A STUDY ON MATERNAL HEALTH CARE IN INDIA

Thesis Submitted
in Partial Fulfilment of the Requirements for the
Degree of

DOCTOR OF PHILOSOPHY

in
Economics

by

Charu Tayal
(2K20/PHDUECO/504)

Under the supervision of

Dr. Kusum Lata
Assistant professor, USME
Delhi Technological University

Dr. Rajesh Sharma
Assistant Professor, Department of Humanities and Social Sciences,
NIT Kurukshetra

To the
University School of Management and Entrepreneurship
Delhi Technological University
(Formerly Delhi College of Engineering)
Vivek Vihar Phase 2, Block E, Delhi-110095
December, 2025

ACKNOWLEDGEMENT

I would like to express my sincere gratitude and special thanks to Dr. Kusum Lata, Assistant Professor, University School of Management and Entrepreneurship, Delhi Technological University and Dr. Rajesh Sharma, Assistant Professor, Department of Humanities and Social Sciences, NIT Kurukshetra, who, in spite of being so extremely busy with their responsibilities, took time out to hear, guide and keep me on the correct path and allowed me to carry out this research work during my tenure as the research scholar and preparing the thesis. This work is a result of their invaluable and unwavering support, extensive knowledge, patient guidance, constant encouragement, and genuine affection.

I wish to convey my sincere gratitude to Prof. Amit Mookerjee, Director and HoD, Department of University School of Management and Entrepreneurship, DTU, who granted me admission in this PhD program and kept boosting my morale and guided me whenever I took his help.

My humble acknowledgment also goes to entire USME, DTU faculty members: Dr. Naval Garg, Dr. Puneet Arora, Dr. Akanksha Kaushik, Dr Ratnam Mishra for great support and care throughout the 4 years of PhD course and for motivating me to be on track. Further, I would like to thank my SRC and DRC members who took out time from their busy schedules to discuss and resolve any problem that was put in front of them.

I would also like to express my heartfelt thanks to my fellow scholars: Ms. Shreya Jha, Ms. Sanchita Chaudhary, Mrs. Shilpi Gupta Vijay, Dr. Suhans Bansal, Mr. Ojus, Mr. Shubham Prajapati, Ms. Neha Narula and others, and my seniors: Dr. Aashima, Dr. Mehak Nanda, Dr. Shubham Singhania, Dr. Divya Mishra, Dr. Shivangi Verma and others, who constantly motivated me, helped me on many occasions, and with whom countless memories were created. You are great people!

Sincere gratitude is extended to my parents Mrs. Vidushi Tayal and Mr. Pankaj Tayal, and my family Ms. Shweta Tayal, Mr. Abhishek Tayal, Mrs. Nimisha Tayal and Ms Mishita Tayal without whom coming this far would not have been possible.

I am also highly grateful to the Almighty for providing me the knowledge, capability, strength, and the opportunity to embark on and successfully complete the research study presented here. This accomplishment would not have been attainable without his blessings.

Sincerely,

Charu Tayal

(2K20/PHDUECO/504)

CANDIDATE'S DECLARATION

I, Charu Tayal, hereby certify that the work which is being presented in the thesis entitled "A Study on Maternal Health Care in India" in partial fulfilment of the requirements for the award of the Degree of Doctor of Philosophy, submitted in the Department of University School of Management and Entrepreneurship, Delhi Technological University is an authentic record of my own work carried out during the period from 2021 to 2024 under the supervision of Dr. Kusum Lata (Supervisor, Assistant Professor, University School of Management and Entrepreneurship, Delhi Technological University) and Dr. Rajesh Sharma (Joint Supervisor, Assistant Professor, Department of Humanities and Social Sciences, NIT Kurukshetra).

The matter presented in the thesis has not been submitted by me for the award of any other degree of this or any other Institute.

Charu Tayal
(2K20/PHDUECO/504)

CERTIFICATE BY THE SUPERVISOR(s)

Certified that Charu Tayal (2K20/PHDUECO/504) has carried out the research work presented in this thesis entitled "A Study on Maternal Health Care in India" for the award of Doctor of Philosophy from Department of University School of Management and Entrepreneurship, Delhi Technological University, Delhi, under our supervision. The thesis embodies the results of original work, and all studies are carried out by the student herself, and the contents of the thesis do not form the basis for the award of any other degree to the candidate or to anybody else from this or any other University/Institution.

Signature

Dr. Kusum Lata
Assistant Professor
USME, DTU

Signature

Dr. Rajesh Sharma
Assistant Professor
Department of Humanities and Social Sciences, NIT Kurukshetra

ABSTRACT

South Asia is grappling with a triple burden of high maternal mortality and child malnutrition, coupled with the high prevalence of patriarchal social structure. However, maternal healthcare service utilization can significantly reduce maternal mortality and morbidity, improve child health, and is indispensable for achieving several United Nations Sustainable Development Goals. The study analysed the socio-economic and demographic factors affecting maternal healthcare use in the South Asian countries. This analysis used a modified framework of Anderson's behavioural model of health service use and included Afghanistan, Bangladesh, India, Maldives, Nepal, and Pakistan. Furthermore, the concomitant factors influencing breastfeeding practices in India were examined. The study then analysed the impact of maternal healthcare service utilization on under-five child health outcomes in India. To examine under-five child health outcomes in India, the study applied the Fundamental Cause Theory. This theory, derived from Geoffrey Rose's "Cause of Causes," was used to analyze the impact of water and sanitation, maternal healthcare service utilization, and breastfeeding practices. For this purpose, the two latest rounds of the Indian Demographic Health Survey [DHS (2015-16) and DHS (2019-21)] were employed. The study then adopted Connell's gender and power theory. This framework was used to discuss how women's autonomy in managing their healthcare impacts abortion history, knowledge of contraceptive methods, wanted pregnancy, and delivery via caesarean section in India. For this analysis, the study used data from the last two rounds of the Indian Demographic Health Survey. Lastly, the study examined the impact of coercive control experienced by women on child health outcomes in South Asia. The impact of coercive control experienced by women on child health outcomes was elucidated using the family disruption model. The study used data extracted from the nationally representative Demographic and Health Survey. For the analysis, descriptive statistics, generalized ordered logit model, multivariable logistic regression, negative binomial model, time interaction regression model and a mixed- effect logistic model were employed in the study.

The study found that the women who were educated, working, had decision- making autonomy, and were aware of family planning were more likely to avail of maternal healthcare services in South Asia. Furthermore, our study highlighted the disparities in maternal healthcare service utilization and associated factors among the selected South Asian nations. For instance, working mothers had lower odds of receiving antenatal care in Afghanistan and delivery care in Bangladesh. In addition, women with higher educational attainment, access to mass media, resided in rural areas, received maternal healthcare services, and received assistance from Anganwadi were more likely to have optimum breastfeeding practices. Remarkably, employed mothers had higher odds of longer durations of breastfeeding, but they had lower odds of exclusive breastfeeding. We observed that in 2015-16, unimproved sanitation facilities and open defecation increased the odds of poor child health outcomes. In 2019-21, mothers who had not received at least four antenatal care visits

were more likely to have stunted and underweight children. However, the strength of this association between antenatal care visits and child health outcomes diminished between the two survey rounds. However, it is worth noting that in both 2015-16 and 2019-21 the absence of exclusive breastfeeding decreased the odds of under-five wasting. Furthermore, the decline in the prevalence of underweight was likely to be less for children who used unimproved sanitation facilities and practised open defecation and whose mothers have not received postnatal care visits. In 2015-16 and 2019-21, the odds of wanted pregnancy were higher among women who managed their healthcare decisions jointly with their partner. Also, the odds of knowing contraceptive methods were lower among women whose healthcare decisions were made solely by the husband/partner in 2015-16. Furthermore, it was observed that a mother who has experienced physical violence during pregnancy was more likely to have a stunted and underweight child. Women who reported emotional violence, sexual violence, physical violence, interview interruption by an adult and high spousal controlling behaviour were more likely to have a child with poor health outcomes. Policymakers must implement a multi-pronged strategy. This includes conducting regular health education sessions in regional languages, enhancing e-health communication, providing financial incentives, and creating a robust legal framework to safeguard women against intimate partner violence. Furthermore, direct engagement with frontline health workers, encompassing women's empowerment (through education and employment opportunities), and addressing urban-rural health inequalities are imperative.

LIST OF PUBLICATIONS

- Tayal, C., Sharma, R., & Lata, K. (2025). The Temporal Impact of Socioeconomic Deprivation on Child Health Outcomes in India: Evidence from the Demographic Health Survey 2015–2021. *International Journal of Social Determinants of Health and Health Services*. https://doi.org/10.1177/27551938251353008

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MMR: Maternal mortality ratio

MHCSU: Maternal healthcare service utilization

ANC: Antenatal Care

PNC: Postnatal Care

IFA: Iron folic acid

CHOs: Child health outcomes

IPV: Intimate Partner Violence

DHS: Demographic and health survey

OR: Odds Ratio

Coef: Coefficient

IRR: Incidence Rate Ratio

CI: Confidence Interval

SDGs: Sustainable Development Goals

WHO: World Health Organisation

LMICs: Low and middle-income countries

UNICEF: United Nations Children's Fund

CHAPTER 1

INTRODUCTION

1.1 Background

1.1.1 Maternal Healthcare

According to WHO (2025), maternal health refers to the health of women during pregnancy, childbirth and the postnatal period. It is concerning that even in 2025, each day, approximately 712 women die across the globe owing to complications related to pregnancy or childbirth only (UNICEF, 2025). The two-thirds of all maternal deaths occur due to complications arising from severe bleeding (mostly bleeding after childbirth), infections (usually after childbirth), pre-eclampsia and eclampsia (high blood pressure during pregnancy, complications from delivery and unsafe abortions (UNICEF, 2025). Furthermore, it is lamentable that most of these maternal deaths are preventable and treatable if women receive adequate maternal health care (UNICEF, 2025). However, there has been noteworthy development in reducing the global maternal mortality ratio (maternal deaths per 100,000 live births) by 40 per cent from 2000 to 2023 (2.2 % annual rate of reduction), decreasing from 328 deaths to 197 deaths per 100,000 live births (UNICEF, 2025). While substantive, it is much lower than the 15 % annual rate of reduction required to achieve Sustainable Development Goal 3.1 of reducing maternal deaths to 70 per 100,000 live births by 2030 (UNICEF, 2025). It is crucial to highlight that Sub-Saharan Africa and Southern Asia accounted for around 87% of the global maternal deaths in 2020 (WHO, 2024b). In fact, still sub-Saharan Africa alone accounted for 70 per cent of global maternal deaths in 2023 (UNICEF, 2025). The maternal mortality ratio remains alarmingly high in South Asian countries; Afghanistan (521), Nepal (142), Pakistan (155), Bangladesh (115), India (80) and Maldives (32) (World Bank, 2025). In comparison to developed countries where maternal mortality ratio is 3 in Japan, 4 in Denmark and 7 in France (World Bank, 2025).

Onarheim and colleagues (2016) contend that maternal health is fundamental for fostering a cycle of positive societal development. The maternal healthcare services encompass access to high-quality care provided by skilled health professionals during pregnancy (antenatal care), childbirth (intrapartum care), and care and support in the weeks following childbirth (postnatal care) (Menon & Arora, 2021). In India, only 58% of mothers

attended at least four antenatal care checkups, while 70% of women had their first antenatal care visit in the first trimester in 2019- 21 (NFHS-5, 2022). Moreover, the number of institutional births increased from 79% in 2015-16 to 89% in 2019-21 (NFHS-5, 2022). However, this figure is much lower than that of its South Asian peers, with the Maldives at 94% (WHO, 2020) and Sri Lanka at 100% (WHO, 2020b). It is dismaying that antenatal care checkups are also significantly lower in India compared to the Maldives at 82% and Sri Lanka at 93% (WHO, 2020; WHO, 2020b). Similarly, postnatal care in India stands at 82%, while in stark contrast, it is 99% in Sri Lanka (WHO, 2020b; NFHS-5, 2022).

The plethora of studies conducted in South Asia contended that maternal healthcare service utilization reduces the prevalence of maternal mortality and morbidity (Berhan & Berhan, 2014; Kikuchi et al., 2015; Khosravi & Ghahiri, 2015; Bingham et al., 2018; Walker et al., 2019; Mitikie et al., 2020; Zhao et al., 2020; Kumbeni & Apanga, 2021; Umar et al., 2022; Khan & Yildirim, 2024). Das and colleagues (2023) vehemently argue that maternal healthcare service utilization is a pivotal indicator of a nation's progress in safeguarding the health and well-being of the women. Over and beyond, maternal healthcare service utilization is integral to achieving several United Nations Sustainable Development Goals (SDGs), such as reducing poverty through higher educational attainment and income potential (SDG 1), improving nutrition (SDG 2), reducing global maternal mortality to 70 per 100,000 live births by 2030 (SDG 3.1), ending preventable deaths of newborns and children under 5 years of age (SDG 3.2), universal access to sexual and reproductive healthcare services (SDG 3.7), access to quality essential healthcare services (SDG 3.8), fostering inclusive economic growth (SDG 8), and reducing economic, social and gender inequalities (SDG 10) (United Nations, 2024). Despite these benefits, maternal healthcare service utilization is low in India.

1.1.2 Maternal Healthcare and Child Health

Furthermore, maternal healthcare service utilization is imperative to prevent child mortality and morbidity (Kiross et al., 2021; Chauhan et al., 2021). In addition, maternal health plays an imperative role in child development, future human capital production, and a country's overall development (Onarheim et al., 2016). As per the endogenous growth model, a country's per capita income in the long run inherently depends on human capital, emphasising that a country must strive for robust human health to sustain faster economic growth (Romer, 1996). However, it is pertinent to note that child malnutrition is a persistent problem in low and middle-income countries (WHO, 2024c). It is distressing that malnutrition contributes to nearly half of all deaths in children under the age of five years globally (WHO, 2024c). In 2022, 45 million under-five children were estimated to be wasted, while the prevalence of stunting was high, affecting 149 million children (WHO, 2024c). Economically, malnutrition imposes a colossal burden of US$3 trillion a year in the form of productivity loss, ranging from 3 to 16% of GDP in low-income

countries (World Bank, 2023).

Notably, under-five malnutrition among children in the form of stunting, wasting, and underweight have long-lasting effects on an individual's life (Komakech et al., 2022). Numerous scholars have put forward that malnutrition has several negative ramifications including lower emotional well-being and self-esteem, vulnerability to infections and chronic diseases, impaired physical and cognitive development, impaired physical and cognitive development, poor learning capacity, lower educational attainment and economic productivity in adulthood (Pelletier et al.,

1994; Black et al., 2013, Komakech et al., 2022; Khura et al., 2023). According to WHO (2024c), child malnutrition not only has a serious and lasting impact on individuals but also on families, communities and countries at large.

In India, malnutrition remains overwhelmingly high in India, with under-five stunting at 35.5%, underweight at 32.1% and wasting being one of the highest in the world at 19.3% (NFHS-5, 2022; Economic Times, 2022). Furthermore, in terms of the global hunger index (GHI), India (111) lags behind its South Asian peers namely, Pakistan (102), Bangladesh (81), Nepal (69), and Sri Lanka (60), which is concerning for a developing country such as India (Concern Worldwide & Welthungerhilfe, 2023). Given the concerning rates of child malnutrition in India, it is crucial to promote safe and accessible maternal healthcare services in India (Kuhnt & Vollmer, 2017). The utilization of maternal healthcare services has multifarious benefits, including the prevention of still-births (Ota et al., 2020) and neonatal deaths (Hofmeyr et al., 2023), as well as reducing the risk of fetal growth restriction, congenital abnormalities or asphyxia (EBCOG Scientific Committee, 2015), postpartum haemorrhage, and hypertensive disorders (UNICEF, 2024b). It also prevents respiratory infections (Victora et al., 2016), leukemia (Amitay & Keinan- Boker, 2015), dental malocclusions (Peres et al., 2015), overweight and obesity (Anderson et al., 2020), systolic blood pressure, type 2 diabetes (Horta et al., 2015), and ensures better neurocognitive functions (Ogbo et al., 2018). Therefore, maternal healthcare services serve as a comprehensive solution, simultaneously enhancing both maternal and child health outcomes.

1.1.3 Maternal Healthcare and Gender Dynamics

In order to increase the uptake of maternal health care service utilization in India, it is imperative to address the barriers, including poverty, lack of women's autonomy, cultural beliefs, gender-based violence, lack of education, poor quality of care, transportation barriers to health facilities and lack of family support (Dahab & Sakellariou, 2020; Okoli et al., 2020; Omer et al., 2021). The majority of these barriers can be mitigated by challenging the entrenched gender inequalities.

Notably, patriarchy remains deep-rooted in South Asian countries (UNICEF, 2023). These deep-seated forces detrimentally affect a woman's life, starting from childhood and continuing through adolescence, reproductive age, and old age (UNICEF, 2023). It is perturbing that the emergence of unequal

power dynamics impedes girls' educational opportunities, employment, access to nutrition, leads to early marriage, and subjects them to intimate partner violence (UNICEF, 2023). According to UNICEF (2023), a girl is three times less likely to go to school and five times less likely to have access to mass media in comparison to a boy, depriving her of educational and employment opportunities. Furthermore, 25 % of the girls are married before the age of 18 years, while 19 % of girls aged 15 to 19 years have experienced physical or sexual violence by an intimate partner (UNICEF, 2023).

In India, gender-based privileges, kinship structures, and other cultural contextual factors undermine women's autonomy in reproductive healthcare decisions (Gaikwad, 2023). Moreover, a woman's limited decision-making power can compromise her own and the child's health, potentially resulting in lower infant birth weight and affecting the quality of infant care and nutrition (Rahman et al., 2015). Moreover, a mother who manages her own healthcare decisions is more likely to make greater use of available maternal healthcare services (Saaka, 2020). Saaka (2020) argues that maternal healthcare decision-making autonomy, particularly mothers' involvement in decisions regarding their own healthcare, seeking medical attention, and caring for children during illness, emerged as the most significant factor influencing child growth. The subservience, subordination, compliance, and passivity imposed on women hamper maternal healthcare service utilization in India and, furthermore, impact child health as well.

1.2 Research Gaps

The high maternal mortality ratio represents a critical public health challenge, particularly in South Asian countries, indicating a severe health crisis. Despite the proven benefits of maternal healthcare service utilization, many women lack access to healthcare services, with substantial regional disparities persisting within South Asian countries. Therefore, understanding the socio-economic and demographic determinants of maternal healthcare service utilization in South Asian countries is crucial for its improvement. Numerous scholars have investigated the determinants of maternal healthcare service utilization at a country level, while only a few have examined these factors across South Asian countries as a whole. However, to the best of the authors' knowledge, none of the studies conducted within the South Asian context has incorporated the latest WHO recommendations on antenatal care while investigating maternal healthcare service utilization. As outlined in the WHO report titled 'WHO recommendations on antenatal care for positive pregnancy outcomes', the minimum number of antenatal care contacts recommended by the WHO has been revised from four to eight, with the first antenatal care contact in the first trimester according to the latest 2016 WHO antenatal care model (WHO, 2016a). Nevertheless, studies conducted in the South Asian context so far have predominantly employed the earlier focused antenatal care (FANC) model, which recommends at least four antenatal care

visits. Consequently, these studies fail to capture the full scope of care recommended by the latest guidelines, providing a less comprehensive understanding of the effective maternal healthcare essential for optimal pregnancy outcomes.

Previous studies have analysed the impact of parent's age at the time of the survey on outcomes. However, to the best of our knowledge, no study has examined the impact of parent's age at the time of childbirth on maternal healthcare service utilization. Determining a parent's age at the birth of a child is crucial, as it enables one to comprehend their maturity levels during the utilization of maternal healthcare services and offers more accurate predictions compared to their current age at the time of the survey. The data for parents' age were taken from the Demographic and Health Survey, and parents' age at the time of childbirth was calculated by subtracting the child's age from the parents' current age at the time of the survey. Towards this direction, ours is the first study to calculate parents' age at childbirth and examine its association with indicators of maternal healthcare service utilization.

Furthermore, our study contributed by focusing on paternal factors as one of the essential drivers of breastfeeding practices in India, which have been under- emphasised in the previous literature. The rationale for including paternal factors is to examine breastfeeding practices within the framework of family dynamics, progressing from a dyadic (mother-infant) to a triadic (mother-father-infant) perspective. Additionally, there is a dearth of evidence in the literature examining whether maternal ownership of a bank account and land, counselling received from healthcare providers, and assistance from Anganwadi workers are associated with breastfeeding practices. Our study addresses this noticeable gap. Moreover, to the best of our knowledge, ours is the first study examining the factors associated with breastfeeding duration in India. Understanding the determinants of breastfeeding duration is crucial because studies have found that longer breastfeeding durations have long-term implications for child health, maternal health and improved child- mother bonding.

In India, the majority of the studies examined either the impact of water and sanitation facilities or maternal healthcare service utilization or breastfeeding practices on child health outcomes. However, to the best of our knowledge, no study in India has examined the impact of water and sanitation facilities, maternal healthcare service utilization and breastfeeding practices together in improving poor child health outcomes. The foremost contribution of the paper is to bring the focus on community-level services (water and sanitation facilities) and individual-level health behaviour (maternal healthcare service utilization and breastfeeding practices) concurrently as factors influencing child health outcomes since there is limited empirical evidence regarding this association in India. Furthermore, to the best of our knowledge, no research has looked into the temporal impact of water and sanitation facilities, maternal healthcare service utilization and breastfeeding practices on a comprehensive set of major child health indicators namely under-five stunting, wasting and underweight in India. This holistic assessment is expected

to contribute to the existing literature on child health using nationally representative data and aims to aid in evidence-based policymaking towards improving child health in India.

The existence of a patriarchal social structure undermines women's autonomy in their own reproductive health choices. In this regard, our study intends to examine the underexplored impact of women's autonomy in managing one's healthcare on abortion history, knowledge of contraceptive methods, wanted pregnancy, and delivery by caesarean section using the latest two rounds of Demographic and Health Survey in India. Furthermore, to the best of the authors' knowledge, the temporal impact of women's autonomy in managing their healthcare on a comprehensive set of reproductive healthcare services has not been explored.

Over the years, many socioeconomic and demographic factors influencing anthropometric indicators of child health have been identified in the research literature, like poverty, rural-urban disparities, climate change, exposure to mass media and the effect of government schemes. Given the global burden of child malnutrition and its long-term impact on human capital formation, coupled with the high prevalence of patriarchal social structure in South Asia, it is crucial to investigate the effects of coercive control on child health. However, to the best of our knowledge, no research has explored the impact of domestic violence (physical violence) during pregnancy on anthropometric indicators namely stunting and wasting in South Asian countries. Furthermore, our study examines the impact of the intergenerational impact of violence, women's attitudes towards intimate partner violence and spousal-controlling behaviour on child health, areas which have largely been understudied in South Asian countries. Additionally, to the best of the author's knowledge, no study has investigated the effect of an adult's interruption during interviews about domestic violence on child health in South Asia. This research, therefore, is expected to provide valuable insights for policymakers, healthcare providers, and stakeholders to formulate effective policies and strategies to prevent coercive control and enhance child health in South Asia.

1.3 Research Objectives

Against this backdrop, and to address the research gaps in the literature, we have focused on the following research objectives:

1. To study the impact of socio-economic and demographic factors on the utilization of maternal health care services in India and other developing countries.
2. To examine the influence of utilization of maternal healthcare services on child health outcomes in India.
3. To examine the associations between women's autonomy in managing one's healthcare and reproductive health outcomes.
4. To conduct a comparative study on the interaction between coercive

control experienced by women and child health outcomes in India and other developing countries.

1.4 Organization of the thesis

This thesis is organized into eight chapters to accommodate all the research objectives. Each chapter is structured to be self-contained.

Chapter 1: The introductory section of the study provides information about the concerning situation of maternal mortality and child malnutrition coupled with the high prevalence of patriarchal social structure in South Asia, followed by the role of maternal healthcare service utilization in enhancing both maternal and child health. Further, research gaps addressed by the study, followed by the research objectives, and an overview of the overall thesis organization are also detailed in this chapter.

Chapter 2: This chapter addresses the first research objective by providing the socio-economic and demographic determinants of maternal healthcare service utilization in South Asian countries. For this purpose, our study adopted a modified framework of Anderson's behavioural model of health service use, which aims to understand individuals' use of health services (Andersen, 1995). The data for this chapter was extracted from the latest round of the Demographic and health survey conducted in South Asian countries namely- Afghanistan, Bangladesh, India, Maldives, Nepal and Pakistan. Three main maternal healthcare service utilization indicators were considered: antenatal care (number of antenatal care visits, number of days iron folic acid tablets consumed, and the month of the first antenatal care visit), delivery care and postnatal care. Descriptive statistics, generalized ordered logit model and multivariable logistic regression were employed for analysis in the chapter. This chapter intends to provide country-specific, yet comparable empirical evidence for tailored intervention policies to promote maternal healthcare service utilization in these countries.

Chapter 3: The third chapter provides the concomitant factors influencing breastfeeding practices in India, thereby further fulfilling the first objective of the study. This chapter employed data from the latest round of the Indian demographic and health survey [DHS (2019-21)]. Descriptive statistics, multivariable logistic regression and negative binomial models were used to investigate the determinants of early initiation of breastfeeding (within one hour), exclusive breastfeeding (under six months), continued breastfeeding (12-23 months), and duration (months) of breastfeeding among children under the age of two years/23 months. By examining the socioeconomic and demographic factors of mothers, paternal factors, and assistance from Anganwadi workers, our study seeks to provide valuable insights for policymakers, healthcare providers, and stakeholders to formulate effective policies and strategies to improve breastfeeding practices in India.

Chapter 4: The fourth chapter addresses the second objective by discussing the influence of maternal healthcare service utilization on under-five

child health outcomes, namely stunting, wasting, anaemia, underweight and overweight in India. This chapter employed data extracted from the Indian Demographic Health Survey (2019-21). Furthermore, to analyse the association between maternal healthcare service utilization indicators and under-five child health outcomes, namely stunting, wasting, anaemia, underweight and overweight, descriptive statistics and multivariable logistic regression techniques were used. This chapter aids in evidence-based policymaking towards improving child health outcomes in a developing country such as India.

Chapter 5: This chapter provides an overview of the impact of water and sanitation, maternal health care service utilization and breastfeeding practices on under-five child health outcomes, namely stunting, wasting and underweight in India using the two latest rounds of the Indian Demographic Health Survey [DHS (2015- 16) and DHS (2019-21)]. By integrating these factors, it builds upon the previous chapter to deliver a comprehensive analysis, thereby fully addressing and deepening the investigation of the study's second objective. The Fundamental Cause Theory derived from Geoffrey Rose's Cause of Causes was applied to highlight the role of socioeconomic deprivation on health outcomes. Descriptive statistics, multivariable logistic regression and time interaction regression model were employed for analysis in this chapter. This holistic assessment is expected to contribute to the existing literature on child health using nationally representative data and aims to aid in evidence-based policymaking towards improving child health in India.

Chapter 6: The sixth chapter addresses the third objective and discusses the impact of women's autonomy in managing one's healthcare on abortion history, knowledge of contraceptive methods, wanted pregnancy and delivery via caesarean section in India. Connell's gender and power theory was adopted to explain the association between women's autonomy in healthcare decision-making and reproductive health outcomes. The data for this chapter were extracted from two rounds of the Indian Demographic Health Survey [DHS (2015-16) and DHS (2019-21)]. Descriptive statistics, multivariable logistic regression and time interaction regression model were employed for the analysis. This chapter aims to provide crucial insights for evidence-based policymaking as well as tailored policy interventions to enhance women's health in India.

Chapter 7: This chapter provides a comparative study on the interaction between coercive control experienced by women and child health outcomes in India and other developing countries, thereby fulfilling the fourth objective of the study. The chapter employed mixed-effect logistic model using data from the latest round of the Demographic health survey conducted in South Asian countries- namely, India, Maldives and Pakistan. The impact of coercive control experienced by women on child health outcomes was elucidated using the family disruption model. This chapter, therefore, is expected to provide valuable insights for policymakers, healthcare providers, and stakeholders to formulate effective policies and strategies to prevent coercive control and enhance child health in South Asia.

Chapter 8: This last chapter concludes the thesis with a recapitulation of the major findings of the study. The salient findings and conclusions of the research study, pertaining to the socio-economic and demographic determinants of maternal healthcare service utilization, the association between maternal healthcare service utilization and child health outcomes, and the role of gender dynamics in maternal healthcare and child health in India and other South Asian countries. The chapter also detailed the policy implications, recommendations, and the area of scope for future research.

