highly significant in all columns. In the chosen specifications in columns (3) and (6), the coefficients are 0.786 when

Table 2.3: IV: Effects of Female Representation on Early Birth Outcomes (First Birth Before 19 and Before 17)

Panel A: Second stage						
Outcome variable:	=1 if first birth before age 19			=1 if first birth before age 17		
	(1)	(2)	(3)	(4)	(5)	(6)
SF	-0.775***	-0.783***	-0.786***	-0.154	-0.315**	-0.316**
	(0.257)	(0.247)	(0.249)	(0.170)	(0.151)	(0.152)
Panel B: First stage						
Outcome variable:	SF: Average share of female leaders (age 0 to 12)					
SFC	-0.034***	-0.039***	-0.039***	-0.034***	-0.039***	-0.039***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
N	46,076	36,149	36,149	46,076	36,149	36,149
State FE	yes	yes	no	yes	yes	no
Cohort FE	yes	yes	yes	yes	yes	yes
State trends	no	no	yes	no	no	yes
Controls	no	yes	yes	no	yes	yes
First-stage F-stat	44.38	64.06	63.77	44.38	64.06	63.77

Notes: Robust standard errors clustered at the state-year level in parenthesis. ***, ** and * represent significance at 1 percent, 5 percent and 10 percent levels respectively. In Panel A, the outcome variable is first birth before 19 in columns (1) to (3) and first birth before age 17 in columns (4) to (6). Columns (1) and (4) control for state and cohort fixed effects, columns (2) and (5) include individual controls while columns (3) and (6) control for state trends. Individual controls include religion, rural-urban residency, castes, wealth index and secondary school attainment. We also control for the share of close elections between a man and a woman in the state. Full regression results are shown in Appendix Table 2.B.6.

the outcome variable is first birth before age 19 and 0.316 when the outcome variable is first birth before age 17. This implies that women are less likely to have their first births before 19 years and 17 years of age. More specifically, we find that increasing the share of female leaders by one percentage point is associated with a decline in the likelihood that a woman gives birth to her first child before age 19 (before age 17) by 0.786 (0.316) percentage points. To put this into context, we consider the effect size of an additional female leader elected in a state. Given that the median number of constituency seats in a state is 8 seats and the median share of female leaders is 0, electing an additional woman increases the median share of seats from 0/8 to 1/8 or 0.125. This shows that, increasing the share of female leaders by 0.125 percentage points (by 1 additional woman), reduces the likelihood of early birth before age 19 by 0.098 percentage points and reduces the likelihood of early birth before age 17 by 0.04 percentage points.

Beyond age 18, women can further be influenced by female leaders to pursue a career or better educational opportunities after secondary education (Castilla, 2018). Since higher education beyond this level usually occurs after age 18 and may take up to age 23, we examine whether female representation influences early birth from age 19 to age 23. This

Table 2.4: IV: Effects of Female Representation on Early Birth Outcomes (First Birth from 19 to 23 years)

Panel A: Second stage	(1)	(2)	(3)
Dependent variable:	=1 if first birth from age 19 to 23	=1 if first birth from age 19 to 23	=1 if first birth from age 19 to 23
SF	-1.129**	-1.038**	-1.042**
	(0.464)	(0.413)	(0.415)
Panel B: First stage			
Dependent variable:	SF: Average share of female leaders (13 to 18)		
SFC	-0.043***	-0.047***	-0.047***
	(0.013)	(0.014)	(0.014)
Observations	12,311	11,697	11,697
state FE	yes	yes	no
cohort FE	yes	yes	yes
state trends	no	no	yes
controls	no	yes	yes
first-stage F-stat	10.42	11.19	11.15

Notes: Robust standard errors clustered at the state-year level in parenthesis. ***, ** and * represent significance at 1 percent, 5 percent and 10 percent levels respectively. In Panel A, the outcome variable is first birth between 19 to 23 years. The share of female leaders is computed as the average share of female leaders from age 13 to age 18 and the share of female leaders that win in close elections are also computed using same period averages. We also include same controls as in Table 3.3. Full regression results are shown in Appendix Table 2.B.6.

contributes to the understanding of women's attitudes about childbirth and motherhood in general when exposed to female role models or female leaders who can implement policies that benefit women. The results are shown in Table 2.4. In this table, the outcome variable is binary, and it is 1 for first births occurring from age 19 to age 23 years and 0 for first births occurring after 23 years old. We alter the RHS variable to capture female representation in years just before the woman turns 19. That is, the share of female leaders, which is our main variable of interest, is the average share of female leaders from age 13 to age 18. We again find that female representation is negatively associated with first birth between 19 to 23 years. The coefficient is even larger, indicating a slightly bigger effect of female representation on the likelihood of first birth around this age range. Thus, our chosen specification in column 3 shows that, a one percentage point increase in the share of female leaders a woman is exposed to is associated with a 1.042 percentage points decrease in the likelihood that a woman will have her first child between 19 and 23 years of age, compared to having a child after this age range. In context, increasing the share of female leaders in a state by 0.125 percentage points (i.e. by one additional woman) corresponds to a 0.13 percentage points decline in the likelihood of birth between ages 19 and 23. Overall, the findings show that indeed female representation is beneficial for young girls' development by decreasing the probability that women have their first birth at a young age.

Unlike Anukriti et al. (2022) paper that finds no changes to birth outcomes such as whether or not a child is born or the number of children given birth to by a woman when exposed to female leaders, we find that female political representation can cause women to delay having a child. Our findings are more consistent with Castilla (2018), who finds that reserved seats for women decrease women's age at first marriage and the number of child brides, as well as similar to Beaman et al. (2012) on improvements in educational aspirations for girls when female leaders become role models. Noting that girls can delay childbirth by substituting it with education or by having to engage in marriage at a later age, we explore in subsequent sections these underlying channels.

The first stage estimates from the IV specification in equation 2 are also shown in Tables 2.3 and 2.4. We find the instrument to be a strong predictor of the share of female leaders. They, however, carry negative signs, which is contrary to expectation. In fact, in Figure 2.1, we show a jump in the share of female leaders when women win in close elections just around the cutoff of 0, which is positive, although regressions using average values show a negative association. Again, a sketch in Figure 2.A.4 in the Appendix proves the negative correlation between the two variables measured in averages.

An alternative way of examining how female leaders influence women's childbearing decisions is to look at women's fertility. Both Anukriti et al. (2022) and Bhalotra and Clots-Figueras (2014) find that both the number of children and probability of birth do not necessarily vary when women are exposed to female leaders. However, Anukriti et al. (2022) find increasing birth spacing among women exposed to female leaders. Here, we investigate the effects of female representation on the total number of children, the ideal number of children, and the desire for more children. We instrument our share of female leaders measure with the close elections measure as before. The results are shown in Table 2.5.

In columns (1) and (2) of Table 2.5, the outcome variable equals the total number of children ever born to a woman. In columns (3) and (4), the outcome variable is the total ideal number of children. In columns (5) and (6), it is an indicator for desiring more children, and it is a dummy variable equal to 1 if a woman's ideal number of children is greater than her total number of children and 0 if it is lesser. The OLS coefficients in columns (1), (3) and (5) are negative and not significant and are smaller than the IV coefficients showing the these coefficients may have been underestimated due to endogeneity.

From the IV estimates in Table 2.5, we find no significant effect of female representation on women's total number of children and ideal number of children in columns (2) and (4). In column (6), we find a significant negative effect of the share of female leaders on the indicator for desiring more children. A one percentage point increase in the presence of female leaders results in a 1.062 percentage points decline in the desire for more children than a woman has. This indicates that exposure to female leaders is associated with a decrease in the likelihood that a woman would desire more children than she already has.

Table 2.5: OLS and IV: Effects of Female Representation on Total Fertility

	(1)	(2)	(3)	(4)	(5)	(6)
	Total number of children		Ideal number of children		Ideal – actual number of children	
Dependent variable:	OLS	IV	OLS	IV	OLS	IV
SF	-0.102	1.333	-0.019	1.461	-0.039	-1.062***
	(0.169)	(1.454)	(0.088)	(1.054)	(0.034)	(0.342)
Panel B: First stage for IV						
SFC		-0.047***		-0.046***		-0.047***
		(0.014)		(0.014)		(0.014)
Observations	25,052	20,931	24,379	20,430	25,052	20,931
cohort FE	yes	yes	yes	yes	yes	yes
state trends	yes	yes	yes	yes	yes	yes
controls	yes	yes	yes	yes	yes	yes
first-stage F-stat		11.82		11.36		11.82

Notes: Robust standard errors clustered at the state-year level in parenthesis. ***, ** and * represent significance at 1 percent, 5 percent and 10 percent respectively. In columns (1) and (2), the outcome variable is an indicator for the total number of children ever born to a woman. In column (3) and (4) it is the total ideal number of children for a woman. In column (5) and (6) is binary for whether 1 a woman's ideal number of children is greater than her actual number of children. We use 13 to 18 years average to compute the share of female leaders and the corresponding share of female leaders in close elections. All regressions include controls as in baseline Table 2.3. Full regression results are shown in Appendix Table 2.B.7.

Although our baseline results show that when women are exposed to female leaders, they are likely to delay first births, here when they do start to have children, they may not desire more than they presently have. Overall, this finding may be the result of girls finding role models in female leaders who themselves have fewer children, causing them to alter their desire for more children (Anukriti et al., 2022) or a result of direct policies by female political officeholders that prevent women from having more children by providing opportunities for career advancements (Castilla, 2018).

2.5.2 Robustness

The randomness of the gender of winners in close elections only occurs within the small area where either a man or a woman could win and their vote margin is small, almost zero. Hence, it is important to examine whether the outcome of our results will change when the threshold for close elections is altered. We examine the effects of female representation on both early birth and fertility outcomes using different close election thresholds: 1%, 1.5%, 2.5%, and 3%. This alteration is in line with some studies that have shown no changes to estimates when close election thresholds are altered slightly around the cutoff of zero (Anukriti et al., 2022; Bhalotra et al., 2013). The results are shown in Appendix Table 2.B.8. The outcome variables are all early birth and fertility outcomes as in baseline regressions. We narrow the threshold below the baseline 2% in columns (1), (2), (5), and (6) and increase it above 2% in columns (3), (4), (7), and (8). The signs of the coefficients do not change, although the magnitudes are higher while some are smaller in some cases than the baseline estimates. Our results suggest that women delay first birth and as well may not want more children than they already have when they are exposed to female leaders.

In Tables 2.B.9, we use alternative measures of the average share of female representation (Clots-Figueras, 2012). We measure the share of female leaders using the average share of female leaders from age 6 to 12, from age 7 to 12, from age 8 to 12, and lastly from age 9 to 12 and run only early birth estimates. These shorter time periods thus control for the possibility that years exposed to female leaders closer to the teenage years may be more effective in affecting decisions. Our results show that, the coefficients carry the same signs as in our baseline estimates, although they are only marginally significant in some cases,. This may be consistent with female legislators being able to effect changes when they have rather stayed longer in power.[31]

Lastly, we include political party controls in Table 2.B.10. These political party controls include the share of winners from each of five party groups: independent parties, local parties, national parties, state parties; and other parties.[32] This allows us to show that party group affiliations is not reason behind our estimates but indeed, our estimates are a result of electing female leaders irrespective of these affiliations. Although it only increases and the estimates are not statistically significant in some cases, we find that the signs of the coefficients remain robust to the inclusion of these party controls.

2.5.3 Effects on Marriage and Education

This section examines the effects of female political representation on the timing of first marriage and educational attainment. One potential way young girls may have children early in life is by getting married at an early age. Female political leaders could shape their attitude towards early marriage, which may reduce the likelihood of having children at that early age. Even parental beliefs about girls' achievements could improve as a result of female leaders serving as symbols to reduce societal stereotypical notions about them (Beaman et al., 2012) lending support to their delayed timing of marriage. Because early marriage is one reason

[31] Bhalotra et al. (2013) find similar results when they find that the share of Muslim representation in the year prior to primary education had no significant effect on illiteracy and primary school attainment.
[32] Both Anukriti et al (2022) and Bhalotra and Clots-Figueras (2014) include the fraction of seats won by seven major parties. In Bhalotra and Clots-Figueras (2014) they include: soft left, congress, Hindu, regional parties, independents, Janata and hard left parties.

why women may have first births early, it is important to examine whether female leaders influence the age at first marriage. Available evidence from Castilla (2018) shows that in places where seats are reserved for female leaders in India, women are more likely to delay their first marriage, have their gauna late, or are less likely to become child brides.

We use the same specifications in equations (1) and (2) but with early marriage dummy variables as the outcome variables. The results from the marriage regressions shown in Table

Table 2.6: Effects on Marriage

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Married before 17		Married before 19		Married from 19 to 23	
SF: Average share of female leaders (age 0 to 12)	-0.686***	-0.694***	-0.891***	-0.901***		
	(0.214)	(0.216)	(0.263)	(0.265)		
SF: Average share of female leaders (age 13 to 18)					0.024	0.026
					(0.231)	(0.231)
First stage:						
SFC: Average share of female leaders that win in close elections against a man (age 0 to 12)	-0.040***	-0.040***	-0.040***	-0.040***		
	(0.005)	(0.005)	(0.005)	(0.005)		
SFC: Average share of female leaders that win in close elections against a man (age 13 to 18)					-0.042***	-0.042***
					(0.013)	(0.013)
Observations	33,068	33,068	33,068	33,068	13,530	13,530
State FE	yes	no	yes	no	yes	no
Cohort FE	yes	yes	yes	yes	yes	yes
state trends	no	yes	no	yes	no	yes
first-stage F-stat	67.48	67.18	67.48	67.18	10.48	10.51

Notes: Robust standard errors clustered at the state-year level in parenthesis. ***, ** and * represent significance at 1 percent, 5 percent and 10 percent levels respectively. In Panel A, the outcome variable is first marriage before 17 in columns (1) and (2), first marriage before age 19 in columns (3) and (4) and first marriage from age 19 to age 23 in columns (5) and (6). Columns (1), (3) and (5) control for state and cohort fixed effects while columns (2), (4) and (6) control for cohort fixed effects and state trends. All regressions include other controls as in the baseline Table 2.3.

2.6 are similar to Castilla (2018). In columns (1) and (2), the outcome variable is a dummy for first marriage before age 17, where 1 represents first marriage before 17 years and 0 otherwise. It is also a dummy in columns (3) to (6). In columns (3) and (4), 1 represents first marriage before 19 years, and in columns (5) and (6), 1 represents first marriage from 19 to 23 years of age and 0 otherwise. The coefficients show a negative and significant association between the share of female leaders and the age at first marriage in columns (1) to (4). Overall, women are less likely to have their first marriage before 17 and before 19. The coefficients thus translate into a 0.694 and a 0.901 percentage points decrease in the likelihood of first marriage before 17 and before 19 for a 1 percentage point increase in the share of female representation. This appears to show that indeed the presence of females in political positions causes women to delay their age at first marriage, which potentially causes a delay in their age at first birth. In columns (5) and (6) when the outcome variable is first marriage from 19 to 23 years, the coefficients are not significant.

Regarding education, if female leaders can influence women to delay their first birth around their adolescent or teenage years, one potential explanation to that is that around the time, they may have pursued secondary school education as those years are the age range around which children are expected to be in secondary school. Consequently, women may delay births to chase their educational aspirations. Beaman et al. (2012) show that girls' educational aspirations improve after seats are reserved for women in the panchayat system. Similarly, Clots-Figueras (2012) finds that constituents attain at least primary education when exposed to female state legislators in India. In this study, we examine whether female leaders in state legislatures influence women's secondary school attainment, which may explain why they delay first births. In Table 2.7, there is no evidence of a significant effect on women's likelihood of attaining secondary education after several years of being exposed to female leaders; hence, our baseline results cannot be explained by the secondary education channel.

Table 2.7: Effects on Educational Outcomes

VARIABLES	(1) Had secondary education	(2) Had secondary education
SF: Average share of female leaders (age 0 to 12)	-0.035	-0.038
	(0.258)	(0.256)
First stage:		
SFC: Average share of female leaders that win in close elections against a man (age 0 to 12)	-0.039***	-0.039***
	(0.005)	(0.005)
Observations	36,149	36,149
state FE	yes	no
cohort FE	yes	yes
state trends	no	yes
first-stage F-stat	63.53	63.82

Notes: *:* Robust standard errors clustered at the state-year level in parenthesis. ***, ** and * represent significance at 1 percent, 5 percent and 10 percent levels respectively. The dependent variable is dummy for secondary education attainment. It is equal to 1 if the woman has had at least secondary education and 0 otherwise. The outcome variable is an indicator for whether the woman had secondary education or not. Column (1) controls for state and cohort fixed effects while column (2) controls for cohort fixed effects and state trends. All regressions include controls as in the baseline Table 2.3 with the exception of education.

2.5.4 Effects on Labour Market outcomes

In this section, we examine the effects of female political representation on women's labour force participation. One way in which female leaders can influence women's delayed birth choices is by influencing their labour market outcomes. Women may focus on their career paths by observing political role models and delaying time for having children. Female politicians may also influence the labour market through their policies that favour women's employment (Anukriti et al., 2022; Ghani et al., 2014).

Due to data limitations, it is difficult to access women's labour market outcomes when they were younger, between 13 and 18 years old. The closest sample to this age range are women

Table 2.8: Effects on Labour Force Participation

	(1)	(2)	(3)
Outcome variable:	Worked	Worked in the last seven days	Worked in last year
Share of female leaders	1.287	1.243	-0.024
	(1.239)	(1.273)	(0.412)
Proportion of sc/st reserved seats	0.038	0.035	-0.002
	(0.056)	(0.059)	(0.019)
Proportion of general seats	0.006	-0.002	0.003
	(0.040)	(0.039)	(0.011)
Observations	6,709	6,709	6,709
cohort FE	yes	yes	yes
state trends	yes	yes	yes

Notes: Robust standard errors clustered at the state-year level in parenthesis. ***, ** and * represent significance at 1 percent, 5 percent and 10 percent levels respectively. The share of female leaders is computed as the average share of female leaders from age 13 to age 18 and the share of female leaders that win in close elections are also computed using same period averages. Individual controls and the share of close elections are also included.

in the survey from ages 19 to 23 years. This is plausible since our baseline analysis also includes the effects on women's birth outcomes within this range. The NFHS datasets provide us with information on current labour force participation, at least since the last seven days and the previous years before the respective surveys. Hence, we are able to examine the effects of female representation on current labour market outcomes of women between ages 19 and 23. We use the average fraction of female leaders from age 13 to age 18 to examine the effects of female representation on women's labour market outcomes. We further control for the proportion of general seats and sc/st reserved seats in our regressions, as these can also affect women's inclination to the labour market.

The results are shown in Table 2.8. The outcome variable is whether a woman has worked either in the past year or the last seven days in column (1). In columns (2) and (3), we examine separately the effects on work in the last seven days and in the past year, respectively. All coefficients show that women's labour market outcomes do not vary with female representation. Hence, the labour market analysis does not help in explaining our baseline results. If younger women from 19 to 23 years spent ample time in education, then we would not expect this channel to work for these women. Nevertheless, our education channel does not allow us to examine educational attainments within this age range.

2.5.5 Heterogeneous Effects

In this section, we examine the existence of heterogeneities in the effect of female representation on women's early birth and fertility outcomes. Heterogeneous effects are important as they help in revealing which group of women respond to female political representation as role models or which group is influenced by their policies. We focus on heterogeneous effects by religion and caste, as women from different groups may exhibit varying effects. Table 2.9 presents results for religion heterogeneities, while Table 2.10 presents results for caste heterogeneities.

In Table 2.9, we do not find heterogeneities by religion with the different outcomes for age at first birth in columns (1) to (3) showing no disparities in the effects of female representation on early birth outcomes by religion. In column (6), Christian women are less likely to want more children than they already have when exposed to female leaders. In Table 2.10, if anything, we find a weak heterogeneous effect for ST women with first birth before age 19 in column (1). A more prominent effect of female representation on fertility outcomes is found among ST women. ST women are less likely to want more children than they already have in column (7). Generally, our finding suggests that our results for fertility outcomes are driven by Christian and ST women who may not desire more children than they already have.

Table 2.9: Heterogeneity by Religion

	(1)	(2)	(3)	(4)	(5)	(6)
Sample	=1 if first birth before age 19	=1 if first birth before age 17	=1 if first birth from age 19 to 23	Total number of children	Ideal number of children	Ideal – actual number of children
Hindu	0.037	0.184	-0.265	0.113	-0.522	-0.331
	(0.372)	(0.261)	(0.256)	(0.813)	(0.549)	(0.250)
N	*24,432*	*24,432*	*21,052*	*14,436*	*14,385*	*14,436*
Muslim	9.820	4.431	-5.134	-40.280	1.685	4.844
	(11.218)	(5.589)	(11.288)	(91.894)	(14.107)	(12.037)
N	*3,086*	*3,086*	*2,700*	*1,877*	*1,851*	*1,877*
Christian	0.253	0.800*	-0.164	-1.014	1.177	-2.231**
	(0.564)	(0.468)	(0.487)	(2.890)	(1.957)	(0.966)
N	*7,736*	*7,736*	*5,785*	*4,145*	*3,762*	*4,145*
Sikh	10.277	0.343	14.218	-0.229	-0.183	-0.785
	(8.013)	(1.755)	(86.990)	(2.552)	(0.489)	(1.984)
N	*188*	*188*	*158*	*119*	*119*	*119*

Notes: Robust standard errors clustered at the state-year level in parenthesis. ***, ** and * represent significance at 1 percent, 5 percent and 10 percent levels respectively. The outcome variables are early birth outcomes in columns (1) to (3) and fertility outcomes in columns (4) to (6). Each coefficient is a result of a separate regression. All regressions include individual and political control as indicated in baseline Table 2.3.

Table 2.10: Heterogeneity by Caste

Sample	=1 if first birth before age 19	=1 if first birth before age 17	=1 if first birth from age 19 to 23	Total number of children	Ideal number of children	Ideal – actual number of children
SC	2.096	0.680	-0.351	0.621	-0.464	-0.218
	(2.517)	(1.811)	(0.511)	(1.491)	(1.366)	(0.565)
N	*6,240*	*6,240*	*5,493*	*3,552*	*3,537*	*3,552*
ST	-0.537*	-0.046	-0.306	1.507	0.767	-1.774***
	(0.274)	(0.184)	(0.263)	(1.097)	(0.841)	(0.395)
N	*11,658*	*11,658*	*9,005*	*6,196*	*5,773*	*6,196*

Continuation of Table 2.10						
OBC	0.437	0.487	-0.122	-2.598	-1.720	-0.512
	(0.876)	(0.638)	(0.384)	(1.845)	(1.117)	(0.426)
N	*12,940*	*12,940*	*11,184*	*7,893*	*7,850*	*7,893*
Higher castes	-0.408	-0.392	-1.569	-1.112	1.632	0.612
	(0.819)	(0.633)	(1.240)	(2.765)	(2.224)	(1.011)
N	*5,311*	*5,311*	*4,556*	*3,290*	*3,270*	*3,290*

Notes: Robust standard errors clustered at the state-year level in parenthesis. ***, ** and * represent significance at 1 percent, 5 percent and 10 percent levels respectively. The outcome variables are early birth outcomes in columns (1) to (3) and fertility outcomes in columns (4) to (6). Each coefficient is a result of a separate regression. All regressions include individual and political control as indicated in baseline Table 2.3.

2.6. Conclusions

Female representation is an important factor in shaping the well-being of women and young girls, and it is receiving increasing attention in current research. In this chapter, we examine the effects of female representation on women's early birth and fertility choices in India. Pooling the last three cross-sectional rounds of data from the National Family Household Survey of India for 19 states and merging these with political data from the Trivedi Centre for Political Data-Indian Elections Dataset, we employ the instrumental variable approach to account for the endogeneity of politicians' gender using information on close elections between a man and a woman.