1.5 References

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CHAPTER 2

EVIDENCE FROM MATERNAL HEALTHCARE SERVICES IN SOUTH ASIA: DEMOGRAPHY VS. HEALTHCARE

2.1 Introduction

According to the World Health Organisation (WHO), maternal mortality remains unacceptably high worldwide, with one maternal death occurring every two minutes in 2020, representing a grave public health concern (WHO, 2024). Despite an average annual decline of 2.2% in maternal mortality, this rate is significantly lower than the 6.4% required to meet Sustainable Development Goal 3.1, which aims to reduce maternal deaths to 70 per 100,000 live births by 2030 (UNICEF, 2025). Kirigia and colleagues (2008) contend that even a single maternal death could reduce per capita GDP by US $0.36 per year. Maternal mortality, caused by complications from pregnancy or childbirth (UNICEF, 2023), claimed about 287,000 women's lives in 2020, with almost 95% of maternal deaths occurring in low and middle- income countries (LMICs) (WHO, 2024). Sub-Saharan Africa and Southern Asia disproportionately account for approximately 87% (253,000) of these deaths in 2020, highlighting the importance of utilizing maternal healthcare services (WHO, 2024). In fact, still sub-Saharan Africa alone accounted for 70 per cent of global maternal deaths in 2023 (UNICEF, 2025).

This alarming burden of maternal mortality, particularly in LMICs, underscores not only a pressing health crisis but also a significant impediment to economic development. As per endogenous growth model a country's per capita income in the long run inherently depends on human capital, emphasising that a country must strive for robust human health to sustain faster economic growth (Romer, 1996). In this regard, maternal health is fundamental for fostering a cycle of positive societal development, given its imperative role in child development, the production of future human capital, and the overall development of a country (Onarheim et al., 2016). However, despite proven evidence of the benefits of maternal health, it is dismaying that the maternal mortality ratio (MMR) remains alarmingly high in South Asian countries. The maternal mortality ratio remains alarmingly high in South Asian countries; Afghanistan (521), Nepal (142), Pakistan (155), Bangladesh (115), India (80) and Maldives (32) World Bank, 2025). In comparison to developed countries where maternal mortality ratio is 3 in Japan, 4 in Denmark and 7 in France (World Bank, 2025). Furthermore, maternal healthcare service utilization

(MHCSU) treats severe bleeding (mostly occurring after childbirth), infections (usually after childbirth), high blood pressure during pregnancy (preeclampsia and eclampsia), unsafe abortion (WHO 2024), lochia, postpartum depression (WHO, 2013), promote care-seeking behaviours (Tessema & Minyihun, 2021), and breastfeeding (WHO, 2013). However, despite these benefits, many women still lack access to maternal and reproductive health care services in South Asian countries (Shahi et al., 2017). Globally, 86% of births are assisted by skilled health personnel (Rahman et al., 2021); nevertheless, substantial regional disparities exist, with Bangladesh at (40%), Nepal (62%), and Pakistan (69%) (Rahman et al., 2021), in contrast with 100% in Ukraine and Armenia (Hasan et al., 2021). Similarly, postnatal care (PNC) reaches even fewer women in South Asia (47%), with Bangladesh (31.6%), Nepal (43.3%), and Pakistan (58.1%) (Singh et al., 2015). It is alarming that the number of women who received at least four antenatal care (ANC) check-ups is the lowest in South Asia (55%), significantly lower than the global average of 69% (UNICEF, 2024). Neupane and colleagues (2023) found that only 8% women received at least four ANC check-ups in Afghanistan, compared to 42–46% in Bangladesh, India and Pakistan and 65% in Nepal.

Against this backdrop, the main objective of this study is to examine the socio-economic and demographic determinants of MHCSU in South Asian countries, namely Afghanistan, Bangladesh, India, Maldives, Nepal and Pakistan. For this purpose, our study adopted a modified framework of Anderson's behavioural model of health service use, which aims to understand individuals' use of health services (Andersen, 1995). The determinants affecting MHCSU are categorised into three primary factors: the geographical environment, predisposing and enabling factors (Andersen, 1995; Chanda et al., 2020). The geographical, environmental factors include the division and participant's place of residence (Chanda et al., 2020). The predisposing factors reflect the characteristics of an individual, including; age, gender, birth order and education (Andersen, 1995). Finally, the enabling factors either enable or impede the use of health services, including an individual's income, access to a source of regular care, mass media exposure and employment (Andersen, 1995).

The plethora of previous studies conducted in Bangladesh (Haider et al., 2017; Khan et al., 2020; Kabir, 2021), Nepal (Mahara et al., 2015; Adhikari, 2016; Adhikari et al., 2021; Thapa et al., 2023), India (Hamal et al., 2020; Paul & Chouhan, 2020; Yadav et al., 2021; Singh et al., 2021; Debsarma et al., 2022), and Afghanistan (Stanikzai et al., 2021; Rahman et al., 2022; Tawfiq et al., 2023) have examined the determinants of MHCSU. Moreover, numerous studies have investigated the determinants of MHCSU in South Asia countries (Goli et al., 2017; Fatema & Lariscy, 2020; Rahman et al., 2021; Anik et al., 2021; Rahman et al., 2024; Al- Zubayer et al., 2024). However, to the best of the authors' knowledge, none of the studies conducted within the South Asian context have incorporated the latest WHO recommendations on ANC while investigating MHCSU. As outlined in the WHO report titled 'WHO recommendations on ANC for positive pregnancy outcomes', the minimum

number of ANC contacts recommended by the WHO has been revised from four to eight, with the first ANC contact in the first trimester according to the latest 2016 WHO ANC model (WHO, 2016a). Nevertheless, studies conducted in South Asia have predominantly employed the earlier focused ANC (FANC) model, which recommends at least four ANC visits (Goli et al., 2017; Fatema & Lariscy, 2020; Anik et al., 2021; Rahman et al., 2024; Al-Zubayer et al., 2024). Consequently, these studies fail to capture the full scope of care recommended by the latest guidelines, providing a less comprehensive understanding of the effective maternal healthcare essential for optimal pregnancy outcomes. Secondly, to the best of our knowledge, no study has examined the impact of parent's age at the time of childbirth on MHCSU. The parent's age at the time of childbirth was calculated by subtracting the child's age from the parent's current age at the time of the survey. Determining a parent's age at the birth of a child is crucial, as it enables one to comprehend their maturity levels during the utilization of maternal healthcare services and offers more accurate predictions compared to their current age at the time of the survey. Towards this direction, ours is the first study to calculate parents' age at childbirth and examine its association with indicators of MHCSU. Furthermore, to understand the impact of socioeconomic deprivation (limited wealth, restricted educational opportunities, and inadequate health infrastructure) on health outcomes, we used the Fundamental Cause Theory derived from Geoffrey Rose's Cause of Causes (Rose, 1985; Link & Phelan, 1995). Lastly, this study intends to provide country-specific yet comparable empirical evidence for tailored intervention policies to promote MHCSU in these countries.

2.2 Data and Methodology

2.2.1 Data Source

The study employed data extracted from the latest round of the nationally representative Demographic and Health Survey (DHS) conducted in South Asian countries namely Afghanistan (2015), Bangladesh (2017–2018), India (2019–21),
Maldives (2016–17), Nepal (2022), and Pakistan (2017– 2018). However, Sri Lanka (1987) was excluded from this study due to a lack of recent data. The relevant DHS rounds were conducted under the stewardship of the Central Statistics Organization and Ministry of Public Health, Kabul in Afghanistan, the National Institute of Population Research and Training in Bangladesh, the International Institute for Population Studies (IIPS) in India, Ministry of Health in Maldives, New ERA under the aegis of the Ministry of Health and Population in Nepal and National Institute of Population Studies, Government of Pakistan in Pakistan. The DHS covered a population representative sample survey of 24,395 households (Afghanistan), 19,457 households (Bangladesh), 636,699 households (India), 6,050 households (Maldives), 13786 households (Nepal) and 14,540 households (Pakistan). Interviews were completed for

women aged 15–49 years and men aged 15–54 years. Since the analysis aimed to investigate MHCSU, the sample was confined to women who had given live birth in the five years preceding the survey. Moreover, all children aged 0–5 years in the sampled households were covered. For the purpose of this analysis, the final study participants for this research comprised 25,258 respondents in Afghanistan, 17,021 in Bangladesh; 69,202 in India; 4,902 in Maldives; 10,184 in Nepal and 12,463 in Pakistan, after excluding respondents with missing responses to the selected relevant variables. In all six selected countries, robust multistage stratified sampling was adopted and relevant sampling weights were employed, where applicable. A detailed description of the survey's sampling procedures is accessible online (https://dhsprogram.com/data/available-datasets.cfm).

2.2.2 Outcome variables

To examine the influence of socio-economic and demographic factors on MHCSU in South Asian countries, the study analysed three outcomes in the context of MHCSU: ANC, delivery care and PNC. According to guidelines published by the WHO in a report titled 'WHO recommendations on ANC for positive pregnancy outcomes', the minimum number of ANC contacts prescribed is eight, with the first ANC contact being in the first trimester, as per the latest 2016 WHO ANC model (WHO, 2016a). Coupled with that, to ensure positive perinatal and maternal outcomes, daily iron and folic acid supplementation is recommended as a part of ANC to prevent maternal anaemia, low birth weight, and preterm birth (WHO, 2016a). According to a report titled 'WHO recommendations on maternal and newborn care for a positive postnatal experience', PNC is imperative for improving maternal and newborn health and well-being (WHO, 2022). The report titled 'Standards for improving quality of maternal and new- born care in health facilities' highlights that a birth in a health facility, along with quality care are imperative for preventing stillbirths and reducing the prevalence of morbidity and mortality (WHO, 2016b).

The first outcome variable namely ANC was taken as a categorical variable with 1 = standard care, 2 = moderate care and 3 = substandard care, which is defined as follows. Standard care is defined as the mother (a) receiving at least 8 ANC contacts, (b) having the first contact in the first trimester, and (c) consuming iron folic acid tablets for at least 180 days, implying that the mother has received adequate care in all three parameters. Substandard care refers to the mother (a) receiving less than 8 ANC contacts, (b) having the first visit in the second or third trimester and (c) consuming iron folic acid tablets for fewer than 180 days, implying that the mother has received inadequate care in all three parameters. Moderate care is defined as the mother receiving adequate care in one or two parameters out of the three. The second and third

outcome variables, delivery care and PNC were dichotomized into two categories: '1' was assigned if the mother delivered the child at a health facility or received PNC, and '0' was assigned if the mother delivered the child at home or did not receive PNC.

2.2.3 Explanatory variables

The socio-economic and demographic determinants of MHCSU included in the analysis are maternal/individual-level characteristics such as maternal age at the time of childbirth (14–24, 25–34, 35–49 years), educational attainment (no education, primary, secondary, higher education), currently working (yes/no), age of

respondent at the time of first birth (<15, 15– 24, 25–34, 35–49 years), childbirth order (firstborn, 2nd-4th, 5th or more), exposure/reads the newspaper (not at all, less than once a week, at least once a week), exposure/listens to radio (not at all, less than once a week, at least once a week), exposure/watches TV (not at all, less than once a week, at least once a week), maternal autonomy in managing one's healthcare (mother alone, mother and partner, husband/ partner alone, someone else), maternal autonomy over the husband's earnings (mother alone, mother and partner, husband/partner alone, someone else), and awareness about family planning (yes/no).

We also included household-level characteristics, which include place of residence (rural/urban) and household wealth quintile (poorest, poorer, middle, richer, and richest), husband's educational attainment (no education, primary, secondary, higher education), husband's age at the time of childbirth (11–24, 25–34, 35–49, above 50 years), and husband's occupation (professional/ technical/ managerial, agricultural, skilled and unskilled manual, other). The husband's age at the time of childbirth was calculated by subtracting the child's age from the husband's current age at the time of the survey.

2.2.4 Analytical Strategy

Descriptive statistics were used to decipher the respondent characteristics using percentages and frequency distributions at the univariate level. Below, we describe the methodology applied to examine the influence of various socio- demographic and economic factors on MHCSU in six South Asian countries.

2.2.4.1 Generalized ordered logit (gologit) model

The first outcome variable, ANC, is polychotomous and hence multinomial logistic regression and ordered logistic regression can be used (Das & Rahman, 2011). However, when the inherent setting of the data is

ordered (ordinal), ordered logistic regression is considered the most suitable option (Das & Rahman, 2011). The ordered logistic regression imposes the assumption of proportional odds on the data, also known as the parallel lines/ parallel regressions assumption (Williams, 2006). In practice, the proportional odds assumption is often violated, so the generalized ordered logit model can be used (Williams, 2006).

The generalized ordered logit model can be expressed as follows.

$$P(Yi > j) = \frac{\exp(\alpha j + Xi\beta j}{1 + [\exp(\alpha j + Xi\beta j)}, j = 1,2, \dots, M - 1 \quad (2.1)$$

Where M is the number of categories of the ordinal dependent variable.

In our analysis, certain variables failed to meet the parallel lines assumption and hence we considered the generalized ordered logit model (*gologit2 command in STATA*) with the *autofit* option for our analysis. The *autofit* option in STATA uses an iterative process to identify the partial proportional odds model that best fits the data, where the parallel lines/ proportional odds assumption is relaxed for some explanatory variables while maintaining for the others (Williams, 2006).

The partial proportional odds model can be expressed as follows.

$$P(Y_i > j) = \frac{\exp(\alpha j + X1i\beta 1 + X2i\beta 2 + X3i\beta 3j + \dots.. Xni\beta n)}{1 + [\exp(\alpha j + X1i\beta 1 + X2i\beta 2 + X3i\beta 3j + \dots.. Xni\beta n)]},$$

$$j = 1,2, \dots, M - 1 \quad (2.2)$$

The p-value of 0.05 is set as a determinant of statistical significance, in other words, the 95% confidence interval of the beta coefficient must not include 0 for a variable to be statistically significant at a 5% level.

2.2.4.2 Multivariable logistic regression

The study employed multivariable logistic regression to examine the association between binary outcomes variables (namely, delivery care and PNC) and socio-economic and demographic determinants of MHCSU.

The specific form of the logistic regression model is as follows.

$$\text{logit (Y)} = \ln \frac{P1}{1-P1}$$

$$= \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots\ldots\ldots\ldots\ldots \beta_K X_K \qquad (2.3)$$

In the above equation logit (Y) is the log (odds) of the outcomes, Y is the dichotomous outcome. P_1 refers to the likelihood of the mother delivering the child at a health facility and received PNC. The parameter β_0 measures the log odds of outcome variables in relation to the base category, and β_1 , β_2 ... ... β_k are the maximum likelihood estimates of the explanatory variables (Cabrera, 1994). The maximum likelihood estimation of β is interpreted as the differential log of outcome variables, associated with covariates X_1, X_2 ... ... X_k compared to the base category. The regression coefficients can be interpreted using estimated log odds ratio (ORs) with 95% confidence intervals (CIs). If the 95% CI includes 1, then OR must be interpreted as statistically insignificant at 5% level. The analysis was performed using STATA version 12.0 StataCorp LP, College Station, TX, USA (StataCorp, 2011). The validity of the statistical models employed was tested using the likelihood-ratio and Hosmer-Lemeshow test (Supplementary Table I.4).

2.3 Data analysis and results

2.3.1 Descriptive statistics

A summary of socio-economic and demographic characteristics of mothers aged 14–49 years and men aged 11–54 years in Afghanistan, Bangladesh, India, Maldives, Nepal and Pakistan is presented in Table 2.1. The majority of women belonged to the 35–49 years age category at the time of childbirth. Most women had secondary educational attainment in Bangladesh (38.69%), India (45.25%) and Maldives (45.84%) while the prevalence of no education was higher in Afghanistan (86.54%), Nepal (34.97%), and Pakistan (51.67%). Across countries, a significant proportion of women were predominantly unemployed, which is a matter of concern. More than 74% women neither read newspapers nor listened to radio in Bangladesh, India and Pakistan. It is dismaying that in Afghanistan and Pakistan, the majority of the decisions related to maternal healthcare and earnings were taken by the husband/partner alone. Except for India, approximately 75% of women respondents in all other countries were unaware of family planning practices. The majority of fathers had either primary or secondary educational attainment, except in Afghanistan. In all six countries, most fathers belonged to 35– 49 years age group at the time of childbirth (Table

2.1).

Supplementary Figure I.1 illustrates the geographical variation in the prevalence of ANC, delivery care and PNC in South Asia. Among South Asian countries, Afghanistan exhibits the lowest prevalence of standard ANC (0.64%) and PNC (77.71%) among women. Other countries performed relatively better in availing standard ANC, with India at (10.02%), Pakistan at (7.15%), Bangladesh at (5.28%), and Nepal at (4.13%). Only 53.19% of women delivered in health facilities in Bangladesh, in stark contrast to 99.61% in Maldives, 92.37% in India, 82.08% in Nepal, and 80.56% in Pakistan. Notably, 99.13% of women received PNC in Bangladesh, followed by Maldives (95.31%), India (89%), Nepal (83.8%),
Pakistan (83.16%) and Afghanistan (77.71%).

Table 2.1. Socio-economic and demographic characteristics of women aged 14–49 years and men aged 11-54 years who had at least one live birth in the past five years preceding the survey in Afghanistan (2015), Bangladesh (2017-2018), India (2019- 21), Maldives (2016-17), Nepal (2022) and Pakistan (2017-2018)

Variables	Afghanistan	Bangladesh	India	Maldives	Nepal	Pakistan
	25,258	17,021	69,202	4,902	10,184	12463
	Frequency (Percentage)	Frequency (Percentage)	Frequency (Percentage)	Frequency (Percentage)	Frequency (Percentage)	Frequency (Percentage)
Maternal age at childbirth						
14-24	5623 (22.26)	3805 (22.36)	8301 (12)	388 (7.92)	1813 (17.8)	1884 (15.12)
25-34	10027 (39.69)	6462 (37.96)	26877 (38.84)	2227 (45.43)	3881 (38.11)	5175 (41.52)
35-49	9608 (38.05)	6754 (39.68)	34024 (49.16)	2287 (46.65)	4490 (44.09)	5404 (43.36)
Maternal education						
No education	21858 (86.54)	2706 (15.9)	20713 (29.93)	292 (5.96)	3561 (34.97)	6440 (51.67)
Primary	1645 (6.51)	5614 (32.98)	10146 (14.66)	1729 (35.27)	3443 (33.81)	1723 (13.82)
Secondary	1395 (5.52)	6586 (38.69)	31312 (45.25)	2247 (45.84)	2889 (28.37)	2545 (20.42)
Higher	360 (1.43)	2115 (12.43)	7031 (10.16)	634 (12.93)	291 (2.86)	1755 (14.08)
Mother currently						

working						
No	22746 (90.05)	8638 (50.75)	50064 (72.34)	2998 (61.16)	3167 (31.1)	10878 (87.28)
Yes	2512 (9.95)	8383 (49.25)	19138 (27.66)	1904 (38.84)	7017 (68.9)	1585 (12.72)
Age of respondent at 1st birth						
<15	1447 (5.73)	1589 (9.34)	1653 (2.39)	52 (1.06)	173 (1.7)	325 (2.61)
15-24	21950 (86.9)	14597 (85.76)	56876 (82.19)	3814 (77.8)	9031 (88.68)	9723 (78.01)
25-34	1815 (7.19)	811 (4.76)	10372 (14.99)	1000 (20.4)	953 (9.36)	2328 (18.68)
35-49	46 (0.18)	24 (0.14)	301 (0.43)	36 (0.73)	27 (0.27)	87 (0.7)
Childbirth order						
First born	3046 (12.05)	4008 (23.55)	13948 (20.16)	1392 (28.4)	2440 (23.96)	1881 (15.09)
2^{nd}- 4^{th} born	9960 (39.43)	11137 (65.43)	48872 (70.62)	2915 (59.47)	6765 (66.43)	6416 (51.48)
5^{th} or higher birth order	12252 (48.51)	1876 (11.02)	6382 (9.22)	595 (12.14)	979 (9.61)	4166 (33.43)
Mother reads newspaper						
Not at all	24234 (95.95)	15347 (90.17)	51215 (74.01)	1547 (31.56)	8521 (83.67)	10387 (83.34)
Less than once	515	1029	10880	980	1197	1332

a week	(2.04)	(6.05)	(15.72)	(19.99)	(11.75)	(10.69)
At least once a week	509 (2.02)	645 (3.79)	7107 (10.27)	2375 (48.45)	466 (4.58)	744 (5.97)
Mother listens to radio						
Not at all	15197 (60.17)	16324 (95.91)	60547 (87.49)	1793 (36.58)	4776 (46.9)	11251 (90.28)
Less than once a week	3819 (15.12)	408 (2.4)	6065 (8.76)	859 (17.52)	2811 (27.6)	634 (5.09)
At least once a week	6242 (24.71)	289 (1.7)	2590 (3.74)	2250 (45.9)	2597 (25.5)	578 (4.64)
Mother watches TV						
Not at all	14251 (56.42)	6318 (37.12)	20327 (29.37)	292 (5.96)	4543 (44.61)	5120 (41.08)
Less than once a week	2577 (10.2)	1491 (8.76)	14762 (21.33)	435 (8.87)	2416 (23.72)	1346 (10.8)
At least once a week	8430 (33.38)	9212 (54.12)	34113 (49.29)	4175 (85.17)	3225 (31.67)	5997 (48.12)
Maternal autonomy in managing one's own healthcare						
Mother alone	1876 (6.95)	1708 (10.03)	7116 (9.81)	1001 (20.42)	2180 (21.41)	1262 (10.13)
mother and partner	10696 (42.35)	11671 (68.2)	49942 (72.17)	3396 (69.28)	5211 (51.17)	4935 (39.6)
husband/partner alone	11687 (46.27)	3112 (18.28)	11491 (16.61)	477 (9.73)	2138 (20.99)	5057 (40.58)

someone else	999 (3.96)	530 (3.11)	653 (0.94)	28 (0.43)	655 (6.43)	1209 (9.7)
Maternal autonomy over the husband's earnings						
Mother alone	437 (1.73)	785 (4.61)	4655 (6.73)	342 (6.98)	1143 (11.22)	843 (6.76)
mother and partner	9075 (35.6)	11420 (67.09)	49770 (71.92)	3895 (79.46)	6264 (61.51)	4699 (37.7)
husband/partner alone	14444 (57.19)	4268 (25.07)	14050 (20.3)	627 (12.79)	1979 (19.43)	5395 (43.29)
someone else	1302 (5.15)	548 (3.22)	727 (1.05)	38 (0.77)	798 (7.2)	1526 (12.25)
Awareness about family planning						
No	18912 (74.88)	14355 (84.34)	29816 (43.09)	3881 (79.17)	8374 (82.23)	9939 (79.75)
yes	6346 (25.12)	2666 (15.66)	39386 (56.91)	1021 (20.83)	1810 (17.77)	2524 (20.25)
Type of residence						
Urban	6048 (23.94)	6148 (36.12)	16522 (23.88)	501 (10.22)	5355 (52.58)	6019 (48.29)
Rural	19210 (76)	10873 (63.88)	52680 (76.12)	4401 (89.78)	4829 (47.42)	6444 (51.71)
Wealth quintile						
Poorest	4915	3282	14482	1346	2807	2431

	(19.46)	(19.28)	(20.93)	(27.46)	(27.56)	(19.51)
Poorer	5784 (22.9)	3284 (19.29)	15465 (22.35)	1389 (28.34)	2127 (20.89)	2666 (21.39)
Middle	5414 (21.43)	3316 (19.48)	14434 (20.86)	1380 (28.15)	2080 (20.42)	2448 (19.64)
Richer	5344 (21.16)	3434 (20.18)	13217 (19.1)	535 (10.91)	1823 (17.9)	2354 (18.89)
Richest	3801 (15.05)	3705 (21.77)	11604 (16.77)	252 (5.14)	1347 (13.23)	2564 (20.57)
Paternal education						
No education	14764 (58.49)	3860 (22.46)	12204 (17.64)	611 (12.46)	1399 (13.74)	3467 (27.71)
Primary	3379 (13.38)	5441 (31.97)	10128 (14.64)	1773 (36.17)	4395 (43.16)	1691 (13.49)
Secondary	5428 (21.49)	4907 (28.83)	37365 (53.99)	1941 (39.6)	3753 (36.85)	4389 (35.22)
Higher	1687 (6.68)	2813 (16.53)	9505 (13.74)	577 (11.77)	637 (6.25)	2916 (23.4)
Husband age						
11-24	2096 (8.3)	442 (2.6)	2344 (3.39)	108 (2.2)	819 (8.04)	596 (4.78)
25-34	9153 (36.24)	4324 (25.4)	20346 (29.4)	1854 (37.82)	3436 (33.74)	3934 (31.57)
35-49	10794 (42.73)	8060 (47.35)	35847 (51.8)	2248 (45.86)	4810 (47.23)	6203 (49.77)
Above 50	3215 (12.73)	4195 (24.65)	10665 (15.41)	692 (14.12)	1119 (10.99)	1730 (13.88)

Husband occupation						
did not work	0 (0)	377 (2.21)	0 (0)	135 (2.75)	181 (1.78)	587 (4.71)
Professional/ technical/ managerial	5525 (21.87)	1436 (8.44)	5123 (7.4)	1159 (23.64)	1006 (9.88)	2102 (16.87)
Clerical	774 (3.06)	0 (0)	1607 (2.32)	31 (0.63)	232 (2.28)	329 (2.64)
Sales	0 (0)	3240 (19.04)	6896 (9.97)	166 (3.39)	1946 (19.11)	1682 (13.5)
Service/ household and domestic	3941 (15.6)	1923 (11.3)	6194 (8.95)	414 (8.45)	0 (0)	897 (7.2)
Agricultural	7328 (29.01)	4323 (25.4)	26078 (37.68)	951 (19.4)	2176 (21.37)	1569 (12.59)
Skilled and unskilled manual	7690 (30.44)	5707 (33.53)	19807 (28.62)	1528 (31.17)	4578 (44.95)	5284 (42.4)
Other	0 (0)	15 (0.09)	3497 (5.05)	518 (10.57)	65 (0.64)	13 (0.1)

Source: Authors' calculations based on DHS survey data

2.3.2 Determinants of Maternal healthcare service utilization

Women who were mature (35–49 years) at the time of childbirth were more likely to receive adequate ANC (Pakistan [Coef 0.22]) and PNC (Afghanistan [OR 2.57; 95% CI 1.47–4.49]), however, maternal age had statistically insignificant ($p > 0.05$) association with MHCSU in Bangladesh, India, Maldives and Nepal. Additionally, we found that educated mothers were more likely to avail MHCSU in South Asia (Supplementary Figure I.2). Working mothers were more likely to receive adequate ANC and PNC in South Asia. However, it is worth mentioning that, conversely, working mothers were less likely to receive ANC in Afghanistan [Coef −0.17] and delivery care in Bangladesh [OR 0.74; 95% CI 0.61–0.91] (Table 2.2 and Supplementary Table I.5–I.6).

Women who were mature at the time of their first childbirth were more likely to receive ANC in South Asia (Bangladesh [Coef 0.34]; India [Coef 0.14]; Nepal [Coef 0.48]). Interestingly, our study found that women with higher childbirth order had lower odds of receiving adequate ANC in South Asia (Afghanistan [Coef −0.15]; Bangladesh [Coef -0.25]; India [Coef−0.23]; Maldives [Coef −1.13]; Nepal [Coef−0.28]; Pakistan [Coef−0.51]). They are also less likely to have avail delivery care and PNC. Maternal exposure to mass media (Newspaper/TV/ Radio) increased the odds of receiving ANC, delivery care and PNC in South Asia. In contrast, mothers who listened to the radio in Afghanistan were less likely to have received standard ANC [Coef −0.12] and PNC [OR 0.69; 95% CI 0.5–0.94].

Furthermore, our study found that women's decision-making autonomy had a statistically significant impact on MHCSU in South Asia. Women who had lower or no autonomy over their husband's earnings were less likely to receive adequate ANC (Afghanistan [Coef −0.11]; Bangladesh [Coef −0.08]) and PNC (Maldives [OR 0.35; 95% CI 0.16–0.74]). Also, mothers who lacked the autonomy to manage their own healthcare decisions were less likely to receive PNC (Afghanistan [OR 0.21; 95% CI 0.05–0.89]; Maldives [OR 0.49; 95% CI 0.29–0.8]). We found that mothers who were aware of family planning had higher odds of receiving ANC, delivery care and PNC in South Asia.