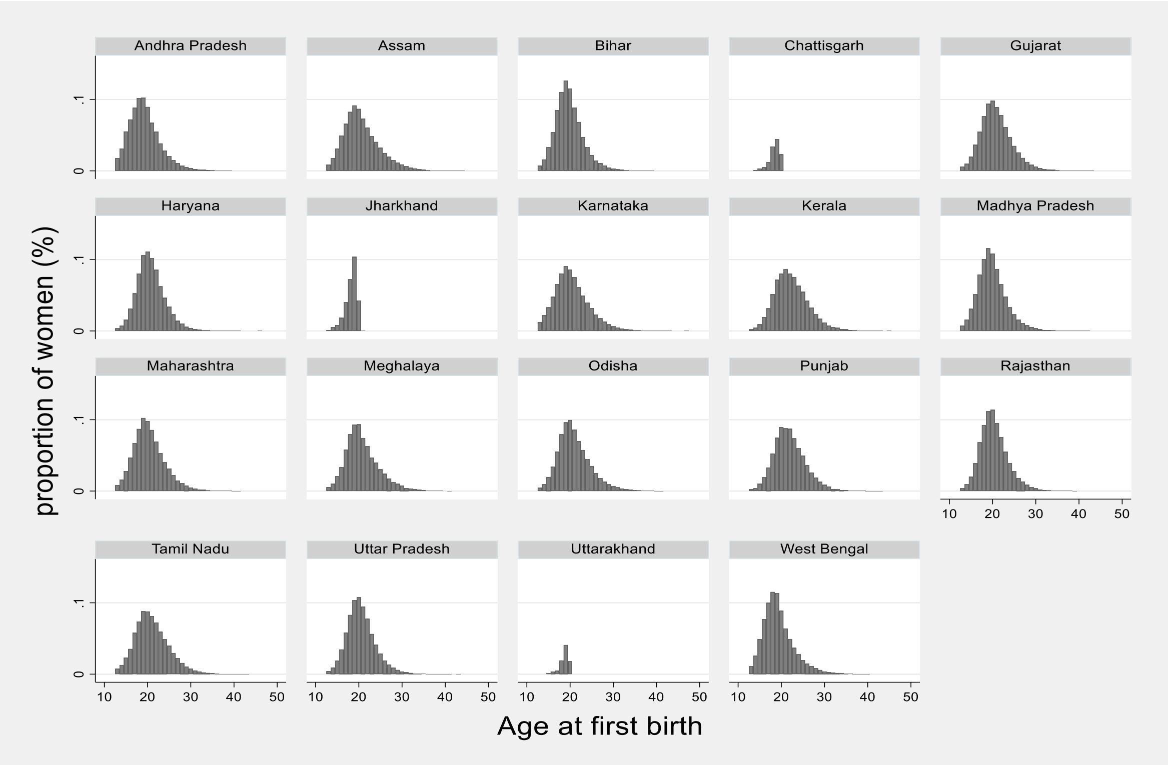
Our results provide evidence for the effect of female representation on lowered early birth and fertility among young women and women in general. We find that being exposed to female leaders before their teenage years by one percentage point, young girls are less likely to have their first births before age 19 by 0.786 percentage points, before age 17 by 0.316 percentage points, and between ages 19 and 23 by 1.042 percentage points. The results also depict a decline in the likelihood that a woman would desire more children than she actually has. Exploring possible channels through which this effect occurs, we find that the effect of female leaders on early birth appears to be driven by a delay in age at first marriage but not by educational attainments or labour market outcomes. Further heterogeneous effects show that Christian and Scheduled Tribe women drive the results.

In general, the findings show that female representation is beneficial for women's wellbeing as they can help prevent early births and shape women's fertility decisions by potentially acting as role models or by implementing policies that act in favour of women. Significant policy implications may include the need for policies that support electing more female leaders in leadership positions or ensuring gender equality in representation. As the 73rd Amendment Act of India only acts in favour of local-level female leaders, governments and stakeholders can prioritise the implementation of reservations for women in state legislatures, as women can be more powerful at the state level and help effect change that could positively alter the wellbeing of younger constituents.

Appendix 2

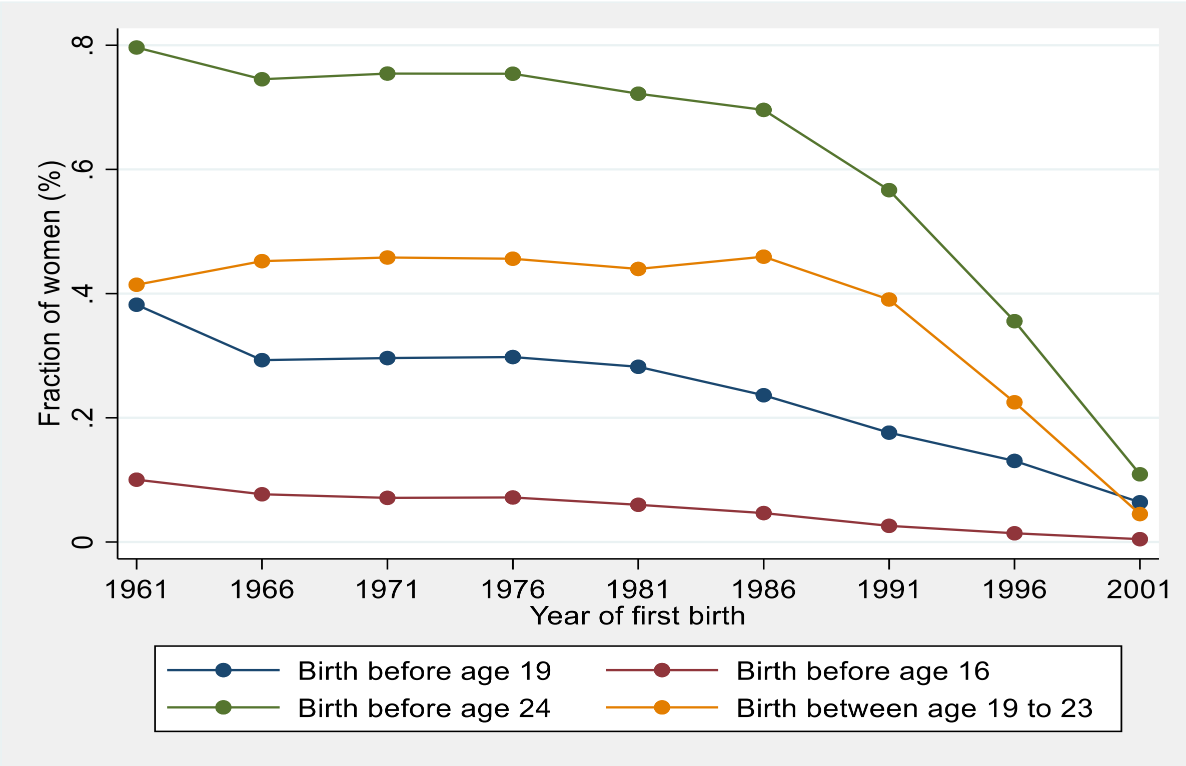
2.A Figures

Figure 2.A.1: Age at First Birth by State



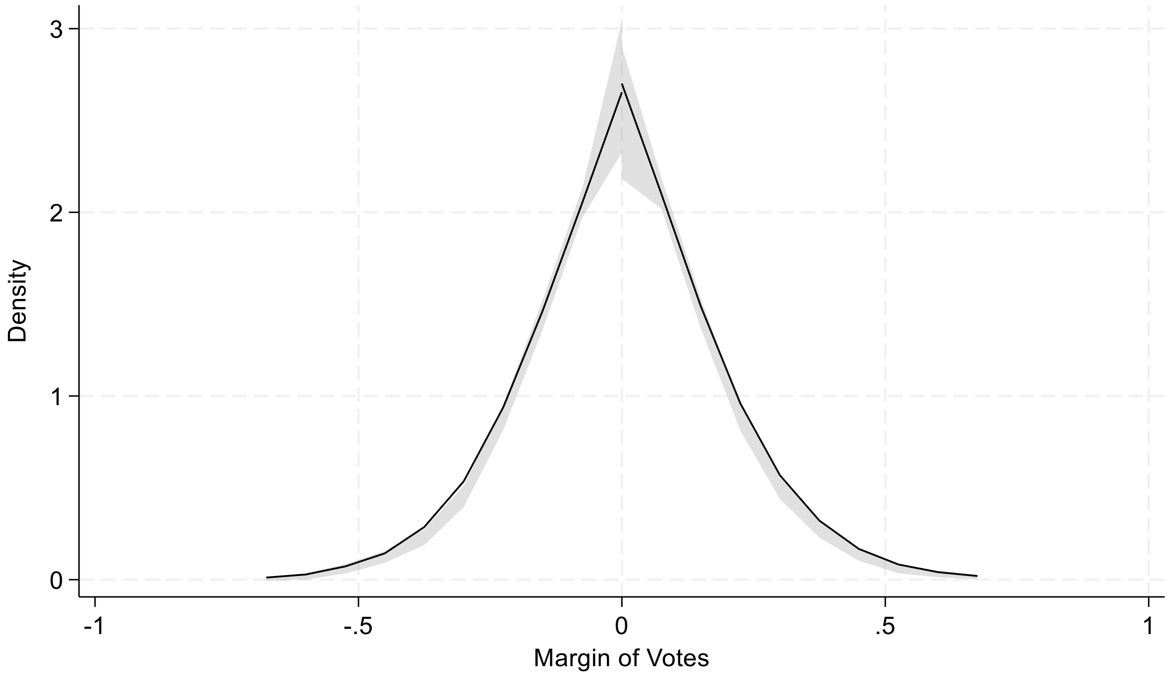
Notes: The Figure constructs the proportion of women having first births at various ages using a sample of 19 states in India.

Figure 2.A.2: First Birth by Cohort and Age



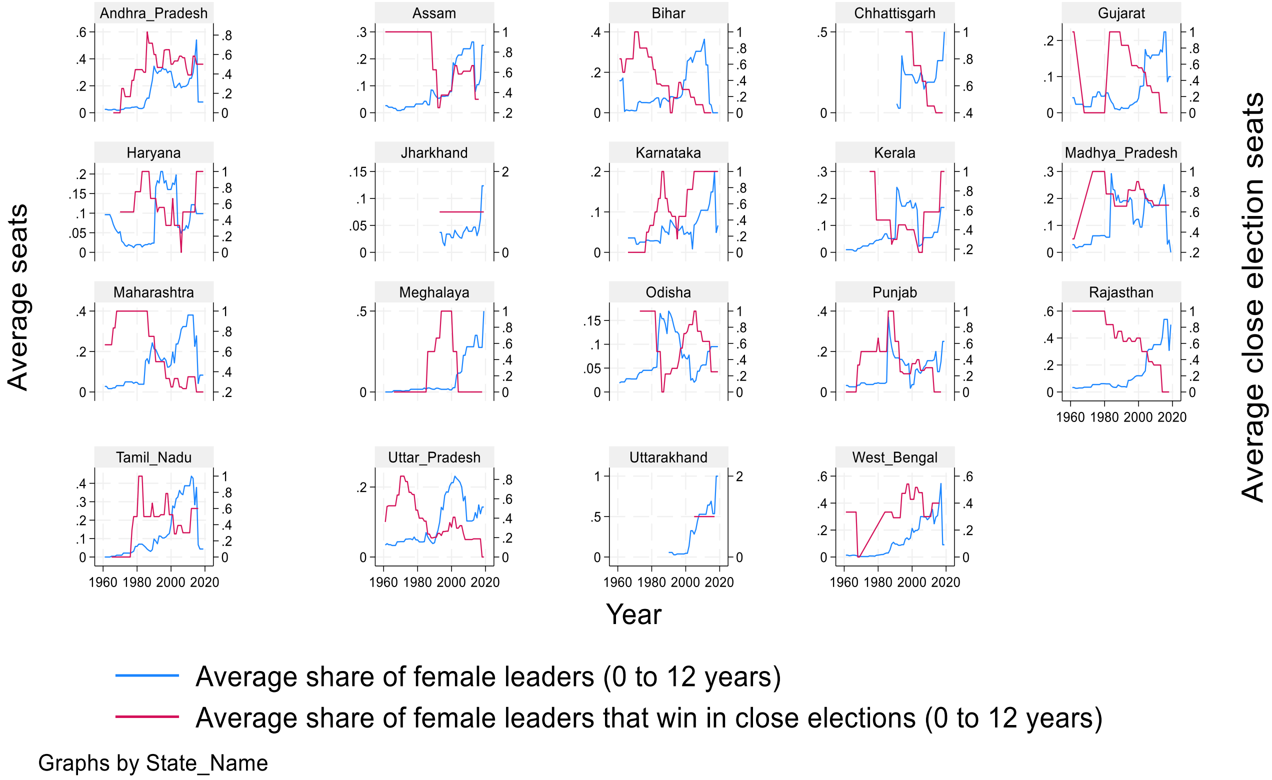
Notes: The Figure constructs the fraction of women in each cohort having first birth by specific ages of age range. Each year on the horizontal axis corresponds to 5 birth cohorts. For example, 1971 represents women born from 1971 to 1976 and so on.

Figure 2.A.3: McCrary Density Test for Manipulation of Margin of Votes



Notes: P-value = 0.603

Figure 2.A.4: Female Leaders in General and Female Leaders in Close Elections by State



Notes: The average share of female leaders sketched against the average share of female leaders that win in close elections. Close elections threshold is 2 percent. We use all 19 states in the sample.

2.B: Tables

Table 2.B.1: Data organisation

Woman	State	Year of Birth	Year turns 12	Elections within period (year and SF)				Average share of female leaders (average)
				Election 1	Election 2	Election 3	Election 4	
A	1	1975	1987	1971 0.25	***1976*** ***0.11***	***1981*** ***0.33***	***1986*** ***0.02***	0.153
B	2	1993	2005	***1993*** ***0.06***	***1998*** ***0.30***	***2003*** ***0.15***	2008 0.03	0.17
C	3	2000	2012	1994 0.09	***2000*** ***0.10***	***2004*** ***0.25***	***2009*** ***0.25***	0.20
D	4	1988	2000	***1988*** ***0.30***	***1990*** ***0.03***	***1994*** ***0.05***	***1999*** ***0.23***	0.153

Notes: Boldened and italicised texts are those elections included in computing the averages

Table 2.B.2: Proof that Constituency and Candidate Characteristics do not vary

Variable		Winner is a woman in close election (n=222)	Winner is a man in close election (n=221)	Difference
Winner is the incumbent	Mean	0.234	0.240	0.006
	Std. error	(0.028)	(0.029)	(0.040)
Number of winner votes	Mean	41899.33	43607.48	1708.151
	Std. error	(1358.109)	(1384.725)	(1939.493)
Total number of constituency valid votes	Mean	106691.1	114865.3	8174.213
	Std. error	(3093.63)	(3104.934)	(4383.04)
Total number of constituency candidates	Mean	10.496	10.303	-0.192
	Std. error	(0.380)	(0.356)	(0.521)
Turnout percentage	Mean	63.805	65.314	1.509
	Std. error	(0.925)	(0.882)	(1.278)
Independent parties	Mean	0.027	0.081	0.054**
	Std. error	(0.011)	(0.018)	(0.021)
Local parties	Mean	0.023	0.036	0.014
	Std. error	(0.010)	(0.013)	(0.016)
National parties	Mean	0.694	0.489	-0.205***
	Std. error	(0.031)	(0.034)	(0.046)
State parties	Mean	0.234	0.357	0.123***
	Std. error	(0.022)	(0.032)	(0.043)
Other Parties	Mean	0.029	0.036	0.014
	Std. error	(0.008)	(0.013)	(0.016)

Table 2.B.3: Proof that Individual Characteristics do not vary (SF is average of 0 to 12 years)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Outcome variable:	Rural residence	Secondary education	Poorest	Poorer	Middle	Richer	Richest
SF	-0.473	0.087	-0.456	0.078	0.105	0.275*	-0.000
	(0.169)	(0.270)	(0.193)	(0.196)	(0.193)	(0.166)	(0.131)
Share of close elections	-0.228	0.317	-0.206	-0.059	0.117	0.055	0.093
	(0.160)	(0.226)	(0.165)	(0.141)	(0.175)	(0.120)	(0.107)
Observations	36,149	36,149	36,149	36,149	36,149	36,149	36,149
first-stage F-stat	63.71	63.71	63.71	63.71	63.71	63.71	63.71
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Outcome variable:	Hindu	Christian	Muslim	Sikh	SC	St	OBC
SF	-0.016	0.090	0.106	-0.023	0.191	0.315*	-0.183
	(0.139)	(0.079)	(0.130)	(0.015)	(0.168)	(0.155)	(0.185)
Share of close elections	-0.060	0.015	0.071	-0.012	0.085	0.390***	-0.031
	(0.127)	(0.067)	(0.104)	(0.012)	(0.138)	(0.143)	(0.176)
Observations	36,149	36,149	36,149	36,149	36,149	36,149	36,149
first-stage F-stat	63.71	63.71	63.71	63.71	63.71	63.71	63.71

Notes: Robust standard errors clustered at the state-year level in parenthesis. ***, ** and * represent significance at 1 percent, 5 percent and 10 percent respectively. Here, we use the share of female leaders from 0 to 12 years and the corresponding share of female leaders that win in close elections from 0 to 12 years. All regressions include cohort fixed effects and state trends. We also include the share of close elections in the state as an additional control.

Table 2.B.4: Proof that Individual Characteristics do not vary (SF is average of 13 to 18 years)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Outcome variable:	Rural residence	Secondary education	Poorest	Poorer	Middle	Richer	Richest
SF	-0.022	0.056	0.031	0.031	0.061	-0.289*	0.181
	(0.145)	(0.249)	(0.173)	(0.173)	(0.193)	(0.156)	(0.123)
Share of close elections	-0.005	0.023	0.062	0.062	-0.075	0.093	-0.074
	(0.061)	(0.133)	(0.074)	(0.074)	(0.097)	(0.063)	(0.054)
Observations	30,238	30,238	30,238	30,238	30,238	30,238	30,238
first-stage F-stat	11.94	11.94	11.94	11.94	11.94	11.94	11.94
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Outcome variable:	Hindu	Christian	Muslim	Sikh	SC	ST	OBC
SF	-0.055	0.016	0.122	-0.004	-0.119	-0.078	-0.112
	(0.111)	(0.080)	(0.091)	(0.017)	(0.151)	(0.135)	(0.153)
Share of close elections	-0.049	0.056	-0.018	0.000	0.036	0.202**	-0.075
	(0.071)	(0.048)	(0.064)	(0.006)	(0.062)	(0.092)	(0.085)
Observations	30,238	30,238	30,238	30,238	30,238	30,238	30,238
first-stage F-stat	11.94	11.94	11.94	11.94	11.94	11.94	11.94

Notes: Robust standard errors clustered at the state-year level in parenthesis. ***, ** and * represent significance at 1 percent, 5 percent and 10 percent respectively. Here, we use the share of female leaders from 13 to 18 years and the corresponding share of female leaders that win in close elections from 0 to 12 years. All regressions include cohort fixed effects and state trends. We also include the share of close elections in the state as an additional control.

Full Regression Tables Showing All Additional Covariates

Table 2.B.5: OLS full Regression Results: Effects on Early Birth and Fertility Outcomes

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	=1 if first birth before age 19		=1 if first birth before age 17		=1 if first birth between age 19 and 23	
SF	-0.328***	-0.330***	-0.235***	-0.237***	-0.035	-0.035
	(0.067)	(0.068)	(0.050)	(0.050)	(0.030)	(0.030)
Prop. of close election	0.079	0.080	-0.049	-0.050	-0.010	-0.009
	(0.214)	(0.214)	(0.125)	(0.125)	(0.097)	(0.097)
Caste: SC						
ST	-0.019**	-0.019**	-0.022***	-0.022***	-0.002	-0.001
	(0.009)	(0.009)	(0.007)	(0.007)	(0.009)	(0.009)
OBC	-0.033***	-0.033***	-0.028***	-0.028***	0.026***	0.026***
	(0.007)	(0.007)	(0.006)	(0.006)	(0.008)	(0.008)
Others	-0.040***	-0.040***	-0.021***	-0.021***	0.024***	0.024***
	(0.008)	(0.008)	(0.007)	(0.007)	(0.009)	(0.009)
Religion: Hindu						
Muslim	0.011	0.010	0.012*	0.012*	0.028***	0.028***
	(0.009)	(0.009)	(0.007)	(0.007)	(0.010)	(0.010)
Christian	-0.003	-0.004	-0.004	-0.004	-0.010	-0.010
	(0.012)	(0.012)	(0.009)	(0.009)	(0.014)	(0.014)
Sikh	0.000	0.000	-0.013	-0.013	-0.096**	-0.096**
	(0.034)	(0.034)	(0.031)	(0.031)	(0.045)	(0.045)
Others	0.017	0.017	-0.000	-0.001	-0.042**	-0.042**
	(0.019)	(0.019)	(0.011)	(0.011)	(0.020)	(0.020)
Wealth Quintile: Poorest						
Poorer	0.028***	0.028***	0.012**	0.012**	-0.001	-0.001
	(0.007)	(0.007)	(0.005)	(0.005)	(0.008)	(0.008)
Middle	0.034***	0.034***	0.020***	0.020***	-0.004	-0.004
	(0.009)	(0.009)	(0.006)	(0.006)	(0.009)	(0.009)
Richer	0.036***	0.036***	0.015**	0.015**	-0.020**	-0.020**
	(0.011)	(0.011)	(0.007)	(0.007)	(0.010)	(0.010)

	(1)	(2)	(3)	(4)	(5)	(6)
Richest	-0.020	-0.020	-0.007	-0.007	-0.039***	-0.039***
	(0.012)	(0.012)	(0.008)	(0.008)	(0.013)	(0.013)
Residence: Rural						
Urban	-0.006	-0.006	-0.007	-0.007	-0.011	-0.011
	(0.007)	(0.007)	(0.005)	(0.005)	(0.007)	(0.007)
Sec. education	-0.174***	-0.175***	-0.101***	-0.101***	0.051***	0.051***
	(0.005)	(0.005)	(0.004)	(0.004)	(0.006)	(0.006)
Observations	39,333	39,333	39,333	39,333	39,329	39,329
state FE	yes	no	yes	no	yes	no
cohort FE	yes	yes	yes	yes	yes	yes
state trends	no	yes	no	yes	no	yes

Notes: Robust standard errors clustered at the state-year level in parenthesis. ***, ** and * represent significance at 1 percent, 5 percent and 10 percent levels respectively. The outcome variable is first birth before 19 in columns (1) and (2), first birth before age 17 in columns (3) and (4) and first birth from age 19 to 23 in columns (5) and (6). In columns (5) and (6), the share of female leaders is computed as the average share of female leaders from age 13 to age 18 and the share of female leaders that win in close elections are also computed using same period averages. Columns (1), (3) and (5) control for state fixed effects and cohort fixed effects while columns (2), (4) and (6) control for cohort fixed effects and state trends.

Table 2.B.6: IV Full Regression Results: Effects on Early Birth Outcomes

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	=1 if first birth before age 19		=1 if first birth before age 17		=1 if first birth between age 19 and 23	
SF	-0.783***	-0.786***	-0.315**	-0.316**	-1.038**	-1.042**
	(0.247)	(0.249)	(0.151)	(0.152)	(0.413)	(0.415)
Prop. of close election	0.007	0.007	-0.058	-0.058	0.165	0.167
	(0.225)	(0.226)	(0.129)	(0.129)	(0.288)	(0.289)
Caste: SC						
ST	-0.014	-0.014	-0.020***	-0.020***	-0.018	-0.018
	(0.010)	(0.010)	(0.008)	(0.008)	(0.020)	(0.020)
OBC	-0.033***	-0.033***	-0.028***	-0.028***	0.019	0.019
	(0.007)	(0.007)	(0.006)	(0.006)	(0.016)	(0.016)
Others	-0.040***	-0.040***	-0.021***	-0.021***	0.017	0.017
	(0.009)	(0.009)	(0.007)	(0.007)	(0.019)	(0.019)
Religion: Hindu						
Muslim	0.009	0.009	0.011	0.011	0.042**	0.042**
	(0.010)	(0.010)	(0.007)	(0.007)	(0.019)	(0.019)
Christian	-0.005	-0.006	-0.003	-0.004	-0.015	-0.016
	(0.012)	(0.012)	(0.010)	(0.010)	(0.024)	(0.024)
Sikh	0.002	0.003	-0.011	-0.011	-0.198***	-0.197***
	(0.034)	(0.034)	(0.031)	(0.031)	(0.061)	(0.061)
Others	0.012	0.012	-0.000	-0.001	-0.031	-0.031
	(0.020)	(0.020)	(0.012)	(0.012)	(0.059)	(0.059)
Wealth Quintile: Poorest						
Poorer	0.026***	0.026***	0.011**	0.011**	0.013	0.013
	(0.008)	(0.008)	(0.005)	(0.005)	(0.013)	(0.013)
Middle	0.028***	0.028***	0.015**	0.015**	-0.020	-0.020
	(0.009)	(0.009)	(0.006)	(0.006)	(0.016)	(0.016)
Richer	0.032***	0.032***	0.010	0.010	-0.040*	-0.040*
	(0.011)	(0.011)	(0.007)	(0.007)	(0.021)	(0.021)
Richest	-0.029**	-0.029**	-0.015*	-0.015*	-0.142***	-0.142***
	(0.012)	(0.012)	(0.008)	(0.008)	(0.025)	(0.025)

Residence: Rural						
Urban	-0.006	-0.006	-0.003	-0.003	-0.006	-0.006
	(0.007)	(0.007)	(0.005)	(0.005)	(0.015)	(0.015)
Sec. education	-0.172***	-0.172***	-0.101***	-0.101***	-0.125***	-0.125***
	(0.006)	(0.006)	(0.005)	(0.005)	(0.013)	(0.013)
Observations	36,149	36,149	36,149	36,149	11,697	11,697
state FE	yes	no	yes	yes	yes	no
cohort FE	yes	yes	yes	yes	yes	yes
state trends	no	yes	no	no	no	yes
first-stage F-stat	64.06	63.77	64.06	63.77	11.19	11.15

Notes: Robust standard errors clustered at the state-year level in parenthesis. ***, ** and * represent significance at 1 percent, 5 percent and 10 percent levels respectively. The outcome variable is first birth before 19 in columns (1) and (2), first birth before age 17 in columns (3) and (4) and first birth from age 19 to 23 in columns (5) and (6). In columns (5) and (6), the share of female leaders is computed as the average share of female leaders from age 13 to age 18 and the share of female leaders that win in close elections are also computed using same period averages. Columns (1), (3) and (5) control for state and cohort fixed effects while columns (2), (4) and (6) control for cohort fixed effects and state trends.

Table 2.B.7: OLS and IV Full Regression Results: Effects on Fertility Outcomes

	Total number of children		Ideal number of children		Ideal – actual number of children	
Dependent Variable:	OLS	IV	OLS	IV	OLS	IV
SF	-0.102	1.333	-0.019	1.461	-0.039	-1.062***
	(0.169)	(1.454)	(0.088)	(1.054)	(0.034)	(0.342)
Prop. of close election	0.420	0.011	0.095	-0.340	0.073	0.321
	(0.294)	(0.426)	(0.243)	(0.429)	(0.087)	(0.220)
Caste: SC						
ST	0.036	0.044	0.179***	0.167***	0.025**	0.019
	(0.031)	(0.032)	(0.027)	(0.027)	(0.011)	(0.012)
OBC	-0.137***	-0.131***	-0.006	-0.017	0.011	0.012
	(0.022)	(0.024)	(0.018)	(0.020)	(0.008)	(0.010)
Others	-0.197***	-0.176***	-0.059**	-0.073***	0.012	0.010
	(0.028)	(0.031)	(0.024)	(0.026)	(0.010)	(0.012)
Religion: Hindu						
Muslim	0.496***	0.491***	0.418***	0.417***	0.031***	0.020*
	(0.039)	(0.043)	(0.029)	(0.032)	(0.010)	(0.011)
Christian	0.375***	0.366***	0.442***	0.434***	0.049***	0.039**
	(0.066)	(0.073)	(0.064)	(0.071)	(0.016)	(0.018)
Sikh	-0.211*	-0.241*	-0.127	-0.077	0.095**	0.115**
	(0.115)	(0.128)	(0.081)	(0.081)	(0.046)	(0.052)
Others	0.493***	0.479***	0.733***	0.684***	0.134***	0.126***
	(0.113)	(0.122)	(0.133)	(0.149)	(0.026)	(0.030)
Wealth Quintile: Poorest						
Poorer	-0.244***	-0.215***	-0.099***	-0.110***	0.005	-0.000
	(0.029)	(0.029)	(0.029)	(0.033)	(0.009)	(0.011)
Middle	-0.384***	-0.361***	-0.128***	-0.133***	0.016	0.012
	(0.035)	(0.037)	(0.032)	(0.036)	(0.011)	(0.013)
Richer	-0.494***	-0.456***	-0.175***	-0.176***	0.035***	0.030**
	(0.034)	(0.036)	(0.037)	(0.043)	(0.013)	(0.014)
Richest	-0.656***	-0.608***	-0.223***	-0.233***	0.047***	0.038**
	(0.039)	(0.041)	(0.037)	(0.041)	(0.014)	(0.015)
Residence: Rural						
Urban	-0.064***	-0.072***	-0.087***	-0.076***	0.004	0.013
	(0.020)	(0.022)	(0.022)	(0.023)	(0.008)	(0.009)
Sec. education	-0.335***	-0.355***	-0.177***	-0.192***	0.017**	0.019**
	(0.022)	(0.024)	(0.019)	(0.020)	(0.007)	(0.008)
Observations	25,052	20,931	24,379	20,430	25,052	20,931
first-stage F-stat		11.82		11.36		11.82

Notes: Robust standard errors clustered at the state-year level in parenthesis. ***, ** and * represent significance at 1 percent, 5 percent and 10 percent respectively. In columns (1) and (2), the outcome variable is an indicator for the total number of children ever born to a woman. In columns (3) and (4) it is the total ideal number of children for a woman. In columns (5) and (6) it is a binary variable for whether a woman's ideal number of children is greater than her actual number of children.

Robustness Using Alternate Close Elections Threshold

Table 2.B.8: Effects on Early Birth and Fertility Outcomes

Panel A:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Outcome Variable:	=1 if first birth before age 19				=1 if first birth before age 17			
CE cutoff	1% SFC	1.5% SFC	2.5% SFC	3% SFC	1% SFC	1.5% SFC	2.5% SFC	3% SFC
SF	-0.932***	-0.821***	-1.135***	-0.725**	-0.516***	-0.360***	-0.533**	-0.227
	(0.238)	(0.193)	(0.372)	(0.330)	(0.141)	(0.120)	(0.237)	(0.234)
Prop. of close election	0.337	-0.054	-0.121	-0.106	0.891*	-0.092	-0.110	-0.102
	(0.708)	(0.227)	(0.235)	(0.219)	(0.462)	(0.130)	(0.131)	(0.124)
Observations	30,789	33,722	36,889	37,949	30,789	33,722	36,889	37,949
first-stage F-stat	42.74	97.35	23.85	29.40	42.74	97.35	23.85	29.40
Panel B:								
Outcome Variable:	=1 if first birth between 19 and 23				Total number of children			
CE cutoff	1% SFC	1.5% SFC	2.5% SFC	3% SFC	1% SFC	1.5% SFC	2.5% SFC	3% SFC
SF	-0.525	-0.136	-0.291	-0.357	8.431	3.131**	1.149	2.833
	(0.722)	(0.204)	(0.200)	(0.354)	(8.077)	(1.393)	(1.124)	(2.219)
Prop. of close election	0.333	0.001	0.044	0.062	-4.626	-0.609	-0.153	-0.721
	(0.428)	(0.110)	(0.130)	(0.167)	(4.810)	(0.602)	(0.389)	(0.890)
Observations	26,100	32,118	34,726	36,322	16,687	20,533	21,889	23,092
first-stage F-stat	1.285	13.95	18.19	4.852	1.290	12.89	20.78	5.324
Panel C:								
Outcome Variable:	Ideal number of children				Ideal – actual number of children			
CE cutoff:	1% SFC	1.5% SFC	2.5% SFC	3% SFC	1% SFC	1.5% SFC	2.5% SFC	3% SFC
SF	2.918	1.722*	0.982	2.337	-0.975	-0.744***	-0.624***	-1.318**
	(3.424)	(1.027)	(0.781)	(1.570)	(0.948)	(0.242)	(0.242)	(0.623)
Prop. of close election	-1.991	-0.433	-0.314	-0.782	0.522	0.220	0.238	0.495

	(2.022)	(0.439)	(0.354)	(0.701)	(0.575)	(0.148)	(0.148)	(0.325)
Observations	16,383	20,110	21,383	22,529	16,687	20,533	21,889	23,092
first-stage F-stat	1.146	12.43	20.53	5.048	1.290	12.89	20.78	5.324

Notes: Robust standard errors clustered at the state-year level in parenthesis. ***, ** and * represent significance at 1 percent, 5 percent and 10 percent respectively. In Panel A, the outcome variable is first birth before 19 in columns (1) to (4) and first birth before age 17 in columns (5) to (8). In Panel C, the outcome variable is first birth from 19 to 23 years in columns (1) to (4) and total number of children in columns (5) to (8). In Panel C, the outcome variable is ideal number of children in columns (1) to (4) and the difference between ideal and Total number of children in columns (5) to (8). All regressions include individual controls and control for cohort fixed effects and state trends.

Robustness Using Alternate Time Periods

Table 2.B.9: Effects on Early Birth Outcomes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Outcome variable:	=1 if first birth before age 19				=1 if first birth before age 17			
Robustness:	6 to 12 years	7 to 12 years	8 to 12 years	9 to 12 years	6 to 12 years	7 to 12 years	8 to 12 years	9 to 12 years
Sf (6 to 12 years)	-0.539*	-0.544*	-0.472	-0.342	-0.212	-0.187	-0.075	-0.030
	(0.277)	(0.304)	(0.383)	(0.403)	(0.181)	(0.199)	(0.264)	(0.306)
Prop. of close election (6 to 12 years)	0.138	0.157	0.155	0.140	-0.020	-0.036	-0.019	-0.024
	(0.161)	(0.154)	(0.132)	(0.120)	(0.089)	(0.083)	(0.078)	(0.071)
Caste: SC								
ST	-0.012	-0.011	-0.011	-0.009	-0.018**	-0.020**	-0.022***	-0.020**
	(0.010)	(0.010)	(0.011)	(0.011)	(0.008)	(0.008)	(0.008)	(0.009)
OBC	-0.030***	-0.028***	-0.028***	-0.028***	-0.026***	-0.026***	-0.027***	-0.027***
	(0.008)	(0.008)	(0.008)	(0.009)	(0.006)	(0.007)	(0.007)	(0.007)
Others	-0.038***	-0.035***	-0.036***	-0.032***	-0.023***	-0.023***	-0.023***	-0.021**
	(0.009)	(0.009)	(0.010)	(0.010)	(0.007)	(0.007)	(0.008)	(0.008)
Religion: Hindu								
Muslim	0.004	0.003	0.004	0.010	0.008	0.010	0.012	0.016*
	(0.010)	(0.011)	(0.011)	(0.012)	(0.007)	(0.007)	(0.008)	(0.008)
Christian	-0.011	-0.007	-0.010	-0.011	-0.002	0.006	0.006	0.008
	(0.014)	(0.014)	(0.015)	(0.015)	(0.011)	(0.011)	(0.012)	(0.013)
Sikh	0.017	0.034	0.038	0.048	-0.007	0.004	-0.012	-0.008
	(0.036)	(0.036)	(0.039)	(0.042)	(0.035)	(0.034)	(0.035)	(0.036)
Others	-0.008	-0.003	-0.003	-0.015	0.001	0.004	-0.002	-0.004
	(0.019)	(0.020)	(0.020)	(0.020)	(0.013)	(0.013)	(0.013)	(0.013)
Wealth Quintile: Poorest								
Poorer	0.025***	0.028***	0.026***	0.031***	0.010*	0.011*	0.012*	0.015**
	(0.008)	(0.008)	(0.009)	(0.009)	(0.006)	(0.006)	(0.006)	(0.007)
Middle	0.024**	0.026***	0.023**	0.025**	0.012*	0.014**	0.015**	0.018**
	(0.010)	(0.010)	(0.010)	(0.011)	(0.007)	(0.007)	(0.007)	(0.008)
Richer	0.028**	0.027**	0.026**	0.026*	0.008	0.007	0.009	0.010
	(0.012)	(0.013)	(0.013)	(0.014)	(0.008)	(0.009)	(0.009)	(0.010)

Richest	-0.029**	-0.029**	-0.033**	-0.029*	-0.015*	-0.015	-0.015	-0.014
	(0.014)	(0.014)	(0.015)	(0.015)	(0.009)	(0.009)	(0.009)	(0.010)
Residence: Rural								
Urban	-0.009	-0.008	-0.007	-0.007	-0.004	-0.006	-0.006	-0.007
	(0.008)	(0.008)	(0.008)	(0.009)	(0.005)	(0.006)	(0.006)	(0.006)
Sec. education	-0.175***	-0.176***	-0.175***	-0.175***	-0.101***	-0.102***	-0.100***	-0.100***
	(0.006)	(0.006)	(0.006)	(0.007)	(0.005)	(0.005)	(0.005)	(0.006)
Observations	31,462	30,122	28,844	24,630	31,462	30,122	28,844	24,630
first-stage F-stat	21.03	14.17	7.895	5.835	21.03	14.17	7.895	5.835

Notes: Robust standard errors clustered at the state-year level in parenthesis. ***, ** and * represent significance at 1 percent, 5 percent and 10 percent levels respectively. The outcome variable is first birth before 19 in columns (1) to (4) and first birth before age 17 in columns (5) to (8). The share of female leaders averages the share from age 6 to 12 in columns (1) and (5), 7 to 12 years in columns (2) and (6), 8 to 12 years in columns (3) and (7) and lastly 9 to 12 years in columns (4) and (8). All regressions control for cohort fixed effects and state trends.

Robustness Adding Political Controls

Table 2.B.10: Effects on Early Birth and Fertility Outcomes

Outcome Variable:	(1) =1 if first birth before age 19	(2) =1 if first birth before age 17	(3) =1 if first birth between 19 and 23	(4) Total number of children	(5) Ideal number of children	(6) Ideal – actual number of children
SF	-0.814	-1.167*	-0.084	2.180*	2.229	-0.804**
	(0.851)	(0.627)	(0.266)	(1.143)	(1.000)	(0.390)
Prop. of close election	0.154	-0.180		1.467*	0.843	0.493**
	(0.421)	(0.382)		(0.844)	(0.736)	(0.243)
Caste: SC						
ST	-0.028	-0.037***	0.007	0.088*	0.188***	0.011
	(0.019)	(0.014)	(0.019)	(0.052)	(0.047)	(0.023)
OBC	-0.005	-0.016	0.001	-0.076**	-0.009	0.002
	(0.013)	(0.011)	(0.014)	(0.039)	(0.038)	(0.017)
Others	-0.035**	-0.018	0.026	-0.121**	-0.048	-0.010
	(0.016)	(0.014)	(0.016)	(0.055)	(0.041)	(0.021)
Religion: Hindu						
Muslim	-0.001	0.010	0.027	0.415***	0.400***	0.052**
	(0.018)	(0.013)	(0.020)	(0.074)	(0.053)	(0.021)
Christian	0.008	0.007	-0.053*	0.251*	0.369**	0.065**
	(0.027)	(0.020)	(0.027)	(0.146)	(0.153)	(0.026)
Sikh	-0.094*	-0.039	-0.074	-0.458**	-0.130	0.207**
	(0.053)	(0.055)	(0.089)	(0.193)	(0.195)	(0.099)
Others	-0.009	0.013	-0.111**	0.778**	1.029***	0.199***
	(0.038)	(0.025)	(0.044)	(0.347)	(0.305)	(0.057)
Wealth Quintile: Poorest						
Poorer	0.007	0.004	0.009	-0.157***	-0.094*	-0.001
	(0.013)	(0.010)	(0.013)	(0.045)	(0.051)	(0.018)
Middle	0.007	0.004	0.004	-0.243***	-0.140***	0.000
	(0.015)	(0.011)	(0.013)	(0.051)	(0.052)	(0.021)
Richer	-0.015	-0.012	0.012	-0.309***	-0.148**	0.023
	(0.018)	(0.012)	(0.018)	(0.060)	(0.059)	(0.026)
Richest	-0.060***	-0.026*	-0.009	-0.541***	-0.242***	0.036

	(0.019)	(0.015)	(0.021)	(0.080)	(0.068)	(0.029)
Residence: Rural						
Urban	0.006	0.009	-0.005	-0.035	-0.088*	0.014
	(0.014)	(0.010)	(0.015)	(0.048)	(0.048)	(0.016)
Sec. education	-0.160***	-0.083***	0.064***	-0.328***	-0.155***	0.022
	(0.011)	(0.009)	(0.013)	(0.038)	(0.034)	(0.017)
Independents	-0.100*	-0.081*	0.070	-0.354*	-0.046	0.056
	(0.057)	(0.048)	(0.048)	(0.208)	(0.206)	(0.089)
Local Parties	0.002	-0.047	-0.024	-0.218	-0.130	-0.165
	(0.070)	(0.042)	(0.063)	(0.229)	(0.244)	(0.107)
National Parties	-0.037	0.040	0.010	-0.219	-0.234	-0.075
	(0.042)	(0.036)	(0.036)	(0.176)	(0.175)	(0.075)
Satet Parties	-0.052	0.060	0.071	-0.032	-0.037	0.113
	(0.078)	(0.058)	(0.045)	(0.217)	(0.227)	(0.096)
Other Parties	-0.256	-0.235***	0.176	1.306	1.280	0.201
	(0.177)	(0.088)	(0.142)	(0.864)	(0.892)	(0.385)
Observations	10,171	10,171	9,636	5,847	5,728	5,847
first-stage F-stat	6.544	6.544	9.572	7.035	6.846	7.035

Notes: Robust standard errors clustered at the state-year level in parenthesis. ***, ** and * represent significance at 1 percent, 5 percent and 10 percent levels respectively. The share of female leaders averages the share from age 0 to 12 years in columns (1) and (2) and 13 to 18 years in columns (3) to (6). All regressions control for cohort fixed effects and state trends.

2.C. Data

Elections data used in this chapter taken from the TCPD-IED ranges from the year 1961 to 2020.The year 2020 is when the youngest woman from the individual dataset, the NFHS, born in the year 2002 would have turned 18. In this chapter, we aggregate elections data from the constituency level which is the original level, to the state level. First we compute the total number of constituencies in each state and the total number of female winners in each state by year. Second we compute the share of female leaders, by dividing the latter by the former. Next, we take 12 year averages for each year. For instance, when we take the 1961, we compute the average share of female leaders for the next 12 years after this period. For the year 1961, the next 12 years would have ended in 1973. Hence, the share of female leaders from all elections from 1961 to 1973 are summed and averaged. This procedure is done for all years and for all states. Finally, to merge the NFHS individual women's data to this elections data, if a woman was born and has stayed in a particular state from birth till date, we use her birth year to match her with the share of female leaders (the 12 years average) in her state. So for a 1961 born woman, born in state A, the average of this state from 1961 to 1973 represents the share of female leaders she has been exposed to before becoming a teenager. This procedure has been further shown in Table 2.B.1. Also in some estimations, 13 to 18 year averages, 6 to 12 year, 7 to 12 year, 8 to 12 year and 9 to 12 year averages were used. The corresponding share of female leaders that win in close elections also use the same time periods for their respective calculation of averages.

Note that, the fact that we only include women who have stayed in their states of birth till date and the fact that we exclude women born in states that were formed after they were born, brings the sample to only include women from 19 states. For example, because Chhattisgarh was carved from Madhya Pradesh in 2000, any woman born before the year 2000 who was previously part of Madhya Pradesh will now be part of Chhattisgarh, hence, is excluded from the sample.

CHAPTER 3

Child Multidimensional Health Deprivations in Sub-Saharan Africa: Nature, Variations and Sources

3.1 Introduction

The early stage of every child's life is important to their later life outcomes especially in terms of their cognitive ability, education, income and productivity (Case et al., 2005, Currie & Almond, 2011). In order for children to grow and develop their full potential, they need to receive good nutritional care and health, timely immunisations, enjoy safety in their environments and have access to opportunities for learning at an early age (World Health Organisation [WHO], 2020). The World Health Organisation (WHO, 2020) has emphasized that, up to 250 million children worldwide below age 5 are at a risk of growing below their potential which usually results in their untimely deaths. In 2019 alone, 70 percent of child and youth mortality occurred among children under age 5 constituting 5.2 million deaths out of which 2.4 million occurred in the first month of life (United Nations Inter-agency Group for Child Mortality Estimation [UN IGME], 2020), prevalent in lower-and middle-income countries.

In different parts of the world children may face differences in health outcomes resulting from say differences in their socio-economic backgrounds, political, cultural and ethnic backgrounds (Orach & Garimoi, 2009). Such differences and variations in health outcomes among individuals and groups are referred to as health inequalities. This phenomenon has received substantial attention in research and driven policy as it is imperative to several other social and economic outcomes. However, evidence on the dynamics of health inequalities among children in the sub-Saharan African region (SSA) has been limited. Understanding health inequalities is of critical policy concern (Makdissi & Yazbeck, 2014). Thus, achieving equality in child health requires the ability of health systems to identify and target vulnerable children.

Early childhood health inequalities may be pervasive in the SSA region as a result of severe constraints in their health systems particularly due to limited investments in healthcare and health infrastructure (Habimana et al., 2010). The lack of access to primary healthcare remains a pervasive challenge and a threat to a vast majority of its population (Mckinsey, 2010). In recent times, there has been speculation that the impact of the COVID-19 pandemic could be devastating as a result of Africa's previous pandemic/epidemic outbreaks such as Ebola, Tuberculosis, HIV/AIDS, etc., that have already weakened the health systems (Mckinsey, 2020). Thus, such pandemics awaken a deeper understanding of the challenges facing the healthcare systems in a deprived region like sub-Saharan Africa (Mckinsey, 2020). The region faces a limited supply of skilled health workers failing to reach the UN's minimum threshold (Mckinsey, 2020), as well as limited infrastructure to deliver healthcare, limited investments in medical products, poor service delivery, among others.

The existence of simultaneous inequalities in different health indicators makes the measurement and analysis of inequalities in health quiet challenging. Though previous studies have contributed to deepening our understanding of health-related inequalities, the degree and direction of inequalities tend to differ based on the indicator of health outcome adopted. Thus, to fully understand the nature and extent of child health inequalities, it is imperative to focus on a multidimensional framework. A multidimensional health indicator will enable the examination of the severity and simultaneous inequalities in multiple health indicators. The main challenge has been measuring health outcomes within a robust multidimensional framework that focuses on individual level health indicators. The measurement of health inequalities within a multidimensional framework will be essential for assessing progress in health systems within and between countries, as well as provide evidence of the severity of inequalities in child health. This study focuses on measuring health outcomes and assessing health inequalities among children in sub-Saharan Africa using a robust measure of multidimensionality propounded by Alkire and Foster (2011). We are interested in finding out the intensity and incidence of health deprivations from a multidimensional perspective, making sub-group comparisons within and across countries.

Existing studies have focused on unidimensional indicators such as immunisation, malnutrition, mortality, morbidity/diseases, life expectancy, among others (see for instance Singh, 2011; Victorino & Gauthier, 2009; Onsomu et al., 2015; Egondi et al., 2015; Houweling et al, 2003; Sanoussi, 2017; Ebaidalla, 2019). Houweling et al. (2003) examine whether there are differences in child health outcomes across 10 developing countries using immunisation coverage and under-5 mortality rates. The study finds inequalities in immunisation coverage and mortality among children and as well inequalities across countries. Similarly, Victorino and Gauthier (2009) investigate inequalities in child health determinants across 6 different health outcomes in the United States. They find inequalities in child health due to differences in their family's financial statuses. Fotso (2006) did a study of child health inequalities in sub-Saharan Africa using only malnutrition (stunting) as a measure of health. Fotso (2006) finds intra-urban variations in malnutrition; which are somewhat larger than the overall population variations. Other examples include Brockerhoff and Hewett (2000) on child survival in SSA, which find ethnical inequalities in child health and Onsomu et al. (2015) on immunisation among Kenyan children.

Since the seminal papers of Sen (1976, 1999), wellbeing has been seen as a multidimensional concept that encompasses various aspects of human life. In the paper, Sen (1999) argues that, a person's ability to live should not be measured by a mere income or how much they earn but by the kind of freedoms they enjoy. Sen (1999) emphasizes that, with a high income/wealth status, not being able to speak freely for instance deprives a person of something they value in a society. This points to the fact that development does not only involve a narrower view such as industrialisation or GNP growth. It also entails expansion of freedoms such as political freedom, protective security, economic facilities, transparency guarantees and lastly social opportunities, all together enriching human life. This has resulted in a new way of looking at all forms of wellbeing including poverty outcomes, health outcomes, and others.

In the literature, various aggregation methods have been proposed to capture multidimensionality. Amongst these are the fuzzy approach to multidimensional poverty and the Alkire and Foster (AF) approach, among others. The one study that has adopted the use of a multidimensional measure to examine health was done by Alperin (2016) on a Luxembourg sample of individuals aged 50 and above and their partners. In this study, the fuzzy approach to multidimensional poverty propounded by Cerioli and Zani (1990) was applied. Health outcome is measured by both mental and physical health status of individuals estimated using indicators such as depression and memory (mental illness) and long-term illness, limitation activities, overweight and obesity, eyesight and hearing (physical illness). Other studies in the poverty and wellbeing literature have adopted this composite approach (Aristide et al., 2012; Diallo, 2010; Appiah-Kubi et al., 2007). In Ghana, Appiah-Kubi et al. (2007) uses this approach to study poverty by combining both monetary and non-monetary indicators of poverty such as housing conditions, ownership of durable goods, disposable income, expenditure and other welfare measures of households. Estimates show some changes in poverty levels between the two time periods used. A similar study was conducted by Diallo (2010) on a Guinean household sample. Aristide et al. (2012) also employ this strategy to ascertain multidimensional poverty associated with living conditions and inequality in Cameroon and finds high levels of deprivation and low inequality among households.

The Alkire and Foster (2011) approach, one of the most recent approaches in the literature has been applied to composite wellbeing deprivation measures such as poverty, vulnerability, food security, empowerment and happiness among others. Alkire and Foster (2011) proposes one of the reliable and robust frameworks that measures simultaneous deprivations on a number of wellbeing dimensions and indicators. This approach is important for some reasons. It measures the depth, breath and severity of simultaneous deprivations in multiple number of indicators. It also allows one to decompose population deprivations by sub-groups such as gender, location, etc; to show whether there are differences in the characteristics of multidimensionality for each group. In addition, it allows dimensional breakdown which shows the contribution to deprivation by each dimension revealing the most important and the least important deprivation dimensions. It also gives the flexibility to assign weights to each dimension or indicator which is relevant as some dimensions may be more important than others.