In addition, our study found that household characteristics significantly influenced MHCSU in South Asia. Women who resided in rural areas were less likely to receive adequate ANC (India [Coef – 0.15]). Moreover, women from wealthier households were more likely to receive standard ANC, delivery care and PNC in South Asia. Notably, we found that women with educated husband were more likely to receive adequate ANC (Afghanistan [Coef 0.05]; Bangladesh [Coef 0.14]), delivery care (Afghanistan [OR 1.39; 95% CI 1.08–1.79]); Bangladesh [OR 1.55; 95% CI 1.04–2.29]; Nepal [OR 1.84; 95% CI 1.21–2.8] and PNC (Afghanistan [OR 1.49; 95% CI 1.12–1.98]); Bangladesh [OR 1.45; 95% CI 1.17–1.79]; Maldives [OR 2.51; 95% CI 1.13–3.61]; Pakistan [OR 1.61; 95% CI 1.1–2.34]. A mother whose husband

was mature (aged 35–49 years) at the time of childbirth had a higher prevalence of receiving standard ANC and delivery care in South Asia.

Table 2.2. Generalized ordered logit model for analysing the impact of socio- economic and demographic factors on antenatal care using DHS rounds conducted in Afghanistan (2015), Bangladesh (2017-2018), India (2019-21), Maldives (2016-17), Nepal (2022) and Pakistan (2017-2018)

Standard care v/s moderate care, substandard care	Afghanistan	Bangladesh	India	Maldives	Nepal	Pakistan
	Coef.;CI(95 %)	Coef.;CI(95 %)	Coef.;CI(95 %)	Coef.;CI(95 %)	Coef.;CI(95 %)	Coef.;CI(95 %)
Maternal age at childbirth	0.08 (-0.04 to 0.2)	0.02 (-0.15 to 0.19)	-0.01 (-0.1 to 0.07)	-0.11 (-0.38 to 0.17)	-0.04 (-0.31 to 0.24)	0.22* (0.07 to 0.37)
Maternal education	0 (-0.09 to 0.09)	0.28* (0.17 to 0.4)	0.06* (0.01 to 0.1)	-0.11 (-0.31 to 0.09)	0.35* (0.18 to 0.52)	0.26* (0.18 to 0.34)
Mother currently working	-0.17 (-0.37 to 0.02)	-0.13 (-0.28 to 0.01)	0.14* (0.06 to 0.22)	0.25* (0.01 to 0.48)	0.14 (-0.1 to 0.37)	-0.21 (-0.42 to 0)
Age of respondent at 1st birth	0.12 (-0.05 to 0.29)	0.34* (0.1 to 0.57)	0.14* (0.04 to 0.23)	0.12 (-0.16 to 0.4)	0.48* (0.09 to 0.86)	-0.05 (-0.22 to 0.11)
Childbirth order	-0.15* (-0.27 to -0.04)	-0.25* (-0.41 to -0.08)	-0.23* (-0.3 to -0.15)	-1.13* (-1.83 to -0.44)	-0.28* (-0.53 to -0.02)	-0.51* (-0.64 to -0.37)
Mother reads newspaper	0.16* (0 to 0.32)	0.28* (0.12 to 0.44)	0.01 (-0.04 to 0.07)	0.19* (0.05 to 0.32)	0.42* (0.17 to 0.67)	0.03 (-0.09 to 0.15)

Mother listens to radio	-0.12* (-0.19 to -0.06)	0.15 (-0.03 to 0.34)	0 (-0.06 to 0.07)	-0.07 (-0.19 to 0.05)	0.28* (0.11 to 0.45)	-0.04 (-0.17 to 0.09)
Mother watches TV	0.04 (-0.03 to 0.11)	0.04 (-0.05 to 0.13)	0.19* (0.13 to 0.24)	0.29* (0.09 to 0.5)	-0.06 (-0.22 to 0.09)	-0.03 (-0.11 to 0.06)
Maternal autonomy in managing one's own healthcare	0.04 (-0.02 to 0.09)	-0.01 (-0.08 to 0.06)	0.02 (-0.02 to 0.06)	0.06 (-0.08 to 0.21)	0.02 (-0.07 to 0.12)	-0.03 (-0.09 to 0.03)
Maternal autonomy over the husband's earnings	-0.11* (-0.16 to -0.06)	-0.08* (-0.15 to -0.02)	0.03 (-0.01 to 0.07)	-0.01 (-0.16 to 0.13)	-0.04 (-0.12 to 0.04)	0.01 (-0.03 to 0.05)
Awareness about family planning	0.27* (0.14 to 0.4)	0.04 (-0.15 to 0.22)	-0.1 (-0.19 to -0.02)	0.49* (0.21 to 0.78)	0.52* (0.15 to 0.88)	0.09 (-0.07 to 0.26)
Type of residence	0.12 (-0.03 to 0.27)	-0.16 (-0.31 to 0)	-0.15* (-0.23 to -0.06)	1.33 (-0.26 to 2.93)	-0.04 (-0.27 to 0.2)	-0.12 (-0.27 to 0.03)
Wealth quintile	0.15* (0.1 to 0.2)	0.14* (0.07 to 0.2)	0.23* (0.19 to 0.26)	0.5* (0.04 to 0.96)	0.25* (0.14 to 0.36)	0.34* (0.27 to 0.41)
Paternal education	0.05* (0 to 0.1)	0.14* (0.06 to 0.23)	0 (-0.04 to 0.04)	-0.04 (-0.13 to 0.05)	0 (-0.11 to 0.11)	0.02 (-0.05 to 0.1)
Husband age	-0.01	0.21*	0.03	-0.07	0.24*	0.12

at childbirth	(-0.11 to 0.1)	(0.08 to 0.34)	(-0.05 to 0.1)	(-0.3 to 0.16)	(0.03 to 0.46)	(0 to 0.24)
Husband occupation	0.04 (-0.01 to 0.1)	-0.02 (-0.04 to 0.01)	0.01 (-0.01 to 0.03)	0 (0 to 0.01)	0.01 (-0.01 to 0.02)	0 (-0.01 to 0.02)
Standard care, moderate care v/s substandard care						
Maternal age at childbirth	0.08 (-0.04 to 0.2)	0.02 (-0.15 to 0.19)	0.13* (0.02 to 0.23)	-0.11 (-0.38 to 0.17)	-0.04 (-0.31 to 0.24)	0.22* (0.07 to 0.37)
Maternal education	0 (-0.09 to 0.09)	0.28* (0.17 to 0.4)	0.2* (0.13 to 0.27)	-0.11 (-0.31 to 0.09)	0.35* (0.18 to 0.52)	0.47* (0.33 to 0.6)
Mother currently working	-0.17* (-0.37 to 0.02)	-0.13 (-0.28 to 0.01)	0.14* (0.06 to 0.22)	0.25* (0.01 to 0.48)	0.14 (-0.1 to 0.37)	-0.21 (-0.42 to 0)
Age of respondent at 1st birth	0.12 (-0.05 to 0.29)	0.34* (0.1 to 0.57)	0.14* (0.04 to 0.23)	0.12 (-0.16 to 0.4)	0.48* (0.09 to 0.86)	-0.05 (-0.22 to 0.11)
Childbirth order	-0.15* (-0.27 to -0.04)	-0.25* (-0.41 to -0.08)	-0.23* (-0.3 to -0.15)	-0.05 (-0.33 to 0.23)	-0.28* (-0.53 to -0.02)	-0.51* (-0.64 to -0.37)
Mother reads newspaper	0.16 (0 to 0.32)	0.28* (0.12 to 0.44)	0.01 (-0.04 to 0.07)	0.19* (0.05 to 0.32)	0.42* (0.17 to 0.67)	0.03 (-0.09 to 0.15)

Mother listens to radio	-0.12* (-0.19 to -0.06)	0.15 (-0.03 to 0.34)	0 (-0.06 to 0.07)	-0.07 (-0.19 to 0.05)	-0.08 (-0.35 to 0.18)	-0.04 (-0.17 to 0.09)
Mother watches TV	0.04 (-0.03 to 0.11)	0.38* (0.15 to 0.61)	0.34* (0.27 to 0.42)	0.29* (0.09 to 0.5)	-0.06 (-0.22 to 0.09)	-0.03 (-0.11 to 0.06)
Maternal autonomy in managing one's own healthcare	0.04 (-0.02 to 0.09)	-0.01 (-0.08 to 0.06)	0.02 (-0.02 to 0.06)	0.06 (-0.08 to 0.21)	0.02 (-0.07 to 0.12)	-0.03 (-0.09 to 0.03)
Maternal autonomy over the husband's earnings	-0.11* (-0.16 to -0.06)	-0.08* (-0.15 to -0.02)	-0.03 (-0.07 to 0.02)	-0.01 (-0.16 to 0.13)	-0.04 (-0.12 to 0.04)	0.01 (-0.03 to 0.05)
Awareness about family planning	0.27* (0.14 to 0.4)	0.04 (-0.15 to 0.22)	-0.25* (-0.36 to -0.14)	0.49* (0.21 to 0.78)	0.52* (0.15 to 0.88)	0.09 (-0.07 to 0.26)
Type of residence	-0.55 (-1.12 to 0.03)	-0.16 (-0.31 to 0)	-0.15* (-0.23 to -0.06)	-0.97* (-1.42 to -0.52)	-0.04 (-0.27 to 0.2)	-0.12 (-0.27 to 0.03)
Wealth quintile	0.15* (0.1 to 0.2)	0.14* (0.07 to 0.2)	0.23* (0.19 to 0.26)	-0.01 (-0.13 to 0.11)	0.25* (0.14 to 0.36)	0.34* (0.27 to 0.41)
Husband education	0.05* (0 to 0.1)	0.14* (0.06 to 0.23)	0 (-0.04 to 0.04)	-0.04 (-0.13 to 0.05)	0 (-0.11 to 0.11)	0.02 (-0.05 to 0.1)
Husband age	-0.01	0.21*	0.16*	-0.07	0.24*	0.12

at childbirth	(-0.11 to 0.1)	(0.08 to 0.34)	(0.07 to 0.26)	(-0.3 to 0.16)	(0.03 to 0.46)	(0 to 0.24)
Husband occupation	0.04 (-0.01 to 0.1)	-0.02 (-0.04 to 0.01)	0.01 (-0.01 to 0.03)	0 (0 to 0.01)	0.01 (-0.01 to 0.02)	0 (-0.01 to 0.02)

Notes: Level of significance for Gologit model: * Significant at 5 percent level; Coef, Coefficient; CI, Confidence interval

Source: Authors' calculations based on DHS survey data

2.4 Discussion

To the best of our knowledge, this is the first study to provide a comparative assessment of the association between socioeconomic and demographic factors and indicators of MHCSU across six South Asian countries using the latest DHS rounds in the respective countries. The study highlights several important factors affecting MHCSU in South Asia. First, South Asia is grappling with a dismally low women's workforce participation rate of 25%, coupled with fewer educational opportunities for women (World Bank, 2024). Second, it is disconcerting that only 50% of girls completed secondary education in South Asia, and a 41% gap exists between girls and boys in accessing mass media (UNICEF, 2023). In tandem with previous studies in Ethiopia (Tiruneh et al., 2017; Tadese et al., 2022) and Malawi (Khaki, 2019), we found that women who were educated, working, had decision-making autonomy, and were aware of family planning were more likely to avail MHCSU in South Asia. Kassahun and Zewdie (2022) vehemently argue that educated women are more likely to be employed, and these employed mothers are more inclined to access healthcare services due to their economic independence, greater awareness, and empowerment to make autonomous decisions regarding maternal healthcare (Yadav et al., 2020). Wood and colleagues (2022) contend that non-working women are often forced to rely on their partner's financial support to seek care, further discouraging MHCSU. Remarkably, one of the notable distinctions observed across South Asian countries is that working mothers had lower odds of receiving ANC in Afghanistan and delivery care in Bangladesh. This observation is consistent with the previous studies conducted in Nepal (DHS 2001 and 2006) (Mahara et al., 2015) and Bangladesh (DHS 2014) (Goldenberg & Stephenson, 2017). This may seem counterintuitive, but a plausible explanation could be that in low-income countries, employment may be poverty-induced, indicating resource constraints of the household, and thus, working mothers are less likely to use maternal health services (Gabrysch & Campbell, 2009). These findings imply a necessity for tailored interventions aimed at addressing the specific barriers faced by employed mothers in accessing maternal healthcare in these countries. Furthermore, it is imperative to underscore that, despite women being employed, decisions regarding their healthcare are predominantly taken by their husband alone in Afghanistan and Bangladesh, resulting in lower utilization of maternal healthcare services (Table 2.1). Addressing this requires strengthening the role of frontline health workers, such as midwives[1] in Afghanistan (Turkmani et al., 2013) and Shasthya Shebika and Shasthya Kormi[2] in Bangladesh (Joardar et al., 2021), who are culturally compatible and

[1] A midwife is a healthcare provider who deals with pregnancy, childbirth, newborn care and postpartum health (Turkmani et al., 2013).

[2] Shasthya Shebika educate families on nutrition, safe delivery, family planning, immunizations, hygiene, and water and sanitation, while Shasthya Kormi supervises Shasthya Shebika and provides services such as pregnancy confirmation, antenatal and postnatal care, detection of danger signs in mothers and children and referral, education about breast and

can provide vital support while improving MHCSU in these countries. This can be achieved by providing funding, training, logistical supplies, and satisfactory work environments, as frontline health workers are often inadequately compensated and face unrealistically broad roles and responsibilities (Turkmani et al., 2013; Joardar et al., 2021).

According to UNICEF, South Asia harbors 290 million child brides, constituting 45% of the global total (UNICEF, 2023). It is alarming that South Asia has one of the highest rates of adolescent pregnancy globally, with Bangladesh at 45%, followed by Nepal (21%) and India (21%) (Poudel et al., 2022). In line with a previous study conducted in Ethiopia (Negero et al., 2023), women of mature age at the time of first birth were more likely to receive ANC and delivery care. Negero and colleagues (2023) argue that adolescent mothers lack sufficient knowledge and are subjected to healthcare providers' judgmental attitudes, discouraging them from opting for maternal health services. In this regard, policymakers should aim at strict adherence to marriage age laws, prioritising comprehensive sex education, community sensitization, encouraging girls' school enrolment, and establishing adolescent- friendly health services at schools and healthcare centres to prevent adolescent pregnancies (Yakubu & Salisu, 2018). Furthermore, to improve MHCSU, the novel approach of the skilled health entrepreneurs programme implemented in the Sylhet district of Bangladesh (Curry et al., 2023), can be adapted for use in Afghanistan, India, Maldives, Nepal and Pakistan. This programme employs a public-private approach to develop and support a cadre of skilled birth attendants, transforming the relationship between women, delivery caregivers, and the broader healthcare delivery system (Curry et al., 2023). Additionally, we found that women who were mature (35–49 years) at childbirth were more likely to receive MHCSU in South Asia. This may happen because mature-aged women are emotionally or intellectually mature and have more experience, promoting their health-seeking behaviour (Negero et al., 2023). In contrast, women with higher childbirth orders were less likely to receive MHCSU in South Asia. Lagerberg and Magnusson (2013) argue that multiparous women receive less social support, such as babysitters and helpful grandparents, and are more stressed than first-time mothers.

The Fundamental Cause Theory, derived from Geoffrey Rose's Cause of Causes, emphasizes that socioeconomic deprivation significantly impacts health outcomes (Rose, 1985; Link & Phelan, 1995). Therefore, material deprivation, such as limited wealth and access to mass media, along with structural disadvantages like rural residence, restricted educational opportunities, and limited health infrastructure, significantly influence access to healthcare services among women belonging to lower socioeconomic strata. In this regard, we found that women who belonged to the wealthier households and had mass media exposure had higher odds of receiving MHCSU in South Asia. Household wealth reduces the cost of healthcare, medications, and transportation, encouraging MHCSU (Solanke et al., 2017; Tiruneh et al.,

cervical cancer, breast self-screening, and facilitation of referrals for women with gynaecological problems (Joardar et al., 2021).

2017). However, women who resided in rural areas were less likely to receive adequate ANC. There are various financial incentive schemes, such as the Safe Delivery Incentive Programme in Nepal (Powell-Jackson & Hanson, 2012), Janani Suraksha Yojana in India (Gopalan & Durairaj, 2012), performance-based incentive schemes and Vouchers, demand-side financing instruments in Bangladesh (Rob & Alam, 2014; Talukder et al., 2014) and Afya credits incentive in Kenya (Vanhuyse et al., 2022), which have significantly improved MHCSU. In contrast, the cessation of international funding for the Sehatmandi project in 2021 – a financial incentive scheme that provides approximately 75% of primary and secondary health services in Afghanistan led to a 59% decline in MHCSU (Safi et al., 2023; Hamdana et al., 2023). Furthermore, it is projected to lead to an estimated 4.8 million unattended pregnancies and 51,000 maternal deaths between 2021 and 2025 (Safi et al., 2023; Hamdana et al., 2023). Therefore, to encourage women to uptake MHCSU and reduce preventable maternal mortality, it is imperative to implement financial incentive schemes, along with encouragement towards universal health coverage (Herwansyah et al., 2022), backed by global financial aid, especially targeting women residing in rural areas or those from the lower socio-economic strata. Additionally, exposure to mass media facilitates access to critical health information and promotes informed decision-making. However, it is perturbing that 201 million women still lack access to mobile phone technology in South Asia, with Afghanistan and Pakistan having the largest gender digital divide (UNICEF, 2023). Hence, it is overdue to address barriers to mass media access, including affordability, lack of literacy and digital skills, social norms such as family disapproval, and the perception of the internet as an unsafe space (UNICEF, 2023). Coleman and colleagues (2017) contend that the Mobile Alliance for Maternal Action or MAMA (a package of e- health communication) that disseminates culturally sensitive maternal health- care information via SMS messaging, interactive websites, voicemails and MXit (a popular social media platform) has significantly improved MHCSU in South Africa. Consequently, the use of e-health communication can be extended to South Asian countries to promote MHCSU. However, it is worth mentioning that, in Afghanistan, women who listened to the radio had lower odds of ANC and PNC. This finding is intriguing, and warrants further investigation. A plausible explanation for this finding could be cultural influences, less perceived necessity for ANC and PNC and lower decision- making authority among mothers.

Another noteworthy contribution of the study is that it highlights the role of partners' education, age, and profession as important determinants of whether a woman avails maternal health services or not. In tandem with the previous studies conducted in Ethiopia (Tiruneh et al., 2017; Adane et al., 2020) and Malawi (Khaki, 2019), our study found that a woman whose husband was educated and mature (aged 35–49 years) at the time of childbirth was more likely to avail MHCSU in South Asia. Adane and colleagues (2020) contend that an educated and mature- aged husband has better socioeconomic status and awareness and encourages health- seeking behaviour. The existing empirical evidence on these associations is limited,

highlighting the need for further research. The WHO recommends men's involvement during pregnancy, childbirth, and postnatal care to facilitate and improve maternal health outcomes (WHO, 2015). However, Suandi and colleagues (2019) contend that husbands' involvement in MHCSU is limited in South Asia due to the region's patriarchal social structure. Numerous scholars have confirmed the abysmally low involvement and knowledge of husbands in maternal healthcare in Bangladesh (Rahman, et al., 2018) Nepal (Sharma et al., 2020), Pakistan (Nohri et al., 2022), India (Chattopadhyay & Govil, 2020), and Afghanistan (Alemi et al., 2020), demanding immediate policy attention. Policymakers can learn from program such as Suami SIAGA (Alert Husband) campaign, initiated in 1998 in Indonesia, which has significantly boosted MHCSU (Kurniati et al., 2017). It aims to promote male participation by educating men about the importance of their support during prenatal care, facilitating safe childbirth, and ensuring access to healthcare (Kurniati et al., 2017). A similar scheme is warranted in Bangladesh, Nepal, Pakistan, India, and Afghanistan to instil paternal responsibility and enhance husbands' active participation in maternal healthcare services and thereby boost maternal and child health.

2.5 Limitations of the study

The results of this study must be viewed in the light of a few limitations. First, we were unable to study the quality of MHCSU, including the skill level or the quality of care provided by healthcare providers, which can significantly impact maternal health (Singh et al., 2015). Secondly, there is a possibility that respondents may have overreported their use of MHCSU to please the interviewer (Rahman et al., 2010). Thirdly, our findings are susceptible to recall bias, information bias, underreporting and social desirability bias, as DHS data is collected retro- respectively and is self-reported (Komakech et al., 2022). Lastly, the study used cross-sectional data, which precludes us from making casual inferences (Kang et al., 2024).

2.6 Conclusion and policy recommendations

In summary, we found that women who were educated, mature (35–49 years) at the time of childbirth, employed, belonged to wealthier households, and had mass media exposure were more likely to utilize maternal health care services. Conversely, mothers with higher childbirth orders and who lacked decision-making autonomy were less likely to opt for MHCSU in South Asia. Furthermore, our study highlighted the disparities in MHCSU and associated factors among the selected South Asian nations. Firstly, working mothers exhibited lower odds of ANC and delivery care in Bangladesh because, despite being employed, decisions regarding their healthcare were predominantly made by their husband. Secondly, in Afghanistan, mothers who listened to the radio were less likely to receive ANC and PNC, which might be

due to cultural influences and lower decision-making authority among mothers. To achieve Sustainable Development Goal 3.1 of reducing maternal deaths to 70 per 100,000 live births by 2030, policymakers must implement a multi-pronged strategy to improve maternal health in South Asia. This includes conducting regular health education sessions in regional languages, providing financial incentives to promote MHCSU, establishing adolescent- friendly health services, and enhancing e-health communication. Additionally, initiatives aimed at enhancing maternal education, financial independence, decision-making power, psychological and emotional support from partners, and exposure to mass media are imperative. Future research could explore the impact of the education level of in-laws and the skill level or the quality of care provided by healthcare providers on maternal healthcare services in South Asia.

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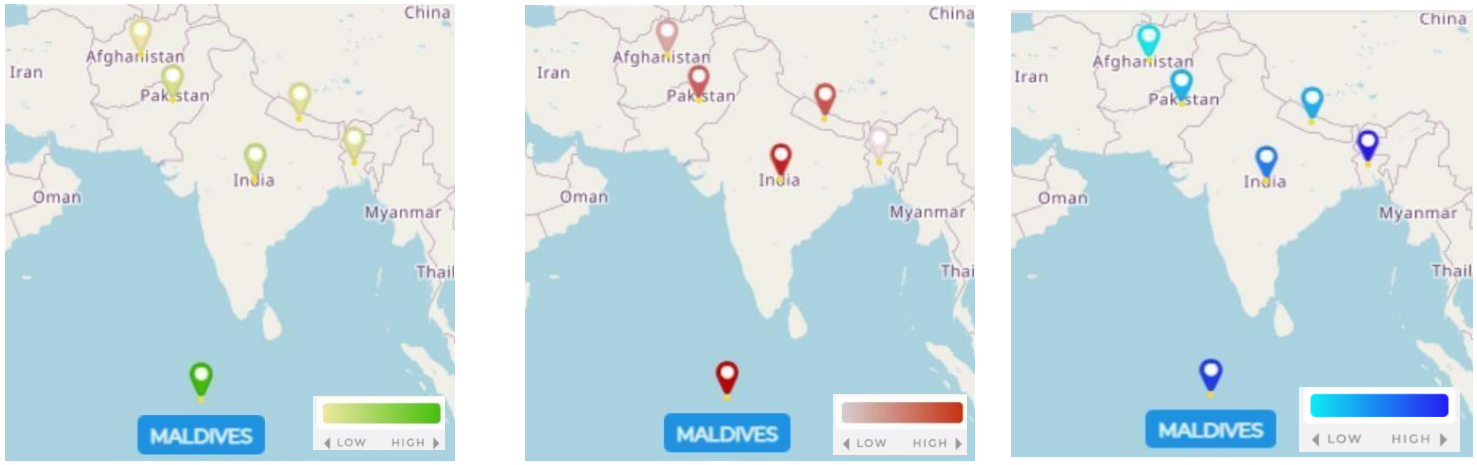
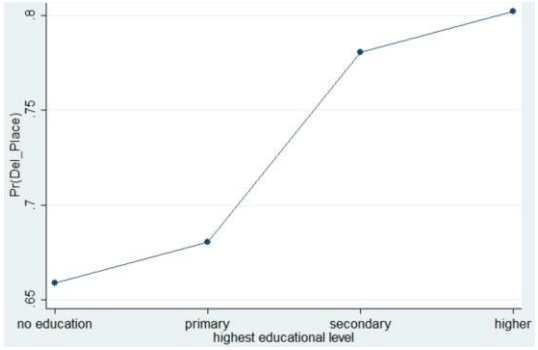
2.8 Appendix



(a) Standard ANC (b) Delivery Care (c) PNC

Supplementary Fig. I.1 The geographical variation in the prevalence of ANC, Delivery Care and PNC in Afghanistan (2015), Bangladesh (2017-2018), India (2019-21), Maldives (2016-17), Nepal (2022) and Pakistan (2017-2018)

Source: Authors' calculations based on DHS survey data



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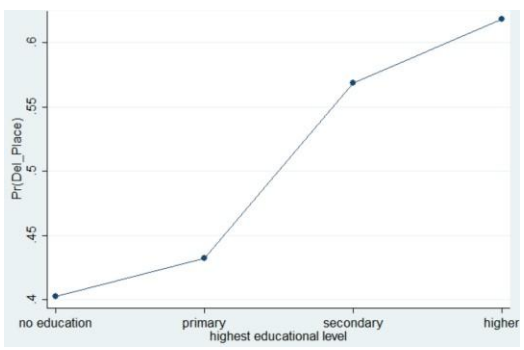

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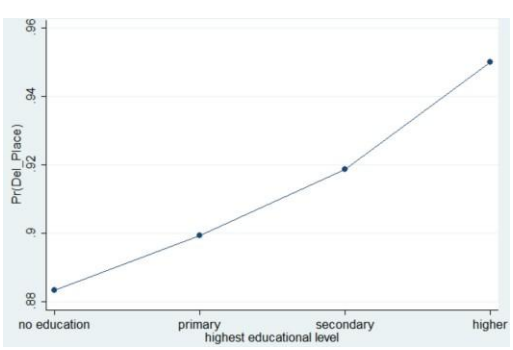
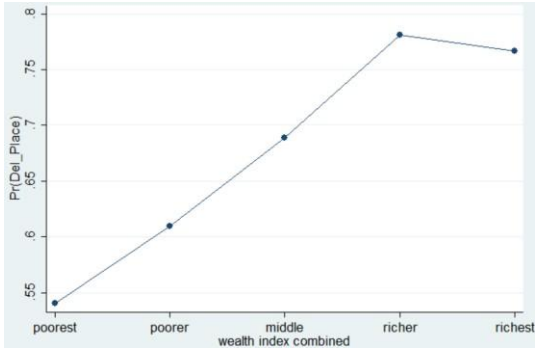
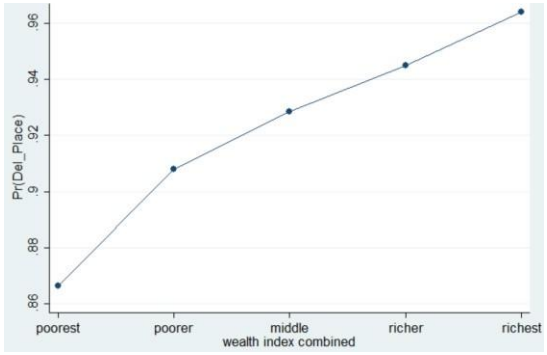


(c) India

Fig I.2a. Association between maternal educational attainment and delivery care in South Asia



(a) Afghanistan



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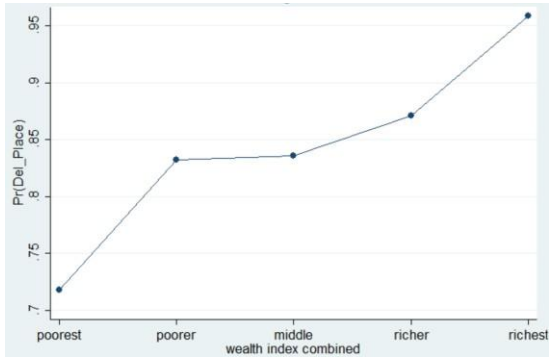
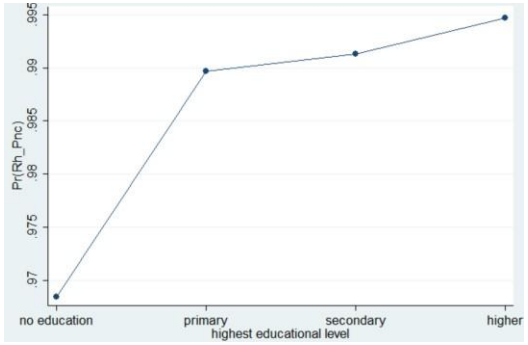