A lot of studies in contemporary literature have adopted the use of the AF approach. Batana (2013) applies it to examine multidimensional poverty in 14 sub-Saharan African countries under four dimensions of poverty; health, education, empowerment and asset. Comparing the composite measure with standard measures of poverty, the results show very low correlation between income and asset poverty measures and the AF measure of poverty and as well show a negative correlation between Human Development Index (HDI) and gender related Development Index (GDI) and the AF measures. This suggest that, having more dimensions included in estimating poverty other than the standard measures only, country-level poverty rankings will tend to be different. Departing from monetary poverty, a simple comparative framework was built by Castro et al. (2012) using a broader indicator and applying the AF measure. Their findings suggest that, relying on monetary standards, there is an increasing risk of classifying as non-poor those individuals who are deprived in other indicators of poverty. Alkire et al. (2014) examine multidimensional poverty dynamics using cross-sectional data for EU-Statistics on Income and Living Conditions (EU-SILC) countries. In this study, sub-group decomposition of poverty was undertaken. These include gender and age decompositions. Employing the AF procedure, Beja and Yap (2013) determine aggregate happiness level using data from the Philippines. More recently, Agyire-Tettey et al. (2021) study multidimensional poverty among children in Ghana, making cross-year comparisons from Ghana's last two rounds of the Demographic and Health Surveys (DHSs). They find a decline in both intensity and incidence of child poverty between the years using the AF approach and additionally find significant differences across sub-groups. In general, the findings of these studies support the assertion that one-dimensionality could be at odds with multidimensionality. In a nut shell, there seems to exist no such empirical study as one involving multidimensional health deprivation in the sub-Sahara African region.

Although these two composite measures (the AF and Fuzzy approaches) have some similarities such as that they break the restriction of only two possible health outcomes for an individual which is the widely used subjective measure where a person is regarded as healthy if they are not deprived and unhealthy otherwise, the AF approach appears quite robust and convenient compared to the fuzzy approach. The AF index considers both the incidence and the severity of health among the population represented by the average level of deprivation also known as deprivation severity or intensity. The approach also makes use of a dual cutoff where the first cutoff is the minimum achievement required in order to be deprived in an indicator and the second cutoff is the minimum deprivation a person needs to show in order to be classified as multidimensionally/completely poor or unhealthy. This dual cutoff approach clarifies the requirement of two distinct set of cutoffs that defines deprivation from a composite perspective (Alkire & Foster, 2011). In the fuzzy approach, a child will be considered as poor if they are deprived in at least one indicator regardless of their overall score which would have determined their deprivation status under the AF method. Atkinson (2003) defines this as the union criterion.[1] As long as an individual is deprived in one indicator through the membership function, they are added to the fuzzy set and then the index is computed. The total deprivation index is computed by a weighted average of the multidimensional index of health of each person or a weighted average of unidimensional index of health that is, across deprivation attributes or dimensions. It thus becomes unnecessary to specify an arbitrary poverty line or cutoff as is done by the AF method (Appiah-Kubi et al., 2007).[2] Thus, contrary to the AF method, the fuzzy strategy does not consider the joint distribution of deprivation when identifying the deprived. The approach in actual sense considers the vagueness about the exact point at which someone is considered deprived.

[1] Atkinson (2003) pioneered the terms union and intersection criteria. The union criterion implies being deprived in at least one indicator whiles under the intersection criterion, a person is poor/deprived when they fail to meet the achievement cutoff for all indicators. Alkire and Foster (2011) proposes the use of a natural middle-ground as an alternative; i.e. the intermediate cutoff level.
[2] These are discussed further in the methodology section.

As sub-Saharan Africa fell short of achieving the health-related targets of the Millennium Development Goals, it would require significant sustained investments and commitments to attain the targets under the Sustainable Development Goals (Fullman et al., 2017). To achieve equitable and inclusive health systems, programmes and interventions must be targeted, consistent and efficient. In general, this research offers to fill up the existing gaps in the literature by providing evidence of health inequalities among children under five years in SSA from a multidimensional perspective. It contributes to the extant literature in the following ways: First, we add to the ongoing literature by focusing on children under age-5 in the sub-Saharan African region where health related inequalities have been understudied. Our work in general is different from previous studies in the sense that we focus mainly on a multidimensional framework, a marked departure from the current strand of studies on single measures of health such as morbidity, mortality and immunisation that have been adopted by those studies. We rely on Sen (1999) assertion that wellbeing is better measured multidimensionally as adopted by some researchers (Batana, 2013; Fotso, 2006). Our measure of child health is based on the Alkire and Foster (2011) methodology on composite measures used mostly in the poverty literature, adopting 11 indicators of health grouped under 4 main dimensions including nutrition, environment, natal-care and morbidity. In addition, we identify sub-groups such as gender, location and region of residence of the child and examine variations in MHI across the groups. This informs us about the most vulnerable groups in each sample and allows for cross-country comparisons for policy purposes. Subsequently, we compute the contributions of each dimension (indicator) to multidimensional health vulnerability. This allows us to identify variations and inequalities in the contributions to MHI across countries. It is as well possible to look at a further breakdown of sub-group variations in these contributions.

Briefly summarising our findings, we find significant cross country variations in health deprivations. Overall, Ethiopia has the highest deprivation rate of 37.3 percent while Ghana has the lowest of 4.5 percent. On average, deprived children are vulnerable on more than 50 percent of all deprivations. Within countries, we further find that male children are highly deprived than female children. Across countries, Ethiopia followed by Congo DR top as the most deprived countries and Ghana is still the least deprived across sexes. By location of residence, we find that mostly urban children are less deprived than rural children. Additionally, significant regional level differences is masked by the indices for the overall country level analysis and urban regions are the least deprived in most cases. Examining the sources of deprivations, we find that morbidity is the largest source of deprivations for under 5 children and nutrition contributes the least for most countries just after natal-care. Our baseline estimates are robust to alternative weighting structures and pairwise country comparisons of our indices.

The remaining sections are organised as follows. In section 3.2, we present the data and descriptive statistics of the indicators of health. We discuss the AF approach and cutoffs for the indicators and dimensions in section 3.3. This is followed my the results and discussion in section 3.4. Finally, in section 3.5 we present conclusions, limitations to the study, and present some policy recommendations.

3.2 Data

Empirical analysis of this study relies on publicly available cross-sectional datasets, the Demographic and Health Surveys (DHS), for selected SSA countries,. The DHSs are nationally representative household surveys that collect data on a wide range of indicators such as health, and demographics. The datasets are suitable for the analysis of comparable cross-country multidimensional child health outcomes as the survey instruments are standardised across countries. Information on child health indicators such as immunisation, nutrition, fever, pre and post-natal care, to mention a few, are contained in the DHS datasets. The availability of demographical information in the dataset enables us to study patterns of child health inequalities within and across countries.

The surveys contain 7 files-the Person Recode (PR), Birth Recode (BR), Male Recode (MR), Individual Recode (IR), Children Recode (KR), and Household Recode (HR) files. The Household Recode (HR) file contains data on all households surveyed, the Individual Recode (IR) file captures women between ages 15 to 49 in all households who are interviewed, although in some countries only married women are interviewed. The unit of analysis in the Male Recode (MR) file is men whiles in the Children Recode (KR), the unit of analysis is children aged 0 to 5 years old whose mothers were interviewed. The Birth Recode (BR) file contains all information about all live births of interviewed women. The Person Recode (PR) file contains information about all usual members of the households including those children living in the households whose mothers were not interviewed hence were not included in the KR and BR files. Our unit of analysis is any child in the household aged 0 to 5 years (0 to 59months). As such, the HR file for each survey was merged with their respective KR file in STATA to obtain the appropriate information needed to carry out our estimations for this study.

Eight countries have been selected across income and geographical classifications with the most recent survey selected for each country. These countries include Kenya, Ghana, Lesotho, Cameroon, Ethiopia, Malawi, Benin and Congo DR. We present in Table 3.1 below the countries, their geographical and income classification, year of survey and size of households. Of the countries selected, two are in the Eastern part of SSA, two in Western, two in Southern and the remaining two also in Central SSA. Kenya has the largest household size whiles Lesotho has the lowest. As it is important to study multidimensional health from the most vulnerable populations in the region, half of these countries selected represent lower-middle income countries whiles the remaining half are low income countries.

Second, the availability of recent datasets is very essential to make comparisons across countries. Additionally, expenditure on public health is significantly lower for these countries compared to other countries in the SSA region. Thus, these countries tend to invest a lower proportion of their GDP to public health. Appendix Figure 3.A.1 shows the public health expenditure between year 2000 and year 2018 in the eight countries shown in a line graph. Lesotho happens to be the only country whose expenditure exceeds 5 percent, peaking around 5.8 percent in 2014 and 5.4 percent in 2018. Despite that, it still remains lower than the low income, lower middle income and upper-middle income countries' average (WHO, 2019). Central African countries, Cameroon and Congo DR have much lower expenditure together with Ethiopia and Benin not exceeding 1 percent of GDP in 2018. Hence, these countries form a good representation of SSA as they constitute some of the most vulnerable countries in the region.

After constructing each indicator of health, we only consider children who have complete information on all indicators in our samples, hence the data used has no missing information about any indicator used in the computation of indices. All children who have zero information on any single indicator are dropped from the final sample making it exclusive of missing values of health indicators. This resulted in the sample size for each country as presented in the last column of Table 3.1. The proportion of children dropped from each sample is small for all countries.

Table 3.1: Description of Study Countries and Sample Size.

Country	Survey year	Income group	Location	Household size	Sample size (no. of children)
Kenya	2014	Lower-middle	Eastern	36430	6548
Ghana	2014	Lower-middle	Western	11835	2044
Lesotho	2014	Lower-middle	Southern	9402	1102
Cameroon	2018	Lower-middle	Central	11710	3000
Ethiopia	2016	Low	Eastern	16650	6116
Malawi	2016	Low	Southern	26361	4161
Benin	2017	Low	Western	14500	8067
Congo DR	2014	Low	Central	18171	5010

Notes: Data is taken from the DHS for all countries.

As can be clearly seen, the different survey years from 2014 to 2018 could be a key data limitation for cross-country comparisons. Nevertheless, we see the variations spanning between 1 to 4 years which can be considered as a short period hence making the datasets not too dispersed in time for comparisons. This study is able to derive unbiased estimates of the indices by making use of the specific sampling weight for each survey. Thus, each survey has a complex sample design[3], by which a specific sampling weight is assigned to each unit of measurement. If the sample used is not weighted, it will leave our estimated indices biased and not correspond to the national population. By this, we apply the appropriate sampling weights for children in all the surveys to expand the samples and make them as nationally representative of the respective population of each country as possible. This is imperative as it facilitates comparisons across the countries despite the different sample sizes.

[3] All the DHSs follow a multi-stage stratified design where the primary sampling unit (psu) are the clusters.

3.3 Methodology

3.3.1 The Alkire and Foster (AF) Approach

First, we are interested in finding out who is multidimensionally poor in health in order that we estimate whether there are inequalities in health. In order to achieve this objective, we adopt the AF procedure, an approach that is quite novel to the child health literature. Although the Alkire and Foster (AF) method is a framework that was designed originally to examine multidimensional poverty, it is also appropriate to use for the measurement of other phenomena like health outcomes (Alkire & Foster, 2011). The AF methodology is flexible in the sense that, many key decisions such as the individual deprivation and composite deprivation cutoffs, indicators, unit of analysis, are left in the hands of the researcher (Alkire & Foster, 2011).

We extend the methodology to assess multidimensional child health and as well decompose the multidimensional index to examine subgroup differentials in health outcomes. The approach involves generating a composite index of child health from multiple child health indicators. In this study, 11 sets of indicators are considered. These include vaccination, stunting, wasting, underweight, diseases, access to sanitation, access to safe water, antenatal care, postnatal care, birth attended by health professional and place of delivery. These indicators are grouped into 4 dimensions namely, nutrition, natal-care, morbidity and environmental dimensions as described in the next sections.

To start with, the AF approach involves two distinct steps, identification, and aggregation. Identification requires us to determine who is deprived in each health dimension by making a comparison between individual achievements and a deprivation cutoff, and then focusing on only deprived achievements of all children to identify who is multidimensionally poor in health. Thus, under this approach, we apply dual-cutoffs such that we define two distinct sets of thresholds, dimensional cutoff, and multidimensional cutoff. On the other hand, aggregation sums the overall level of deprivations in health by focusing on only those that are deprived multidimensionally and summarizing the deprivation profiles of different members. This step is ideal for sub-group decomposition analysis.

We start with identification; assuming there are n individuals, we define their health achievements by an $n \times d$ matrix X , where x_{ij} is the achievement of child i in health indicator j and $i = 1, \ldots, n; j = 1, \ldots, d$. We present matrix X below:

$$X = \begin{bmatrix} x_{11} & \cdot & \cdot \\ \cdot & \cdot & \cdot \\ \cdot & \cdot & x_{nd} \end{bmatrix} \qquad (1)$$

For each indicator j, a threshold z_j, known as the deprivation cutoff defines the minimum achievement required in order that the child is not deprived on that indicator and is collected in a d-dimensional vector, $z = (z_{1,\ldots,}z_d)$. Here a child is deprived on an indicator if their indicator achievement is lower than the cutoff $(x_{ij} < z_j)$. As such we assign them a value of "1" for that indicator and "0" otherwise. These are collected in a deprivation matrix g^0 such that g_{ij}^0 with 1s if deprived and 0s otherwise for all $i = 1, \ldots, n \; and \; j = 1, \ldots, d$. We describe the deprivation cutoff of each indicator in the middle column of Table 3.2 below which we explain in detail in later sections. Thus, any child that fails to achieve the deprivation cutoff is deprived on that corresponding indicator.

Since all dimensions and indicators may not have equal relative importance, the method allows that we assign weights $w = (w_1, \ldots, w_d)$ to them such that $w_j > 0$, where higher weights indicate greater relative value, and the dimensional (indicator) weights sum up to 1 or 100%, i.e. $\sum_{j=1}^{d} w_j = 1$. After weighting, we generate a column vector $c = (c_1, \dots, c_n)$ of individual deprivation scores c_i which shows the breath of each person's deprivation across all dimensions as it sums up each child's weighted deprivation values and $c_i = \sum_{j=1}^{d} w_j g_{ij}^0$.

In a next step, we identify who is multidimensionally deprived in health by applying a second cutoff to the weighted deprivation scores of children. We do this by assigning a defined cutoff say k such that a person is identified as being multidimensionally deprived in health if $c_i \geq k$ and $0 < k \leq 1$. An identification function ρ_k is implemented where a child is given a value 1 if they are deprived multidimensionally, and 0 otherwise. Now this is called the dual cutoff identification strategy by the AF approach because first it uses z_j (dimensional/indicator cutoff) to identify whether or not a child is deprived in each dimension and then k (multidimensional cutoff) to identify who is multidimensionally deprived in health.

We obtain a censored deprivation matrix ($g^0(k)$) and a censored deprivation score for each child. By censoring, if $c_i \geq k$, we maintain their entries thus "1" in the deprivation matrix as in their censored deprivation matrix and assign a value of "0" if otherwise. In a next approach, we generate the censored deprivation score vector $c(k)$ from the censored deprivation matrix. This forms the basis for aggregation.

We move onto the aggregation step which is the second broad step in the AF methodology that builds upon the Foster-Greer-Thorbecke (FGT) class of unidimensional measures and is adjusted for multidimensional purposes. This step also allows us to estimate sub-group inequalities in health by spatial characteristics (example location and region of residence), by gender of the child, and by other socio-economic characteristics of the child. We will estimate the Multidimensional Health Index by the incidence (headcount ratio) and intensity of deprivation. First, headcount (H) is calculated as:

$$H = \frac{q}{n} \qquad (2)$$

Where q represents the number of children identified as multidimensionally deprived in health and n represents the total number of children in the sample. On the other hand, intensity is given as:

$$A = \frac{1}{q}\sum_{i=1}^{q} c_i(k) \qquad (3)$$

Thus, the summation of censored deprivation scores divided by the total number of deprived children. This gives us the average deprivation score. Finally, the Multidimensional Health Index (MHI) is obtained by:

$$MHI = H \times A \qquad (4)$$

MHI defines the both the incidence and severity of poor health among children in SSA, which can be decomposable by sub-group components. If we perceive overall health deprivation as population-share weighted sum of subgroup deprivation levels, we can make subgroup deprivation analysis by gender, by location and by region of residence. If we let ψ represent a subgroup, and denote the population share of this sub-group by $v^{\Psi} = n^{\Psi}/n$ and it's respective achievement matrix by X^{Ψ}, then we can express overall MHI in an additive form as:

$$MHI\ (X) = \sum_{\Psi=1}^{m} v^{\Psi}\ MHI(\ X^{\Psi}) \qquad (4)$$

We also estimate the contribution of each dimension and indicator to MHI where the sum of contributions needs to be 100 % (1). This can also be decomposed by subgroups which is shown in later sections. In the next section we focus on deprivation cutoff for each indicators and dimensions below which a child 5 years and below may be considered deprived.

3.3.2 Deprivation Cutoffs for Indicators

Our multidimensional health index is derived from 11 indicators of health that are grouped into 4 health dimensions that reflect different aspects of individuals' health. These four dimensions (indicators) are as follows: Nutrition (stunting, wasting, underweight), Morbidity (vaccination, diseases), Environment (sanitation, water source) and Natal-care (prenatal, postnatal, place of delivery, access to health professional at birth). Indicators are carefully selected following closely the World Health Organisation's (WHO's) global reference list of core health indicators and health-related SDGs from 4 main domains - risk factors, health status, service coverage and health systems (WHO, 2018). This may serve as a standard measure of health and as well appropriate guidance for policymakers. In the following paragraphs, we explain each indicator cutoff considered followed by a summary in Table 3.2.

3.3.2.1 Nutrition

Stunting: Stunting is considered as the severest form of malnutrition among children below age 5. It indicates past or chronic nutritional inadequacies (Wagstaff et al., 2007). As stunted children are too short for their age, they may suffer the consequences through their lifetime growth pattern and in their cognitive development (United Nations Children's Fund [UNICEF] et al. 2021). The UNICEF et al. (2021) report on child nutrition show that the percentage of under age 5 children affected by stunting reduced from 41.5 percent to 30.7 percent in Africa from 2000 to 2020. Despite this decline, the continent reports the second highest on stunting prevalence, following Oceania (35.6 percent) in 2020. A child is severely stunted if their height-for-age z-score is below -3 standard deviation and moderately stunted if their z-score is lower than -2 standard deviation from a referenced population median height-for-age of the WHO child growth standards. The DHS captures this as a continuous variable for all countries. However, a majority of studies have used categories that groups them into those that are stunted and those that are not (Amara & Jemmali, 2017; Nikoi, 2011). For the purposes of this study, we follow a similar fashion to obtain a binary variable where children whose z-scores are below -2 standard deviation are considered deprived on stunting and given a value of "1". Those whose z-scores are -2 and above are judged as not stunted and given a value of "0".

Wasting: Poor nutritional quality can also result in wasting among younger children. Wasting refers to a situation where a child is too thin for their height and is usually perceived as an indicator for current nutritional deficiency (UNICEF et al., 2021). Wasting could be used in assessing short-term changes in their nutritional status (Wagstaff et al, 2007). Although wasting is considered as one of the less severe forms of malnutrition, about 27 percent of all wasted children live in Africa which is quite a huge proportion (UNICEF et al., 2021). Similar to stunting, it is captured as a continuous variable in the DHSs for all countries. It is obtained using a threshold from the under-5 weight-for-height z-scores with reference to an international WHO standard. That is to say, a child is said to be wasted if their weight-for-height z-score is below -2 and -3 for moderate and severe wasting respectively. We obtain a dummy variable from this where all children with z-scores below -2 standard deviation are considered wasted and coded "1", and "0" otherwise.

Table 3.2: Definitions of Dimensions/Indicators, Thresholds and Weights Assigned

Dimensions and Indicators	Deprivation threshold	Weights
Nutrition		**0.25**
• *Stunting*	1 if the child's height for age z-score is less than -2 standard deviation	*0.083*
• *Wasting*	1 if the child's weight for height z-score is less than -2 standard deviation	*0.083*
• *Underweight*	1 if the child's weight for age z-score is less than -2 standard deviation	*0.083*
Morbidity		**0.25**
• *Vaccination*	1 if the child has not taken basic vaccination	*0.125*
• *Diseases*	1 if the child has suffered from malaria/fever/Anaemia or had problems with chest/blocked and running nose	*0.125*
Environment		**0.25**
• *Sanitation facility*	1 if the household sanitation facility is unimproved	*0.125*
• *Water source*	1 if the sources of drinking water are not improved or if it takes more than 30 minutes to and from the source	*0.125*
Natal care		**0.25**
• *Prenatal care*	1 if the mother did not take any blood test or her blood pressure was not checked during pregnancy	*0.0625*
• *Postnatal care*	1 if the child did not receive any postnatal checks within two months of birth	*0.0625*
• *Health Professional*	1 if the child's birth was not attended to by a health professional	*0.0625*
• *Delivery place*	1 if the birth of the child did not take place in a health facility	*0.0625*

Notes*:* Equal weights are assigned to all dimensions.

Underweight: The third important nutritional indicator used in this study is underweight. This captures the weight of a child relative to their age. It confounds the effects of the previous two indicators as it composes elements of both (Wagstaff et al., 2007). It is measured using the weight-for-age z-scores from the median weight-for-age reference from the WHO child growth standards. We analyse underweight as a binary variable just as is done in many studies (Nikoi, 2011; Amara & Jemmali, 2017). For a child to be deprived on underweight, their weight-for-height z-score must fall below -2 standard deviation, capturing both severe (below

-3) and moderate (below -2) underweight. Those whose weight-for-age z-scores are equal to or lie above -2 are captured as not underweight.

3.3.2.2 Morbidity

Vaccination: Vaccines are considered as agents that help in preventing life threatening childhood diseases such as polio, hepatitis; and as well combat infant mortality. According to WHO (2020), global infant mortality rate was reduced by 24 percent due in greater part to immunisations between 2010 and 2017. In this study, we incorporate vaccination as an essential component of under-5 child health. A child is defined as deprived on vaccination if they have not received in full their age specific basic vaccination (WHO, 2018). From the DHS guide (2020), under-5 basic vaccination includes 4 main vaccine types -1 dose of Tuberculosis vaccine known as Bacille Calmette-Guerin (BCG), 1 dose of Measles Containing Vaccines (MCV), 3 doses of polio vaccines and 3 doses of Diphtheria, Pertussis, Tetanus (DPT)-containing vaccine. Some studies that have applied the use of basic vaccination to capture this health indicator include the study by Donfouet et al. (2019) on immunisation trends in 3 sub-Saharan African countries (Kenya, Ghana and Cote d'Ivoire) and Onsomu et al. (2015) on maternal education and child health in Kenya. In addition to these, Ataguba et al. (2016) incorporates additional vaccines such as yellow fever, MMR and Vitamin A to capture immunisation in their study. We follow the former to construct our vaccination indicator in this paper. The DHS datasets for all countries report 2 responses to consider that a child has received their basic vaccines for all vaccine types. For some children, evidence is shown by the date reported on vaccination card whiles others are reported from the mothers' recall. Our paper considers those who report "yes" for both sources as positive and hence not deprived on vaccination. We assign the value “1” for those who are deprived and report “no” in their responses.

Diseases: Given that the level of sickness of a child is important to the child’s development, we include this indicator to capture whether a child has recently suffered from certain diseases or not. We consider 4 main sicknesses from the DHS datasets namely Acute Respiratory Infection (ARI), fever, Anaemia and malaria status of the child. With ARI, it is captured by the DHS using symptoms such as the child experiencing cough which leads to short rapid breathe and or problems in the chest or blocked nose within two weeks before the survey. All three levels of Anaemia – severe, mild and moderate – are considered. Thus, all children whose haemoglobin counts are less than 11 grams per decilitre (g/dl) are anemic and those with haemoglobin counts above this threshold are not anemic. It is judged that, a child who has suffered from any of these four diseases within the last two weeks before the survey is deprived on the indicator.

3.3.2.3 Environment

Sanitation: Access to safely managed sanitation facilities contributes towards the health outcomes of children as they are made prone to certain diseases if these facilities are unhygienic. Following the WHO’s (2018) description of improved sanitation, the DHS captures this variable using common means of managing sanitation facilities by households. These include flush to sewer systems, septic tanks or pit latrines, flush to somewhere else (unknown), ventilated improved pit latrines, composting toilets, pit latrines with slabs or without slabs (open pits), bucket toilets, hanging toilets and others. We define a child as being deprived on this indicator if the sanitation facility used by the household is not improved or if it is shared with other households. That is, unimproved facilities include those that use a pit latrine without slab or a bucket toilet or a hanging toilet and those that are flushed into somewhere else. This indicator is dichotomized such that we assign “1” to those that are deprived and “0” for those children not deprived.