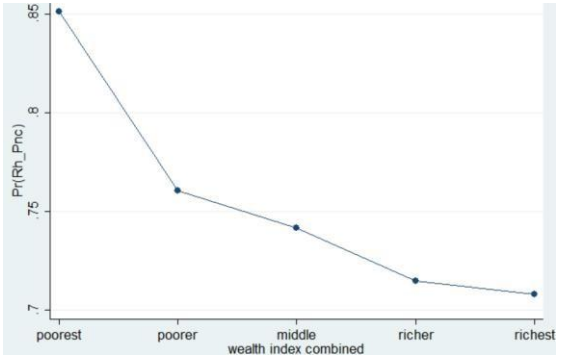
(c) Nepal

Fig I.2b. Association between household wealth and delivery care in South Asia

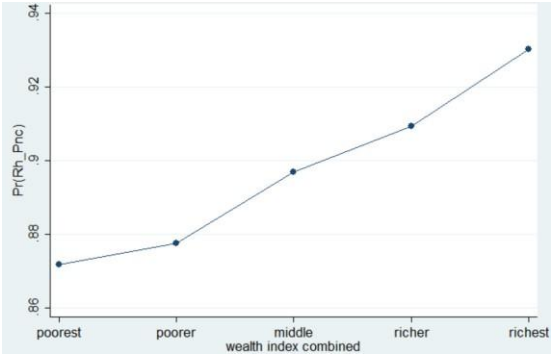


(a) Bangladesh

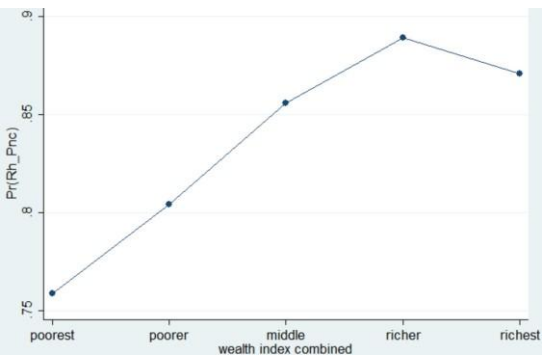
Fig I.2c. Association between maternal educational attainment and PNC in South Asia



(a) Afghanistan



(b) India



(c) Nepal

Fig I.2d. Association between household wealth and PNC in South Asia

Supplementary Fig. I.2 Impact of socio-economic and demographic factors on delivery care and PNC in Afghanistan (2015), Bangladesh (2017-2018), India (2019-21), Maldives (2016-17), Nepal (2022) and Pakistan (2017-2018)
Source: Authors' calculations based on DHS survey data

Supplementary Table I.3. Chi-square statistic test for parallel lines assumption in a generalized ordered logit model

Countries	Afghanistan	Bangladesh	India	Maldives	Nepal	Pakistan
LR chi^2	48.26	22.41	91.91	30.54	22.51	24.94
P > chi^2	0.00	0.13	0.00	0.02	0.13	0.07

Note. P-value < 0.05 shows that the parallel lines assumption is violated, LR-test; Likelihood Ratio test

Source: Authors' calculations based on DHS survey data

Supplementary Table I.4. Validity of the statistical models

Results of Likelihood-ratio test

I.4a. Standard ANC

Countries	Afghanistan	Bangladesh	India	Maldives	Nepal	Pakistan
LR chi^2	215.78	432.91	1293.65	95.95	202.88	728.05
P > chi^2	0.00	0.00	0.00	0.00	0.00	0.00

Note. P-value < 0.05 indicates that the model is a significantly better-fit model

Results of Hosmer-Lemeshow test

I.4b. Delivery care

Countries	Afghanistan	Bangladesh	India	Maldives	Nepal	Pakistan
Hosmer-Lemeshow chi^2	7.98	5.73	10.22	8.01	6.34	7.46
P > chi^2	0.44	0.68	0.25	0.42	0.38	0.49

Note. P-value > 0.05 shows that the model is correctly specified

I.4c. PNC

Countries	Afghanistan	Bangladesh	India	Maldives	Nepal	Pakistan
Hosmer-Lemeshow chi^2	8.00	1.62	6.40	5.89	7.87	7.95
P > chi^2	0.43	0.99	0.60	0.69	0.45	0.44

Note. P-value > 0.05 shows that the model is correctly specified

Source: Authors' calculations based on DHS survey data

Supplementary Table I.5. Multivariate logistic regressions for analysing the impact of socio-economic and demographic factors on delivery care using DHS rounds conducted in Afghanistan (2015), Bangladesh (2017-2018), India (2019-21), Maldives (2016-17), Nepal (2022) and Pakistan (2017-2018)

Delivery Care	Afghanistan	Bangladesh	India	Maldives	Nepal	Pakistan
	OR;CI (95%)	OR;CI (95%)	OR;CI (95%)	OR;CI (95%)	OR;CI (95%)	OR; CI (95%)
Maternal age at childbirth						
14-24 (ref.)						
25-34	1.01 (0.72 to 1.43)	1.03 (0.8 to 1.32)	0.86 (0.71 to 1.04)	0.97 (0.83 to 1.12)	1.41 (0.97 to 2.05)	1.08 (0.77 to 1.51)
35-49	1.55 (1 to 2.4)	1.28 (0.73 to 2.24)	0.99 (0.69 to 1.43)	0.89 (0.68 to 1.16)	1.64 (0.68 to 3.98)	1.25 (0.7 to 2.24)
Maternal education						

No education (ref.)						
Primary	1.24 (0.88 to 1.75)	0.93 (0.57 to 1.53)	1.46* (1.18 to 1.8)	0.91 (0.79 to 1.04)	1.25 (0.89 to 1.76)	0.9 (0.62 to 1.31)
Secondary	2.41* (1.48 to 3.91)	1.81* (1.12 to 2.92)	1.91* (1.56 to 2.34)	0.97 (0.91 to 1.15)	1.98* (1.26 to 3.1)	1.11 (0.74 to 1.66)
Higher	3.16* (2.26 to 4.93)	2.32* (1.36 to 3.95)	3.59* (2.35 to 5.47)	0.98 (0.76 to 1.27)	1.3 (0.5 to 2.03)	2.67* (1.48 to 4.82)
Mother currently working						
No (ref.)						
Yes	0.9 (0.65 to 1.24)	0.74* (0.61 to 0.91)	0.95 (0.8 to 1.13)	0.8 (0.02 to 1.13)	1.05 (0.79 to 1.4)	0.82 (0.54 to 1.24)
Age of respondent at 1st birth						
<15 (ref.)						
15-24	0.85 (0.56 to 1.28)	1.17 (0.78 to 1.75)	1.03 (0.57 to 1.88)	0.61 (0.31 to 1.19)	0.53 (0.17 to 1.67)	0.65 (0.28 to 1.51)
25-34	1.02 (0.60 to 1.76)	2.3* (1.25 to 4.24)	1.35 (0.71 to 2.59)	0.84 (0.41 to 1.74)	0.84 (0.22 to 3.21)	0.96 (0.38 to 2.4)
35-49	0.39 (0.06 to 2.63)	1 (0.8 to 3.4)	1.65 (1.05 to 20.67)	0.67 (0.15 to 3.03)	0.99 (0.35 to 4.32)	0.7 (0.14 to 3.47)

Childbirth order						
First born (ref.)						
2nd- 4th born	0.6* (0.44 to 0.8)	0.59* (0.46 to 0.75)	0.48* (0.39 to 0.58)	0.07 (0 to 1.02)	0.33* (0.24 to 0.45)	0.66* (0.45 to 0.97)
5th or higher birth order	0.46* (0.3 to 0.7)	0.22* (0.11 to 0.42)	0.3* (0.22 to 0.41)	0.16 (0.05 to 0.58)	0.27* (0.14 to 0.51)	0.44* (0.27 to 0.72)
Mother reads newspaper						
Not at all (ref.)						
Less than once a week	0.46 (0.21 to 1.01)	0.9 (0.63 to 1.29)	1.07 (0.82 to 1.4)	0.7 (0.57 to 0.97)	1.18 (0.8 to 1.75)	1.05 (0.64 to 1.71)
At least once a week	0.67 (0.3 to 1.48)	0.89 (0.51 to 1.55)	1.73* (1.16 to 2.57)	0.99 (0.66 to 1.47)	3.49 (0.84 to 14.48)	2.03 (1.94 to 3.39)
Mother listens to radio						
Not at all (ref.)						
Less than once a week	1.36* (1.01 to 1.83)	1.3 (0.81 to 2.09)	0.71 (0.55 to 1.03)	0.94 (0.57 to 1.53)	1.08 (0.78 to 1.49)	0.95 (0.51 to 1.78)
At least once a week	1.63* (1.23 to 2.18)	1.04 (0.61 to 1.77)	0.97 (0.61 to 1.55)	0.87 (0.57 to 1.35)	1.5* (1.03 to 2.19)	0.93 (0.48 to 1.8)
Mother watches TV						

Not at all (ref.)						
Less than once a week	1.28 (0.96 to 1.7)	1.23 (0.87 to 1.74)	1.31* (1.07 to 1.6)	1.25 (0.94 to 1.67)	0.77 (0.52 to 1.14)	1.58 (0.97 to 2.56)
At least once a week	1.49* (1.15 to 1.92)	1.49* (1.17 to 1.9)	1.56* (1.27 to 1.93)	1.11 (0.88 to 1.39)	0.82 (0.56 to 1.21)	1.2 (0.89 to 1.61)
Maternal autonomy in managing one's own healthcare						
Mother alone (ref.)						
mother and partner	0.91 (0.6 to 1.39)	0.77 (0.53 to 1.13)	0.95 (0.7 to 1.29)	0.97 (0.66 to 1.43)	1.02 (0.7 to 1.48)	0.87 (0.46 to 1.66)
husband/partner alone	1.11 (0.73 to 1.69)	0.67 (0.44 to 1.02)	1.04 (0.74 to 1.44)	0.77 (0.51 to 1.16)	0.85 (0.55 to 1.29)	0.79 (0.41 to 1.5)
someone else	1.42 (0.74 to 2.75)	0.76 (0.45 to 1.28)	1.29 (0.63 to 2.64)	0.79 (0.47 to 1.31)	0.88 (0.56 to 1.38)	0.53 (0.26 to 1.06)
Maternal autonomy over the husband's earnings						
Mother alone (ref.)						
mother and partner	0.95 (0.41 to 2.22)	0.67 (0.36 to 1.26)	0.93 (0.64 to 1.34)	0.79 (0.44 to 1.44)	1.01 (0.6 to 1.67)	0.72 (0.36 to 1.47)
husband/partner alone	0.73 (0.34 to	0.63 (0.33 to	0.96 (0.65 to	0.71 (0.4 to	0.9 (0.53 to	0.61 (0.31 to 1.2)

	1.58)	1.21)	1.42)	1.28)	1.54)	
someone else	0.79 (0.32 to 1.98)	0.77 (0.36 to 1.61)	0.87 (0.38 to 2.01)	0.83 (0.31 to 2.28)	0.67 (0.36 to 1.25)	0.66 (0.16 to 2.72)
Awareness about family planning						
No (ref.)						
yes	1.02 (0.77 to 1.34)	1.02 (0.79 to 1.32)	1.27* (1.08 to 1.51)	1 (0.8 to 1.24)	1.02 (0.7 to 1.49)	1.31 (0.92 to 1.86)
Type of residence						
Urban (ref.)						
Rural	0.66 (0.41 to 1.06)	0.84 (0.66 to 1.07)	0.9 (0.7 to 1.16)	0.88 (0.74 to 1.04)	1.16 (0.85 to 1.57)	1.01 (0.71 to 1.44)
Wealth quintile						
Poorest (ref.)						
Poorer	1.45* (1.05 to 2)	1.08 (0.79 to 1.49)	1.88* (1.58 to 2.26)	2.04* (1.5 to 2.78)	2.06* (1.46 to 2.89)	1.01 (0.67 to 1.51)
Middle	2.14* (1.52 to 3)	1.32 (0.96 to 1.83)	2.06* (1.63 to 2.59)	2.5* (1.77 to 3.55)	2.37* (1.64 to 3.43)	1.43 (0.93 to 2.22)
Richer	2.76*	1.59*	2.67*	1.17	3.07*	2.2*

	(1.6 to 3.44)	(1.13 to 2.23)	(1.91 to 3.72)	(0.92 to 1.49)	(2.04 to 4.57)	(1.26 to 3.83)
Richest	3.01* (2.13 to 4.51)	2.72* (1.82 to 4.07)	3.74* (2.43 to 5.76)	1.11 (0.75 to 1.64)	3.16* (2.13 to 4.74)	3.22* (1.65 to 3.57)
Paternal education						
No education (ref.)						
Primary	1.23 (0.86 to 1.75)	0.73* (0.54 to 0.99)	1.05 (0.84 to 1.31)	1.07 (0.9 to 1.27)	1.58* (1.08 to 2.32)	0.74 (0.5 to 1.1)
Secondary	1.39* (1.08 to 1.79)	0.95 (0.69 to 1.31)	1.17 (0.96 to 1.42)	1 (0.8 to 1.24)	1.84* (1.21 to 2.8)	0.93 (0.67 to 1.29)
Higher	1.35 (0.92 to 1.98)	1.55* (1.04 to 2.29)	1.29 (0.92 to 1.82)	1.01 (0.87 to 1.18)	1.45 (0.68 to 3.12)	1.34 (0.86 to 2.06)
Husband age at childbirth						
11-24 (ref.)						
25-34	1.13 (0.81 to 1.57)	1.22 (0.92 to 1.61)	1.42* (1.14 to 1.77)	1.11 (0.79 to 1.54)	1.09 (0.77 to 1.53)	0.74 (0.46 to 1.18)
35-49	1.05 (0.7 to 1.56)	1.58* (1.11 to 2.24)	1.42* (1.07 to 1.89)	0.92 (0.58 to 1.45)	1.05 (0.6 to 1.82)	0.71 (0.42 to 1.22)
Above 50	1.01	1.66	0.94	0.63	0.49	0.91

	(0.61 to 1.67)	(0.63 to 4.37)	(0.43 to 2.06)	(0.23 to 1.73)	(0.11 to 2.3)	(0.38 to 2.18)
Husband occupation						
Professional/ technical/ managerial (ref.)						
Agricultural	0.85 (0.62 to 1.17)	0.91 (0.59 to 1.4)	0.94 (0.64 to 1.38)	0.93 (0.68 to 1.27)	1.16 (0.6 to 2.27)	0.84 (0.51 to 1.4)
Skilled and unskilled manual	1.08 (0.84 to 1.39)	0.86 (0.59 to 1.25)	1.05 (0.73 to 1.52)	1.02 (0.74 to 1.39)	1.38 (0.74 to 2.55)	0.85 (0.54 to 1.35)
Others	1.14 (0.82 to 1.59)	1.19 (0.81 to 1.75)	0.99 (0.68 to 1.44)	1.18 (0.95 to 1.48)	1.38 (0.7 to 2.71)	0.98 (0.6 to 1.61)

Notes: Level of significance for logistic model: *** Significant at 1 percent level; ** Significant at 5 percent level; * Significant at 10 percent level; OR, Odds ratio; CI, Confidence interval

Source: Authors' calculations based on DHS survey data

Supplementary Table I.6. Multivariate logistic regressions for analysing the impact of socio-economic and demographic factors on postnatal care using DHS rounds conducted in Afghanistan (2015), Bangladesh (2017-2018), India (2019-21), Maldives (2016-17), Nepal (2022) and Pakistan (2017-2018)

Postnatal care	Afghanistan	Bangladesh	India	Maldives	Nepal	Pakistan
	OR; CI	OR; CI	OR; CI	OR; CI	OR; CI	OR; CI

	(95%)	(95%)	(95%)	(95%)	(95%)	(95%)
Maternal age at childbirth						
14-24 (ref.)						
25-34	1.68* (1.11 to 2.53)	1.05 (0.76 to 1.46)	1.36 (1.14 to 1.62)	1.31 (0.78 to 2.21)	0.98 (0.65 to 1.48)	1.49 (0.99 to 2.23)
35-49	2.57* (1.47 to 4.49)	1.04 (0.5 to 2.15)	1.36 (0.89 to 2.06)	1.39 (0.62 to 3.14)	0.42 (0.15 to 1.15)	1.55 (0.82 to 2.94)
Maternal education						
No education (ref.)						
Primary	1.61 (0.97 to 1.78)	1.87* (1.57 to 2.12)	1 (0.79 to 1.28)	1.21 (0.42 to 3.46)	0.79 (0.51 to 1.24)	1.06 (0.67 to 1.68)
Secondary	1.45 (0.84 to 2.51)	2.95* (1.15 to 3.02)	0.9 (0.72 to 1.12)	1.08 (0.38 to 3.08)	0.87 (0.54 to 1.41)	1.23 (0.79 to 1.9)
Higher	2.11 (0.7 to 6.37)	7.68 (0.93 to 10.69)	0.96 (0.7 to 1.31)	1.64 (0.5 to 4.35)	0.94 (0.37 to 2.37)	0.8 (0.41 to 1.57)
Mother currently working						
No (ref.)						
Yes	1.34 (0.87 to	1.17 (0.41 to 3.3)	1.42* (1.17 to	1.83* (1.23 to	0.98 (0.73 to	1.57 (0.93 to

	2.06)		1.73)	2.72)	1.31)	2.65)
Age of respondent at 1st birth						
<15 (ref.)						
15-24	1.6 (0.9 to 2.84)	1.4 (0.83 to 2.38)	1.34 (0.67 to 1.69)	1.1 (0.2 to 2.32)	0.74 (0.22 to 2.41)	1.51 (0.64 to 3.53)
25-34	1.29 (0.58 to 2.83)	1.33 (0.75 to 2.36)	1.32 (0.63 to 1.78)	1.9 (0.41 to 2.8)	1.69 (0.44 to 6.49)	1.4 (0.56 to 3.49)
35-49	0.81 (0.05 to 2.52)	1.19 (0.03 to 3.52)	1.16 (0.86 to 1.58)	2.04 (0.45 to 3.28)	1.1 (0.34 to 3.78)	0.66 (0.31 to 1.4)
Childbirth order						
First born (ref.)						
2^{nd}- 4^{th} born	0.86 (0.53 to 1.39)	1.19 (0.31 to 3.47)	0.92 (0.78 to 1.08)	0.87 (0.55 to 1.39)	1.01 (0.69 to 1.46)	0.84 (0.58 to 1.23)
5^{th} or higher birth order	0.62 (0.31 to 1.24)	0.22 (0.02 to 2.01)	0.65* (0.45 to 0.93)	1.52 (0.52 to 4.48)	0.73 (0.29 to 1.82)	0.47* (0.28 to 0.79)
Mother reads newspaper						
Not at all (ref.)						
Less than once a week	0.63 (0.3 to 1.34)	1.08 (0.96 to	1.07 (0.89 to	0.91 (0.58 to	1.2 (0.78 to	0.98 (0.57 to

		1.22)	1.28)	1.43)	1.87)	1.69)
At least once a week	0.62 (0.15 to 2.53)	1.14 (0.97 to 1.34)	1.03 (0.8 to 1.33)	1.05 (0.7 to 1.58)	1.38 (0.7 to 2.69)	1.5 (0.75 to 3.01)
Mother listens to radio						
Not at all (ref.)						
Less than once a week	0.47* (0.32 to 0.68)	0.52 (0.23 to 1.21)	0.88 (0.7 to 1.11)	0.84 (0.56 to 1.26)	1.75* (1.24 to 2.48)	0.79 (0.37 to 1.69)
At least once a week	0.69* (0.5 to 0.94)	0.97 (0.49 to 1.94)	1.03 (0.73 to 1.45)	1.62* (1.1 to 2.39)	1.91* (1.36 to 2.69)	2.22* (1.09 to 4.54)
Mother watches TV						
Not at all (ref.)						
Less than once a week	1 (0.67 to 1.49)	1 (0.72 to 1.38)	1.21* (1 to 1.46)	0.52 (0.23 to 1.18)	1.1 (0.75 to 1.62)	1.19 (0.68 to 2.06)
At least once a week	1.21 (0.88 to 1.66)	0.92 (0.67 to 1.26)	1.62* (1.32 to 1.99)	0.86 (0.41 to 1.79)	0.94 (0.63 to 1.4)	1.01 (0.68 to 1.5)
Maternal autonomy in managing one's own healthcare						
Mother alone (ref.)						
mother and	0.36	1.07	1	0.49*	0.72	1.86

partner	(0.11 to 1.22)	(0.22 to 5.27)	(0.76 to 1.33)	(0.29 to 0.8)	(0.5 to 1.06)	(0.93 to 3.36)
husband/partner alone	0.36 (0.13 to 0.99)	0.52 (0.1 to 2.74)	0.99 (0.74 to 1.33)	0.65 (0.33 to 1.28)	0.78 (0.5 to 1.23)	1 (0.59 to 1.71)
someone else	0.21* (0.05 to 0.89)	0.03 (0 to 1.1)	1.41 (0.79 to 2.52)	1.03 (0.72 to 2.04)	0.71 (0.4 to 1.25)	0.85 (0.41 to 1.76)
Maternal autonomy over the husband's earnings						
Mother alone (ref.)						
mother and partner	1.73 (0.95 to 3.21)	1.05 (0.68 to 1.61)	1.23 (0.88 to 1.73)	1.44 (0.7 to 2.96)	1.69 (0.98 to 2.9)	0.97 (0.47 to 1.99)
husband/partner alone	1.84 (0.72 to 3.71)	0.83 (0.55 to 1.26)	0.95 (0.67 to 1.35)	0.35* (0.16 to 0.74)	1.75 (0.97 to 3.14)	0.88 (0.45 to 1.7)
someone else	3.55 (0.98 to 4.62)	0.27 (0 to 4.63)	1.21 (0.65 to 2.25)	0.89 (0.23 to 1.44)	0.93 (0.45 to 1.92)	0.84 (0.3 to 2.36)
Awareness about family planning						
No (ref.)						
yes	2.21*	1.71	1.1	0.76	1.76*	1.84*

	(1.5 to 3.24)	(0.4 to 7.35)	(0.93 to 1.29)	(0.5 to 1.14)	(1.08 to 2.89)	(1.22 to 2.79)
Type of residence						
Urban (ref.)						
Rural	1.13 (0.76 to 1.68)	1.88 (0.64 to 3.51)	1.06 (0.86 to 1.3)	0.54 (0.2 to 1.42)	0.91 (0.66 to 1.26)	0.99 (0.66 to 1.48)
Wealth quintile						
Poorest (ref.)						
Poorer	0.83 (0.52 to 1.33)	0.85 (0.51 to 1.43)	1.07 (0.88 to 1.29)	0.94 (0.62 to 1.44)	1.16 (0.76 to 1.77)	0.78 (0.45 to 1.35)
Middle	0.52* (0.33 to 0.81)	0.89 (0.52 to 1.53)	1.53* (1.23 to 1.91)	0.9 (0.58 to 1.38)	2.01* (1.26 to 3.2)	0.58 (0.32 to 1.05)
Richer	0.35* (0.21 to 0.57)	0.78 (0.38 to 1.61)	1.69* (1.32 to 2.17)	0.89 (0.47 to 1.68)	2.34* (1.41 to 3.9)	0.93 (0.49 to 1.78)
Richest	0.32* (0.18 to 0.55)	0.62 (0.24 to 1.55)	2.25* (1.64 to 3.07)	0.81 (0.21 to 3.11)	2.15* (1.19 to 3.9)	1.75 (0.86 to 3.56)
Paternal education						
No education (ref.)						
Primary	1.08	1.45*	0.96	2.16	1.22	1.07

	(0.62 to 1.89)	(1.17 to 1.79)	(0.74 to 1.24)	(1.02 to 3.21)	(0.76 to 1.96)	(0.69 to 1.65)
Secondary	1.49* (1.12 to 1.98)	3.31 (0.68 to 16.19)	1.12 (0.91 to 1.39)	2.51* (1.13 to 3.61)	1.09 (0.66 to 1.81)	1.61* (1.1 to 2.34)
Higher	1.68 (0.92 to 3.08)	1.89 (0.23 to 15.75)	1.16 (0.86 to 1.56)	2.93* (1.51 to 3.74)	1.16 (0.53 to 2.54)	1.41 (0.87 to 2.3)
Husband age at childbirth						
11-24 (ref.)						
25-34	0.92 (0.6 to 1.41)	0.87 (0.19 to 3.98)	1.13 (0.93 to 1.36)	0.4 (0.14 to 1.19)	0.92 (0.63 to 1.35)	1.25 (0.78 to 2)
35-49	0.56 (0.28 to 1.12)	1.08 (0.93 to 1.25)	0.94 (0.71 to 1.23)	0.32 (0.1 to 1.01)	1.19 (0.62 to 2.28)	1.28 (0.71 to 2.3)
Above 50	0.55 (0.24 to 1.25)	0.49 (0.1 to 2.36)	0.89 (0.43 to 1.87)	0.67 (0.13 to 3.42)	1 (0.28 to 3.54)	0.92 (0.32 to 2.58)
Husband occupation						
Professional/ technical/ managerial (ref.)						
Agricultural	1.55 (0.98 to 2.43)	1.11 (0.83 to 1.5)	1.28 (0.95 to 1.72)	1.17 (0.64 to 2.14)	0.91 (0.5 to 1.64)	0.83 (0.49 to 1.4)
Skilled and	1.26	1.21	1.29	1.01	0.95	1.05

unskilled manual	(0.86 to 1.85)	(0.86 to 1.71)	(0.97 to 1.73)	(0.61 to 1.66)	(0.54 to 1.67)	(0.66 to 1.66)
Others	1.52 (0.99 to 2.33)	0.95 (0.57 to 1.59)	1.06 (0.81 to 1.39)	0.39* (0.25 to 0.6)	1.15 (0.65 to 2.02)	0.94 (0.55 to 1.6)

Notes: Level of significance for logistic model: *** Significant at 1 percent level; ** Significant at 5 percent level; * Significant at 10 percent level; OR, Odds ratio; CI, Confidence interval; ref.: Reference category of the variable

Source: Authors' calculations based on DHS survey data

CHAPTER 3

CONCOMITANT FACTORS INFLUENCING BREASTFEEDING PRACTICES IN INDIA: EVIDENCE FROM DEMOGRAPHIC AND HEALTH SURVEY 2019-21

3.1 Introduction

The late pediatrician Bo Vahlquist emphatically stated, "In all mammalian species, the reproductive cycle comprises both pregnancy and breast-feeding: in the absence of the latter, none of these species, man included, could have survived" (WHO, 1981). Mother's milk benefits a child's immunity, growth, and survival through its effects on microRNAs and epigenetic changes (Lawrence, 2022). Rich in essential nutrients like vitamins, proteins, antibodies, hormones, growth factors, and enzymes, it protects against various pathologies, including cholera, respiratory infections, and sepsis (Lawrence, 2022). Colostrum provides natural immunity with immunoglobulins and other bioactive molecules essential for a child's nutritional needs and healthy growth (Godhia & Patel, 2013).

Breastfeeding is integral to achieving several United Nations Sustainable Development Goals (SDGs), such as eliminating hunger (SDG 2), ensuring healthy lives and preventing non-communicable diseases like breast cancer and diabetes (SDG 3), reducing poverty through higher educational attainment and income potential (SDG 1), fostering inclusive economic growth (SDG 8), and reducing inequalities (SDG 10) (United Nations, 2023). Numerous studies have confirmed that children who were breastfed for longer durations have lower odds of diarrhoea and respiratory infections (Victora et al., 2016), leukemia (Amitay & Keinan-Boker, 2015), dental malocclusions (Peres et al., 2015), overweight and obesity (Anderson et al., 2020), systolic blood pressure, type 2 diabetes (Horta et al., 2015), and better neurocognitive functions (Ogbo et al., 2018) compared to those who were breastfed for shorter durations or not at all. Victora et al. (2015) argue that prolonged breastfeeding increases a child's IQ, leading to higher educational attainment and greater earning potential. At the global level, breastfeeding can save 823,000 child deaths (under 5 years) annually (Victora et al., 2016). Moreover, not breastfeeding is associated with a global income loss of US$302 billion annually (Rollins et al., 2016). Prolonged breastfeeding also offers numerous benefits to mothers, including lower risks of breast and ovarian cancers (Victora et al., 2016), more rapid postpartum weight loss (Bobrow et al., 2012),

reduced postpartum blood loss, decreased cardiovascular disease risk, and lower maternal anemia risk (Hatsu et al., 2008; Sattari et al., 2019). Victora et al. (2016) suggest that extended breastfeeding duration can prevent an estimated 20,000 maternal breast cancer deaths annually, highlighting its critical importance.