Water source: The second indicator considered as part of environmental risk factors is the household’s water source. Having an unimproved water source could pose dangers like water-borne diseases to the child. Thus, we measure access to safe drinking water by whether the source is improved and as well consider the distance it takes from the home to the source as households are likely to spend more resources on water, the farther it is from the home. Measuring improved water is based on the DHS’s definition such as that it is piped into a dwelling or yard or to neighbor, public tap/standpipe, a protected well or spring, rainwater or bottled water, tube well or borehole and atanker truck; located on the household premises and available when needed. Unimproved water sources are those from unprotected wells or springs, surface water such as river, dam, pond water and so on. A child is therefore defined as deprived if water sources are unimproved or if it takes more than 30 minutes to arrive at the source.

3.3.2.4 Natal Care

Prenatal care: Having a proper prenatal care could reduce the risk of perinatal mortality and other abnormalities when a baby is born. This indicator is measured by whether a mother took any blood test during her pregnancy within the last 5 years preceding the survey or whether she had her blood pressure checked. This has been adopted by Amara and Jemmali (2017) to examine the lack of antenatal care among mothers of under-5 children. To be deprived on this indicator, we consider those whose mothers’ blood pressure or blood sample was not taken during their pregnancy.

Health professional: Also, having a child's birth not attended by a health professional could have complications to a child's health outcome. Health professionals can provide life-saving care and provide all the necessary supervision and healthy advice to mothers during the postpartum period. As per WHO's recommendation, a child is judged as deprived on this indicator if their birth was not attended by a professional. We follow the DHS and define who a health professional is which is country specific but typically include Doctors, Nurses or Midwives, and Auxiliary, Nurses or Midwives.

Place of delivery: The indicator, place of delivery demonstrates the environment where the child's delivery took place. A child is deprived if their birth did not take place in a modern health institution or facility. In the DHS, respondents (women) were asked about their most recent births - those that occurred in the last 5 years before the survey – and where it occurred. Responses were grouped into the following: respondent's home, government hospital, government health centre or clinic, government health post, private hospital or clinic, maternity home, other public facilities and others. In this study, we consider all children whose birth occurred at home or other places (traditional environments) as deprived on this indicator.

Post-natal care: As the early days or months after the birth of every child are very essential to their health, the child's postnatal checks during that time are very important to this course. Children are more likely to be sick the longer it takes to be given postnatal care. In this paper, this variable is measured using postnatal checks that occurred within two months of childbirth. That is to say, a child is considered deprived on this indicator if there were no checks within two months after their birth.

3.3.3 Robustness Checks

The arbitrary nature of our indicators' cutoffs, overall cutoff and weights assigned in our baseline estimations as stated above may affect our multidimensional health indices or the comparisons we make within and across countries. Suffice to say that there is no unambiguous way to choose these parameters to identify the deprived or unhealthy. To address these concerns, Alkire and Santos (2014) and Alkire et al. (2020) assessed the robustness of Global Multidimensional poverty indices across various countries and regions in the world using different alternative weighting structures and applying pairwise comparisons to test the robustness. In this approach, a single dimension is assigned twice the weight of the other dimensions and subsequently, the other dimensions also get assigned double weights. Such a robustness criterion makes comparison of indices such that, the measurement is regarded as robust if the ranking of countries does not reverse with changes in weights (Foster et al., 2009). That is to say, multidimensional indices would be considered as robust if individual countries' ranks are retained regardless of the weights assigned to each indicator.

Employing this strategy, we use four sets of alternative weighting structures in computing multidimensional indices. Since in a strict sense, there exist an infinite arrangement of weights and it is impossible to fully evaluate the robustness of multidimensional indices in this paper, we limit it to these four alternatives. In a quartet arrangement, we allocate in turn 40% of the relative weight to one dimension, then 20% each to the remaining three dimensions such that they sum up to 100% in all four arrangements. Table 3.C.1 in the Appendix details these alternative weights with the nested indicators' weights (weighted equally) shown under each dimension. Our indicator thresholds follow the same description as in Table 3.2.

To find out whether country rankings remain robust, assuming 2 countries have indices MHI_1 and MHI_2, and assuming country 1 is multidimensionally deprived than country B in the baseline estimates, we would like to find out whether this ranking remains robust with the different weighting structures. We use all possible pairwise comparisons of countries in our sample to assess the robustness. Thus, each country is compared with another country 5 times with the 5 different weighting structures. We apply two tests: pairwise comparisons of means using standard errors and pairwise comparisons using confidence intervals of the indices. The first approach involves tests of differences in means between the MHIs of all possible paired countries. This involves testing whether deprivation rates are significantly different between paired countries or not. The second one checks the significance of pairwise country comparisons using their confidence intervals and assessing their significance by whether they do overlap or not. By that, suppose we want to compare country A and country B; whenever the upper bound MHI of country B is less than the lower bound of country A, we conclude that A is unambiguously deprived than B and this constitutes a significant pairwise comparison.

Note that, we apply each test across the 5 weighting structures (including the baseline structure). For each methodology, if the paired countries have the same significant relationship across the 5 different weighting structures, we conclude that the pairwise comparison is robust. For instance, based on the example above, if we continue to conclude that A is deprived than B from our baseline estimates and across all the alternative structures, then this finding is robust. We then compute the fraction of robust pairwise country comparisons, first as a proportion of the total possible pairwise country comparisons and second, as a proportion of total significant pairwise country comparisons from the baseline estimates (those with equal weights). Suffice to say that a pairwise comparison that is not significant in the baseline cannot be defined as being a robust one hence the latter computation using the baseline is imperative.

A different approach proposed by Atkinson (2003) uses dominance analysis where a range of deprivation cutoffs are considered, and multidimensional deprivations are compared across two population distributions for each cutoff (k). Such a dominance analysis based on certain conditions helps in identifying the robustness of saying one population (country A) is deprived than another (country B) while moving from the union to the intersection identification. However, we do not employ this type of checks since it requires a larger sample size (Alkire & Santos; 2014) than those in our study. Besides, it will not be possible as some country's report zero deprivations when certain cutoffs (mainly larger cutoffs) are applied leaving our estimates limited and biased and not easily comparable across countries.

3.4 Results

3.4.1 Unidimensional Deprivations

Before examining the multidimensional indices (headcount, intensity, and adjusted headcount), we outline the unidimensional deprivation rates of each indicator and dimension in Table 3.3 below. The indicator deprivation rates are based on the thresholds described in Table 3.2, whereas dimensional deprivation rates are based on the averages of the respective indicators. The unidimensional deprivation rates indicates the percentage of children that are deprived on each indicator and dimension.

Results from the table indicates that, for most of the countries, children are highly deprived on the morbidity dimension, except for Kenya where the deprivation rate is highest in the Environment dimension (67.12 percent). This is followed by environment (7 countries except Kenya), natal-care and then nutritional health. That is to say, all countries face their lowest deprivations in nutritional health ranging from 10.3 percent to about 23 percent.[4]

Table 3.3: Indicator & Dimensional Deprivation Rates (in %)

Dimensions & Indicators	Kenya	Ethiopia	Benin	Ghana	Lesotho	Malawi	Cameroon	Congo DR
Nutrition	**12.39**	**22.95**	**16.66**	**10.27**	**13.97**	**15.91**	**14.11**	**21.83**
Stunting	24.31	36.18	28.67	15.42	29.49	34.10	27.75	35.86
Wasting	9.22	21.52	15.70	10.14	9.22	10.54	10.28	19.77
Underweight	3.65	11.16	5.61	5.25	3.21	3.13	4.31	9.87
Morbidity	**42.08**	**70.96**	**59.81**	**54.15**	**50.59**	**67.87**	**66.12**	**70.05**
Vaccination	41.24	78.55	68.62	43.57	42.05	61.29	69.58	69.89
Diseases	42.69	63.37	51.08	64.72	59.12	74.45	62.66	70.21
Environment	**67.12**	**64.14**	**47.55**	**48.98**	**38.12**	**47.70**	**59.64**	**69.03**
Sanitation	64.35	59.30	30.29	63.60	20.99	44.76	53.93	66.02
Water source	69.86	68.97	64.81	34.35	55.24	50.63	65.35	72.03
Natal care	**19.40**	**59.17**	**28.73**	**14.27**	**31.85**	**24.47**	**29.74**	**44.87**
Prenatal	7.87	23.43	10.53	2.05	3.95	21.49	3.54	40.62
Health professional	4.49	54.28	10.41	2.83	84.98	12.27	13.17	35.82
Delivery place	33.80	67.63	13.62	26.46	20.50	7.66	30.17	20.48
Postnatal	31.44	91.34	80.35	25.74	17.95	56.45	72.08	82.55

Notes: Dimensional deprivations are based on indicators' averages

Additionally, we find some country level heterogeneities on dimensions. For instance, Ghana is better off on nutrition and natal care than all countries, whiles Kenya and Lesotho have the lowest deprivations than all countries on morbidity (42%) and environment (38%) dimensions respectively. Ethiopia is worst off on nutrition, morbidity and natal care and as well the

[4] Despite nutritional deprivations being the lowest, it is worth noting that most of the countries have not achieved some of the Global nutrition targets by 2030 and should be equally treated as important (See from UNICEF et al. 2021). These targets include reducing and maintaining childhood wasting by 3 percent, reducing and maintaining childhood overweight by 3 percent and reducing the number of under 5 year old children who are stunted by 5 percent.

highest deprived in their respective indicators, except for diseases, prenatal care and access to health professional. Compared to the other countries, Congo DR faces the highest deprivation rate on environment (69 percent) which can be attributed to the high deprivation rates on the indicators. This is about 10 percent higher than the environment deprivation rate for it's Central African counterpart Cameroon. Such variations are found in Houweling et al. (2003) where differences in measles immunisation coverage is estimated on a sample of 15 developing countries including Kenya, Cameroon and Malawi. In Houweling et al. (2003), deprivation rates are between 12 percent and 42 percent for Kenya and Malawi which is higher for Cameroon between 24 percent and 60 percent across wealth groups.

We also observe marked disparities in deprivation prevalence between the indicators under all dimensions. Stunting is the most important indicator under nutrition compared to wasting and being underweight with the highest stunting rate of 36 percent and lowest of 15 percent. Underweight prevalence ranges from about 4 to 11 percent while wasting prevalence is from 9 to 22 percent across the countries. Under morbidity, vaccination is important in three countries, namely, Ethiopia, Benin and Cameroon compared to the other 5 countries with rather higher vulnerabilities found with diseases. Kenya reports the lowest on both diseases and vaccination deficiencies. Only children in Ghana are most vulnerable on sanitation than water sources. Children from five countries (Ethiopia, Benin, Malawi, Cameroon, Congo DR) are mostly deprived on postnatal care compared to the other 3 indicators of natal care. For instance, while Benin suffers 80.35 vulnerabilities in postnatal care, it suffers only 13.62 on child delivery place vulnerabilities. Prenatal care shows the least deprivation in half of the countries. Children from Lesotho are highly deprived on health professionals with a wide gap when compared with other countries.

Generally, one could tell from the unidimensional deprivation rates that some dimensions (indicators) have higher levels of deprivation rates than others. Apart from the existence of heterogeneities in health dimensions and indicators within countries, we also observe differences across the eight countries. Although these are insightful and offers some understanding of health inequalities among children in one of the world's poorest regions, a multidimensional approach to examining such deprivations in health would be more imperative for understanding multiple deprivations to be able to target the most vulnerable populations and for policy purposes. Besides, country rankings change based on the dimension of health deprivations. In the next section, we present multidimensional measures of health deprivation across the 8 countries.

3.4.2 Multidimensional Health Index and Sub-Group Decompositions

Moving on to the indices, we present in Tables 3.4 to 3.14 the Headcount (H), Intensity (I) and Adjusted headcount also known as the Multidimensional Health Index (MHI) for all countries included in this chapter. We show both the overall indices and sub-group decompositions. By sub-group, we mean by sex, by location, and by regional differences. These measurements, as stated in the methodology, for our baseline estimations are based on a weighted deprivation cutoff of 0.5. That is, a child is considered as deprived if their weighted sum of deprivation is above 50 percent or if they are deprived in at least two dimensions as dimensions are equally weighted. First, the headcount is calculated, followed by the intensity of deprivation and the composite health deprivation index.

3.4.2.1 Overall

Our preliminary analysis is based on the indicator thresholds outlined in Table 3.2 and a multidimensional deprivation cutoff (k) of 0.5. This implies that only children with at least two simultaneous deprivations are considered deprived in health. Table 3.4 presents overall country level indices. From the table, overall headcount is highest in Ethiopia followed by Congo DR. Respectively, 58 percent and 50 percent of children between ages 0 to 5 years are deprived in health multidimensionally. These two countries fall within low income countries following the recent World-bank country classifications. These are followed by Cameroon (27.8 percent) and Benin (19.6 percent). The remaining comprises three lower-middle-income countries and a single low income country (Malawi) with deprivations below 20 percent. They are Malawi (19.2 percent), Kenya (12.6 percent), Lesotho (10.7 percent), and Ghana (7.6 percent). These figures show clearly significant differences in the headcount across countries suggesting that while only 7.6 percent of children in Ghana experience simultaneous deprivations in health, in Ethiopia, 58 percent of children are deprived and it is the worst case across all countries.

Table 3.4: Multidimensional Health Index (Overall)

Country	Measurements		
	H	A	MHI
Benin	0.196	0.594	0.116
	(0.007)	(0.002)	(0.004)
Ghana	0.076	0.588	0.045
	(0.007)	(0.006)	(0.004)
Ethiopia	0.582	0.641	0.373
	(0.014)	(0.003)	(0.010)
Kenya	0.126	0.589	0.074
	(0.005)	(0.003)	(0.003)
Lesotho	0.107	0.581	0.062
	(0.011)	(0.005)	(0.006)
Malawi	0.192	0.593	0.114
	(0.008)	(0.003)	(0.005)
Cameroon	0.278	0.611	0.170
	(0.014)	(0.004)	(0.009)
DR Congo	0.498	0.642	0.320
	(0.016)	(0.003)	(0.011)

Notes: Standard errors in parenthesis. All specifications are weighted.

The intensity of health deprivations or average deprivation rate (A) falls between about 58 percent and 64 percent across all countries. That is to say, on average unhealthy children are deprived on at least 58 percent of all weighted health dimensions (indicators). Thus, we observe only slight differences in the severity of health deprivations among children across the different parts of sub-Saharan Africa.

Regarding the deprivation index (MHI), again Ethiopia and DR Congo show larger indices than all countries; 0.373 and 0.320 correspondingly. These high MHIs could be attributed to the high headcount ratios and as well the high individual indicator deprivations observed in the unidimensional indicators and dimensions for both countries. These two countries are some of the poorest countries in the region and also experience conflicts and displacements, corruption and widespread diseases like Ebola and diarrhoea (Kalisya et al., 2015; Mogess et. al., 2023). Again we observe that, the ranking of countries does not change with this index when compared with headcount ratios and Ghana is the least deprived with an MHI of 0.045. We observe that, for the relatively less poor countries like Ghana and Kenya, deprivation rates are not more than, say, 20 percent of deprivations in the most deprived countries (Congo DR and Ethiopia), a clear indication of marked disparities across countries.

3.4.2.2 Sub-Group Decompositions

By Location

Considering the location of households, as shown in Table 3.5, except for Benin, Lesotho and Malawi, both MHI and H are significantly higher in rural than in urban areas. For Benin and Malawi however, although urban deprivations are higher than rural deprivations, we find only slight differences in the degree of MHI between the two areas for both incidence and the

Table 3.5: Sub-Group Decomposition of Multidimensional Health Index (By Location of Residence)

Country	Urban			Rural		
	H	A	MHI	H	A	MHI
Benin	0.198	0.591	0.117	0.195	0.595	0.116
	(0.010)	(0.003)	(0.006)	(0.009)	(0.003)	(0.006)
Ghana	0.056	0.582	0.032	0.094	0.591	0.055
	(0.009)	(0.007)	(0.005)	(0.011)	(0.009)	(0.007)
Ethiopia	0.368	0.609	0.224	0.614	0.644	0.395
	(0.026)	(0.008)	(0.017)	(0.015)	(0.003)	(0.010)
Kenya	0.076	0.582	0.044	0.155	0.591	0.092
	(0.007)	(0.005)	(0.004)	(0.007)	(0.003)	(0.004)
Lesotho	0.146	0.589	0.086	0.093	0.577	0.053
	(0.024)	(0.010)	(0.014)	(0.012)	(0.006)	(0.007)
Malawi	0.193	0.595	0.115	0.192	0.592	0.114
	(0.020)	(0.007)	(0.012)	(0.009)	(0.003)	(0.005)
Cameroon	0.153	0.588	0.090	0.390	0.620	0.242
	(0.014)	(0.007)	(0.008)	(0.023)	(0.004)	(0.014)
DR Congo	0.318	0.623	0.198	0.580	0.647	0.375
	(0.021)	(0.005)	(0.013)	(0.021)	(0.003)	(0.014)

Notes: Standard errors in parenthesis. All specifications are weighted.

Table 3.6: Sub-Group Decomposition of Multidimensional Health Index (By Sex)

Country	Male			Female		
	H	A	MHI	H	A	MHI
Benin	0.204	0.594	0.121	0.188	0.593	0.111
	(0.008)	(0.003)	(0.005)	(0.008)	(0.003)	(0.005)
Ghana	0.079	0.589	0.046	0.073	0.586	0.043
	(0.010)	(0.008)	(0.006)	(0.009)	(0.008)	(0.006)
Ethiopia	0.589	0.641	0.377	0.575	0.642	0.369
	(0.016)	(0.004)	(0.011)	(0.017)	(0.004)	(0.011)
Kenya	0.134	0.594	0.079	0.118	0.583	0.069
	(0.007)	(0.004)	(0.004)	(0.007)	(0.003)	(0.004)
Lesotho	0.141	0.582	0.082	0.079	0.580	0.046
	(0.020)	(0.007)	(0.012)	(0.013)	(0.008)	(0.008)
Malawi	0.209	0.593	0.124	0.176	0.593	0.105
	(0.012)	(0.004)	(0.007)	(0.011)	(0.004)	(0.006)
Cameroon	0.298	0.617	0.183	0.258	0.605	0.156
	(0.017)	(0.005)	(0.011)	(0.016)	(0.005)	(0.010)
DR Congo	0.512	0.648	0.331	0.485	0.636	0.308
	(0.021)	(0.004)	(0.014)	(0.016)	(0.004)	(0.011)

Notes: Standard errors in parenthesis. All specifications are weighted.

deprivation index. Multidimensional index is 0.117 and 0.115 among urban children compared to 0.116 and 0.114 among rural children in Benin and Malawi, respectively. This is consistent with Fotso (2006) who finds that stunting inequalities are larger in urban areas across SSA countries.

Again Ethiopia and Congo DR experience the highest forms of vulnerabilities. Ethiopia faces the highest deprivations among rural and urban folks considering both H and MHI, followed by Congo DR. Deprivation prevalence in urban Ghana is the least compared to other urban places and lowest in rural Lesotho than other rural places. Additionally, only slight differences are observed in deprivation severity rates - hovering around 58 and 65 percent - across both urban and rural children in all countries. This goes to show that, children suffer relatively equal deprivation severities across the SSA region. The relatively higher deprivations in rural areas could be a result of unequal access to health-care facilities and unimproved health-care services in rural areas (Orach & Garimoi, 2009). Considering that, policy makers should channel healthcare interventions equitably such that more rural children are carried along together with their urban counterparts.

By Sex

Surprisingly, the results also indicate, in all countries, higher health deprivations among males than females as shown in Table 3.6. Also, we find marked differences in deprivation rates across countries. For instance, Ethiopian male children face the highest vulnerabilities (37.7 percent), followed by Congo DR (33.1 percent) and then Cameroon (18.3 percent). The high MHI in the top two countries is a result of the associated high headcount ratios and the over 60 percent intensity rates among under 5 children than the other countries. The other countries include Malawi (12.4 percent), Benin (12.1 percent), Lesotho (8.2 percent), Kenya

(7.9 percent) and Ghana (4.6 percent). The ranking of countries slightly changes with females, and not surprising that Ethiopian females children have the largest deprivations. Overall, females in Ghana followed by Lesotho are better off than those in other countries.

By Region of Residence

We present each country's regional results in Tables 3.7 to 3.14. We do not observe much disparities in the severity of deprivations, which hovers around 55 to 65 percent. For both intensity and headcount, we find significant regional differences within countries. This is seen to have been masked by the overall estimates of multidimensional health deprivations as explained in the previous section. For example, in Congo DR (Table 3.14), whiles around 53 and 56 percent of under-5 children are multidimensionally deprived in health in Maneima and Orientale respectively, the rate is 20 percent in Kinshasha which is also the region with the lowest headcount. This results in a relatively higher MHI for those regions (former). Equateur is the highest deprived as it has the largest prevalence of multidimensionally deprived children (H=62.5 percent) with a corresponding MHI of 40.4 percent.

In Ghana, it is not surprising that one amongst the three Northern regions exhibit the largest incidence as shown from Table 3.8 (last three regions). Thus, 16.7 percent of under-5 children in the Northern region are multidimensionally deprived on health and it is also significantly higher than all other regions. This is followed by Eastern (16.3 percent), Central (12.9 percent) and the remaining regions revealing less than 10 percent on incidence. Eastern region's MHI tend to be higher than that of the Northern because of its higher severity index (A). Overall, the country's capital region, Greater Accra shows the lowest on both incidence rate and MHI.

For Benin (Table 3.7), whiles more than 20 percent of children are multidimensionally health deprived in Alibora, Atlantic, Borgou, Couffo, Oueme and Littoral, less then 20 percent of children in the remaining regions experience simultaneous deprivations, with the lowest being Collines (9.1 percent). The corresponding MHI shows the former regions as the top 6 deprived in health. The North-Eastern region being a highly rural region faces the highest incidence and MHI than any other region in Kenya (Table 3.9). This is followed by the Western and Rift-Valley regions. The Capital city (Nairobi) with about 1 percent being rural, experiences the lowest on both incidence (3.5 percent) and multidimensional index (0.020).

From the Ethiopian side in Table 3.10, as high as 68.2 percent and 62 percent of children are multidimensionally deprived in Afar and Somali regions respectively. These are the two highest within Ethiopia and across all countries. This contributes to the high indices of 44.7 and 39.2 percents for the two regions. The lowest on incidence and MHI is Addis Ababa (19.4 percent on incidence and 11.2 on MHI), a fully urban region and the country's capital. This is not surprising as Table 3.5 shows a marked difference between urban and rural areas. The table shows clear disparities with some regions facing very large deprivations than others hence contributing to the large overall deprivations in the country. All other regions show headcount rates between 20 percent and 45 percent revealing that Ethiopia is one of the highly deprived countries in the SSA region.

From Table 3.11, we observe that regions in Malawi have a relatively balanced incidence between 16 percent and 19 percent which is somewhat translated to the below 12 percent on MHI across the regions. In Cameroon (Table 3.13), a lower proportion of under-5 children are multidimensionally deprived in Doula (8.6 percent), in Littoral (9.4 percent) and in Yaounde (9.8 percent) than in other regions like the North (39.6 percent), Adamawa (48.5 percent) and Far-North (42.4 percent) showing large inequalities in health deprivations.

Multidimensional index is as well low in the former than in the latter regions. It is 4.8 percent in Doula and as high as 30.4 percent in Adamawa, showing a wide gap.

Across all countries, one could tell that under-5 children in Congo DR and Ethiopian regions face the most unequal and highest deprivations in health than in other countries. Notably some regions contribute more to deprivations than other regions. These results are somewhat consistent with Brockerhoff and Hewett (2000) findings where significant ethnical differences among under-5 children were found in different countries of the sub-Saharan African region. Such inequalities suggest the inability of health care resources to reach children in certain places suggesting the need for policymakers to target regions with high vulnerabilities and equitably distribute health resources. This also results in an inclusive environment where no child regardless of their location or region is left behind.

Table 3.7: Decomposition of H, A and MHI by Region (Benin)

Region	Measurements		
	H	A	MHI
Alibori	0.301	0.609	0.183
	(0.027)	(0.006)	(0.183)
Atacora	0.164	0.589	0.096
	(0.020)	(0.005)	(0.012)
Atlantic	0.206	0.586	0.121
	(0.017)	(0.004)	(0.010)
Borgou	0.231	0.594	0.137
	(0.023)	(0.007)	(0.015)
Collines	0.091	0.581	0.053
	(0.017)	(0.007)	(0.009)
Couffo	0.218	0.583	0.127
	(0.020)	(0.005)	(0.012)
Donga	0.164	0.592	0.097
	(0.025)	(0.006)	(0.015)
Littoral	0.211	0.587	0.124
	(0.023)	(0.007)	(0.013)
Mono	0.160	0.586	0.094
	(0.020)	(0.010)	(0.011)
Oueme	0.201	0.594	0.120
	(0.021)	(0.007)	(0.013)
Plateau	0.180	0.603	0.108
	(0.019)	(0.009)	(0.012)
Zou	0.116	0.581	0.067
	(0.016)	(0.007)	(0.009)

Notes: Standard errors in parenthesis. All specifications are weighted.

Table 3.8: Decomposition of H, A and MHI by Region (Ghana)

Region	Measurements		
	H	A	MHI
Western	0.062	0.576	0.036
	(0.016)	(0.010)	(0.009)
Central	0.129	0.557	0.072
	(0.021)	(0.012)	(0.013)
Greater Accra	0.017	0.593	0.010
	(0.010)	(0.039)	(0.006)
Volta	0.041	0.601	0.024
	(0.015)	(0.012)	(0.009)
Eastern	0.163	0.615	0.100
	(0.029)	(0.018)	(0.019)
Ashanti	0.049	0.573	0.028
	(0.016)	(0.011)	(0.009)
Brong-Ahafo	0.046	0.589	0.027
	(0.015)	(0.017)	(0.009)
Northern	0.167	0.594	0.099
	(0.035)	(0.011)	(0.022)
Upper East	0.019	0.618	0.012
	(0.012)	(0.006)	(0.007)
Upper West	0.035	0.616	0.021
	(0.013)	(0.052)	(0.008)

Notes: Standard errors in parenthesis. All specifications are weighted.

Table 3.9: Decomposition of H, A and MHI by Region (Kenya)

Region	Measurements		
	H	A	MHI
Coast	0.112	0.579	0.065
	(0.018)	(0.007)	(0.010)
North-Eastern	0.239	0.590	0.141
	(0.041)	(0.007)	(0.024)
Eastern	0.105	0.589	0.062
	(0.013)	(0.007)	(0.008)
Central	0.067	0.559	0.038
	(0.012)	(0.005)	(0.007)
Rift Valley	0.158	0.589	0.093
	(0.009)	(0.004)	(0.006)
Western	0.184	0.606	0.111
	(0.020)	(0.007)	(0.012)
Nyanza	0.134	0.592	0.079
	(0.014)	(0.006)	(0.008)
Nairobi	0.035	0.569	0.020
	(0.015)	(0.013)	(0.008)

Notes: Standard errors in parenthesis. All specifications are weighted.

Table 3.10: Decomposition of H, A and MHI by Region (Ethiopia)

Region	Measurements		
	H	A	MHI
Tigray	0.331	0.608	0.201
	(0.029)	(0.007)	(0.018)
Afar	0.682	0.655	0.447
	(0.030)	(0.007)	(0.022)
Amhara	0.576	0.635	0.366
	(0.026)	(0.005)	(0.018)
Oromia	0.659	0.648	0.427
	(0.025)	(0.005)	(0.018)
Somali	0.620	0.633	0.392
	(0.033)	(0.005)	(0.021)
Benishangul	0.510	0.646	0.329
	(0.034)	(0.008)	(0.024)
Snnpr	0.577	0.642	0.370
	(0.024)	(0.006)	(0.017)
Gambela	0.327	0.625	0.205
	(0.041)	(0.007)	(0.026)
Harari	0.430	0.631	0.271
	(0.038)	(0.006)	(0.024)
Addis Ababa (fully urban)	0.194	0.580	0.112
	(0.024)	(0.007)	(0.015)
Dire Dawa	0.452	0.629	0.284
	(0.030)	(0.011)	(0.021)

Notes: Standard errors in parenthesis. All specifications are weighted.

Table 3.11: Decomposition of H, A and MHI by Region (Malawi)

Region	Measurements		
	H	A	MHI
Northern	0.165	0.580	0.096
	(0.020)	(0.010)	(0.012)
Central	0.196	0.591	0.116
	(0.014)	(0.005)	(0.008)
Southern	0.195	0.597	0.117
	(0.011)	(0.004)	(0.007)

Notes: Standard errors in parenthesis. All specifications are weighted.

Table 3.12: Decomposition of H, A and MHI by Region (Lesotho)

Region	Measurements		
	H	A	MHI
Botha-Bothe	0.093	0.572	0.053
	(0.029)	(0.011)	(0.017)
Leribe	0.103	0.605	0.062
	(0.024)	(0.019)	(0.015)
Berea	0.107	0.559	0.060
	(0.037)	(0.011)	(0.021)
Maseru	0.103	0.590	0.061
	(0.026)	(0.013)	(0.016)
Mafeteng	0.081	0.580	0.047
	(0.027)	(0.019)	(0.016)
Mohale's hoek	0.095	0.568	0.054
	(0.029)	(0.009)	0.016)
Quthing	0.078	0.551	0.043
	(0.035)	(0.016)	(0.019)
Qacha's-nek	0.034	0.594	0.020
	(0.018)	(0.027)	(0.011)
Mokhotlong	0.193	0.583	0.112
	(0.039)	(0.010)	(0.022)
Thaba Tseka	0.150	0.580	0.087
	(0.040)	(0.013)	(0.023)

Notes: Standard errors in parenthesis. All specifications are weighted.

Table 3.13: Decomposition of H, A and MHI by Region (Cameroon)

Region	Measurements		
	H	A	MHI
Adamawa	0.485	0.627	0.304
	(0.047)	(0.012)	(0.029)
Centre	0.265	0.618	0.164
	(0.035)	(0.010)	(0.023)
Doula	0.086	0.566	0.048
	(0.026)	(0.008)	(0.015)
East	0.395	0.603	0.238
	(0.031)	(0.011)	(0.018)
Far-North	0.424	0.626	0.266
	(0.037)	(0.008)	(0.023)
Littoral	0.094	0.575	0.054
	(0.025)	(0.011)	(0.015)
North	0.396	0.627	0.248
	(0.060)	(0.008)	(0.039)
North-West	0.236	0.575	0.136
	(0.055)	(0.015)	(0.034)
West	0.174	0.577	0.101
	(0.026)	(0.010)	(0.016)
South	0.173	0.586	0.101

	(0.029)	(0.009)	(0.017)
South-West	0.164	0.534	0.087
	(0.049)	(0.009)	(0.025)
Yaounde	0.098	0.571	0.056
	(0.026)	(0.011)	(0.015)

Notes: Standard errors in parenthesis. All specifications are weighted.

Table 3.14: Decomposition of H, A and MHI by Region (Congo DR)

Region	Measurements		
	H	A	MHI
Kinshasha	0.200	0.584	0.117
	(0.026)	(0.007)	(0.015)
Bandundu	0.496	0.637	0.316
	(0.042)	(0.006)	(0.028)
Bas-congo	0.459	0.640	0.293
	(0.073)	(0.018)	(0.053)
Equateur	0.625	0.647	0.404
	(0.053)	(0.005)	(0.035)
Kasai-occi	0.606	0.643	0.390
	(0.044)	(0.005)	(0.029)
Kasai-ori	0.611	0.658	0.402
	(0.035)	(0.009)	(0.023)
Katanga	0.544	0.655	0.356
	(0.043)	(0.005)	(0.028)
Maniema	0.532	0.643	0.342
	(0.054)	(0.011)	(0.040)
Nord-kivu	0.236	0.615	0.145
	(0.048)	(0.021)	(0.033)
Orientale	0.557	0.646	0.360
	(0.035)	(0.008)	(0.024)
Sud-kivu	0.258	0.590	0.152
	(0.027)	(0.007)	(0.016)

Notes: Standard errors in parenthesis. All specifications are weighted.

3.4.3 Contribution of Dimensions and Indicators to MHI

In order to examine how health deprivations are impacted by the different dimensions and indicators, we examine the contribution of each dimension and indicator to MHI. Thus, the kind of deprivation that unhealthy children face the most is explained by the contribution of each indicator and dimension. The results of dimensional and indicator contributions are presented in Table 3.15 below.

From the table, we find slightly different patterns of dimensional contributions across the countries. For example, morbidity contributes the most to the multidimensional health deprivation index for all countries except for the case of Kenya where deprivation in environment contributes the largest although only slightly higher than the contribution by morbidity (by 0.041). This is plausible as Table 3.3 revealed that more than 40 percent of children in all countries are deprived on Morbidity. Kenya's deprivation on environmental factors could be explained by the over 17 percent contributions on both sanitation and water source. For all other countries, environmental deprivations follow morbidity. Nutrition is the least important dimension for Cameroon, Kenya, Lesotho, Congo DR and Ethiopia while, natal-care contributes the least for the remaining 3 countries. Again, here, we see that Ethiopia followed by Congo DR have relatively higher contributions to MHI under natal-care above 20 percent than the remaining countries (remember that they have the highest MHIs and headcounts, and wider inequalities in these measures across regions).

Subsequently, we breakdown the dimensions shares into contributions by their nested indicators. This is as well shown in Table 3.15. For all countries, stunting contributes the largest to nutrition deprivations. This is followed by wasting and then underweight which contributes the least. Between the two morbidity indicators, half of the countries (Cameroon, Ethiopia, Benin and Congo DR) have larger contributions by vaccination and the other half (Kenya, Ghana, Lesotho and Malawi) by diseases.

Cameroon, Ethiopia, Malawi, Benin and Congo DR show the highest contribution by postnatal care from the natal-care dimension. This is followed by deprivations in delivery facility.

Delivery place contributes more for Ghana and Kenya, while health professional for Lesotho. Also, the lowest contributions is mostly by prenatal-care deprivations except for Malawi, Kenya and Congo DR where health professional deprivations contribute the least in Kenya and Malawi and delivery place for Congo DR.

Additionally, we show in Appendix 3.B the contributions of each dimension and indicator by the sub-group decompositions. We observe that, the contributions do not differ by subgroup from the overall contributions as shown in Table 3.15. Thus our estimates from the Tables reveal that, by decomposing into sub-groups, dimensional and indicator contributions are not very different from the overall and they show how important each dimension is to targeting child health in SSA.

Table 3.15: Indicator and Dimensional Contributions to MHI (Overall)

Indicator/Dimension	Kenya	Ghana	Lesotho	Cameroon	Ethiopia	Malawi	Benin	Congo DR
Nutrition	**0.152**	**0.181**	**0.167**	**0.130**	**0.128**	**0.148**	**0.172**	**0.133**
Stunting	0.085	0.083	0.103	0.077	0.066	0.094	0.090	0.069
Wasting	0.046	0.064	0.050	0.039	0.042	0.041	0.060	0.043
Underweight	0.021	0.033	0.014	0.015	0.021	0.012	0.022	0.021
Morbidity	**0.319**	**0.377**	**0.342**	**0.351**	**0.324**	**0.372**	**0.368**	**0.332**
Vaccination	0.156	0.182	0.147	0.181	0.171	0.183	0.191	0.167
Diseases	0.164	0.195	0.194	0.170	0.152	0.189	0.177	0.165
Environment	**0.360**	**0.313**	**0.304**	**0.329**	**0.283**	**0.332**	**0.294**	**0.320**
Sanitation	0.174	0.160	0.107	0.164	0.129	0.163	0.109	0.147
Water source	0.186	0.153	0.197	0.164	0.154	0.170	0.185	0.173
Natal-care	**0.168**	**0.129**	**0.188**	**0.190**	**0.265**	**0.148**	**0.166**	**0.215**
Prenatal	0.022	0.007	0.010	0.007	0.027	0.035	0.012	0.049
Health professional	0.016	0.016	0.103	0.033	0.065	0.019	0.027	0.046
Delivery place	0.069	0.059	0.042	0.062	0.079	0.017	0.033	0.033
Postnatal	0.061	0.046	0.032	0.089	0.093	0.077	0.094	0.087

Notes: Total contribution of all dimensions (indicators) is 100 percent for each country. The sum of indicators' contributions under each dimension gives the respective dimension's contribution. Example for Kenya, under nutrition, 0.085 (stunting) + 0.046 (wasting) + 0.021 (underweight) = 0.152 (Nutrition).

3.4.4 Robustness of Country Ranking to Changes in Weights

In this section, we apply the methods described in sub-section 3.3.3 to examine whether country ranking of multidimensional health indices are robust to changes in weights. The H, A and MHI results for the four alternative weighting structures are reported in Appendix Tables 3.C.2 to 3.C.5. Appendix Tables 3.C.6 to 3.C.9 also presents tables describing whether or not pairwise comparisons are significant or not in all weighting structures using both hypothesis tests and confidence interval analysis. They show whether or not the relationships between the paired countries are significant or not across the five alternative structures. Since we are interested in the robustness of country ranking, we will focus on Table 3.16 below. The total number of possible pairwise comparisons is 28. Table 3.16 mainly shows the proportions of the total possible pairwise comparisons and the total significant pairwise comparisons from the baseline that are robust under each approach. These were computed using only the overall baseline results and the baseline together with alternative weighting results.

From the first row of Table 3.16, TPC provides the proportion of total possible pairwise comparisons that are robust. The second row SPB shows the percentage with regards to those pairwise comparisons that were significant from the baseline analysis. Column 1 and column 3 shows the results according to the hypothesis tests while columns 2 and 4 reports the percentages for which the confidence intervals of the various paired countries do not overlap.

We find that by MHI of the entire countries in this study, 96 percent and 89 percent of the total possible pairwise comparisons are significant in the baseline according to the hypothesis tests and confidence intervals correspondingly[5]. When we compare the baseline results with the four alternatives, we find that 82 percent under TPC are robust according to the -

Table 3.16: Robust Pairwise Comparisons: Proportion of Total Possible Pairwise Comparison and Proportion of Baseline Significant Pairwise Comparison (in %)

	Baseline only		Baseline and 4 other alternative weighting structures	
	Hypothesis Test	CI (non overlapping)	Hypothesis Test	CI (non overlapping)
	(1)	(2)	(3)	(4)
Panel A: MHI				
TPC	96.43	89.29	82.14	75.00
SPB	100	100	85.18	84.00
Panel B: H				
TPC	89.29	89.29	67.86	71.43
SPB	100	100	76.00	80.00

Notes: TPC and SPB represent total possible pairwise comparisons and significant pairwise comparisons in baseline. In columns 1 and 2, we take the total number of significant pairwise comparisons in the baseline and divide it by the total number of pairs (28). For instance, in panel A, in the TPC row under hypothesis test, the former is 27, hence, 27/28=96.43% and under CI, column (2) this is 25/28=89.29%. In columns 3 and 4, the number of robust comparisons across the 5 weighting structures is divided by the TPC in both the hypothesis test and CI approaches. Baseline comparisons in the SPC row is 100% as it is a proportion of itself.

Table 3.17: Correlation Between Baseline Indices and Alternative Weights' Indices: Spearman Correlation Coefficients

	Baseline (equal weight)	40-20-20-20[6]	20-40-20-20[7]	20-20-40-20[8]
40-20-20-20	1.000			
20-40-20-20	0.976	0.976		
20-20-40-20	0.958	0.958	0.994	
20-20-20-40[9]	1.000	1.000	0.976	0.958

***Notes**:* All 8 countries considered.

[5] The proportion is always 100% under the baseline as it is a proportion of itself.
[6] 40% weight to Nutrition, 20% to Morbidity, 20 % to Environment and 20% to Natal-care
[7] 40% weight to Morbidity, 20% to Nutrition, 20 % to Environment and 20% to Natal-care
[8] 40% weight to Environment, 20% to Morbidity, 20 % to Morbidity and 20% to Natal-care
[9] 40% weight to Natal-care, 20% to Morbidity, 20 % to Environment and 20% to Morbidity

Table 3.18: Correlation Between Baseline Indices and Alternative Weights' Indices: Kendall Tau-b Correlation Coefficients

	Baseline (equal weight)	40-20-20-20	20-40-20-20	20-20-40-20
40-20-20-20	1.000			
20-40-20-20	0.929	0.929		
20-20-40-20	0.893	0.893	0.964	
20-20-20-40	1.000	1.000	0.929	0.893

***Notes**:* All 8 countries considered.

hypothesis tests. The result is 75 percent by CIs. Further, it shows that 85 percent of pairwise comparisons that were significant in the baseline are preserved through the 5 alternative structures considered by Hypothesis tests and 84 percent by CIs. These tests therefore fairly proof the robustness of using alternative weights in our multidimensional analysis. To support the results, the table shows between 68 percent and 80 percent robust Headcount results across countries reported in panel B. Table 3.17 and Table 3.18 show high correlation rates between indices of the different weights, further supporting the results. In conclusion, the results of the robustness analysis show that a country's position relative to others in our sample is robust to changes in weights.

3.5 Discussion and Conclusions

This chapter adopts the Alkire and Foster (2011) approach to multidimensionality, popular in the poverty literature, to examine child multidimensional health deprivations in 8 countries in sub-Saharan Africa, including Kenya, Ethiopia, Ghana, Malawi, Benin, Lesotho, Congo DR, and Cameroon. As children's health is important for their future lives, it is important to examine their early life health vulnerabilities from a multidimensional perspective, as achieving some equality in children's health will require appropriate targeting of vulnerable children and dimensions of health. We, therefore, use the Demographic and Health Surveys of the countries conducted between 2014 and 2018 to analyze the nature of multidimensional deprivations, assess the inequalities in deprivations both within and across countries by child sex, location, and region of residence, and examine the sources of such deprivations.

Using the Alkire and Foster (2011) approach to multidimensionality, we consider four dimensions of child health, including nutrition, morbidity, environment, and natal care. Under each dimension are nested indicators, namely stunting, wasting, and underweight (nutrition), vaccination and diseases (morbidity), water sources and sanitation (environment), and lastly health professionals, postnatal care, prenatal care and delivery place (natal care). We assign equal weights of 0.25 to each dimension and use a weighted deprivation cutoff of 0.5 above which a child is considered deprived in health. Overall, we find the highest deprivation rates in Ethiopia (37 percent), followed by Congo DR (32 percent) with the lowest recorded by Ghana (4.5 percent). The results also show that unhealthy children are on average deprived on not less than 58 percent of all deprivations measured by the intensity A. Besides, the type of robustness analysis where different weighting structures (4 additional structures) are adopted and pairwise comparisons of countries' Multidimensional Health Index (MHI) and Headcount (H) are made to show that the ranking of countries is robust to changes in weights of the health indicators. At least 82 percent and 68 percent of all pairwise country rankings by MHI and H remain robust across all weighting structures.

Moreover, our results show significant sex and spatial variations in health vulnerabilities. More specifically, we find that for most countries urban children face less deprivations than rural children and the highest across countries for both locations is still Ethiopia. Males compared to females suffer more deprivations in all countries. When we decompose by region, we find that significant regional differences within countries are masked by the baseline overall estimates. Thus for instance, the high deprivation rates in Ethiopia and Congo DR are not driven by all regions as some regions record deprivation rates as low as 11 percent (e.g. Addis Ababa in Ethiopia and Kinshasha in Congo DR), while others record rates above 40 percent (e.g. Afar in Ethiopia and Equateur in Congo DR).

Examining sources of deprivations, we find that for most countries morbidity contributes more to deprivations, followed by environment except for Kenya where the reverse is the case. Specifically, children falling sick (diseases) and lack of access to vaccination appropriate for their age (vaccination) are the major sources of under 5 health deprivations in most countries. While nutrition contributes the least to 5 countries and natal care contributes the least to the remaining 3 countries, these should not be overlooked in dealing with children's vulnerabilities as a considerable percentage contribution of at least 12 percent for the two is still hugely troubling to children's wellbeing.

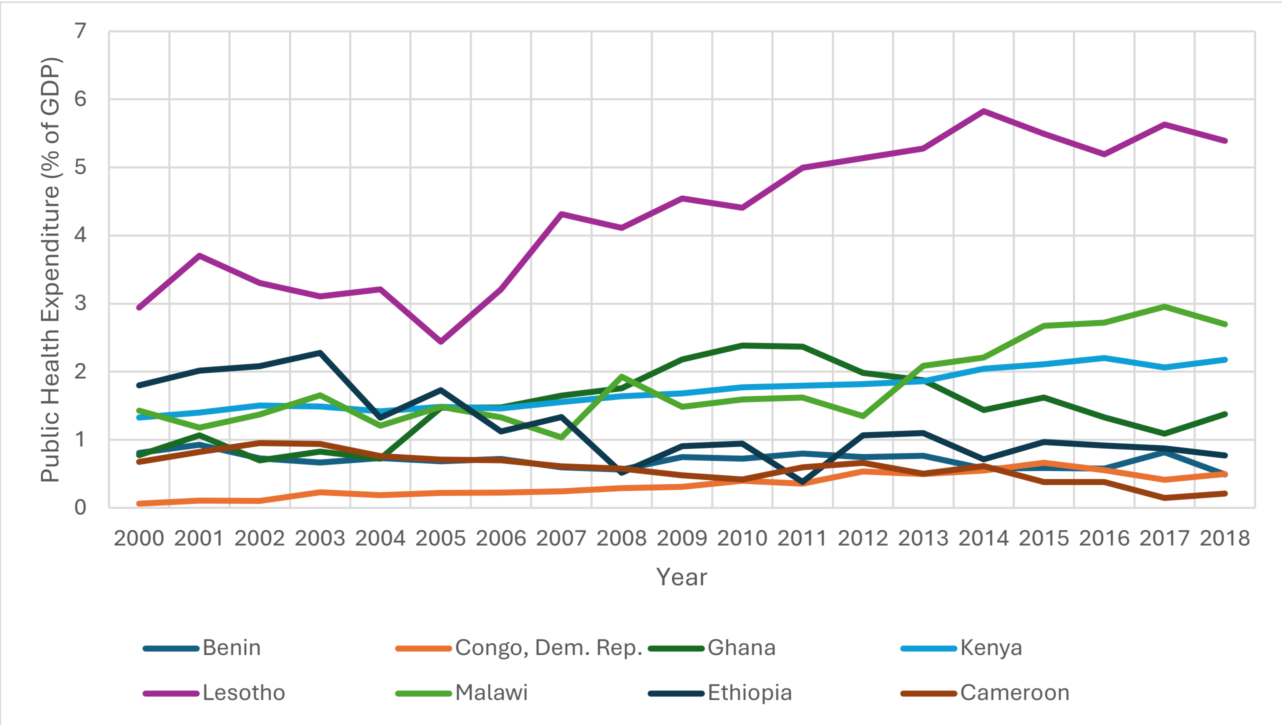
Altogether, the multidimensional approach by Alkire and Foster (2011) seems a suitable approach to measuring early childhood health deprivations in SSA as results are plausible and remain robust to arbitrary changes in weights and to making pairwise country comparisons. Countries should develop more equitable health policies that prioritise inclusion and can reach all children regardless of geography, gender, or administrative area. Policies should be influenced by people's needs and be capable of overcoming economic, social, and political barriers to accessing adequate healthcare.

Although this makes relevant contributions to the literature, there are some limitations. The main limitation of the study is the small size of the sample of under 5 children in the data. In our study, Benin has the largest sample of 8067 children while Lesotho has the lowest sample of 1102 children. To reduce the effect of this limitation, we weighted the datasets for each country using the DHS child weights hence the data is representative of the population for each country. Another limitation is the use of data collected at different periods across the sampled countries. Although the time difference between the earliest 2014 and the latest 2018 is small, country comparisons may have shown a different picture if data for the same years were utilized. Nevertheless, this chapter provides a picture of the nature of under-5 child health from a multidimensional perspective across countries drifting away from the popularly used unidimensional frameworks which is less robust to accounting for simultaneous child health deprivations. Future research should look at more comparable datasets by year and also consider some determinants of multidimensional health deprivations of under-5 children.