Despite these benefits, only 1 in 5 newborns in India receive breast milk within the first hour of birth (UNICEF, 2022), even though almost 90% of births occur in healthcare facilities (NFHS-5, 2022). In India, only 64% of children under six months are exclusively breastfed, lower than in other developing South Asian countries such as Sri Lanka (82%) (Torlesse & Raju, 2018) and Nepal (71%) (USAID, 2021). Moreover, breastfeeding rates in India fall short of the global target of 70% by 2030 (UNICEF & WHO, 2023). Despite improvements in child mortality achieved in the Millennium Development Goal era, malnutrition among children remains alarmingly high in India, which has the highest prevalence of wasted children at 19.3% - a strong predictor of mortality (Economic Times, 2022). India ranked 111th out of 125 in the 2023 Global Hunger Index, indicating a severe level of hunger (Concern Worldwide & Welthungerhilfe, 2023). Empirical evidence also confirms that optimal breastfeeding lowers the prevalence of stunting and underweight in India (Koya et al., 2020; Chakrabarti et al., 2021), Bangladesh (Khan & Islam, 2017), Indonesia (Lestari et al., 2018), and the Democratic Republic of Congo (Luzingu et al., 2022). Therefore, examining the determinants of breastfeeding practices is crucial for improving breastfeeding rates and child and maternal health.

Why are fewer children breastfed in India and what are the socio-economic determinants of breastfeeding practices (early initiation, exclusive breastfeeding, continued breastfeeding, and duration) in a country with the highest number of under-five deaths and alarmingly high rates of child stunting, wasting and underweight? Several studies in India have highlighted various socioeconomic and demographic characteristics of children, including gender, birth size, and birth order (Bhanderi et al., 2019; Ogbo et al., 2019; Ghosh et al., 2022); maternal factors such as age, educational attainment, mass media exposure, and decision-making power (Senanayake et al., 2019; Kazmi et al., 2021; Dhami et al., 2021; Ogbo et al., 2019; Jain et al., 2020); household factors like place of residence, religion, and wealth quintile (Sandor & Dalal, 2013; Dhami et al., 2021; Ghosh et al., 2022; Idowu et al., 2022); and health service-related factors including antenatal and postnatal care (Senanayake et al., 2019; Dhami et al., 2021; Ogbo et al., 2019; Joseph et al., 2022; Idowu et al., 2022) as determinants of breastfeeding. Our study seeks to answer these questions by examining the socio-economic and demographic determinants of breastfeeding practices in India using the latest round of the demographic and health survey DHS (2019-21). In addition to socio-economic and demographic factors relating to the mother, we also examine the association of paternal factors such as age, educational attainment, and occupation with breastfeeding practices, which are under-examined in India.

The first contribution of this study is the focus on paternal factors as

one of the essential drivers of breastfeeding practices in India, which have been under- emphasised in the previous literature. The rationale for including paternal factors is to examine breastfeeding practices within the framework of family dynamics, progressing from a dyadic (mother-infant) to a triadic (mother-father-infant) perspective. Agrawal et al. (2022) argue that women's decisions regarding the initiation and duration of breastfeeding are significantly influenced by their husbands' viewpoints, reinforcing the importance of involving fathers in the decision-making process regarding breastfeeding to engage them in child nutrition efforts. The impact of paternal factors has been explored using the previous DHS round (2015-2016) (Senanayake et al. 2019; Dhami et al., 2021). One study using a previous DHS survey contends that the father's occupation had no impact on the early initiation of breastfeeding and exclusive breastfeeding practices (Dhami et al., 2021); the second study, on the other hand, found that higher paternal educational attainment was associated with delayed early initiation of breastfeeding (Senanayake et al., 2019). Given the Government of India's renewed focus on child health, particularly the health of girl children through initiatives like "Beti Bachao Beti Padhao," and more mother-centric health and development initiatives in recent years, it is crucial to understand whether paternal factors, along with maternal factors, influence breastfeeding practices in India or not.

The second contribution of this study is to examine whether maternal ownership of a bank account and land, counselling received from healthcare providers, and assistance from Anganwadi workers are associated with breastfeeding practices.[3] Previous research has highlighted that a woman's legitimate ownership of land and bank accounts is closely associated with decision-making power and empowerment (Allendorf, 2007; Schuler et al., 2010). It has been shown that more empowered women are more likely to provide appropriate breastfeeding for their young children (Bose, 2011; Shroff et al., 2011). Regarding assistance from Anganwadi workers, WHO (2018) recommends that breastfeeding counselling by healthcare providers and frontline health workers is imperative for the best start to breastfeeding. Therefore, support (or a lack of it) from healthcare providers and frontline health workers can be identified as one of the enablers/barriers to optimal breastfeeding in India.

The third significant contribution of our study is to examine the

[3] Anganwadi means "courtyard shelter" in Indian languages. They were started by the Indian government in 1975 as part of the Integrated Child Development Services (ICDS) program to combat child hunger and malnutrition. Furthermore, Anganwadi workers play a crucial role in providing pre-school education for children under six, and nutritional support and healthcare for children and pregnant or lactating mothers. They operate Anganwadi centres (AWCs)—the village- or slum-level delivery mechanism of the ICDS. They work under the purview of the Ministry of Women and Child Development.

determinants of breastfeeding duration in India using a negative binomial model. To the best of our knowledge, ours is the first study examining the factors associated with breastfeeding duration in India. Understanding the determinants of breastfeeding duration is crucial because studies have found that longer breastfeeding durations have long-term implications for child health, maternal health and improved child-mother bonding. By examining socio-economic and demographic factors of mothers, paternal factors, and assistance from Anganwadi workers, our study seeks to provide valuable insights for policymakers, healthcare providers, and stakeholders to formulate effective policies and strategies to improve breastfeeding practices in India.

3.2 Data and Methodology

3.2.1 Data Source

This study extracted data from the latest round of Indian DHS data (2019-21), known as the National Family Health Survey (NFHS-5). The nationally representative survey of Indian households was conducted by the International Institute for Population Sciences (IIPS), under the stewardship of the Ministry of Health and Family Welfare (MoHFW). NFHS-5 covered a population-representative sample of 636,699 households with a response rate of 98% (NFHS-5, 2022). Interviews were completed with 724,115 women aged 15-49 years, with a response rate of 97% and 101,839 men aged 15-54 years, with a response rate of 92% (NFHS- 5, 2022). All children aged 0–5 years in the sampled households were included. NFHS-5 also included some additional focal areas like preschool education, menstrual hygiene, components of micronutrients to children, tobacco usage, death registration, sanitation, perinatal mortality, high-risk sexual behaviour, tuberculosis, non-communicable diseases, and different methods and reasons for abortion (NFHS-5, 2022).

The survey used a two-stage stratified sampling, where in clusters were selected first using probability proportional to cluster size and then, from each cluster, 22 households were selected using a systematic selection from the household listing (NFHS-5, 2022). DHS (2019-21) selected 30,198 primary sampling units (PSUs) from 707 Indian districts. After excluding respondents with missing responses to the selected relevant variables, the final study participants for this research comprised 22,126 respondents. The data were adjusted to control for sampling unit, strata and sample weight, where applicable. A detailed description of the survey's sampling procedures is accessible online (https://dhsprogram.com/data/available-datasets.cfm).

3.2.2 Outcome variables

According to a report titled "Indicators for assessing infant and young

child feeding practices" jointly produced by WHO and UNICEF, early initiation of breastfeeding refers to the percentage of children born in the last 24 months who were put to the breast within one hour of birth (WHO and UNICEF, 2021). Exclusive breastfeeding refers to the percentage of infants (age < 6 months) who were fed exclusively with breast milk during the previous day, while continued breastfeeding refers to the percentage of children aged 12-23 months, who were breastfed during the previous day (WHO and UNICEF, 2021). Accordingly, for this study, we considered four outcome variables: early initiation of breastfeeding (within one hour), exclusive breastfeeding (under six months), continued breastfeeding (12-23 months) and duration (in months) of breastfeeding among children under the age of two years/23 months.

Outcome variables were dichotomized into two categories: a child who has received early initiation of breastfeeding/ exclusive breastfeeding/ continued breastfeeding was coded as "1". In contrast, a child who has not received early initiation of breastfeeding/ no exclusive breastfeeding/ no continued breastfeeding was coded as "0".

3.2.3 Explanatory Variables

Having defined the key outcome variables for this study, we now focus on the explanatory variables of breastfeeding practices, which are categorised under five categories (child, maternal, paternal, household characteristics and maternal health services utilisation) as below.

The child characteristics include child gender (male/female), child size at birth (larger, average, smaller), and childbirth order (firstborn, 2nd-4th, 5th or more). The maternal characteristics include mother's age (15–24, 25–34, 35–49 years), educational attainment (no education, primary education, secondary education, higher education), currently employed (yes/no), exposure/listens to radio (not at all, less than once a week, at least once a week), exposure/watches TV (not at all, less than once a week, at least once a week), has bank account (yes/no) and land ownership (yes/no). The paternal characteristics include age (15–24, 25–34, 35–49, above 50 years) of the father, educational attainment (no education, primary education, secondary education, higher education) and occupation (professional/ technical/ managerial, clerical, sales, service/ household, domestic, agricultural, skilled and unskilled manual, other). Household characteristics include the respondents' place of residence (rural/urban), religion (Hindu, Muslim, other religions), household economic status (poorest, poorer, middle, richer, and richest) and caste (scheduled caste [SC], scheduled tribe [ST], other backward class [OBC], none of them). Lastly, the maternal health care utilisation includes four major indicators: ANC visits (<4 ANC visits and ≥4 ANC visits), PNC received by mothers (yes/no), healthcare provider counselled on breastfeeding during first two days (yes/no), and mother received assistance from Anganwadi while breastfeeding (yes/no).

3.2.4 Analytical Strategy

At the univariate level, percentages and frequency distribution were used to illustrate the respondent characteristics through descriptive statistics. The following section outlines the methodology applied to investigate the various determinants of breastfeeding practices in India.

3.2.4.1 Multivariable logistic regression

Over the past few years, logistic regression has emerged as the preferred analytical method for modelling dichotomous categorical dependent variables (DeMaris, 1995). Since the study used dichotomous outcome variables like early initiation of breastfeeding, exclusive breastfeeding and continued breastfeeding, logistic regression is employed to investigate the association between various maternal and paternal characteristics and breastfeeding (early initiation of breastfeeding (within one hour), exclusive breastfeeding (under six months) and continued breastfeeding (12-23 months).

The specific form of the logistic regression model we employed in this study is defined as follows.

$$\text{logit (Y)} = \ln \frac{P1}{1-P1}$$

$$\ln \frac{P1}{1-P1} = \alpha_1 + \beta_i \, \text{X}i \qquad (3.1)$$

In the above equation, P_1 is the probability that a child has availed early initiation of breastfeeding, exclusive breastfeeding and continued breastfeeding. The log odds of outcome variables concerning the base category are measured by the parameter α_1, and the maximum likelihood estimator for X_i is estimated by β_i (Cabrera, 1994). The maximum likelihood estimation of β is interpreted as the differential log of outcome variables, associated with covariates X, compared to the base category (Cabrera, 1994).

3.2.4.2 Negative binomial model

Since breastfeeding duration (months) is a count variable, the poisson regression or negative binomial model can be utilised. However, the Poisson regression model assumes that mean and variance must be the same (Noriszura & Jemain, 2007). Since the duration (months) of breastfeeding data used in this study displays overdispersion, i.e., the variance of the response variable exceeds the mean; therefore, the standard poisson regression model may give misleading inferences about the regression parameters (Noriszura & Jemain, 2007). Therefore, negative binomial and generalized poisson regression models can be used as alternatives for handling overdispersion (Noriszura & Jemain, 2007). Two of the most regularly used criteria to select the best-fit model are

the Akaike Information Criteria (AIC) and the Bayesian Schwartz Information Criteria (BIC) (Noriszura & Jemain, 2007). Since AIC and BIC values are smaller for the negative binomial model, we employed this model to examine the effect of different factors on breastfeeding duration (months). The regression coefficients can be interpreted using estimated log odds ratio (ORs) and incidence rate ratio (IRR) with 95% confidence intervals (CIs). All analyses were performed using STATA version 12.0 StataCorp LP, College Station, TX, USA (StataCorp, 2011). The statistical models' validity was tested using the likelihood- ratio and Hosmer-Lemeshow test (Supplementary Table II.1).

3.3 Data analysis and results

3.3.1 Descriptive statistics

A summary of the characteristics of respondents in India is presented in Table 3.1. The majority of children are male (53.35%), of 2nd-4th birth order (59.32%), and have average birth size (70.68%). It is perturbing that 80.86% of the women are not working, and only 37.92% have land ownership. However, more than half of the mothers have attained secondary education, and 81.60% have bank accounts, indicating significant financial inclusion in India. The majority of fathers have also attained secondary education (57.84%), belong to the 25-34 years age category (61.15%) and are employed in the agricultural sector (31.55%). More than three- quarters of the respondents reside in rural areas and belong to the Hindu religion. Most women have attended at least four ANC visits, received PNC, were counselled on breastfeeding by healthcare providers and received assistance from Anganwadi.

Table 3.1 Socio-economic and demographic characteristics of the respondents in India

	Frequency	Percentage
Child gender		
Male (ref.)	11,805	53.35
Female	10,321	46.65
Child size at birth		
Larger (ref.)	4,215	19.05
Average	15,638	70.68
Smaller	2,273	10.27
Childbirth order		
First born (ref.)	7,903	35.72
2^{nd}- 4^{th} born	13,125	59.32
5^{th} or higher birth order	1,098	4.96
Maternal age (years)		
15-24 (ref.)	6,817	30.81
25-34	13,159	59.47
35-49	2,150	9.72
Maternal education		
No education (ref.)	3,823	17.28
Primary	2,544	11.50
Secondary	11,971	54.10
Higher	3,788	17.12
Mother currently employed		
No (ref.)	17,892	80.86
Yes	4,234	19.14
Mother listens to radio		
Not at all (ref.)	19,190	86.73

Less than once a week	2,061	9.31
At least once a week	875	3.95
Mother watches TV		
Not at all (ref.)	6,074	27.45
Less than once a week	4,747	21.45
At least once a week	11,305	51.09
Mother has a bank account		
No (ref.)	4,070	18.39
Yes	18,056	81.61
Mother has landownership		
Does not own (ref.)	13,675	61.81
Own	8,451	38.19
Paternal education		
No education (ref.)	2,555	11.55
Primary	2,507	11.33
Secondary	12,782	57.77
Higher	4,282	19.35
Paternal age		
15-24 (ref.)	1,868	8.44
25-34	13,522	61.11
35-49	6,540	29.56
Above 50	196	0.89
Paternal occupation		
Professional/ technical/ managerial (ref.)	1,952	8.82
Clerical	556	2.51
Sales	2,360	10.67
Service/ household and domestic	2,141	9.68
Agricultural	7,006	31.66
Skilled and unskilled manual	6,897	31.17
Other	1,214	5.49
Type of residence		
Urban (ref.)	5,135	23.21
Rural	16,991	76.79
Religion		
Hindu (ref.)	17,090	77.24
Muslim	2,625	11.86
Others	2,411	10.90
Wealth quintile		
Poorest (ref.)	4,541	20.52
Poorer	4,970	22.46
Middle	4,645	20.99
Richer	4,307	19.47
Richest	3,663	16.56
Caste		

SC (ref.)	4,646	21
ST	4,095	18.51
OBC	9,228	41.71
None of them	4,157	18.78
Attended 4+ ANC visits		
No (ref.)	8,311	37.56
Yes	13,815	62.44
Mother's received PNC		
No (ref.)	2,777	12.55
Yes	19,349	87.45
During first 2 days healthcare provider counselled on breastfeeding		
No (ref.)	3,781	17.09
Yes	18,345	82.91
When breastfeeding received assistance from Anganwadi		
No (ref.)	6,898	31.18
Yes	15,228	68.82

Source: Authors' calculations based on DHS survey data

3.3.2 Determinants of Breastfeeding Practices in India

Table 3.2 demonstrates the result of the logistic and negative binomial regression model for breastfeeding practices in India. We found that a female child was more likely to be exclusively breastfed for the initial six months [OR 1.13; CI (1.03 - 1.23)] in comparison to a male child, while the duration of breastfeeding was shorter [IRR 0.96; CI (0.93 - 0.98)]. Children born with the average size at birth [OR
1.18; CI (1.10 - 1.27)] had higher odds of early initiation of breastfeeding compared to those born with a larger size at birth. Children belonging to 2nd-4th birth order had higher odds of early initiation of breastfeeding [OR 1.19; CI (1.11 - 1.26)] and exclusive breastfeeding [OR 1.32; CI (1.19 - 1.46)] compared to firstborn children. In contrast, the children with 2nd or higher birth order were likely to have a shorter duration of breastfeeding [IRR 0.93; CI (0.90 - 0.96)].

Table 3.2 Multivariate logistic and negative binomial regressions for analysing the determinants of breastfeeding practices using DHS (2019-21) in India

	Early Initiation of Breastfeeding Practices		Exclusive Breastfeeding Practices		Continued Breastfeeding Practices		Breastfeeding Duration (Months)	
	OR	CI (95%)	OR	CI (95%)	OR	CI (95%)	IRR	CI (95%)
Child gender								
Male (ref.)	1.00							
Female	0.96	(0.91-1.02)	1.13*	(1.03-1.23)	1.03	(0.97-1.11)	0.96*	(0.93-0.98)
Child size at birth								
Larger (ref.)	1.00							
Average	1.18*	(1.10-1.27)	1.1	(0.98-1.23)	1.08	(1.01-1.18)	0.94*	(0.92-0.97)
Smaller	0.93	(0.84-1.04)	1.11	(0.94-1.32)	1.06	(0.93-1.21)	0.97	(0.92-1.01)
Childbirth order								
First born (ref.)	1.00							
2^{nd}- 4^{th} born	1.19*	(1.11-1.26)	1.32*	(1.19-1.46)	1	(0.92-1.08)	0.93*	(0.90-0.96)
5^{th} or higher birth order	1.27*	(1.09-1.49)	1.89*	(1.45-2.46)	1.2	(0.98-1.46)	0.83*	(0.78-0.89)
Maternal age (years)								
15-24 (ref.)	1.00							
25-34	0.85*	(0.80-0.97)	0.56*	(0.51-0.63)	0.72	(0.66-0.78)	1.23*	(1.19-1.27)
35-49	0.61*	(0.54-0.70)	0.4*	(0.3-0.52)	0.54	(0.45-0.65)	1.36*	(1.28-1.44)

Maternal education								
No education (ref.)	1.00							
Primary	1.13*	(1.00-1.26)	0.84	(0.7-1)	1	(0.87-1.14)	1.03	(0.98-1.08)
Secondary	1.15*	(1.05-1.26)	0.97	(0.84-1.13)	1.04*	(0.93-1.17)	1.04*	(1-1.09)
Higher	1.09	(0.97-1.23)	1.18	(0.98-1.43)	1.24*	(1.06-1.44)	0.91*	(0.87-0.96)
Mother currently employed								
No (ref.)	1.00							
Yes	1.07	(0.99-1.15)	0.50*	(0.43-0.58)	0.79	(0.72-0.87)	1.10*	(1.07-1.14)
Mother listens to radio								
Not at all (ref.)	1.00							
Less than once a week	0.98	(0.88-1.07)	1.06	(0.91-1.24)	1.06	(0.93-1.19)	1.09*	(1.04-1.14)
At least once a week	1.19*	(1.03-1.37)	1.11	(0.87-1.4)	0.89	(0.73-1.07)	1.02	(0.96-1.09)
Mother watches TV								
Not at all (ref.)	1.00							
Less than once a week	1.07	(0.98-1.17)	1.11	(0.97-1.26)	0.94	(0.85-1.05)	1.05*	(1.01-1.09)
At least once a week	1.37*	(1.27-1.48)	1	(0.89-1.13)	0.95*	(0.86-1.04)	1	(0.97-1.04)

Mother has a bank account								
No (ref.)	1.00							
Yes	0.96	(0.89-1.03)	0.89*	(0.8-0.99)	0.98	(0.9-1.07)	1.01	(0.98-1.05)
Mother has landownership								
Does not own (ref.)	1.00							
Own	0.72*	(0.68-0.77)	0.92	(0.83-1.01)	1.01	(0.94-1.09)	1.06*	(1.04-1.09)
Paternal education								
No education (ref.)	1.00							
Primary	0.90	(0.42-0.74)	0.81*	(0.67-0.98)	1*	(0.87-1.15)	1.01	(0.96-1.06)
Secondary	0.88*	(0.58-0.93)	0.82*	(0.70-0.96)	1*	(0.88-1.13)	1.02	(0.97-1.07)
Higher	0.89	(0.36-1.27)	1.06	(0.87-1.29)	0.93	(0.79-1.09)	0.99	(0.93-1.05)
Paternal age								
15-24 (ref.)	1.00							
25-34	1.13*	(1.01-1.27)	0.57*	(0.5-0.66)	0.96	(0.85-1.09)	1.26*	(1.20-1.33)
35-49	1.37*	(1.20-1.56)	0.34*	(0.28-0.41)	0.75*	(0.64-0.88)	1.43*	(1.35-1.52)
Above 50	1.48*	(1.03-2.12)	0.4*	(0.2-0.8)	0.86	(0.53-1.39)	1.54*	(1.31-1.8)
Paternal occupation								
Professional/ technical/ managerial (ref.)	1.00							
Clerical	0.75*	(0.62-0.92)	0.92	(0.66-1.3)	1.12	(0.88-1.42)	1	(0.92-1.08)

Sales	0.90	(0.79-1.03)	1.32*	(1.08-1.62)	0.93	(0.79-1.1)	1	(0.94-1.05)
Service/ household and domestic	0.93	(0.82-1.06)	1.11	(0.9-1.38)	1.05*	(0.89-1.24)	1.07*	(1.02-1.14)
Agricultural	1.02	(0.91-1.15)	1.31*	(1.08-1.59)	0.98	(0.85-1.13)	0.99	(0.95-1.05)
Skilled and unskilled manual	1.24*	(1.12-1.39)	1.15	(0.95-1.38)	1.03*	(0.9-1.19)	0.96	(0.91-1)
Other	0.99	(0.85-1.15)	1.06	(0.83-1.37)	0.97*	(0.8-1.18)	1.09*	(1.02-1.17)
Type of residence								
Urban (ref.)	1.00							
Rural	1.05	(0.98-1.12)	1.28*	(1.14-1.44)	1.06	(0.97-1.16)	0.96*	(0.93-0.99)
Religion								
Hindu (ref.)	1.00							
Muslim	1.02	(0.94-1.12)	1.2*	(1.04-1.37)	1.05	(0.94-1.17)	0.97	(0.94-1.01)
Others	1.34*	(1.17-1.52)	0.96	(0.76-1.2)	0.9	(0.75-1.07)	1.03	(0.97-1.09)
Wealth quintile								
Poorest (ref.)	1.00							
Poorer	0.88*	(0.79-0.95)	1.04	(0.91-1.2)	0.89*	(0.8-0.99)	0.95*	(0.92-0.99)
Middle	0.98	(0.89-1.08)	0.99	(0.85-1.15)	0.89*	(0.79-1.00)	0.94*	(0.90-0.98)
Richer	0.95	(0.85-1.06)	1.06	(0.9-1.26)	0.78	(0.68-0.89)	0.91*	(0.86-0.95)
Richest	0.89	(0.79-1.01)	0.88	(0.72-1.07)	0.71	(0.61-0.83)	0.86*	(0.81-0.90)
Caste								
SC (ref.)	1.00							
ST	1.16*	(1.04-1.29)	1.14	(0.97-1.34)	1.04*	(0.91-1.18)	0.96	(0.92-1.01)
OBC	0.77*	(0.72-0.83)	0.95	(0.84-1.06)	0.94*	(0.86-1.03)	0.95*	(0.92-0.98)

None of them	0.82	(0.75-0.90)	0.82*	(0.71-0.95)	1.06	(0.95-1.19)	0.96*	(0.92-1)
Attended 4+ anc visits								
No (ref.)	1.00							
Yes	1.39*	(1.31-1.47)	1.13*	(1.03-1.25)	0.88	(0.82-0.95)	0.99	(0.97-1.02)
Mother's received PNC								
No (ref.)	1.00							
Yes	1.16*	(1.06-1.27)	1	(0.88-1.14)	1.08	(0.97-1.2)	0.89*	(0.85-0.92)
During first 2 days healthcare provider counselled on breastfeeding								
No (ref.)	1.00							
Yes	1.12*	(1.04-1.21)	1.16*	(1.03-1.31)	1.11	(1-1.22)	0.86*	(0.83-0.89)
When breastfeeding received assistance from Anganwadi								
No (ref.)	1.00							
Yes	1.26*	(1.19-1.34)	0.75*	(0.68-0.82)	1.25*	(1.16-1.36)	1.02	(0.99-1.05)

Note. Level of significance for logistic model: *Significant at 5 percent level; OR, Odds ratio; CI, Confidence interval; ref.: Reference category of the variable

Source: Authors' calculations based on DHS survey data

We found that educated mothers had higher odds of early initiation of breastfeeding [OR 1.15; CI (1.05 - 1.26)], continuous breastfeeding [OR 1.04; CI
(0.93 - 1.17)] and breastfed for a longer duration [IRR 1.04; CI (1.00 - 1.09)] compared to uneducated mothers in India. Working mothers showed higher odds of longer durations of breastfeeding [IRR 1.10; CI (1.07 - 1.14)] compared to unemployed mothers. Notably, maternal land ownership [IRR 1.06; CI (1.04 - 1.09)] was likely to lead to a longer duration of breastfeeding. Furthermore, we found that mothers aged 35-49 years had lower odds of early initiation of breastfeeding [OR 0.61; CI (0.54 - 0.70)] and exclusive breastfeeding [OR 0.40; CI (0.30 - 0.52)] compared to women aged 15-24 years. In terms of duration of breastfeeding, 35-49 years aged females were likely to have prolonged breastfeeding duration [IRR
1.36; CI (1.28 - 1.44)] compared to primipara or younger women.

Our study found that watching television, also resulted in higher odds of early initiation of breastfeeding [OR 1.37; CI (1.27 - 1.48)]. We found that higher paternal educational attainment was associated with lower odds of early initiation of breastfeeding [OR 0.88; CI (0.58 - 0.93)] and exclusive breastfeeding [OR 0.82; CI (0.70 - 0.96)] in comparison to fathers without education. The higher paternal age was associated with lower exclusive breastfeeding [OR 0.57; CI (0.50 - 0.66)] but longer duration of breastfeeding [IRR 1.26; CI (1.20 - 1.33)]. Fathers employed in service or skilled and unskilled manual work were more likely to have higher breastfeeding practices. Additionally, children residing in rural areas had 28% higher odds of exclusive breastfeeding [OR 1.28; CI (1.14 - 1.44)] than children residing in urban areas.

We found that wealthier households had lower odds of continuous breastfeeding [OR 0.89; CI (0.79 - 1.00)] and smaller duration of breastfeeding [IRR 0.86; CI (0.81 - 0.90)] compared to the poorest households. Women from the OBC category had lower odds of early initiation of breastfeeding [OR 0.77; CI (0.72 - 0.83)], continuous breastfeeding [OR 0.94; CI (0.86 - 1.03)] and smaller duration of breastfeeding [IRR 0.95; CI (0.92 - 0.98)]. We found that women who attended at least four ANC visits had higher odds of early initiation of breastfeeding [OR 1.39; CI (1.31 - 1.47)] and exclusive breastfeeding [OR 1.13; CI (1.03 - 1.25)]. Mothers who received PNC and breastfeeding counselling during the first two days had higher odds of early initiation of breastfeeding [OR 1.12; CI (1.04 - 1.21)], exclusive breastfeeding [OR 1.16; CI (1.03 - 1.31)] but shorter duration of breastfeeding [IRR 0.86; CI (0.83 - 0.89)] compared to women who did not receive these visits. Women who received assistance from Anganwadi while breastfeeding had higher odds of early initiation of breastfeeding [OR 1.26; CI (1.19 - 1.34)] and continuous breastfeeding [OR 1.25; CI (1.16 - 1.36)] in comparison to women who did not receive assistance from Anganwadi.

3.4 Discussion

Notably, our study found that a female child was more likely to be exclusively breastfed for the initial six months in comparison to a male child, while the duration of breastfeeding was shorter. Children born with the average size at birth had higher odds of early initiation of breastfeeding compared to those born with a larger size at birth. A previous study in Namibia also concluded that exclusive breastfeeding was less likely among both large and small-sized babies than among average-sized babies (Ndirangu et al., 2018). Infants with lower birth weights often have poor coordination of the suction-deglutition-respiration cycle and the breast- seeking reflex (Walker, 2008); therefore, healthcare providers prioritise stabilising baby's health rather than focusing on early initiation of breastfeeding (De Oliveira Vieira et al., 2010). Additionally, children belonging to 2^{nd}-4^{th} birth order had higher odds of early initiation of breastfeeding and exclusive breastfeeding compared to firstborn children. This might happen as the multiparous women tend to have more knowledge and experience, increasing the odds of early initiation of breastfeeding and exclusive breastfeeding (Ndirangu and colleagues, 2018). In contrast, the children with 2^{nd} or higher birth order were likely to have a shorter duration of breastfeeding, which is in line with a previous study in Maryland (Sutherland et al., 2011). Though the multiparous women have more knowledge and awareness, they may wean earlier due to the need to manage a larger family, financial pressures to return to work sooner, and increased responsibilities from having multiple children.

Our findings indicate that socioeconomic disparities significantly influence the duration of breastfeeding in India. Educated mothers had higher odds of early initiation of breastfeeding, continuous breastfeeding and breastfed for a longer duration compared to uneducated mothers in India. They are better informed about the benefits of breastfeeding practices (Qureshi et al., 2011). Also, educational attainment by women is linked to higher economic opportunities, influencing their financial independence and making them more empowered to make decisions regarding their children's health (Laughlin, 2011). Working mothers showed higher odds of longer durations of breastfeeding compared to unemployed mothers. These findings are consistent with studies conducted in Nairobi (Lakati et al., 2002), Abu Dhabi (Gardner et al., 2015), and Saudi Arabia (Alzaheb, 2016). It is worth noting that while these employed mothers had higher odds of longer durations of breastfeeding, they had lower odds of exclusive breastfeeding. This might seem counterintuitive but could be explained by several factors. For instance, a working mother is more likely to be educated about the benefits of breastfeeding practices; however, due to working hours, she may not focus exclusively on exclusive breastfeeding, and she may have to introduce complementary feeding (Zaidi et al., 2014). A previous study found that working mothers spent most of their time working so that they could breastfeed only in the morning and at night (Lakati et al., 2002). Ranjitha and colleagues (2023) argue that to promote optimum breastfeeding practices among working mothers, it is crucial to promote workplace breastfeeding practices, reduce the working hours per week during the post-partum period and provide lactation rooms in public places. In

this regard, WHO (2014) recommended six months of mandatory paid maternity leave for both formal and informal sector employees.

Notably, maternal land ownership was likely to lead to a longer duration of breastfeeding. Land ownership signifies that women are more empowered (Allendorf, 2007), enabling them to make substantial decisions regarding their health and that of their children. Land ownership suggests greater financial stability, leading to less economic pressure to return to work, greater decision-making power, food security for the mother, and higher access to healthcare services. Furthermore, we found that mothers aged 35-49 years had lower odds of early initiation of breastfeeding and exclusive breastfeeding compared to women aged 15-24 years. Janoudi and colleagues (2015) contend that rates of caesarean section increase with maternal age. Additionally, Hobbs et al. (2016) found that women who delivered by caesarean section were less likely to initiate breastfeeding and experienced a higher proportion of breastfeeding difficulties. A study conducted in Japan found that mothers of late child-bearing age (35 years or older) face the greatest challenges in successfully initiating exclusive breastfeeding (Kitano et al., 2016). In terms of duration of breastfeeding, 35-49 years aged females were likely to have prolonged breastfeeding duration compared to primipara or younger women. This may happen due to limited awareness or knowledge about breastfeeding in younger women (Hossain et al., 2018).

In line with a previous study in Ghana (Seidu et al., 2020), we found that maternal exposure to media, i.e. listening to the radio or watching TV, was associated with higher odds of early initiation of breastfeeding and longer duration of breastfeeding compared to women with no exposure to mass media. Early breastfeeding initiation programs and advertisements promoted via radio have a wider reach due to radio's widespread availability and accessibility, irrespective of an individual's wealth status (Botchway, 2021). Other media of information, such as watching television, also resulted in higher odds of early initiation of breastfeeding. This finding suggests that easily accessible media platforms can substantially increase early breastfeeding initiation (Seidu et al., 2020). In Gujarat (a state in India), Technology Enabled Community Health Operations (TeCHO+), a mobile and web-based application (app) for frontline health workers, was implemented across all 33 districts, catering to a population of over 60 million by the Department of Health and Family Welfare, Government of Gujarat (Saha & Quazi, 2022).[4] It not only improved early initiation of breastfeeding, but also increased the coverage of complete antenatal care, consumption of at least 180 iron folic acid tablets and encouraged five home visits by frontline health workers in Gujarat. Similar information and communication technology tools tailored to literacy levels can be used across other Indian states to improve breastfeeding practices.

Moreover, higher paternal educational attainment was associated with

[4] TeCHO+ includes features such as real-time data entry by frontline health workers, automated generation of the work plan, and a decision support system that stratifies risks based on the input of beneficiaries' details and notifies high-risk cases to workers and pops up relevant educational videos based on risk assessment of the beneficiary (Saha & Quazi, 2022).

lower odds of early initiation of breastfeeding and exclusive breastfeeding in comparison to fathers without education. A study conducted in India using previous DHS data found similar results (Senanayake et al., 2019). The plausible explanation is that fathers with higher educational attainment have higher income levels, and the financial burden of purchasing formula and breastmilk substitutes would be less burdensome financially. Abhinaya and colleagues (2016) argue that irrespective of fathers' educational attainment, they have limited breastfeeding knowledge due to their limited involvement during ANC checkups. Similar to the findings for higher maternal age, we found that higher paternal age was associated with lower exclusive breastfeeding but longer duration of breastfeeding. Fathers employed in service or skilled and unskilled manual work were more likely to have higher breastfeeding practices. The plausible explanation is that breastfeeding is cost-effective compared to formula feeding, which can be a significant consideration for lower- income families. The existing empirical evidence on these associations is limited, highlighting the need for further research. The MenCare Global Fatherhood Campaign, which partners with more than 65 countries, including India, aims to promote men's involvement in active caregiving from their partner's pregnancy through their child's early years (Moura et al., 2024). Though it is not widespread or well-known in India, Moura et al. (2024) argue that initiatives like this are imperative for enhancing fathers' positive behaviour towards breastfeeding practices and increasing their knowledge.

Children residing in rural areas had 28% higher odds of exclusive breastfeeding than children residing in urban areas. Victor and colleagues (2013) contend that most mothers from urban areas are employed, are required to return to work, and can afford breastmilk substitutes. In India, breastfeeding is prevalent in many low-income and rural areas, where the usage of commercial milk formula is limited due to affordability and accessibility issues (Ganapathy & Sekaran, 2023). However, in urban areas, where women are often employed, and formula milk marketing tactics are more prevalent, the practice of supplementing breastfeeding with commercial milk formula has emerged (Ashwini et al., 2014). This threatens breastfeeding practices, especially in urban areas (Ashwini et al., 2014). India has made considerable efforts to protect the health of infants and young children through legislations such as The Infant Milk Substitutes, Feeding Bottles, and Infant Foods (Regulation of Production, Supply, and Distribution) Act 1992, and its Amendment Act 2003, which prohibit any advertising or promotion of infant formula, feeding bottles, and infant foods for children aged 0–2 years (Ganapathy & Sekaran, 2023). However, it is disconcerting that non-compliance with these regulations has been reported, raising concerns about the marketing tactics used by India's commercial formula milk industry (Ganapathy & Sekaran, 2023). We found that wealthier households had lower odds of continuous breastfeeding and smaller duration of breastfeeding compared to the poorest households, consistent with a study conducted in Indonesia (Nurokhmah et al., 2022). Moreover, breastfeeding practices are more common among women from the poor wealth quintile since mothers from

wealthier families can afford alternatives such as instant formula to feed their infants (Nurokhmah et al., 2022; Gessese et al., 2022). We found that women from the OBC category had lower odds of early initiation of breastfeeding, continuous breastfeeding and smaller duration of breastfeeding. A study conducted in India found that women belonging to OBC families had a higher likelihood of early cessation of breastfeeding (Malhotra et al., 2008). This implies that cultural factors, customs and traditions play an important role in influencing breastfeeding duration (Malhotra et al., 2008).

We found that women who attended at least four ANC visits had higher odds of early initiation of breastfeeding and exclusive breastfeeding. A similar finding was observed in Mexico (Maas-Mendoza et al., 2022), Jordan (Fendi et al., 2023) and Ethiopia (Gebeyehu et al., 2023). Women usually receive breastfeeding counselling and child health promotion information during ANC visits, which are imperative for promoting optimum breastfeeding practices (Fendi et al., 2023). Not only ANC but PNC visits are also critical determinants of breastfeeding practices in India. Our study found that mothers who received PNC and breastfeeding counselling during the first two days had higher odds of early initiation of breastfeeding, exclusive breastfeeding but shorter duration of breastfeeding compared to women who did not receive these visits. Karim and colleagues (2018) contend that postnatal support and breastfeeding counselling by healthcare providers immediately after delivery (within 24 hours) significantly help mothers initiate breastfeeding and address any difficulties. According to WHO (2022), at least three PNC visits are recommended for all mothers from birth to six weeks postpartum. However, once these PNC visits stop, breastfeeding practices tend to decline, leading to a shorter duration of breastfeeding. Therefore, rather than limiting postnatal care visits to six months, they should be extended for longer and accompanied by continuous, frequent home visits from frontline health workers to promote breastfeeding practices in India.

Remarkably, our study emphasized the critical significance of directly engaging with frontline health workers in India. Women who received assistance from Anganwadi while breastfeeding had higher odds of early initiation of breastfeeding and continuous breastfeeding in comparison to women who did not receive assistance from Anganwadi. Similar results were found in previous studies conducted in India (Singh et al., 2016; Kim et al., 2023). In India, a significant proportion of deliveries used to occur at home, leaving many women without knowledge of proper breastfeeding practices. To address this issue, the government of India introduced the Janani Suraksha Yojana (JSY), which promotes institutional deliveries. The implementation of JSY has led to a substantial increase in the prevalence of early initiation of breastfeeding and post-natal care in India (Sen et al., 2020). However, healthcare centres enrolled in the JSY program often suffer from understaffing, a lack of essential medications, delays in payment disbursement, and are susceptible to corrupt practices, which undermine the noble intentions of the scheme (Jennings et al., 2019).

3.5 Limitations of the study

This study had a few limitations that should be considered when interpreting its findings. First, there is a potential for recall bias, particularly among multiparous women, about breastfeeding patterns (Yilmaz et al., 2016; Seidu et al., 2020). Secondly, we could not assess the quality of breastfeeding counselling provided to mothers during their ANC/PNC visits (Kim et al., 2023). Thirdly, when examining paternal characteristics as determinants of breastfeeding practices, we could not differentiate the child's biological father from the mother's current partner (Vollmer et al., 2016). Fourth, the cross-sectional nature of the data used in this study precludes us from making causal inferences (Leroy et al., 2014). Fifth, our data got severely constricted after excluding all those females who did not answer the questions on bank account and land holding. Lastly, we were unable to measure all possible variables and/or contextual factors that could potentially affect breastfeeding practices in India, including health literacy, cultural taboos (Kumar et al., 2019; Seidu et al., 2020), partner's preference for breastfeeding (Barnes et al., 1997) and mothers having been breastfed themselves (Riva et al., 1999).

3.6 Conclusion and policy recommendations

In summary, both maternal and paternal characteristics significantly influence breastfeeding practices in India. Addressing educational and involvement gaps among fathers, along with tailored policy interventions can significantly impact breastfeeding outcomes. Factors such as higher maternal educational attainment, exposure to mass media, emotional and psychological support from partners, postpartum education, and financial independence contribute to optimal breastfeeding practices. Moreover, increasing awareness of government initiatives, improving access to antenatal and postnatal visits, and fostering direct engagement with frontline health workers, especially in rural areas, are crucial for promoting the duration of breastfeeding. India's commitment to breastfeeding is exemplified by implementing the Mothers' Absolute Affection scheme. This initiative seeks to enhance breastfeeding coverage through the capacity building of frontline health workers and comprehensive campaigns (PIB, 2024). To further support breastfeeding practices in India, policymakers should adopt a multi-faceted strategy that includes parental education, breastfeeding counselling, regulating the breast milk substitute industry, providing lactation rooms in public spaces, and leveraging media to create awareness and knowledge among prospective parents.

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3.8 Appendix

Supplementary Table II.1. Validity of the statistical models

Results of Hosmer-Lemeshow test

II. 1a. Multivariate logistic regressions for analysing the determinants of early initiation of breastfeeding, exclusive breastfeeding and continued breastfeeding practices using DHS (2019-21) in India

Outcome variables	Early initiation of breastfeeding	Exclusive breastfeeding	Continued breastfeeding
Hosmer-Lemeshow chi^2	4.66	10.85	6.63
P > chi^2	0.79	0.21	0.58

Note: P-value > 0.05 shows that the model is correctly

specified

Source: Authors' calculations based on DHS survey data

Results of Likelihood-ratio test

II. 1b. Multivariate logistic regressions for analysing the determinants of breastfeeding duration (months) using DHS (2019-21) in India

Outcome variables	Breastfeeding duration (months)
LR chi^2	1213.53
P > chi^2	0.00

Note: P-value < 0.05 indicates that the model is a significantly better-fit model

Source: Authors' calculations based on DHS survey data

CHAPTER 4

EXAMINING MATERNAL HEALTHCARE SERVICE UTILIZATION AS A DETERMINANT OF CHILD HEALTH OUTCOMES IN INDIA: DEMOGRAPHIC AND HEALTH SURVEY 2019-21

4.1 Introduction

The period from birth to five years is the most crucial period where critical growth and developmental processes occur (Oumer et al., 2022; Baek et al., 2022). Early CHOs significantly impact later-life outcomes as children who perform poorly on health indicators are more likely to have lower school achievement and earnings in adulthood compared to their counterparts (Alderman, 2009; McGovern et al., 2017; Moffat et al., 2022). Poor CHOs not only harm children's physical health but also adversely impact their emotional well-being and self-esteem (Komakech et al., 2022;). Poor start to life has long-lasting effects on the individual's life as it can lower their productivity, income-earning ability, vulnerability to chronic diseases and obesity during adulthood (Wells et al., 2018; Wells et al., 2020; Siddiqui et al., 2020; Yaya et al., 2020; Popkin et al., 2020). Adequate nutrition during this period plays a vital role in a child's cognitive, physical, emotional and social development (Yaya et al., 2020).

The sustainable development goal 2 "Zero hunger", aims to eradicate malnutrition by 2030, including reducing the prevalence of stunting and wasting in children aged less than five years by 2025 (UNDP, 2022). Nearly half of all deaths among children are due to malnutrition as it makes them more vulnerable to infections, increasing the probability of dying from diseases that are preventable in nature (Paul and Saha, 2022). Notably, child malnutrition hampers country's economic growth and hence the objective of economic development cannot be met without addressing the issue of child malnutrition (Mary, 2018; Abu-Fatima et al., 2020; Nugent et al., 2020; Seth and Jain, 2022; Hakizimana, 2022). As per a report titled "The State of Food Security and Nutrition in the World 2022", globally stunting and wasting among under-five children was 22% and 6.7% in 2020, respectively (FAO, 2022). This report further underscores that the global prevalence of obesity among children has increased, and 42% of under-five children are anaemic with no marked improvement since last two decades (FAO, 2022).

CHOs could be a result of several factors including socio-economic conditions of the mother, weight of women during pregnancy, contaminated drinking water, hygiene, psychological counselling and family planning

practices (Woldeamanuel and Tesfaye, 2019; Fentiana et al., 2022; Maulina et al., 2022). Scarce evidence is available to contextualise mothers' crucial role in childcare practices and health status in the Indian context (Paul and Saha, 2022). Maternal health care services primarily refer to antenatal care (ANC), delivery care and postnatal care (PNC) (James et al., 2021). ANC may help in preventing malnutrition among children as it aids in the early detection and prevention of factors that may adversely affect the health of the child (Shyam et al., 2020). Adequate nourishment during pregnancy, nutritional counselling, emotional and psychological support may prevent infant mortality, neonatal mortality and affect the holistic development of a child (Young et al., 2022; Hinke et al., 2022). Delivery care may potentially ensure the presence of skilled health personnel and round-the-clock supervision during childbirth, minimizing the risk of child mortality and morbidity (Yoseph, 2020). PNC check-ups are essential for educating mothers about warning signs, breastfeeding practices, vaccinations and hygiene, which may assist in preventing poor CHOs (Ahmadinezhad, 2022). However, in India, there is limited empirical evidence regarding associations between CHOs and MHCSU. Also, few existing studies provide contrary results (Mullany et al., 2009; Shyam et al., 2020; Solans et al., 2021; Syeda et al., 2021; Haby et al., 2022; Spies et al., 2022; Choi et al., 2022).

Against this backdrop, the main objective of this study is to examine the impact of MHCSU on CHOs using the latest round of Demographic and Health Survey (DHS) in India, 2019-21, which is a nationally representative sample of 219,187 women aged 15-49 years, who have given live birth in the five years preceding the survey (NFHS-5, 2022) (Figure 1). Our empirical analyses focus on five indicators of MHCSU - ANC visits, number of days IFA tablets consumed, number of months pregnant at the time of first ANC check- up, skilled birth attendant during delivery and PNC received by mothers and five under-five CHOs - stunting, wasting, anaemia, underweight and overweight.

In the hypothesized model, MHCSU influences CHOs in terms of under-five stunting, wasting, anaemia, underweight and overweight (Fig. 4.1)

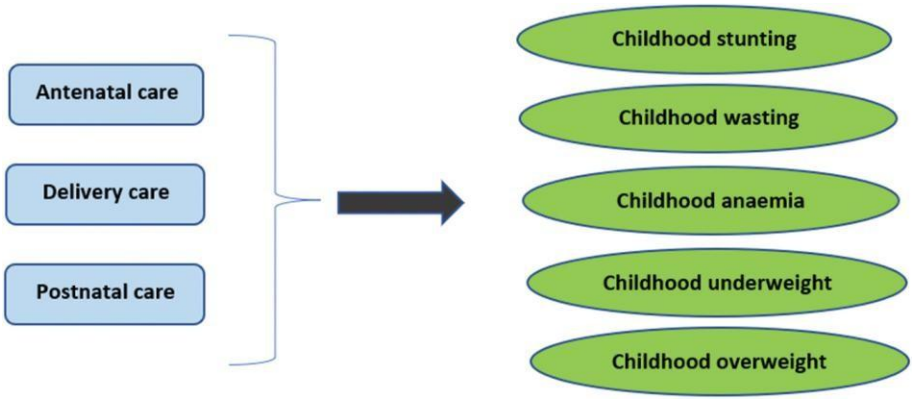

Fig. 4.1 Association between maternal healthcare service utilization and

child health outcomes
Source: Based on DHS survey data

The main contribution of the paper is to provide recent evidence on the association between MHCSU and CHOs using a high-quality nationally representative demographic health survey, DHS (2019-21), increasing the generalizability of our results for all children aged less than five years in India (NFHS-5, 2022). Second, as per DHS (2019-21) number of children who are overweight, severely wasted and anaemic has increased in India; therefore, it is crucial to understand the potential influence of maternal health care in CHOs, since maternal health is crucial towards child behaviours and health outcomes (Hinke et al., 2022). Third, to the best of our knowledge, this is the first study to examine comprehensively the relationship between MHCSU and CHOs using a bucket of five major child health indicators. Due to the persistent prevalence of childhood malnutrition and the dearth of supporting evidence in India on the impact of MHCSU on CHOs, this study significantly contributes to the existing literature on child health using national-level evidence. Lastly, this study aids in evidence-based policymaking towards improving CHOs in a developing country such as India.

4.2 Data and Methodology

4.2.1 Data Source

The data for this study were extracted from India Demographic and Health Survey 2019-21, known as National Family Health Survey (NFHS-5). The NFHS-5 is a nationally representative dataset of Indian households conducted by the International Institute for Population Sciences (IIPS), under the stewardship of the Ministry of Health and Family Welfare (MoHFW), Government of India (NFHS-5, 2022). NFHS-5 covered a population-representative sample survey of 636,699 households with a response rate of 98%, 724,115 women aged 15-49 years with a response rate of 97% and 101,839 men aged 15-54 years with a response rate of 92% (NFHS-5, 2022). Moreover, all children aged 0-5 years in the sampled households were covered. The main aspiration of NFHS is to administer reliable datasets on health, family welfare, fertility level, maternal and child health, infant mortality and socio-economic characteristics of individuals (NFHS-5, 2022). This information intends to aid policymakers in examining India's health sector and in identifying new key areas where targeted intervention is required. The approach of two-stage stratified sampling was employed in the survey, wherein clusters were first selected using probability proportional to cluster size, followed by the systematic selection of 22 households from the household listing in each cluster (NFHS-5, 2022). A detailed description of the sampling procedures for the survey is available online at https://dhsprogram.co m/data/available-datasets.cfm. As this study focuses on MHCSU and CHOs, the final study

participants comprised 88,035 respondents, after excluding respondents with missing responses to the selected relevant variables.

4.2.2 Outcome variables

To examine the impact of MHCSU on CHOs, five anthropometric indicators were considered: stunting, wasting, anaemia, underweight and overweight among children under the age of five years. According to the WHO, a child is categorised as stunted if the height-for-age z score of the child is two standard deviation below the median WHO child growth standards (WHO, 2023). Likewise, a child is defined as wasted if weight-for-height z score of the child is two standard deviation below the median WHO child growth standards (WHO, 2023). The child is anaemic if haemoglobin level adjusted for altitude is less than 11.0 g/dl (WHO, 2024). A child is considered underweight if weight-for-age z score of the child is two standard deviation below the median WHO child growth standards and overweight if weight- for-height z score of the child is two standard deviation above the median WHO child growth standards (WHO, 2023).

The outcome variables were dichotomized into two categories: a child is not stunted/ not wasted/ not anaemic/ not underweight/ not overweight coded as "0" and a child is stunted/wasted/anaemic/underweight/overweight coded as "1".

4.2.3 Explanatory variables

The selected MHCSU predictor variables included in the analysis are: ANC visits (<4ANC visits and ≥4 ANC visits), number of days IFA tablets consumed (<180 days and ≥180 days), number of months pregnant at the time of first ANC check-up (<4 months and ≥4 months), presence of skilled birth attendant during delivery (yes or no) and PNC received by mothers (yes or no).

Furthermore, we included several confounding variables relating to child, women and household characteristics. The child's characteristics included the child's gender (male/female) and birth order (firstborn, 2nd-4th, 5th or more). The maternal characteristics included maternal age at the time of childbirth (13–24, 25–34, 35–49 years) and educational attainment (no education, primary, secondary, or higher education). Lastly, household characteristics included the respondents' place of residence (rural/urban), the religion they belong to (Hindu, Muslim, other religions), caste (Scheduled Caste [SC], Scheduled Tribe [ST], Other Backward Class [OBC], none of them) and household wealth quintile (poorest, poorer, middle, richer, and richest).

4.2.4 Analytical Strategy

Descriptive statistics and multivariable logistic regression were employed in the study. The methodology applied to examine the impact of

MHCSU on CHOs using India DHS (2019-21) is described below

4.2.4.1 Multivariable logistic regression

The outcome variables in this study, namely, under-five stunting, wasting, anaemic, underweight and overweight, were dichotomous Therefore, multivariable logistic regression was employed to analyse the association between MHCSU and CHOs in India.

The multivariable logistic regression model can be expressed as follows.

$$\ln \frac{P1}{1-P1} = \alpha_1 + \beta_i \, X_i \qquad (4.1)$$

In the above equation logit (Y) is the log (odds) of the outcomes variables, whereas P_1 is the probability (likelihood) of the child being stunted, wasted, anaemic, underweight, or overweight (Cabrera, 1994). The parameter α_1 measures the log odds of outcome variables in relation to the base category, and β_i estimates the maximum likelihood estimator for the i^{th} control variable (Cabrera, 1994). The maximum likelihood estimation of β is interpreted as the differential log of a child being stunted, wasted, anaemic, underweight and overweight, associated with covariates X, compared to the base category. To investigate the effect of the number of ANC visits, number of days IFA tablets consumed, number of months pregnant at the time of first ANC check-up, the presence of skilled birth attendant during delivery and PNC received by mothers on CHOs, separate adjusted logistic regression models were employed. The regression coefficients can be interpreted using estimated log odds ratio (ORs) with 95% confidence intervals (CIs). The analysis was performed using STATA version 12.0 StataCorp LP, College Station, TX, USA). Furthermore, the Hosmer-Lemeshow test was used to assess the validity of statistical models (Supplementary Table III.1).

4.3 Data analysis and results

4.3.1 Descriptive statistics

Table 4.1 presents the socio-economic and demographic characteristics of children aged 0-5 years and mothers aged 13-49 years. The majority of children were male (53.96 %) and of second to fourth birth order (59.92 %). Most women belonged to the 25-34 years age category at the time of childbirth (49.25 %) and had secondary educational attainment (55.48 %). Approximately three-fourths of respondents resided in rural areas (76.59 %) and identified themselves as Hindus (79.47 %). Most respondents belonged to the OBC caste (41.63 %) and to poorer wealth quintile households (22.08 %) (Table 4.1). A

summary of the prevalence of child health outcomes and maternal health care services utilization is presented in Table 4.2. It is dismaying that most of the children (68.38 %) are anaemic in India. Notably, the prevalence of stunting (33.91 %), wasting (18.39 %), and underweight (27.62 %) was high among children, raising public health concerns. Almost 3 % of children were overweight. Furthermore, it is perturbing that the majority of women (69.30 %) did not consume IFA tablets for at least 180 days. Only 66.79% of women attended at least 4 ANC visits, while 77.53% attended the first ANC check-up in the first trimester, indicating inadequate ANC coverage in India. Additionally, 18.39 % of women did not have skilled assistance during delivery, and 10.25 % did not receive PNC (Table 4.2). Supplementary Fig. III.2-III.3 illustrates the state-wise geographical variation in under-five CHOs and MHCSU among children aged 0-5 years and mothers aged 13–49 years in India.

Table 4.1. Socio-economic and demographic characteristics of a child aged 0-5 years and women aged 13–49 years who had at least one live birth in the past five years preceding the survey in India, DHS (2019-21)

Variables	Frequency	Percentage
Child Characteristics		
Child gender		
Male	47,503	53.96
Female	40,532	46.04
Childbirth order		
Firstborn (ref.)	31,530	35.82
2^{nd}- 4^{th} born	52,753	59.92
5^{th} or higher birth order	3,752	4.26
Maternal Characteristics		
Maternal age at childbirth		
13-24	40,260	45.73
25-34	43,358	49.25
35-49	4,417	5.02
Maternal education		
No education	13,902	15.79
Primary	9,721	11.04
Secondary	48,839	55.48
Higher	15,573	17.69
Household Characteristics		
Place of residence		
Urban	20,610	23.41
Rural	67,425	76.59
Religion		
Hindu	69,963	79.47
Muslim	8,982	10.20
Others	9,090	10.33
Caste		

Scheduled Caste	18,459	20.97
Scheduled Tribe	16,474	18.71
Other Backward Class	36,645	41.63
None of them	16,457	18.69
Wealth Index		
Poorest	17,504	19.88
Poorer	19,436	22.08
Middle	18,557	21.08
Richer	17,470	19.84
Richest	15,068	17.12

Source: Authors' calculations based on DHS survey data

Table 4.2. Prevalence of child health outcomes and maternal health care services utilization among children aged 0-5 years and women aged 13–49 years who had at least one live birth in the past five years preceding the survey in India, DHS (2019-21)

Variables	Frequency	Percentage
Stunting		
Yes	29,849	33.91
No	58,186	66.09
Wasting		
Yes	16,194	18.39
No	71,841	81.61
Anemic		
Yes	60,201	68.38
No	27,834	31.62
Underweight		
Yes	24,313	27.62
No	63,722	72.38
Overweight		
Yes	2,981	3.39
No	85,054	96.61
Attended at least 4 ANC visits		
Yes	58,797	66.79
No	29,238	33.21
Consumed IFA tablets for at least		

180 days		
Yes	27,029	30.70
No	61,006	69.30
Number of months pregnant at the time of first ANC visit		
<4 months	68,257	77.53
≥4 months	19,778	22.47
Skilled assistance during delivery		
Yes	71,849	81.61
No	16,186	18.39
Mother's received PNC		
Yes	79,010	89.75
No	9,025	10.25

Source: Authors' calculations based on DHS survey data

4.3.2 Estimating the impact of MHCSU on under-five CHOs in India

Table 4.3 presents the results of multivariate logistic regression for estimating the influence of MHCSU on CHOs in India using DHS (2019-21). A mother who consumed IFA tablets for at least 180 days had lower odds of having an anaemic child [OR 0.94; 95% CI 0.9–0.99]. The odds of being underweight were higher among children [OR 1.05; 95% CI 1–1.1] whose mothers were more than three months pregnant at the time of the first ANC check-up. Interestingly, our study found that the mothers who attended at least four ANC visits were more likely to have an overweight child [OR 1.13; 95% CI 1.02–1.25]. The skilled assistance during delivery reduced the odds of wasting [OR 0.96; 95% CI 0.92–0.99] and anaemia [OR 0.9; 95% CI 0.85–0.95] among children. Mothers who received PNC had lower odds of having an anaemic child [OR 0.91; 95% CI 0.85–0.98].