Appendix 3

3.A Figures

Figure 3.A.1: Public health expenditure for 8 SSA countries adopted (from 2000 to 2018)



Notes: Constructed using data from the World Development Indicators (WDI)

3.B: Indicator/Dimension Contributions to MHI (Sub-group Decompositions) for all Countries

Table 3.B.1: Ghana

Indicator/Dimension	Gender		Location		Region									
	Male	Female	Rural	Urban	WES	CEN	GRA	VOL	EAS	ASH	BRA	NOR	UPE	UPW
Contribution to H	**0.541**	**0.459**	**0.660**	**0.340**	**0.086**	**0.192**	**0.036**	**0.040**	**0.191**	**0.111**	**0.059**	**0.262**	**0.011**	**0.013**
Contribution to MHI	**0.542**	**0.458**	**0.663**	**0.337**	**0.085**	**0.182**	**0.036**	**0.040**	**0.199**	**0.108**	**0.059**	**0.265**	**0.011**	**0.013**
Nutrition	**0.188**	**0.173**	**0.182**	**0.179**	**0.202**	**0.179**	**0.176**	**0.146**	**0.121**	**0.210**	**0.132**	**0.214**	**0.361**	**0.239**
Stunting	*0.095*	*0.070*	*0.084*	*0.082*	*0.075*	*0.097*	*0.065*	*0.087*	*0.053*	*0.076*	*0.084*	*0.103*	*0.092*	*0.106*
Wasting	*0.061*	*0.068*	*0.062*	*0.068*	*0.062*	*0.059*	*0.065*	*0.038*	*0.046*	*0.097*	*0.024*	*0.077*	*0.134*	*0.084*
Underweight	*0.032*	*0.035*	*0.036*	*0.028*	*0.065*	*0.023*	*0.046*	*0.021*	*0.023*	*0.037*	*0.024*	*0.034*	*0.134*	*0.049*
Morbidity	**0.365**	**0.391**	**0.365**	**0.403**	**0.397**	**0.356**	**0.394**	**0.335**	**0.363**	**0.405**	**0.425**	**0.390**	**0.202**	**0.299**
Vaccination	*0.181*	*0.184*	*0.175*	*0.196*	*0.204*	*0.188*	*0.183*	*0.152*	*0.160*	*0.200*	*0.213*	*0.190*	*0.000*	*0.127*
Diseases	*0.185*	*0.207*	*0.190*	*0.206*	*0.193*	*0.169*	*0.211*	*0.182*	*0.204*	*0.206*	*0.213*	*0.200*	*0.202*	*0.173*
Environment	**0.313**	**0.313**	**0.305**	**0.329**	**0.297**	**0.360**	**0.324**	**0.319**	**0.364**	**0.344**	**0.304**	**0.233**	**0.405**	**0.260**
Sanitation	*0.156*	*0.164*	*0.139*	*0.200*	*0.197*	*0.193*	*0.211*	*0.183*	*0.204*	*0.197*	*0.172*	*0.065*	*0.202*	*0.092*
Water source	*0.156*	*0.149*	*0.166*	*0.128*	*0.100*	*0.167*	*0.113*	*0.137*	*0.160*	*0.147*	*0.132*	*0.168*	*0.202*	*0.167*
Natal care	**0.134**	**0.123**	**0.149**	**0.090**	**0.104**	**0.105**	**0.106**	**0.200**	**0.152**	**0.040**	**0.139**	**0.163**	**0.032**	**0.202**
Prenatal	*0.009*	*0.005*	*0.008*	*0.006*	*0.010*	*0.005*	*0.000*	*0.000*	*0.000*	*0.000*	*0.033*	*0.014*	*0.000*	*0.000*
Health Pro	*0.019*	*0.013*	*0.018*	*0.013*	*0.000*	*0.007*	*0.035*	*0.076*	*0.016*	*0.006*	*0.000*	*0.023*	*0.000*	*0.037*
Delivery place	*0.059*	*0.060*	*0.076*	*0.026*	*0.050*	*0.063*	*0.028*	*0.063*	*0.055*	*0.000*	*0.060*	*0.091*	*0.032*	*0.087*
Postnatal	*0.047*	*0.045*	*0.047*	*0.047*	*0.044*	*0.030*	*0.043*	*0.061*	*0.081*	*0.034*	*0.046*	*0.035*	*0.000*	*0.078*
All	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**

3.B: Indicator/Dimension Contributions to MHI (Sub-group Decompositions) for all Countries

Table 3.B.1: Ghana

Indicator/Dimension	Gender		Location		Region									
	Male	Female	Rural	Urban	WES	CEN	GRA	VOL	EAS	ASH	BRA	NOR	UPE	UPW
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Contribution to H	**0.541**	**0.459**	**0.660**	**0.340**	**0.086**	**0.192**	**0.036**	**0.040**	**0.191**	**0.111**	**0.059**	**0.262**	**0.011**	**0.013**
Contribution to MHI	**0.542**	**0.458**	**0.663**	**0.337**	**0.085**	**0.182**	**0.036**	**0.040**	**0.199**	**0.108**	**0.059**	**0.265**	**0.011**	**0.013**
Nutrition	**0.188**	**0.173**	**0.182**	**0.179**	**0.202**	**0.179**	**0.176**	**0.146**	**0.121**	**0.210**	**0.132**	**0.214**	**0.361**	**0.239**
Stunting	*0.095*	*0.070*	*0.084*	*0.082*	*0.075*	*0.097*	*0.065*	*0.087*	*0.053*	*0.076*	*0.084*	*0.103*	*0.092*	*0.106*
Wasting	*0.061*	*0.068*	*0.062*	*0.068*	*0.062*	*0.059*	*0.065*	*0.038*	*0.046*	*0.097*	*0.024*	*0.077*	*0.134*	*0.084*
Underweight	*0.032*	*0.035*	*0.036*	*0.028*	*0.065*	*0.023*	*0.046*	*0.021*	*0.023*	*0.037*	*0.024*	*0.034*	*0.134*	*0.049*
Morbidity	**0.365**	**0.391**	**0.365**	**0.403**	**0.397**	**0.356**	**0.394**	**0.335**	**0.363**	**0.405**	**0.425**	**0.390**	**0.202**	**0.299**
Vaccination	*0.181*	*0.184*	*0.175*	*0.196*	*0.204*	*0.188*	*0.183*	*0.152*	*0.160*	*0.200*	*0.213*	*0.190*	*0.000*	*0.127*
Diseases	*0.185*	*0.207*	*0.190*	*0.206*	*0.193*	*0.169*	*0.211*	*0.182*	*0.204*	*0.206*	*0.213*	*0.200*	*0.202*	*0.173*
Environment	**0.313**	**0.313**	**0.305**	**0.329**	**0.297**	**0.360**	**0.324**	**0.319**	**0.364**	**0.344**	**0.304**	**0.233**	**0.405**	**0.260**
Sanitation	*0.156*	*0.164*	*0.139*	*0.200*	*0.197*	*0.193*	*0.211*	*0.183*	*0.204*	*0.197*	*0.172*	*0.065*	*0.202*	*0.092*
Water source	*0.156*	*0.149*	*0.166*	*0.128*	*0.100*	*0.167*	*0.113*	*0.137*	*0.160*	*0.147*	*0.132*	*0.168*	*0.202*	*0.167*
Natal care	**0.134**	**0.123**	**0.149**	**0.090**	**0.104**	**0.105**	**0.106**	**0.200**	**0.152**	**0.040**	**0.139**	**0.163**	**0.032**	**0.202**
Prenatal	*0.009*	*0.005*	*0.008*	*0.006*	*0.010*	*0.005*	*0.000*	*0.000*	*0.000*	*0.000*	*0.033*	*0.014*	*0.000*	*0.000*
Health Pro	*0.019*	*0.013*	*0.018*	*0.013*	*0.000*	*0.007*	*0.035*	*0.076*	*0.016*	*0.006*	*0.000*	*0.023*	*0.000*	*0.037*
Delivery place	*0.059*	*0.060*	*0.076*	*0.026*	*0.050*	*0.063*	*0.028*	*0.063*	*0.055*	*0.000*	*0.060*	*0.091*	*0.032*	*0.087*
Postnatal	*0.047*	*0.045*	*0.047*	*0.047*	*0.044*	*0.030*	*0.043*	*0.061*	*0.081*	*0.034*	*0.046*	*0.035*	*0.000*	*0.078*
All	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**

Notes: Columns (1) and (2) show the contributions by each gender sub-group, columns(3) and (4) by rural-urban sub-group, and columns (5) to (14) by regional sub-groups. Panels A and B show contributions to H and MHI respectively, while Panel C shows the breakdown of contributions to MHI by each dimension and indicator.

Table 3.B.2: Benin

Indicator/Dimension	Gender		Location		Region											
	Male	Female	Rural	Urban	ALI	ATA	ATL	BOR	COL	COU	DON	LIT	MON	OUE	PLA	ZOU
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Contribution to H	**0.524**	**0.476**	**0.601**	**0.399**	**0.210**	**0.075**	**0.120**	**0.148**	**0.032**	**0.072**	**0.055**	**0.049**	**0.036**	**0.092**	**0.054**	**0.056**
Contribution to MHI	**0.525**	**0.475**	**0.603**	**0.397**	**0.216**	**0.074**	**0.119**	**0.148**	**0.031**	**0.071**	**0.055**	**0.049**	**0.036**	**0.092**	**0.055**	**0.055**
Nutrition	**0.180**	**0.164**	**0.182**	**0.157**	**0.167**	**0.201**	**0.168**	**0.191**	**0.165**	**0.152**	**0.159**	**0.132**	**0.172**	**0.152**	**0.193**	**0.206**
Stunting	*0.094*	*0.084*	*0.097*	*0.079*	*0.089*	*0.103*	*0.083*	*0.095*	*0.084*	*0.092*	*0.080*	*0.065*	*0.094*	*0.079*	*0.096*	*0.115*
Wasting	*0.062*	*0.058*	*0.064*	*0.055*	*0.058*	*0.076*	*0.062*	*0.066*	*0.055*	*0.047*	*0.048*	*0.048*	*0.058*	*0.057*	*0.067*	*0.075*
Underweight	*0.024*	*0.021*	*0.021*	*0.024*	*0.020*	*0.023*	*0.023*	*0.029*	*0.025*	*0.013*	*0.032*	*0.019*	*0.021*	*0.017*	*0.030*	*0.016*
Morbidity	**0.364**	**0.371**	**0.373**	**0.359**	**0.357**	**0.365**	**0.367**	**0.364**	**0.394**	**0.388**	**0.370**	**0.358**	**0.389**	**0.362**	**0.398**	**0.355**
Vaccination	*0.189*	*0.193*	*0.194*	*0.185*	*0.188*	*0.192*	*0.184*	*0.200*	*0.201*	*0.207*	*0.197*	*0.177*	*0.195*	*0.172*	*0.205*	*0.184*
Diseases	*0.175*	*0.178*	*0.174*	*0.074*	*0.168*	*0.173*	*0.183*	*0.164*	*0.193*	*0.181*	*0.173*	*0.181*	*0.194*	*0.190*	*0.193*	*0.171*
Environment	**0.294**	**0.294**	**0.259**	**0.346**	**0.280**	**0.207**	**0.341**	**0.221**	**0.299**	**0.306**	**0.297**	**0.401**	**0.299**	**0.368**	**0.277**	**0.328**
Sanitation	*0.110*	*0.107*	*0.082*	*0.150*	*0.102*	*0.025*	*0.154*	*0.050*	*0.106*	*0.106*	*0.100*	*0.189*	*0.097*	*0.180*	*0.107*	*0.141*
Water source	*0.183*	*0.187*	*0.177*	*0.196*	*0.178*	*0.183*	*0.187*	*0.170*	*0.193*	*0.200*	*0.197*	*0.212*	*0.202*	*0.188*	*0.169*	*0.188*
Natal care	**0.162**	**0.172**	**0.186**	**0.137**	**0.280**	**0.227**	**0.123**	**0.224**	**0.142**	**0.154**	**0.173**	**0.108**	**0.140**	**0.118**	**0.132**	**0.111**
Prenatal	*0.012*	*0.012*	*0.013*	*0.011*	*0.004*	*0.018*	*0.018*	*0.003*	*0.022*	*0.021*	*0.004*	*0.011*	*0.029*	*0.011*	*0.017*	*0.023*
Health Pro	*0.026*	*0.029*	*0.036*	*0.015*	*0.044*	*0.047*	*0.004*	*0.062*	*0.009*	*0.014*	*0.035*	*0.004*	*0.006*	*0.002*	*0.017*	*0.003*
Delivery place	*0.030*	*0.035*	*0.043*	*0.017*	*0.057*	*0.066*	*0.002*	*0.060*	*0.014*	*0.028*	*0.041*	*0.001*	*0.005*	*0.002*	*0.020*	*0.005*
Postnatal	*0.093*	*0.096*	*0.095*	*0.094*	*0.092*	*0.096*	*0.100*	*0.100*	*0.097*	*0.091*	*0.093*	*0.092*	*0.100*	*0.103*	*0.078*	*0.080*
All	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**

Notes: Columns (1) and (2) show the contributions by each gender sub-group, columns(3) and (4) by rural-urban sub-group, and columns (5) to (16) by regional sub-groups. Panels A and B show contributions to H and MHI respectively, while Panel C shows the breakdown of contributions to MHI by each dimension and indicator.

Table 3.B.3: Ethiopia

Indicator/Dimension	Gender		Location		Region										
	Male	Female	Rural	Urban	TIG	AFA	AMH	ORO	SOM	BEN	SNN	GAM	HAR	ADS	DIR
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	**(15)**
Contribution to H	**0.516**	**0.484**	**0.919**	**0.081**	**0.042**	**0.010**	**0.222**	**0.462**	**0.034**	**0.009**	**0.206**	**0.001**	**0.002**	**0.009**	**0.003**
Contribution to MHI	**0.516**	**0.484**	**0.923**	**0.077**	**0.040**	**0.010**	**0.220**	**0.467**	**0.033**	**0.009**	**0.206**	**0.001**	**0.002**	**0.008**	**0.003**
Nutrition	**0.135**	**0.122**	**0.128**	**0.137**	**0.176**	**0.167**	**0.155**	**0.113**	**0.145**	**0.168**	**0.119**	**0.158**	**0.129**	**0.111**	**0.167**
Stunting	*0.070*	*0.061*	*0.066*	*0.061*	*0.085*	*0.068*	*0.081*	*0.058*	*0.053*	*0.072*	*0.066*	*0.070*	*0.064*	*0.062*	*0.077*
Wasting	*0.043*	*0.041*	*0.042*	*0.044*	*0.059*	*0.063*	*0.054*	*0.034*	*0.050*	*0.069*	*0.039*	*0.051*	*0.039*	*0.024*	*0.057*
Underweight	*0.022*	*0.020*	*0.020*	*0.032*	*0.032*	*0.036*	*0.021*	*0.021*	*0.042*	*0.027*	*0.014*	*0.037*	*0.026*	*0.024*	*0.033*
Morbidity	**0.320**	**0.328**	**0.322**	**0.348**	**0.328**	**0.357**	**0.311**	**0.335**	**0.355**	**0.269**	**0.304**	**0.349**	**0.342**	**0.352**	**0.331**
Vaccination	*0.170*	*0.173*	*0.171*	*0.175*	*0.159*	*0.186*	*0.173*	*0.176*	*0.184*	*0.144*	*0.159*	*0.187*	*0.183*	*0.175*	*0.147*
Diseases	*0.150*	*0.155*	*0.151*	*0.172*	*0.169*	*0.171*	*0.138*	*0.159*	*0.171*	*0.125*	*0.146*	*0.163*	*0.159*	*0.177*	*0.184*
Environment	**0.283**	**0.282**	**0.277**	**0.358**	**0.292**	**0.231**	**0.279**	**0.275**	**0.228**	**0.292**	**0.310**	**0.235**	**0.311**	**0.416**	**0.302**
Sanitation	*0.132*	*0.126*	*0.125*	*0.178*	*0.110*	*0.053*	*0.114*	*0.129*	*0.054*	*0.160*	*0.160*	*0.111*	*0.132*	*0.207*	*0.119*
Water source	*0.152*	*0.156*	*0.152*	*0.180*	*0.182*	*0.178*	*0.165*	*0.145*	*0.173*	*0.132*	*0.150*	*0.124*	*0.179*	*0.209*	*0.184*
Natal care	**0.262**	**0.268**	**0.274**	**0.157**	**0.203**	**0.245**	**0.255**	**0.277**	**0.272**	**0.271**	**0.267**	**0.258**	**0.219**	**0.121**	**0.200**
Prenatal	*0.027*	*0.028*	*0.029*	*0.012*	*0.023*	*0.018*	*0.027*	*0.026*	*0.017*	*0.034*	*0.035*	*0.028*	*0.017*	*0.007*	*0.020*
Health Pro	*0.065*	*0.066*	*0.069*	*0.024*	*0.038*	*0.053*	*0.058*	*0.074*	*0.070*	*0.066*	*0.062*	*0.051*	*0.045*	*0.017*	*0.032*
Delivery place	*0.078*	*0.081*	*0.083*	*0.030*	*0.051*	*0.082*	*0.078*	*0.083*	*0.090*	*0.081*	*0.080*	*0.079*	*0.060*	*0.004*	*0.054*
Postnatal	*0.092*	*0.093*	*0.093*	*0.091*	*0.091*	*0.092*	*0.092*	*0.94*	*0.095*	*0.091*	*0.090*	*0.099*	*0.097*	*0.092*	*0.093*
All	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**

Notes: Columns (1) and (2) show the contributions by each gender sub-group, columns(3) and (4) by rural-urban sub-group, and columns (5) to (15) by regional sub-groups. Panels A and B show contributions to H and MHI respectively, while Panel C shows the breakdown of contributions to MHI by each dimension and indicator

Table 3.B.4: Kenya

Indicator/Dimension	Gender		Location		Region							
	Male	Female	Rural	Urban	COA	NOR	EAS	CEN	RIF	WES	NYA	NAI
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Contribution to H	**0.541**	**0.459**	**0.776**	**0.224**	**0.090**	**0.047**	**0.113**	**0.056**	**0.349**	**0.173**	**0.144**	**0.028**
Contribution to MHI	**0.546**	**0.454**	**0.779**	**0.221**	**0.088**	**0.047**	**0.113**	**0.053**	**0.349**	**0.178**	**0.145**	**0.027**
Nutrition	**0.157**	**0.146**	**0.151**	**0.156**	**0.177**	**0.144**	**0.2185**	**0.139**	**0.167**	**0.118**	**0.117**	**0.198**
Stunting	*0.089*	*0.080*	*0.086*	*0.082*	*0.087*	*0.064*	*0.099*	*0.074*	*0.093*	*0.077*	*0.076*	*0.088*
Wasting	*0.046*	*0.046*	*0.046*	*0.047*	*0.060*	*0.035*	*0.064*	*0.038*	*0.054*	*0.027*	*0.032*	*0.052*
Underweight	*0.022*	*0.020*	*0.019*	*0.027*	*0.030*	*0.045*	*0.022*	*0.028*	*0.020*	*0.014*	*0.008*	*0.058*
Morbidity	**0.315**	**0.324**	**0.317**	**0.326**	**0.329**	**0.264**	**0.319**	**0.324**	**0.312**	**0.315**	**0.365**	**0.255**
Vaccination	*0.150*	*0.163*	*0.154*	*0.162*	*0.144*	*0.185*	*0.145*	*0.160*	*0.163*	*0.141*	*0.175*	*0.077*
Diseases	*0.165*	*0.162*	*0.164*	*0.165*	*0.185*	*0.079*	*0.175*	*0.164*	*0.149*	*0.174*	*0.191*	*0.178*
Environment	**0.359**	**0.361**	**0.353**	**0.383**	**0.348**	**0.321**	**0.379**	**0.445**	**0.345**	**0.355**	**0.368**	**0.405**
Sanitation	*0.172*	*0.177*	*0.165*	*0.205*	*0.180*	*0.122*	*0.169*	*0.224*	*0.155*	*0.198*	*0.180*	*0.220*
Water source	*0.187*	*0.185*	*0.188*	*0.179*	*0.168*	*0.199*	*0.210*	*0.221*	*0.190*	*0.157*	*0.187*	*0.185*
Natal care	**0.169**	**0.168**	**0.178**	**0.134**	**0.146**	**0.271**	**0.116**	**0.092**	**0.177**	**0.211**	**0.150**	**0.142**
Prenatal	*0.024*	*0.021*	*0.025*	*0.012*	*0.013*	*0.035*	*0.019*	*0.009*	*0.019*	*0.040*	*0.023*	*0.000*
Health Pro	*0.015*	*0.017*	*0.018*	*0.011*	*0.006*	*0.062*	*0.009*	*0.014*	*0.017*	*0.018*	*0.014*	*0.000*
Delivery place	*0.066*	*0.072*	*0.074*	*0.048*	*0.062*	*0.088*	*0.062*	*0.035*	*0.070*	*0.086*	*0.059*	*0.070*
Postnatal	*0.064*	*0.058*	*0.061*	*0.063*	*0.065*	*0.086*	*0.027*	*0.034*	*0.071*	*0.068*	*0.055*	*0.071*
All	**1.000**	**1.000s**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**

Notes: Columns (1) and (2) show the contributions by each gender sub-group, columns(3) and (4) by rural-urban sub-group, and columns (5) to (12) by regional sub-groups. Panels A and B show contributions to H and MHI respectively, while Panel C shows the breakdown of contributions to MHI by each dimension and indicator

Table 3.B.5: Malawi

Indicator/Dimension	Gender		Location		Region		
	Male	Female	Rural	Urban	NOR	CEN	SOU
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Contribution to H	**0.531**	**0.469**	**0.861**	**0.139**	**0.096**	**0.437**	**0.467**
Contribution to MHI	**0.531**	**0.469**	**0.860**	**0.140**	**0.094**	**0.435**	**0.471**
Nutrition	**0.158**	**0.136**	**0.151**	**0.123**	**0.163**	**0.140**	**0.151**
Stunting	*0.099*	*0.088*	*0.098*	*0.073*	*0.104*	*0.093*	*0.094*
Wasting	*0.043*	*0.039*	*0.042*	*0.036*	*0.045*	*0.037*	*0.044*
Underweight	*0.015*	*0.009*	*0.012*	*0.014*	*0.014*	*0.010*	*0.014*
Morbidity	**0.368**	**0.376**	**0.370**	**0.385**	**0.392**	**0.371**	**0.369**
Vaccination	*0.181*	*0.185*	*0.181*	*0.194*	*0.201*	*0.180*	*0.182*
Diseases	*0.187*	*0.191*	*0.189*	*0.190*	*0.191*	*0.191*	*0.187*
Environment	**0.330**	**0.335**	**0.328**	**0.357**	**0.341**	**0.335**	**0.329**
Sanitation	*0.166*	*0.158*	*0.159*	*0.187*	*0.168*	*0.157*	*0.167*
Water source	*0.164*	*0.176*	*0.170*	*0.170*	*0.173*	*0.178*	*0.162*
Natal care	**0.144**	**0.153**	**0.150**	**0.134**	**0.104**	**0.155**	**0.151**
Prenatal	*0.034*	*0.036*	*0.036*	*0.031*	*0.016*	*0.040*	*0.034*
Health Pro	*0.018*	*0.019*	*0.019*	*0.017*	*0.008*	*0.019*	*0.021*
Delivery place	*0.019*	*0.016*	*0.018*	*0.012*	*0.014*	*0.017*	*0.018*
Postnatal	*0.073*	*0.083*	*0.078*	*0.075*	*0.066*	*0.079*	*0.078*
All	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**

Notes: Columns (1) and (2) show the contributions by each gender sub-group, columns(3) and (4) by rural-urban sub-group, and columns (5) to (7) by regional sub-groups. Panels A and B show contributions to H and MHI respectively, while Panel C shows the breakdown of contributions to MHI by each dimension and indicator

Table 3.B.6: Lesotho

Indicator/Dimension	Gender		Location		Region									
	Male	Female	Rural	Urban	BOT	LER	BER	MAS	MAF	MOH	QUT	QAC	MOK	THA
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Contribution to H	**0.592**	**0.408**	**0.634**	**0.366**	**0.058**	**0.143**	**0.126**	**0.246**	**0.062**	**0.078**	**0.039**	**0.009**	**0.117**	**0.122**
Contribution to MHI	**0.593**	**0.407**	**0.629**	**0.371**	**0.057**	**0.148**	**0.121**	**0.249**	**0.062**	**0.076**	**0.037**	**0.010**	**0.117**	**0.122**
Nutrition	**0.182**	**0.145**	**0.167**	**0.166**	**0.142**	**0.237**	**0.126**	**0.143**	**0.175**	**0.188**	**0.113**	**0.184**	**0.193**	**0.154**
Stunting	*0.111*	*0.092*	*0.100*	*0.109*	*0.114*	*0.137*	*0.077*	*0.087*	*0.108*	*0.116*	*0.113*	*0.096*	*0.113*	*0.094*
Wasting	*0.059*	*0.037*	*0.050*	*0.049*	*0.028*	*0.085*	*0.029*	*0.041*	*0.068*	*0.050*	*0.000*	*0.044*	*0.064*	*0.048*
Underweight	*0.012*	*0.016*	*0.017*	*0.009*	*0.000*	*0.015*	*0.019*	*0.015*	*0.000*	*0.022*	*0.000*	*0.044*	*0.016*	*0.012*
Morbidity	**0.308**	**0.390**	**0.370**	**0.293**	**0.342**	**0.294**	**0.353**	**0.307**	**0.293**	**0.340**	**0.403**	**0.355**	**0.406**	**0.403**
Vaccination	*0.119*	*0.189*	*0.178*	*0.095*	*0.166*	*0.087*	*0.201*	*0.094*	*0.111*	*0.170*	*0.201*	*0.211*	*0.195*	*0.200*
Diseases	*0.189*	*0.201*	*0.192*	*0.198*	*0.176*	*0.207*	*0.148*	*0.212*	*0.182*	*0.170*	*0.201*	*0.144*	*0.211*	*0.203*
Environment	**0.320**	**0.280**	**0.251**	**0.394**	**0.348**	**0.287**	**0.336**	**0.396**	**0.316**	**0.290**	**0.227**	**0.227**	**0.206**	**0.210**
Sanitation	*0.117*	*0.092*	*0.055*	*0.195*	*0.152*	*0.095*	*0.113*	*0.194*	*0.161*	*0.088*	*0.000*	*0.080*	*0.033*	*0.009*
Water source	*0.203*	*0.188*	*0.196*	*0.199*	*0.196*	*0.192*	*0.224*	*0.202*	*0.155*	*0.202*	*0.227*	*0.147*	*0.173*	*0.201*
Natal care	**0.190**	**0.185**	**0.212**	**0.147**	**0.168**	**0.181**	**0.184**	**0.155**	**0.215**	**0.182**	**0.257**	**0.234**	**0.195**	**0.233**
Prenatal	*0.010*	*0.011*	*0.011*	*0.009*	*0.000*	*0.025*	*0.018*	*0.007*	*0.000*	*0.000*	*0.000*	*0.032*	*0.010*	*0.007*
Health Pro	*0.102*	*0.105*	*0.106*	*0.099*	*0.109*	*0.092*	*0.112*	*0.099*	*0.108*	*0.098*	*0.114*	*0.105*	*0.107*	*0.108*
Delivery place	*0.044*	*0.039*	*0.057*	*0.018*	*0.037*	*0.053*	*0.030*	*0.021*	*0.062*	*0.047*	*0.066*	*0.065*	*0.041*	*0.064*
Postnatal	*0.033*	*0.030*	*0.039*	*0.020*	*0.022*	*0.011*	*0.024*	*0.027*	*0.045*	*0.037*	*0.078*	*0.032*	*0.036*	*0.054*
All	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**