Furthermore, the odds of stunning [OR 0.89; 95% CI 0.86–0.92], wasting [OR 0.93; 95% CI 0.9–0.96], and underweight [OR 0.86; 95% CI 0.83–0.89] were lower among female children. As a child's birth order increases, the odds of being stunted [OR 1.57; 95% CI 1.42–1.73] and underweight [OR 1.31; 95% CI 1.19–1.45] increase. In contrast with the increase in a child's birth order, the odds of being overweight decrease [OR 0.67; 95% CI 0.53–0.85]. A mother who belonged to mature age (35-49 years) at the time of childbirth had lower odds of having a stunted [OR 0.8; 95% CI 0.73–0.89] and anaemic [OR 0.77; 95% CI 0.7–0.85] child.
Educated mothers were less likely to have stunted [OR 0.81; 95% CI 0.77–0.85], wasted [OR 0.89; 95% CI 0.85–0.94], anaemic [OR 0.84; 95% CI 0.78– 0.89] and underweight [OR 0.8; 95% CI 0.76–0.84] children.

Table 4.3. Multivariate logistic regressions for analysing the impact of maternal health care services utilization on child health outcomes using DHS (2019-21) conducted in India

Dependent Variable →	**Stunting**		**Wasting**		**Anemic**		**Underweight**		**Overweight**	
Independent Variables↓	OR	CI (95%)	OR	CI (95%)	OR	CI (95%)	OR	CI (95%)	OR	CI (95%)
Attended 4+ ANC visits										
No (Ref.)										
Yes	0.97	(0.94-1.01)	1.02	(0.98-1.05)	0.96	(0.92-1.01)	0.98	(0.95-1.02)	1.13*	(1.02-1.25)
Number of days IFA consumed										
Less than 180 days (Ref.)										
At least 180 days	0.97	(0.93-1.01)	1	(0.96-1.03)	0.94*	(0.9-0.99)	0.98	(0.94-1.03)	1.07	(0.97-1.17)
Number of months pregnant at the time of first ANC visit										
<4 months (Ref.)										
≥4 months	1.04	(0.99-1.09)	1	(0.96-1.04)	0.95*	(0.9-1)	1.05*	(1-1.1)	0.95	(0.86-1.06)
Skilled assistance during delivery										
No (Ref.)										
Yes	1.01	(0.96-	0.96*	(0.92-0.99)	0.9*	(0.85-	0.98	(0.94-	1.08	(0.96-

Dependent Variable →	**Stunting**		**Wasting**		**Anemic**		**Underweight**		**Overweight**	
Independent Variables↓	OR	CI (95%)	OR	CI (95%)	OR	CI (95%)	OR	CI (95%)	OR	CI (95%)
		1.05)				0.95)		1.03)		1.21)
Mother's received PNC										
No (Ref.)										
Yes	1.01	(0.95-1.07)	1.02	(0.97-1.07)	0.91*	(0.85-0.98)	0.98	(0.93-1.04)	0.94	(0.82-1.08)
Child gender										
Male (Ref.)										
Female	0.89*	(0.86-0.92)	0.93*	(0.9-0.96)	0.99	(0.95-1.03)	0.86*	(0.83-0.89)	0.96	(0.89-1.05)
Birth order										
First born (Ref.)										
2nd- 4th born	1.2*	(1.15-1.25)	0.98	(0.95-1.02)	0.96*	(0.91-1)	1.15*	(1.1-1.2)	0.76*	(0.69-0.84)
5th or higher birth order	1.57*	(1.42-1.73)	0.92	(0.85-1.01)	0.94	(0.84-1.05)	1.31*	(1.19-1.45)	0.67*	(0.53-0.85)
Maternal age at childbirth										
13-24 (Ref.)										
25-34	0.88*	(0.85-0.92)	1	(0.96-1.03)	0.95*	(0.91-0.99)	0.94*	(0.9-0.98)	1.13*	(1.03-1.25)
35-49	0.8*	(0.73-0.89)	1.04	(0.96-1.12)	0.77*	(0.7-0.85)	0.91	(0.83-1.01)	1.13	(0.91-1.42)
Maternal education										
No education (Ref.)										

Dependent Variable →	**Stunting**		**Wasting**		**Anemic**		**Underweight**		**Overweight**	
Independent Variables↓	OR	CI (95%)	OR	CI (95%)	OR	CI (95%)	OR	CI (95%)	OR	CI (95%)
Primary	0.94	(0.88-1)	0.9*	(0.85-0.95)	0.92*	(0.85-1)	0.94	(0.88-1)	0.86	(0.72-1.02)
Secondary	0.81*	(0.77-0.85)	0.89*	(0.85-0.94)	0.84*	(0.78-0.89)	0.8*	(0.76-0.84)	0.94	(0.81-1.08)
Higher	0.64*	(0.6-0.69)	0.83*	(0.78-0.88)	0.72*	(0.66-0.78)	0.65*	(0.61-0.71)	1.09	(0.92-1.29)
Place of residence										
Urban (Ref.)										
Rural	0.92*	(0.88-0.98)	0.93*	(0.89-0.97)	1.07*	(1.01-1.14)	0.89*	(0.85-0.94)	0.95	(0.84-1.06)
Religion										
Others (Ref.)										
Hindu	1.07	(0.98-1.17)	1.45*	(1.36-1.54)	1.2*	(1.1-1.31)	1.12*	(1.02-1.23)	0.88	(0.74-1.05)
Muslim	1.2*	(1.08-1.34)	1.67*	(1.55-1.81)	1.28*	(1.15-1.43)	1.22*	(1.09-1.36)	0.98	(0.79-1.21)
Caste										
None of them (Ref.)										
SC	1.25*	(1.17-1.33)	1.12*	(1.06-1.18)	1.17*	(1.1-1.25)	1.24*	(1.15-1.33)	0.92	(0.8-1.05)
ST	1.22*	(1.14-1.31)	1.21*	(1.14-1.28)	1.37*	(1.26-1.5)	1.37*	(1.27-1.49)	0.99	(0.84-1.17)
OBC	1.14*	(1.08-1.21)	1.12*	(1.07-1.17)	0.98	(0.92-1.03)	1.15*	(1.08-1.22)	0.88*	(0.78-1)
Wealth Quintile										

Dependent Variable →	**Stunting**		**Wasting**		**Anemic**		**Underweight**		**Overweight**	
Independent Variables↓	OR	CI (95%)	OR	CI (95%)	OR	CI (95%)	OR	CI (95%)	OR	CI (95%)
Poorest (Ref.)										
Poorer	0.88*	(0.83-0.93)	0.86*	(0.82-0.9)	0.95	(0.89-1.01)	0.82*	(0.78-0.87)	1.14	(0.99-1.32)
Middle	0.75*	(0.71-0.79)	0.77*	(0.73-0.81)	0.89*	(0.83-0.95)	0.66*	(0.63-0.7)	1.28*	(1.1-1.5)
Richer	0.62*	(0.58-0.66)	0.72*	(0.68-0.76)	0.83*	(0.77-0.89)	0.56*	(0.52-0.59)	1.33*	(1.12-1.57)
Richest	0.53*	(0.49-0.58)	0.61*	(0.57-0.65)	0.85*	(0.78-0.92)	0.44*	(0.41-0.48)	1.38*	(1.15-1.65)

Note. Level of significance for logistic model: * Significant at 5 percent level; OR, Odds ratio; CI, Confidence interval; ref.: Reference category of the variable.
Source: Authors' calculations based on DHS (2019-21) survey data

Our study found that children residing in rural areas were less likely to be stunted [OR 0.92; 95% CI 0.88–0.98], wasted [OR 0.93; 95% CI 0.89–0.97] and
underweight [OR 0.89; 95% CI 0.85–0.94]. By contrast, the odds of being anaemic [OR 1.07; 95% CI 1.01–1.14] were higher among children residing in rural areas. The poor performance of CHOs was prevalent among children belonging to both Hindu and Muslim communities. However, children from Muslim families were more likely to be stunted [OR 1.2; 95% CI 1.08–1.34], wasted [OR 1.67; 95% CI 1.55–1.81], anaemic [OR 1.28; 95% CI 1.15–1.43] and underweight [OR 1.22; 95% CI 1.09–1.36]. The odds of stunting [OR 1.22; 95% CI 1.14–1.31], wasting [OR 1.21; 95% CI 1.14–1.28], anaemia [OR 1.37; 95% CI 1.26–1.5] and underweight [OR 1.37; 95% CI 1.27–1.49] was highest among children belonging to Scheduled Tribes. The odds of being stunted [OR 0.53; 95% CI 0.49–0.58], wasted [OR 0.61; 95% CI 0.57–0.65], anaemic [OR 0.85; 95% CI 0.78–0.92] and underweight [OR 0.44; 95% CI 0.41–0.48] was lowest among children belonging to the richest households. On the contrary, children from the richest households were more likely to be overweight [OR 1.38; 95% CI 1.15–1.65].

4.4 Discussion

In this paper, we examined the impact of MHCSU on CHOs in India using nationally representative DHS data (2019-21). Our study underscores several significant findings. First, the dismally low performance of CHOs is alarming in India, with 68.38 % of children under the age of five being anaemic. Second, under- five wasting at 18.39 % is the highest in the world (Economic Times, 2022). Third, 69.30 % of the respondents did not consume IFA tablets for at least 180 days, and approximately one-third did not attend at least 4 ANC visits, reflecting suboptimal MHCSU in India.

Furthermore, in tandem with the previous studies conducted in Ethiopia (Yazew and Daba, 2022; Yazew, 2022) and Indonesia (Krisnana et al., 2020), our study found that the odds of being underweight were higher among children whose mothers were more than three months pregnant at the time of the first ANC check-up. The ANC visits during the initial months of pregnancy are imperative since as they allow mothers to consult health professionals about fetal health issues (Nana et al., 2022; Alem et al., 2022). We found that consumption of IFA tablets for at least 180 days reduced the odds of anaemia among children. The probable reason is that antenatal multiple micronutrient supplementations have proven to improve the child and mother's health by preventing the risk of adverse pregnancy including facial clefts, fetal death and fetal growth restriction (Sengpiel et al., 2014; Krisnana et al., 2020; Shinde et al., 2022). Notably, the mothers who attended at least four ANC visits were more likely to have an overweight child. This may seem counterintuitive, but a plausible explanation could be that adequate ANC checkups and prenatal nutritional guidance reduce the possibility of birth defects, miscarriage and

malnutrition among children (Grant and Smarr, 2022). Lansdale et al. (2024) argue that each additional ANC visit leads to a 0.03kg increase in a child's weight, based on a study in West Africa.

We found that skilled assistance during delivery reduced the odds of wasting and anaemia among children. A study conducted in India using previous DHS data (2015-16) found that women who have received at least 4 ANC visits were more likely to opt for skilled assistance during delivery (Islam et al., 2024). Adequate ANC visits provide women with information on risk identification, fetal assessment, health education, immunization and nutrition guidance, leading to improved CHOs (Kuhnt and Vollmer, 2017; Islam et al., 2024). Furthermore, skilled assistance during delivery addresses maternal haemorrhage and sepsis by using clean and sterile equipment, pre-eclampsia and eclampsia (Bale et al., 2003). The skilled attendants can also administer antiretroviral therapies, provide initial care for sick and/or low-birth-weight infants, refer them for further treatment, and support early breastfeeding initiation (Bale et al., 2003). Therefore, skilled assistance during delivery is imperative for improved CHOs. Our study found that the odds of under- five anaemia were lower among children whose mothers have received PNC. PNC visits have several positive ramifications, including promoting colostrum feeding and breastfeeding practices, follow-up for premature and/or low birth weight newborns, treating potential infection or other diseases, preventing pneumonia and diarrhoea, and imparting nutritional and hygiene guidance (Singh et al., 2017). McCauley et al. (2022) contend that PNC improves CHOs as mothers are informed about a child's growth, feeding and well-being. A case-control study conducted at SAT Hospital in Kerala (a state in India) found that the absence of exclusive breastfeeding led to under-five anaemia among children (Anjali et al., 2019).

Additionally, our study also highlighted that the prevalence of stunting, wasting and being underweight was higher among male children compared to female children. A plethora of studies have confirmed similar findings (Ali et al., 2017; Khan et al., 2019; Thurstans et al., 2022; Siddiqa et al., 2022). Khan et al. (2019) vehemently argue that male children require more calories for growth and development than female children, making them more susceptible to malnutrition. Moreover, poor CHOs among male children could be explained by differences in calorie intake, physical activity behaviour, social psychology and environmental factors (Saha et al., 2022). Male foetuses are more likely to experience placental insufficiency, infections and pre-term delivery (Ingemarsson, 2003; Marino et al., 2011). Notably, male children tend to spend more time playing outdoors, leading to greater energy expenditure and increased exposure to environmental risks and sources of infection (Gewa and Yandell, 2011; Akombi et al., 2017). Thereby, it makes male children more prone to poor CHOs. We found that with an increase in a child's birth order, the odds of being stunted and underweight increase. Compared to children of single births, children of multiple births generally receive inadequate breastfeeding, attention and improper nutritional intake (Adeyemi et al., 2022). Our results are compatible with studies conducted in East African countries and India (Woldeamanuel and Tesfaye, 2019; Srivastava and Upadhyay, 2020;

Tamirat et al., 2021; Ibeji et al., 2022; Das et al., 2022; Saha et al., 2022).

In tandem with the previous studies conducted in Nigeria (Ibeji et al., 2022; Adeyemi et al., 2022), Ethiopia (Yazew and Daba, 2022), Pakistan (Asif et al., 2022) and India DHS 2015-16 (Das et al., 2022), our study found that maternal age and education are significant determinants of childhood stunting, wasting, anaemia and underweight in India. Mothers with mature age and higher educational attainment are more likely to be informed and conscious about their child's nutritious diet, have more health-seeking behaviour, and ensure timely vaccination and proper healthcare (Patel et al., 2019; Adeyemi et al., 2022). Our study found that a child born in a rural region was more likely to be anaemic, in line with a similar observation in Nigeria (Ibeji et al., 2022). The probable reasons can be a lack of access to good health care, poor sanitation and lack of awareness in the rural areas of developing countries (Hall et al., 2018; Sisay et al., 2022).

Our study found that a child born in rural region has higher probability of being anaemic in line with a similar observation in Nigeria (Ibeji et al., 2022). The probable reasons can be lack of access to good health care, poor sanitation and lack of awareness in the rural areas of developing countries (Hall et al., 2018; Sisay et al., 2022). The present study also found increased risk of poor CHOs among families belonging to the Muslim religion and scheduled tribe. This result is similar to the results of a previous study conducted in Madhya Pradesh, India using data from National Family Health Survey-3 (2005-06) (Shyam et al., 2020). There is evidence that no-or-partial immunization is more common among children whose mothers belong to non-Hindu religion or backward caste (Puri et al., 2020; Islam et al., 2021). Moreover, in India traditional practices, customs, dietary practices and attitudes are often influenced by the religion and caste of an individual; thereby, impacting CHOs (Puri et al., 2020). We found that children belonging to the richest wealth quintile had lower odds of under-five stunting, wasting, anaemia and underweight. Since family belonging to the richest wealth quintile has availability of high-quality nutrient supplements, more purchasing capacity and access to healthcare services; thereby improving CHOs (Chowdhury et al., 2020; Waghmare et al., 2022; Paul and Saha, 2022). This finding is in line with studies conducted in Nigeria, Ethiopia and India (Woldeamanuel and Tesfaye, 2019; Ibeji et al., 2022; Adeyemi et al., 2022; Yazew and Daba, 2022; Das et al., 2022).

4.5 Limitations of the study

As with all studies, there are also few limitations of the study. First, the study used cross-sectional data, therefore, we abstain from providing causal interpretation regarding relationship between maternal healthcare services and CHOs (Syeda et al., 2021; Paul and Saha, 2022; Alem et al., 2022). Secondly, DHS data were collected retrospectively and self-reported, thus our findings are prone to recall bias, information bias, underreporting and social desirability bias (Komakech et al., 2022; Paul and Saha, 2022; Alem et al., 2022). Lastly,

we acknowledge due to the secondary nature of data, important variables such as women's knowledge about the timing of ANC and PNC, women's perception on quality of MHCSU, and time of recognition of pregnancy were not included in this study (Alem et al., 2022).

4.6 Conclusion and policy recommendations

This paper examined the effect of MHCSU on CHOs in India. The study found that utilization of ANC and PNC can reduce under-five stunting, anaemia and underweight. However, skilled birth attendance during delivery had no association with CHOs. The plausibility of being overweight during childhood is influenced by PNC, though ANC has no significant impact on the same. Furthermore, we observed that the gender of a child, birth order, maternal age, maternal education, religion, caste and household wealth profoundly influence the CHOs. In terms of preventive strategies, policy makers should extensively focus on schemes such as Janani Suraksha Yojana, Surakshit Matritva Aashwasan and Janani Shishu Suraksha Karyakaram to increase number of ANC visits, greater consumption of IFA tablets by pregnant women, adequate availability and affordability of maternal healthcare services, breastfeeding counselling and nutritional guidance .Direct and improved engagement with frontline health workers, namely, Accredited Social Health Activists, Auxiliary Nurses and Midwives, and Anganwadi Workers, can ensure the uptake of services and optimal maternal–newborn outcomes. Towards the achievement of sustainable development goal 2 targets relating to child nutrition, India must first address challenges such as inadequate infrastructure, regular shortage of essential supplies, poor communication and transportation systems, lack of manpower, and negative sociocultural practices. More studies are needed to test and compare the effectiveness, cost-effectiveness, acceptability, and sustainability of various strategies for improving quality of maternal health care and client-provider interaction, especially the poor and vulnerable in India.

4.7 References

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4.8 Appendix

Supplementary Table III.1. Validity of the statistical models

Results of the Hosmer-Lemeshow test

III. 1a. Multivariate logistic regressions for analysing the impact of maternal health care services utilization on child health outcomes using DHS (2019-21) conducted in India.

Variables	Stunting	Wasting	Anaemic	Underweight	Overweight
Hosmer-Lemeshow chi2	1.57	5.77	12.11	10.75	13.93
P > chi2	0.99	0.67	0.15	0.22	0.08

Note. P-value > 0.05 shows that the model is correctly specified

Source: Authors' calculations based on DHS survey data

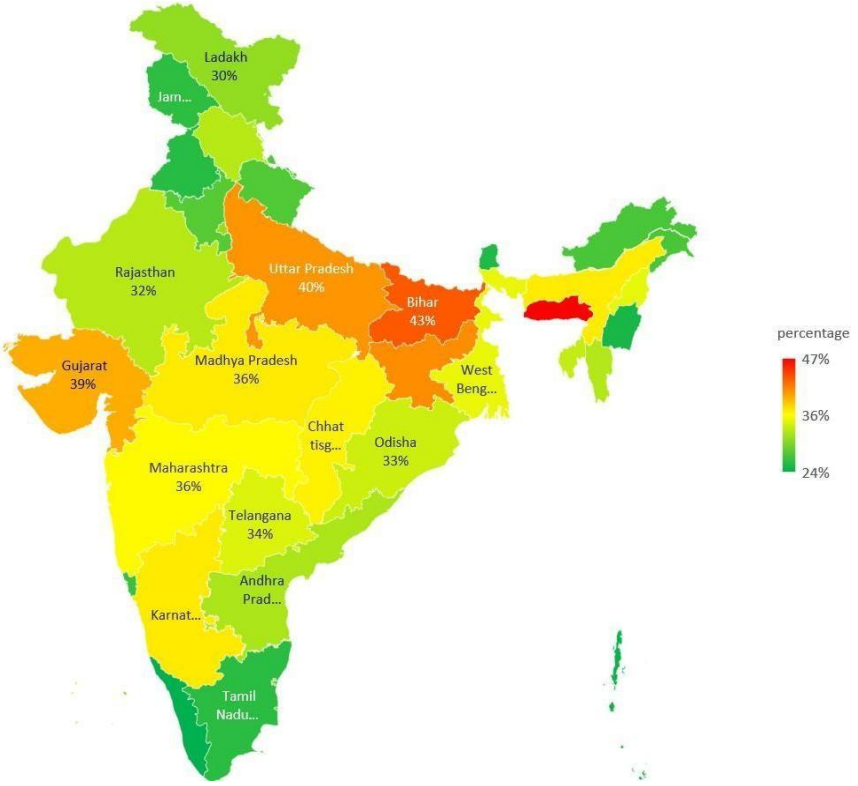


Figure III.2a: Under five stunting

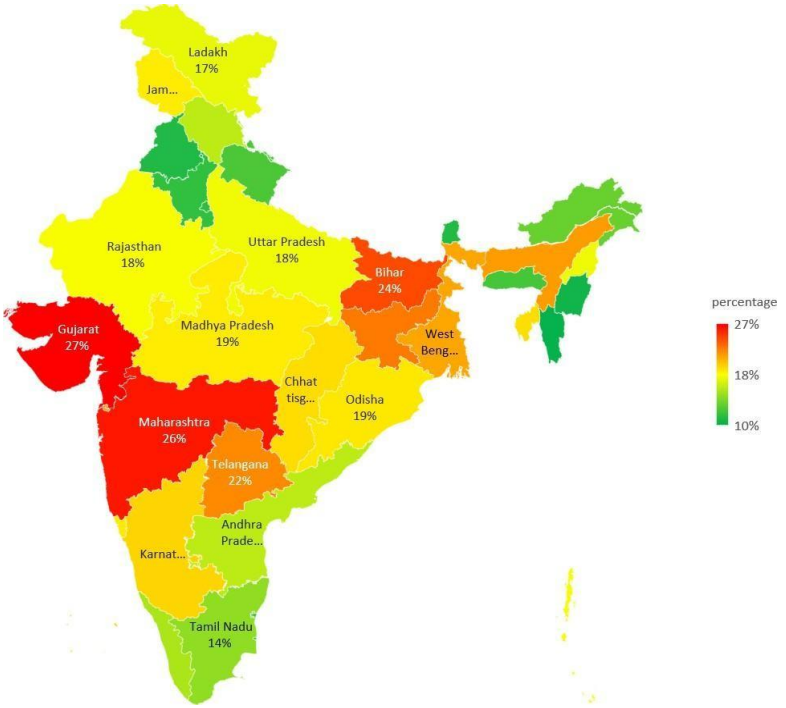


Figure III.2b: Under five wasting

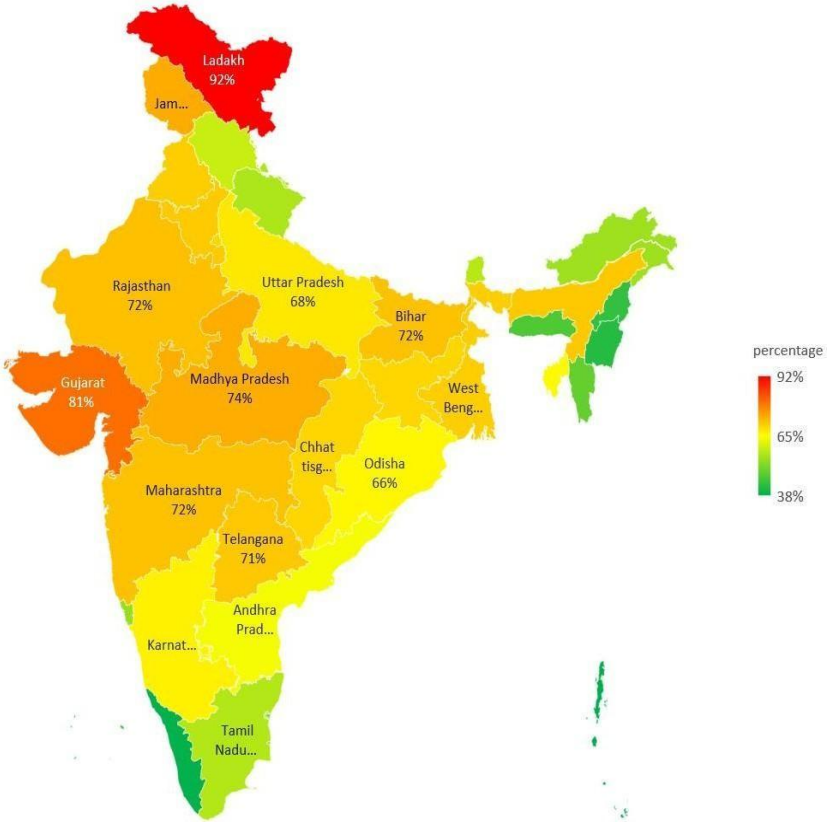


Figure III.2c: Under five anaemia

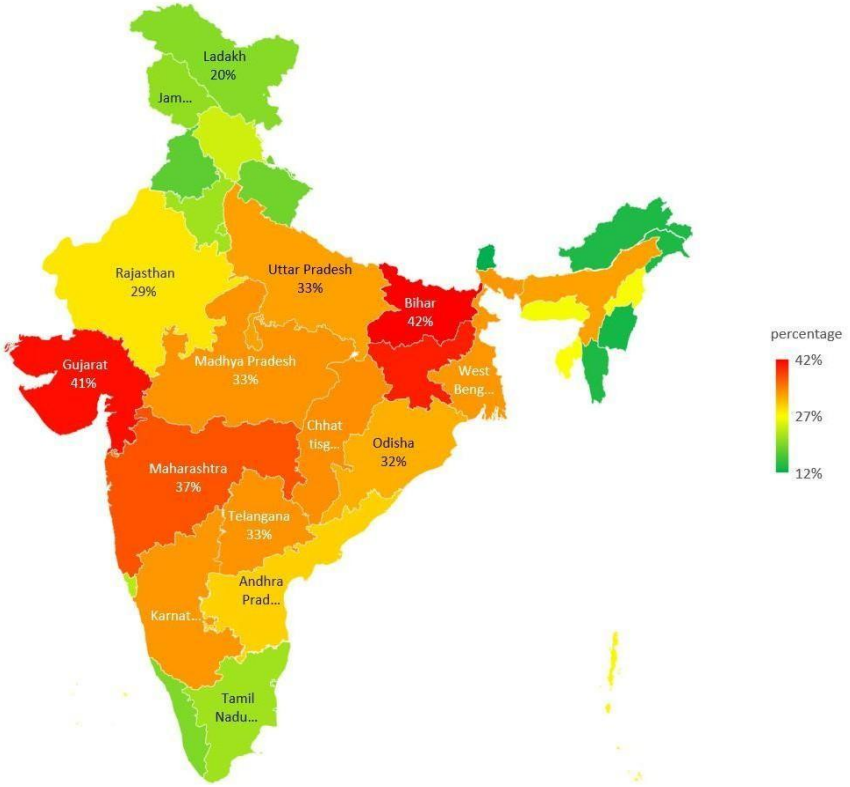


Figure III.2d Under five underweight

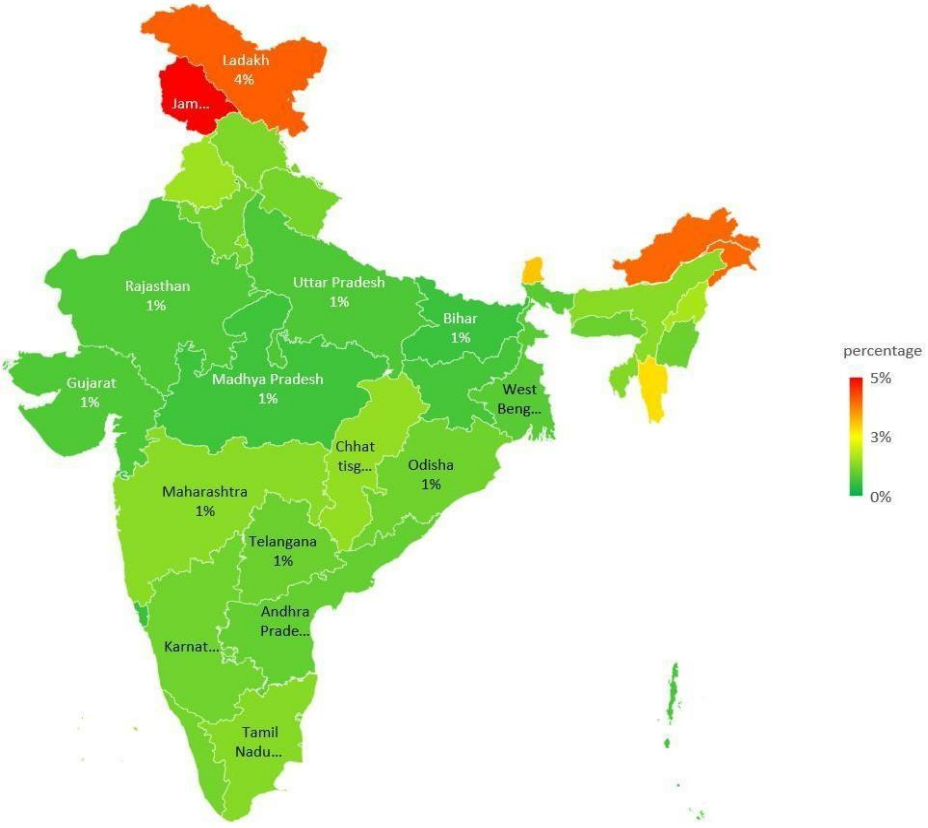


Figure III.2e Under five overweight

Supplementary Fig. III.2 The geographical variation of child health outcomes among children under the age of five years in India

Source: Authors' calculations based on DHS survey data

Supplementary Fig. III.2 demonstrates state wise geographical variation in under-five CHOs in India. Stunting among children was found to be the highest in Meghalaya (47%), followed by Bihar (43%) and Jharkhand (41%), whereas the lowest under five stunting was observed in Kerela (24%), Andaman & Nicobar Islands (24%) and Chandigarh (24%). Under five wasting was the highest in Gujarat (27%), followed by Maharashtra (26%) and Bihar (24%), while it was the lowest in Chandigarh (10%), Mizoram (10%) and Manipur (10%). Five states of India namely, Ladakh (92%), Gujarat (81%), Jammu & Kashmir (74%), Madhya Pradesh (74%) and Dadra & nagar haveli (73%) show a very high percentage of under-five anemic level among children. However, it was the lowest in Andaman & Nicobar Islands (38%), followed by Kerela (38%), Manipur (42%) and Nagaland (44%). Highest prevalence of undernutrition was found in Bihar (42%), Gujarat (41%), Jharkhand (40%) and Maharashtra (37%), whereas the lowest was observed in Sikkim (12%), followed by Manipur (14%), Arunachal Pradesh (14%), Mizoram (14%) and Punjab (18%). Jammu & Kashmir (5%), followed by Ladakh (4%) and Arunachal Pradesh (4%) have the highest number of overweight children, while the lowest was observed in Chandigarh (0%) and Dadra & nagar haveli (0%).