Notes: Columns (1) and (2) show the contributions by each gender sub-group, columns(3) and (4) by rural-urban sub-group, and columns (5) to (14) by regional sub-groups. Panels A and B show contributions to H and MHI respectively, while Panel C shows the breakdown of contributions to MHI by each dimension and indicator

Table 3.B.7: Cameroon

Indicator/Dimension	Gender		Location		Region											
	Male	Female	Rural	Urban	ADA	CEN	DOU	EAS	FAN	LIT	NOR	NOW	WES	SOU	SOW	YAO
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Contribution to H	**0.548**	**0.452**	**0.740**	**0.260**	**0.086**	**0.105**	**0.028**	**0.096**	**0.290**	**0.013**	**0.196**	**0.055**	**0.062**	**0.029**	**0.010**	**0.032**
Contribution to MHI	**0.553**	**0.447**	**0.750**	**0.250**	**0.088**	**0.106**	**0.026**	**0.094**	**0.297**	**0.012**	**0.201**	**0.052**	**0.058**	**0.028**	**0.009**	**0.030**
Nutrition	**0.134**	**0.126**	**0.132**	**0.126**	**0.107**	**0.089**	**0.053**	**0.131**	**0.168**	**0.083**	**0.137**	**0.098**	**0.132**	**0.102**	**0.158**	**0.080**
Stunting	*0.077*	*0.077*	*0.078*	*0.074*	*0.058*	*0.066*	*0.044*	*0.088*	*0.080*	*0.073*	*0.078*	*0.091*	*0.097*	*0.077*	*0.141*	*0.045*
Wasting	*0.039*	*0.038*	*0.041*	*0.033*	*0.032*	*0.020*	*0.005*	*0.031*	*0.065*	*0.010*	*0.043*	*0.003*	*0.032*	*0.018*	*0.009*	*0.017*
Underweight	*0.018*	*0.011*	*0.013*	*0.019*	*0.017*	*0.004*	*0.005*	*0.012*	*0.023*	*0.000*	*0.017*	*0.003*	*0.003*	*0.008*	*0.008*	*0.018*
Morbidity	**0.350**	**0.351**	**0.341**	**0.379**	**0.342**	**0.370**	**0.416**	**0.342**	**0.335**	**0.425**	**0.331**	**0.375**	**0.391**	**0.358**	**0.384**	**0.397**
Vaccination	*0.185*	*0.175*	*0.178*	*0.190*	*0.186*	*0.183*	*0.195*	*0.170*	*0.170*	*0.218*	*0.186*	*0.164*	*0.200*	*0.194*	*0.172*	*0.205*
Diseases	*0.165*	*0.176*	*0.163*	*0.190*	*0.156*	*0.186*	*0.221*	*0.172*	*0.164*	*0.208*	*0.145*	*0.211*	*0.191*	*0.165*	*0.212*	*0.192*
Environment	**0.326**	**0.333**	**0.326**	**0.337**	**0.335**	**0.370**	**0.395**	**0.347**	**0.278**	**0.370**	**0.318**	**0.404**	**0.368**	**0.335**	**0.341**	**0.399**
Sanitation	*0.160*	*0.170*	*0.162*	*0.170*	*0.169*	*0.188*	*0.174*	*0.173*	*0.159*	*0.172*	*0.133*	*0.197*	*0.169*	*0.198*	*0.133*	*0.203*
Water source	*0.166*	*0.163*	*0.164*	*0.167*	*0.167*	*0.182*	*0.228*	*0.174*	*0.119*	*0.198*	*0.185*	*0.207*	*0.198*	*0.137*	*0.208*	*0.195*
Natal care	**0.191**	**0.189**	**0.201**	**0.158**	**0.215**	**0.171**	**0.135**	**0.180**	**0.220**	**0.121**	**0.213**	**0.124**	**0.110**	**0.204**	**0.117**	**0.124**
Prenatal	*0.008*	*0.005*	*0.007*	*0.006*	*0.004*	*0.009*	*0.007*	*0.002*	*0.010*	*0.008*	*0.005*	*0.000*	*0.010*	*0.011*	*0.000*	*0.003*
Health Pro	*0.036*	*0.030*	*0.038*	*0.017*	*0.051*	*0.028*	*0.000*	*0.041*	*0.037*	*0.014*	*0.043*	*0.006*	*0.007*	*0.034*	*0.000*	*0.007*
Delivery place	*0.061*	*0.064*	*0.070*	*0.038*	*0.071*	*0.047*	*0.018*	*0.060*	*0.079*	*0.017*	*0.082*	*0.044*	*0.008*	*0.056*	*0.000*	*0.011*
Postnatal	*0.087*	*0.091*	*0.086*	*0.097*	*0.089*	*0.086*	*0.111*	*0.077*	*0.094*	*0.082*	*0.084*	*0.073*	*0.085*	*0.103*	*0.117*	*0.103*
All	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**

Notes: Columns (1) and (2) show the contributions by each gender sub-group, columns(3) and (4) by rural-urban sub-group, and columns (5) to (16) by regional sub-groups. Panels A and B show contributions to H and MHI respectively, while Panel C shows the breakdown of contributions to MHI by each dimension and indicator

Table 3.B.8: Congo DR

Indicator/Dimension	Gender		Location		Region										
	Male	Female	Rural	Urban	KIN	BAN	BAS	EQU	KAD	KAN	KAT	MAN	NOR	ORI	SUD
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Contribution to H	**0.519**	**0.481**	**0.801**	**0.199**	**0.031**	**0.179**	**0.044**	**0.179**	**0.087**	**0.128**	**0.112**	**0.037**	**0.037**	**0.098**	**0.069**
Contribution to MHI	**0.523**	**0.477**	**0.807**	**0.193**	**0.028**	**0.177**	**0.043**	**0.180**	**0.087**	**0.131**	**0.115**	**0.037**	**0.035**	**0.099**	**0.068**
Nutrition	**0.142**	**0.123**	**0.135**	**0.126**	**0.118**	**0.132**	**0.171**	**0.108**	**0.150**	**0.133**	**0.130**	**0.157**	**0.162**	**0.119**	**0.156**
Stunting	*0.070*	*0.067*	*0.069*	*0.067*	*0.062*	*0.060*	*0.085*	*0.055*	*0.077*	*0.075*	*0.069*	*0.064*	*0.085*	*0.074*	*0.082*
Wasting	*0.048*	*0.038*	*0.044*	*0.038*	*0.032*	*0.045*	*0.057*	*0.036*	*0.053*	*0.041*	*0.042*	*0.048*	*0.057*	*0.032*	*0.051*
Underweight	*0.023*	*0.019*	*0.021*	*0.021*	*0.024*	*0.027*	*0.029*	*0.017*	*0.019*	*0.017*	*0.018*	*0.045*	*0.020*	*0.013*	*0.024*
Morbidity	**0.331**	**0.332**	**0.327**	**0.350**	**0.350**	**0.317**	**0.350**	**0.338**	**0.334**	**0.339**	**0.328**	**0.336**	**0.308**	**0.344**	**0.315**
Vaccination	*0.168*	*0.166*	*0.166*	*0.171*	*0.180*	*0.167*	*0.162*	*0.174*	*0.162*	*0.167*	*0.169*	*0.164*	*0.141*	*0.177*	*0.147*
Diseases	*0.163*	*0.166*	*0.161*	*0.179*	*0.170*	*0.150*	*0.188*	*0.163*	*0.172*	*0.172*	*0.159*	*0.172*	*0.167*	*0.167*	*0.169*
Environment	**0.311**	**0.331**	**0.315**	**0.342**	**0.407**	**0.331**	**0.338**	**0.341**	**0.309**	**0.288**	**0.310**	**0.258**	**0.334**	**0.310**	**0.327**
Sanitation	*0.142*	*0.154*	*0.140*	*0.180*	*0.206*	*0.150*	*0.161*	*0.157*	*0.132*	*0.115*	*0.143*	*0.103*	*0.173*	*0.140*	*0.198*
Water source	*0.169*	*0.177*	*0.175*	*0.162*	*0.201*	*0.182*	*0.177*	*0.184*	*0.177*	*0.173*	*0.167*	*0.156*	*0.161*	*0.170*	*0.130*
Natal care	**0.217**	**0.214**	**0.223**	**0.183**	**0.125**	**0.220**	**0.141**	**0.213**	**0.207**	**0.241**	**0.232**	**0.249**	**0.196**	**0.227**	**0.201**
Prenatal	*0.050*	*0.048*	*0.051*	*0.040*	*0.011*	*0.053*	*0.031*	*0.044*	*0.054*	*0.053*	*0.045*	*0.076*	*0.050*	*0.048*	*0.061*
Health Pro	*0.047*	*0.044*	*0.048*	*0.038*	*0.014*	*0.067*	*0.005*	*0.032*	*0.040*	*0.057*	*0.050*	*0.055*	*0.023*	*0.060*	*0.032*
Delivery place	*0.034*	*0.032*	*0.037*	*0.014*	*0.000*	*0.024*	*0.011*	*0.048*	*0.026*	*0.038*	*0.057*	*0.021*	*0.027*	*0.028*	*0.017*
Postnatal	*0.086*	*0.089*	*0.087*	*0.091*	*0.099*	*0.076*	*0.094*	*0.090*	*0.087*	*0.093*	*0.080*	*0.097*	*0.096*	*0.091*	*0.091*
All	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**

Notes: Columns (1) and (2) show the contributions by each gender sub-group, columns(3) and (4) by rural-urban sub-group, and columns (5) to (15) by regional sub-groups. Panels A and B show contributions to H and MHI respectively, while Panel C shows the breakdown of contributions to MHI by each dimension and indicator

3.C: Robustness using alternative weighting structures

Table 3.C.1: Alternative Weighting Structures

	40% Nutrition 20% Morbidity 20% Environment 20% Natal-care	20% Nutrition, **40% Morbidity** 20% Environment 20% Natal-care	20% Nutrition, 20% Morbidity **40% Environment** 20% Natal-care	20% Nutrition, 20% Morbidity 20% Environment **40% Natal-care**
Nutrition	**0.400**	**0.200**	**0.200**	**0.200**
Stunting	0.133	0.067	0.067	0.067
Underweight	0.133	0.067	0.067	0.067
Wasting	0.133	0.067	0.067	0.067
Morbidity	**0.200**	**0.400**	**0.200**	**0.200**
Vaccination	0.100	0.200	0.100	0.100
Diseases	0.100	0.200	0.100	0.100
Environment	**0.200**	**0.200**	**0.400**	**0.200**
Sanitation	0.100	0.100	0.200	0.100
Water	0.100	0.100	0.200	0.100
Natal-care	**0.200**	**0.200**	**0.200**	**0.400**
Prenatal	0.050	0.050	0.050	0.100
Postnatal	0.050	0.050	0.050	0.100
Health Professional	0.050	0.050	0.050	0.100
Delivery place	0.050	0.050	0.050	0.100

Notes: Each dimension takes 40 percent weight in turn in the four columns while the other dimensions take 20 percent each.

Table 3.C.2: Multidimensional Health Index Using the Weighting Structure 40-20-20-20

Country	Measurements		
	H	A	MHI
Benin	0.144	0.602	0.087
	(0.005)	(0.003)	(0.003)
Ghana	0.054	0.607	0.032
	(0.006)	(0.008)	(0.004)
Ethiopia	0.386	0.640	0.247
	(0.012)	(0.003)	(0.008)
Kenya	0.085	0.589	0.050
	(0.004)	(0.004)	(0.003)
Lesotho	0.080	0.580	0.046
	(0.009)	(0.008)	(0.005)
Malawi	0.116	0.598	0.069
	(0.006)	(0.005)	(0.004)
Cameroon	0.158	0.622	0.098
	(0.010)	(0.005)	(0.006)
DR Congo	0.331	0.641	0.212
	(0.012)	(0.004)	(0.008)

Notes: Standard errors in parenthesis

Table 3.C.3: Multidimensional Health Index Using the Weighting Structure 20-40-20-20

Country	Measurements		
	H	A	MHI
Benin	0.329	0.613	0.202
	(0.008)	(0.002)	(0.005)
Ghana	0.160	0.607	0.097
	(0.011)	(0.005)	(0.007)
Ethiopia	0.656	0.667	0.438
	(0.012)	(0.003)	(0.009)
Kenya	0.195	0.607	0.119
	(0.007)	(0.002)	(0.004)
Lesotho	0.186	0.593	0.111
	(0.014)	(0.005)	(0.009)
Malawi	0.346	0.612	0.211
	(0.009)	(0.002)	(0.006)
Cameroon	0.412	0.629	0.259
	(0.013)	(0.003)	(0.009)
DR Congo	0.591	0.667	0.394
	(0.015)	(0.003)	(0.011)

Notes: Standard errors in parenthesis

Table 3.C.4: Multidimensional Health Index Using the Weighting Structure 20-20-40-20

Country	Measurements		
	H	A	MHI
Benin	0.267	0.604	0.161
	(0.009)	(0.002)	(0.005)
Ghana	0.146	0.594	0.087
	(0.011)	(0.004)	(0.006)
Ethiopia	0.647	0.652	0.422
	(0.013)	(0.004)	(0.010)
Kenya	0.268	0.600	0.161
	(0.008)	(0.002)	(0.005)
Lesotho	0.158	0.596	0.094
	(0.018)	(0.005)	(0.011)
Malawi	0.276	0.615	0.170
	(0.010)	(0.003)	(0.006)
Cameroon	0.381	0.628	0.239
	(0.015)	(0.004)	(0.010)
DR Congo	0.606	0.660	0.400
	(0.016)	(0.003)	(0.012)

Notes: Standard errors in parenthesis

Table 3.C.5: Multidimensional Health Index Using the Weighting Structure 20-20-20-40

Country	Measurements		
	H	A	MHI
Benin	0.128	0.595	0.076
	(0.006)	(0.003)	(0.004)
Ghana	0.039	0.587	0.023
	(0.006)	(0.009)	(0.003)
Ethiopia	0.569	0.656	0.373
	(0.015)	(0.003)	(0.010)
Kenya	0.080	0.595	0.048
	(0.004)	(0.003)	(0.003)
Lesotho	0.081	0.581	0.047
	(0.009)	(0.006)	(0.005)
Malawi	0.110	0.598	0.066
	(0.006)	(0.004)	(0.004)
Cameroon	0.195	0.624	0.122
	(0.013)	(0.004)	(0.008)
DR Congo	0.425	0.649	0.276
	(0.015)	(0.003)	(0.011)

Notes: Standard errors in parenthesis

Table 3.C.6: Pairwise Comparisons of MHI Using Hypothesis Test of Differences in Mean

Paired countries (28)	Baseline (Equal weights)	40-20-20-20	20-40-20-20	20-20-40-20	20-20-20-40	Robust
BEN, COD	yes	yes	yes	no	yes	no
BEN, CMR	yes	yes	yes	yes	yes	yes
BEN, ETH	yes	yes	yes	yes	yes	yes
BEN, GHA	yes	yes	yes	yes	yes	yes
BEN, KEN	yes	yes	yes	yes	yes	yes
BEN, LES	yes	yes	yes	yes	yes	yes
BEN, MWI	yes	yes	yes	yes	yes	yes
COD, CMR	yes	yes	yes	yes	yes	yes
COD, ETH	yes	yes	yes	yes	yes	yes
COD, GHA	yes	yes	yes	yes	yes	yes
COD, KEN	yes	yes	yes	yes	yes	yes
COD, LES	yes	yes	yes	yes	yes	yes
COD, MWI	yes	yes	yes	yes	yes	yes
CMR, ETH	yes	yes	yes	no	yes	no
CMR, GHA	yes	yes	yes	yes	yes	yes
CMR, KEN	yes	yes	yes	yes	yes	yes
CMR, LES	yes	yes	yes	yes	yes	yes
CMR, MWI	no	yes	no	yes	yes	no
ETH, GHA	yes	yes	yes	yes	yes	yes
ETH, KEN	yes	yes	yes	yes	yes	yes
ETH, LES	yes	yes	yes	yes	yes	yes
ETH, MWI	yes	yes	yes	yes	yes	yes
GHA, KEN	yes	yes	yes	no	yes	no
GHA, LES	yes	yes	yes	yes	yes	yes
GHA, MWI	yes	yes	yes	yes	yes	yes
KEN, LES	yes	yes	yes	yes	yes	yes
KEN, MWI	yes	yes	yes	yes	yes	yes
LES, MWI	yes	yes	yes	no	yes	no
Total	**27**					**23**

Notes: yes, is significant in columns 1 to 4 and robust in column 5; no is not significant in columns 1 to 4 and not robust in column 5. BEN: Benin, MWI: Malawi, GHA: Ghana, LES: Lesotho, KEN: Kenya, CMR: Cameroon, COD: Congo DR, ETH: Ethiopia.

Table 3.C.7: Pairwise Comparisons of MHI Using Confidence Intervals (Non-Overlapping)

Paired countries	Baseline (Equal weights)	40-20-20-20	20-40-20-20	20-20-40-20	20-20-20-40	Robust
BEN, COD	yes	yes	yes	yes	yes	yes
BEN, CMR	yes	no	yes	yes	yes	no
BEN, ETH	yes	yes	yes	yes	yes	yes
BEN, GHA	yes	yes	yes	yes	yes	yes
BEN, KEN	yes	yes	yes	yes	yes	yes
BEN, LES	yes	yes	yes	yes	yes	yes
BEN, MWI	no	yes	no	no	no	no
COD, CMR	yes	yes	yes	yes	yes	yes
COD, ETH	yes	yes	yes	no	yes	no
COD, GHA	yes	yes	yes	yes	yes	yes
COD, KEN	yes	yes	yes	yes	yes	yes
COD, LES	yes	yes	yes	yes	yes	yes
COD, MWI	yes	yes	yes	yes	yes	yes
CMR, ETH	yes	yes	yes	yes	yes	yes
CMR, GHA	yes	yes	yes	yes	yes	yes
CMR, KEN	yes	yes	yes	yes	yes	yes
CMR, LES	yes	yes	yes	yes	yes	yes
CMR, MWI	yes	yes	yes	yes	yes	yes
ETH, GHA	yes	yes	yes	yes	yes	yes
ETH, KEN	yes	yes	yes	yes	yes	yes
ETH, LES	yes	yes	yes	yes	yes	yes
ETH, MWI	yes	yes	yes	yes	yes	yes
GHA, KEN	yes	yes	no	yes	yes	no
GHA, LES	no	yes	no	yes	yes	no
GHA, MWI	yes	yes	yes	yes	yes	yes
KEN, LES	no	no	no	no	no	no
KEN, MWI	yes	yes	yes	no	yes	no
LES, MWI	yes	yes	yes	yes	yes	yes
Total	**25**					**21**

Notes: yes, is significant in columns 1 to 4 and robust in column 5; no is not significant in columns 1 to 4 and not robust in column 5. BEN: Benin, MWI: Malawi, GHA: Ghana, LES: Lesotho, KEN: Kenya, CMR: Cameroon, COD: Congo DR, ETH: Ethiopia.

Table 3.C.8: Pairwise Comparisons of H Using Hypothesis Test of Differences in Mean

Paired countries	Baseline (Equal weights)	40-20-20-20	20-40-20-20	20-20-40-20	20-20-20-40	Robust
BEN, COD	yes	no	yes	yes	yes	no
BEN, CMR	yes	yes	yes	yes	yes	yes
BEN, ETH	yes	yes	yes	yes	yes	yes
BEN, GHA	yes	yes	yes	yes	yes	yes
BEN, KEN	yes	yes	yes	yes	no	no
BEN, LES	yes	yes	yes	yes	yes	yes
BEN, MWI	yes	yes	yes	yes	yes	yes
COD, CMR	yes	yes	yes	yes	yes	yes
COD, ETH	yes	yes	yes	yes	yes	yes
COD, GHA	yes	yes	yes	yes	yes	yes
COD, KEN	yes	yes	yes	yes	yes	yes
COD, LES	yes	yes	yes	yes	yes	yes
COD, MWI	yes	yes	yes	yes	yes	yes
CMR, ETH	yes	yes	no	no	yes	no
CMR, GHA	yes	yes	yes	no	yes	no
CMR, KEN	yes	yes	yes	yes	yes	yes
CMR, LES	yes	yes	yes	yes	yes	yes
CMR, MWI	no	no	yes	yes	no	no
ETH, GHA	no	no	no	no	no	no
ETH, KEN	yes	no	yes	yes	yes	no
ETH, LES	yes	yes	yes	yes	yes	yes
ETH, MWI	yes	yes	yes	yes	yes	yes
GHA, KEN	yes	no	yes	no	yes	no
GHA, LES	yes	yes	yes	yes	yes	yes
GHA, MWI	yes	yes	yes	yes	yes	yes
KEN, LES	yes	yes	yes	yes	yes	yes
KEN, MWI	yes	yes	yes	yes	yes	yes
LES, MWI	no	yes	no	no	yes	no
Total	**25**					**19**

Note: yes, is significant in columns 1 to 4 and robust in column 5; no is not significant in columns 1 to 4 and not robust in column 5. BEN: Benin, MWI: Malawi, GHA: Ghana, LES: Lesotho, KEN: Kenya, CMR: Cameroon, COD: Congo DR, ETH: Ethiopia.

Table 3.C.9: Pairwise Comparisons of H Using Confidence Intervals (Non-Overlapping)

Paired countries	Baseline (Equal weights)	40-20-20-20	20-40-20-20	20-20-40-20	20-20-20-40	Robust
BEN, COD	yes	yes	yes	yes	yes	yes
BEN, CMR	yes	no	yes	yes	yes	no
BEN, ETH	yes	yes	yes	yes	yes	yes
BEN, GHA	yes	yes	yes	yes	yes	yes
BEN, KEN	yes	yes	yes	no	yes	no
BEN, LES	yes	yes	yes	yes	yes	yes
BEN, MWI	no	yes	no	no	no	no
COD, CMR	yes	yes	yes	yes	yes	yes
COD, ETH	yes	yes	yes	no	yes	no
COD, GHA	yes	yes	yes	yes	yes	yes
COD, KEN	yes	yes	yes	yes	yes	yes
COD, LES	yes	yes	yes	yes	yes	yes
COD, MWI	yes	yes	yes	yes	yes	yes
CMR, ETH	yes	yes	yes	yes	yes	yes
CMR, GHA	yes	yes	yes	yes	yes	yes
CMR, KEN	yes	yes	yes	yes	yes	yes
CMR, LES	yes	yes	yes	yes	yes	yes
CMR, MWI	yes	yes	yes	yes	yes	yes
ETH, GHA	yes	yes	yes	yes	yes	yes
ETH, KEN	yes	yes	yes	yes	yes	yes
ETH, LES	yes	yes	yes	yes	yes	yes
ETH, MWI	yes	yes	yes	yes	yes	yes
GHA, KEN	yes	yes	yes	yes	yes	yes
GHA, LES	no	no	no	no	yes	no
GHA, MWI	yes	yes	yes	yes	yes	yes
KEN, LES	no	no	yes	yes	no	no
KEN, MWI	yes	yes	yes	no	yes	no
LES, MWI	yes	yes	yes	yes	no	no
Total	**25**					**20**

Note: yes, is significant in columns 1 to 4 and robust in column 5; no is not significant in columns 1 to 4 and not robust in column 5. BEN: Benin, MWI: Malawi, GHA: Ghana, LES: Lesotho, KEN: Kenya, CMR: Cameroon, COD: Congo DR, ETH: Ethiopia.

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