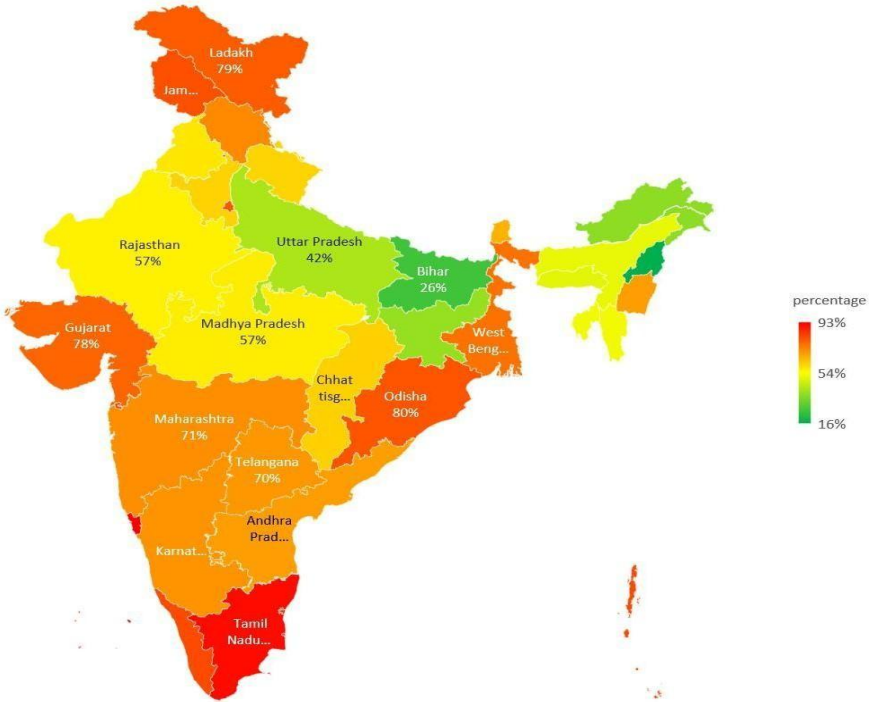


Figure III.3a: Attended at least four ANC visits

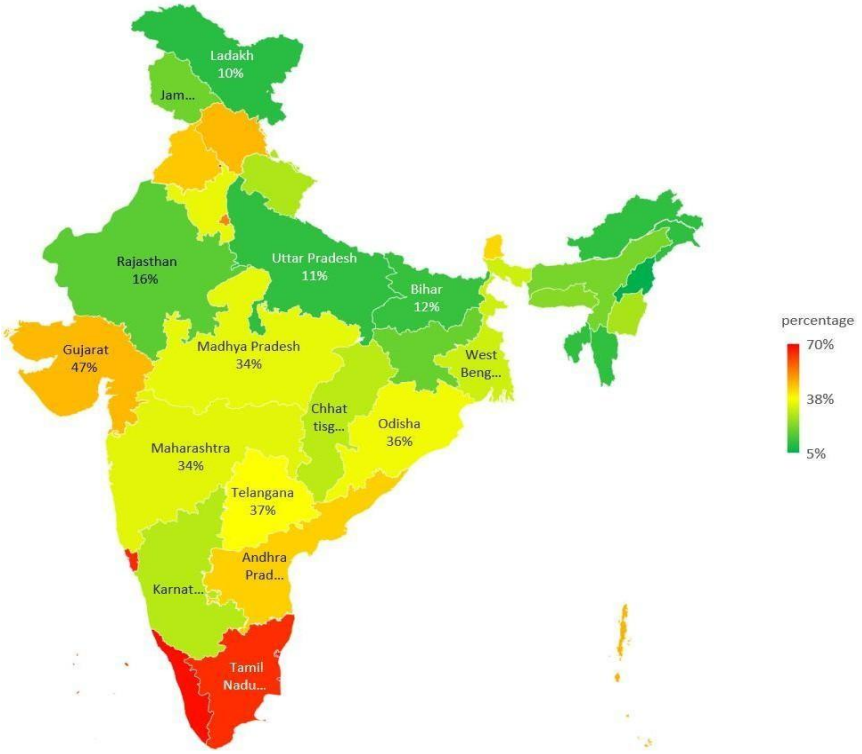


Figure III.3b: Consumed IFA tablets for at least 180 days

Figure III.3c: Received their first ANC visit in the first trimester

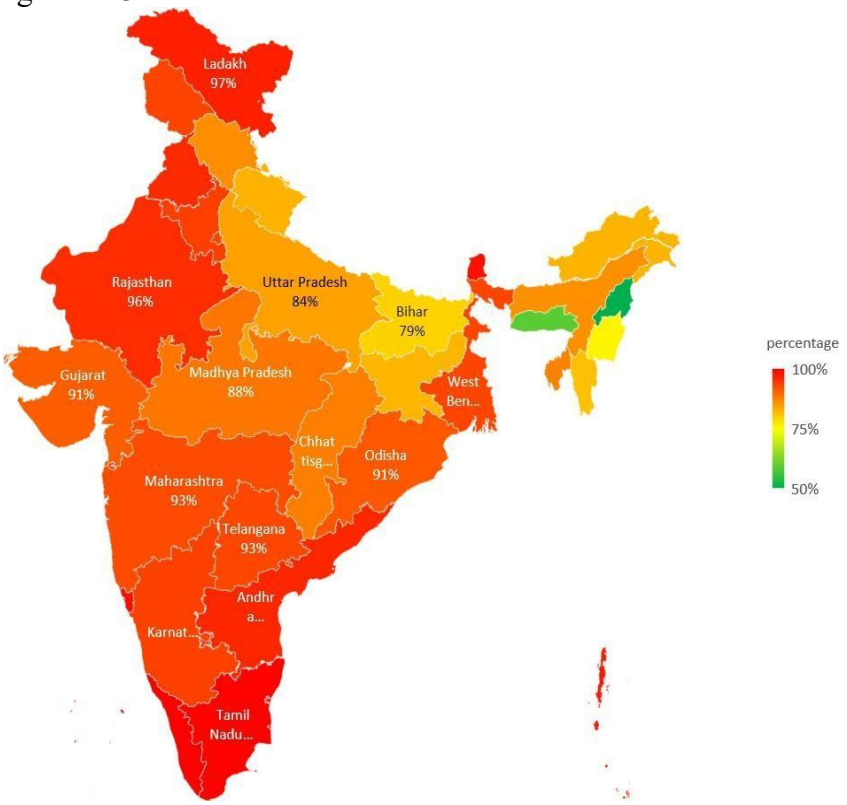


Figure III.3d: Availed skilled assistance during delivery

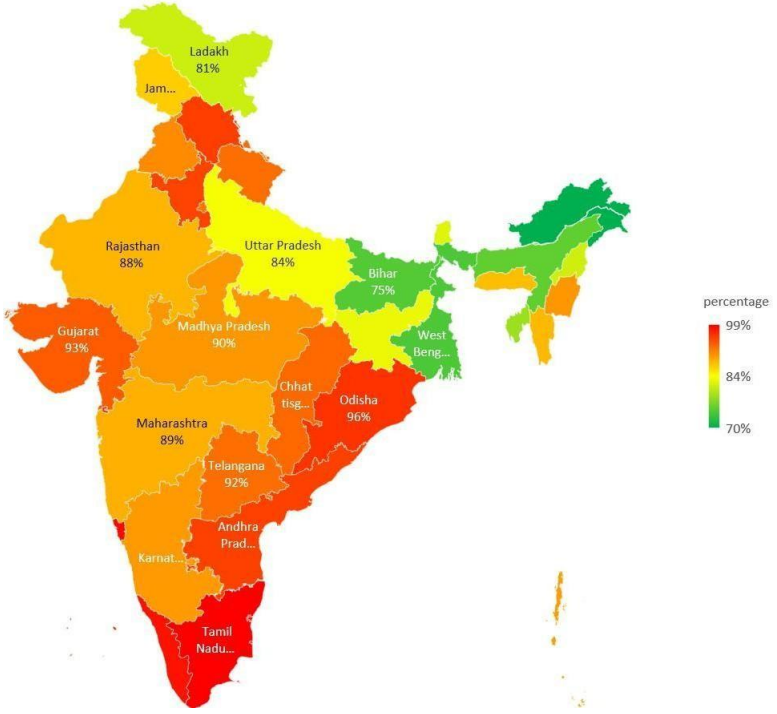


Figure III.3e: Received PNC check-ups

Supplementary Fig. III.3 The geographical variation of maternal

healthcare service utilization among mothers aged 13–49 years in India

Source: Authors' calculations based on DHS survey data

Supplementary Fig. III.3 depicts the geographical variation in MHCSU among mothers aged 15–49 years in India. We found that Goa (93%) has the highest number of mothers who have attended at least four ANC visits, followed by Tamil Nadu (91%), Lakshadweep (91%) and Puducherry (86%), while the lowest was observed in Nagaland (16%), Bihar (26%) and Arunachal Pradesh (37%). The highest consumption of IFA tablets for at least 180 days was found in Puducherry (70%), followed by Kerela (69%), Chandigarh (67%) and Goa (65%), whereas the lowest consumption was found in Nagaland (5%), followed by Ladakh (10%), Arunachal Pradesh (11%), Uttar Pradesh (11%), Tripura (11%) and Mizoram (11%). Lakshadweep (99%), followed by Kerela (93%), Puducherry (89%), Ladakh (89%), Telangana (89%) and Jammu & Kashmir (89%) have the highest number of mothers who received their first ANC visit in the first trimester, while the lowest was found in Meghalaya (60%), followed by Bihar (65%) and Uttar Pradesh (66%). The highest prevalence of skilled assistance during delivery was observed in Tamil Nadu (100%), Kerala (100%), Lakshadweep (100%), followed by Puducherry (99%) and Goa (99%), while the lowest was observed in Nagaland (50%), Meghalaya (59%) and Manipur (76%). Mothers belonging to Tamil Nadu (99%), followed by Goa (98%), Puducherry (98%) and Kerela (98%) received the highest number of PNC visits, whereas the lowest PNC visits were received in Arunachal Pradesh (70%), followed by West Bengal (74%), Assam (75%) and Bihar (75%).

CHAPTER 5

TEMPORAL IMPACT OF SOCIOECONOMIC DEPRIVATION ON CHILD HEALTH OUTCOMES IN INDIA: EVIDENCE FROM DEMOGRAPHIC HEALTH SURVEY 2015-21

5.1 Introduction

Globally, malnutrition contributes to nearly half of all deaths in children under the age of five years (WHO, 2024). It is disconcerting that malnutrition is an alarming predicament worldwide, with 149 million and 45 million children are estimated to be stunted and wasted, respectively (WHO, 2024). The developmental, economic, social and medical ramifications of the global burden of malnutrition are substantial and lasting, affecting individuals, families, communities and nations on multiple levels (WHO, 2024). Economically, malnutrition imposes a colossal burden of US$3 trillion a year in the form of productivity loss, ranging from 3 to 16% of GDP in low-income countries (World Bank, 2023).

Child malnutrition has continued to remain a persistent problem in low and middle-income countries. The poor child health outcomes (CHOs) including stunting (low height for age), wasting (low weight for height) and underweight (low weight for age) impede the development of the child in terms of health and socioeconomic status (McGovern et al., 2017; WHO, 2021). Poor CHOs increase the prevalence of child mortality and morbidity and also lead to impaired physical and cognitive development, poor learning capacity, lower educational attainment and economic productivity in adulthood (Pelletier et al., 1994; Black et al., 2013, Khura et al., 2023).

Despite improvements in the Millennium Development Goal era, malnutrition remains overwhelmingly high in India, with under-five stunting at 35.5%, underweight at 32.1% and wasting being one of the highest in the world at 19.3% (NFHS-5, 2022; Economic Times, 2022). Furthermore, in terms of the global hunger index (GHI), India (111) lags behind its South Asian peers namely, Pakistan (102), Bangladesh (81), Nepal (69), and Sri Lanka (60), which is concerning for a developing country such as India (Concern Worldwide & Welthungerhilfe, 2023). Considering the poor CHOs in India, it is essential to investigate the factors affecting CHOs in India; by targeting those factors, India can achieve the Sustainable Development Goals related to child health.

The Fundamental Cause Theory derived from Geoffrey Rose's Cause of Causes highlights the role of socioeconomic deprivation on health outcomes (Rose, 1985; Link & Phelan, 1995). Therefore, material deprivation and

structural disadvantages such as limited access to water and sanitation facilities, inadequate maternal health care service utilization (MHCSU) and lower breastfeeding practices (often due to mothers returning to work just after childbirth) in India among women belonging to lower socioeconomic status might influence child health. Furthermore, dynamic interrelations exist between individual-level care-seeking behaviour and community-level services and infrastructure (Urie, 1992). Moreover, breastfeeding practices and good sanitation together form a set of sequential barriers protecting children from diarrhoeal morbidity (VanDerslice et al., 1994). Breastfeeding improves an infant's resistance to infection and reduces exposure to water and foodborne pathogens, while good water and sanitation facilities decrease the exposure to water-related diseases and faecal pathogens (VanDerslice et al., 1994). Additionally, developing countries like India struggle with gender-specific discrimination, low economic status and basic survival issues like access to clean water and proper sanitation infrastructure. These socio-political aspects have major implications for a child's well-being (Maggi et al., 2010; Negi & Singh., 2019). Similarly, women belonging to socially marginalized and isolated groups (Scheduled Castes/ Scheduled Tribes/ Other Backward Classes/ Religious Minorities) in India have lower literacy rates, rigid religious beliefs and under-representation in governmental and political positions (Sanneving et al., 2013), potentially affecting child health.

Over the years, numerous scholars have put forward different perspectives regarding the impact of water and sanitation facilities, MHCSU and breastfeeding practices on CHOs. Currently, two prevailing perspectives exist on the impact of water and sanitation facilities on CHOs. The first perspective advocates that unclean water and sanitation facilities increase the prevalence of poor CHOs. The relevant studies using logistic regression, conducted with samples of 7,209 children in Ethiopia (Van Cooten et al., 2018) and 656 children in Pakistan (Haq et al., 2022), found that the unprotected sources of drinking water increased the prevalence of stunting, wasting and underweight among children. Additionally, a study conducted in Cambodia (Lai et al., 2022) involving 4036 children and using generalised estimating equations (GEEs) to fit linear regression models also arrived at a similar conclusion.

Furthermore, studies using logistic regression with a sample of 26,972 women in India (Patel et al., 2019), 4,768 women in Namibia (Abdelhady et al., 2021), 33,763 children in Ethiopia (Sahiledengle et al., 2022) and 656 children in Pakistan (Haq et al., 2022) found that unimproved sanitation facilities, open defecation and shared sanitation facilities increased the risk of stunting, wasting and underweight among children. However, the second perspective suggests that unclean water and sanitation facilities have no impact on CHOs (Bekele et al., 2020; Cameron et al., 2021). Furthermore, counterintuitively, a study using logistic regression with a sample of 33,763 children found that unprotected sources of drinking water lowered the prevalence of wasting among children (Sahiledengle et al., 2022). Sahiledengle and colleagues (2022) contend that due to the unavailability of pertinent

information regarding the bacteriological, chemical, and physical attributes of drinking water, as well as the duration of households utilizing improved water sources, they are unable to elucidate the association between consumption of unprotected sources of drinking water and reduced prevalence of wasting. Similarly, several previous studies conducted in low and middle-income countries found evidence in support of the positive impact of MHCSU on child health. The studies conducted in India (Srivastava & Upadhyay, 2020) using multivariable decomposition regression analysis with a sample of 128,265 children, in Nigeria (Adeyemi et al., 2022) using linear decomposition analyses with 57,507 children, in Ethiopia (Yazew & Daba, 2022) using logistic regression with 612 children, and in Pakistan (Haq and Abbas, 2022) using logistic regression with 10,080 children (Haq and Abbas, 2022) found that the lack of ANC check-ups increased the odds of stunting, wasting and underweight.

A study in India (Rai et al., 2021) using logistic regression with a sample of 120,374 children found that the consumption of iron folic acid (IFA) tablets during pregnancy reduced the prevalence of stunting among children. Furthermore, studies using logistic regression in Nepal (Pokhrel et al., 2016) with 262 women and in Bangladesh (Anik et al., 2021) with 7661 children found that the mothers who have not received PNC were more likely to have children with severe undernutrition.

However, it is worth noting that the practical relevance of the conventional theory that MHCSU has a positive impact on child health has been put into question by a study conducted by Yehuala and colleagues (2023) using logistic regression with a sample of 422 children, which found that PNC visits had no significant impact on child health in Ethiopia. Furthermore, the authors found an inconclusive impact of breastfeeding practices on CHOs. The empirical evidence using logistic regression in Bangladesh (Khan & Islam, 2017) with a sample of 1918 children, in India (Koya et al., 2020) with 240 women and in Democratic Republic of Congo (Luzingu et al., 2022) with 1612 children also confirmed that exclusive breastfeeding practices lower the prevalence of stunting and underweight. Similarly, in Ethiopia (Anato, 2022) using logistic regression with a sample of 392 women found that the absence of early initiation of breastfeeding increased the prevalence of poor CHOs. On the contrary, Syeda et al. (2021), using logistic regression with 1072 children, showed that breastfeeding practices had no significant association with wasting and underweight in Pakistan.

Against this backdrop, the main objective of this study is to examine the impact of water and sanitation facilities, MHCSU and breastfeeding practices together on CHOs using the latest two rounds of the Demographic and Health Survey (DHS) in India (2015-16) and (2019-21). In India, the majority of the studies examined either the impact of water and sanitation facilities (Patel et al., 2019; Sabud et al., 2020; Rahut et al., 2023) or MHCSU (Pokhrel et al., 2016; Srivastava & Upadhyay, 2020; Rai et al., 2021; Preeti et al., 2023) or breastfeeding practices (Koya et al., 2020; Chakrabarti et al., 2021) on CHOs; or were state-specific covering Bengaluru (Koya et al., 2020),

Odisha (Chakrabarti et al., 2021), West Bengal (Sabud et al., 2020) and Uttarakhand (Preeti et al., 2023). However, to the best of our knowledge, no study in India has examined the impact of water and sanitation facilities, MHCSU and breastfeeding practices together in improving poor CHOs. The foremost contribution of the paper is to bring the focus on community- level services (water and sanitation facilities) and individual-level health behaviour (MHCSU and breastfeeding practices) concurrently as factors influencing CHOs, since there is limited empirical evidence regarding this association in India. Our study has also highlighted the existence of sociocultural challenges within Indian society pertaining to the accessibility of water and sanitation facilities, MHCSU, and breastfeeding practices, along with their potential impact on child health. Furthermore, to the best of our knowledge, no research has looked into the temporal impact of water and sanitation facilities, MHCSU and breastfeeding practices on a comprehensive set of major child health indicators namely under-five stunting, wasting and underweight in India. This holistic assessment is expected to contribute to the existing literature on child health using nationally representative data and aims to aid in evidence-based policymaking towards improving child health in India.

5.2 Data and Methodology

5.2.1 Data Source

The data for this study has been extracted from the latest two rounds of DHS (2015-16) and (2019-21), known as the National Family Health Survey (NFHS-4 and 5). Under the direction of the Ministry of Health and Family Welfare (MoHFW), the International Institute for Population Sciences (IIPS) conducts nationally representative surveys of Indian households (NFHS-5, 2022). Since the framework and questions asked and their language are similar in both NFHS-4 and NFHS-5, a comparative analysis of CHOs between these two surveys is possible (Das et al., 2021). The two survey rounds covered a population-representative sample survey of 601,509 (2015-16) and 636,699 (2019-21) households with a response rate of 98% in each of two survey rounds (NFHS-5, 2022). Interviews were completed from 699,686 women aged 15-49 years with a response rate of 97% and 112,122 men aged 15-54 years with a response rate of 92% for DHS (2015-16). For DHS (2019- 21), interviews were completed from 724,115 women, with a response rate of 97% and 101,839 men aged 15-54 years with a response rate of 92% (NFHS-5, 2022). All children aged 0-5 years in the selected sampled households were covered. DHS (2015-16) and (2019-21) covered some additional focal areas like HIV testing during ANC, menstrual hygiene, high-risk sexual behaviour, sanitation, disability insurance coverage, and different methods and reasons for abortion (NFHS-5, 2022). DHS (2015-16) and (2019-21) selected 28,522 and 30,198 Primary Sampling Units (PSUs) from 640 and 707 Indian districts, respectively (NFHS-5, 2022). In both survey rounds, two-stage stratified sampling was employed (NFHS-5, 2022). First, clusters were chosen and then from each cluster, 22 households were selected using a systematic selection from the

household listing (NFHS-5, 2022). The details of sampling procedures for the survey are available in the national report, available online at https://dhsprogram.com/data/available-datasets.cfm. The data were adjusted to control for sampling unit, strata and sample weight.

5.2.2 Outcome variables

To assess the impact of water and sanitation facilities, MHCSU and breastfeeding practices together on CHOs, three anthropometric indicators are considered: stunting, wasting and underweight among children under the age of five years. As per WHO, a child is categorised as stunted, wasted and underweight if the height-for-age z-score, weight-for-height z-score and weight-for-age z-score of the child is two standard deviation below the median WHO child growth standards (WHO, 2023a). Outcome variables are dichotomized into two categories: not stunted/ not wasted/ not underweight coded as "0" and stunted/wasted/underweight among children under the age of five years were coded as "1".

5.2.3 Explanatory variables

The water and sanitation facilities variables included in the analysis are: source of drinking water (protected source of drinking water or unprotected source of drinking water), toilet facilities (Improved sanitation, unimproved sanitation or open defecation) and toilet facilities shared with other households (Yes or no). Protected drinking water sources are defined as those that are protected from outside contamination, and from faecal matter while improved sanitation facilities refer to those facilities that hygienically separate human waste from human contact (WHO, 2023b). According to WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation, protected source of drinking water includes piped supply within the yard, the dwelling, or the plot; a tube well; public standpipes; protected well or protected spring; rainwater collection; or bottled water (WHO & UNICEF, 2018). Meanwhile, the unprotected source of drinking water includes unprotected wells; unprotected springs; surface water (e.g. river/ dam/ lake/ ponds/ stream/ canal), and tanker trucks/carts with drums (WHO & UNICEF, 2018). Improved sanitation facilities include flush or pour-flush to piped sewer system, septic tank, or pit latrines; ventilated-improved pit latrines, or pit latrines with slab or composting toilets (WHO & UNICEF, 2018). Unimproved sanitation facilities include flush or pour-flush to elsewhere, pit latrines without slabs or open pits and dry toilets (WHO & UNICEF, 2018). Open defecation refers to the practice of not using any kind of toilet facilities for defecation.

MHCSU variables include at least four ANC visits (<4ANC visits and ≥4 ANC visits), number of days IFA tablets consumed (<180 days and ≥180 days) and PNC received by mothers (yes or no).

Breastfeeding practices variables include early initiation of breastfeeding i.e. children who were breastfed within 1 hour of birth (yes or no)

and exclusive breastfeeding for the initial six months (yes or no).

Additionally, we included several socio-political and economic hierarchies in societies such as mother's age (15–24, 25–34, 35–49 years), mother's educational attainment (no education, primary, secondary, higher education), place of residence (rural/urban), religion (Hindu, Muslim, other religions), caste (Scheduled Caste, Scheduled Tribe, Other Backward Class, none of them) and household wealth quintile (poorest, poorer, middle, richer, and richest).

5.2.4 Analytical Strategy

At the univariate level, percentages and frequency distribution were used to illustrate the respondent characteristics. Below we further discuss the methodologies applied.

5.2.4.1 Multivariable logistic regression

Logistic regression is one of the most employed techniques for modelling data when the outcome variable is binary (Buya et al., 2020). Since outcome variables, namely stunting, wasting and underweight are dichotomous, logistic regression was utilised in our analysis.

The statistical modelling of the outcome variable takes the following form.

$$\ln \frac{P1}{1-P1} = \alpha_1 + \beta_i \, \mathrm{X}i \qquad (5.1)$$

where P_1 refers to the likelihood of occurrence of outcome variables, α_1 denotes the constant, while the maximum likelihood estimator for i^{th} explanatory variable is measured by β_i (Buya et al., 2020). The parameter β is interpreted as a differential log of outcome variables, associated with covariates X, compared to the base category, while α_i measures the log odds of outcome variables in relation to the base category (Cabrera, 1994). Model 1 and Model 2 estimate the impact of the availability of water and sanitation facilities, MHCSU and breastfeeding practices on under-five CHOs in DHS (2015-16) and DHS (2019-21) respectively.

5.2.4.2 Time-interaction regression model

The temporal change between the two survey rounds was examined using the time-interaction term and the time-interaction regression model can be expressed as follows.

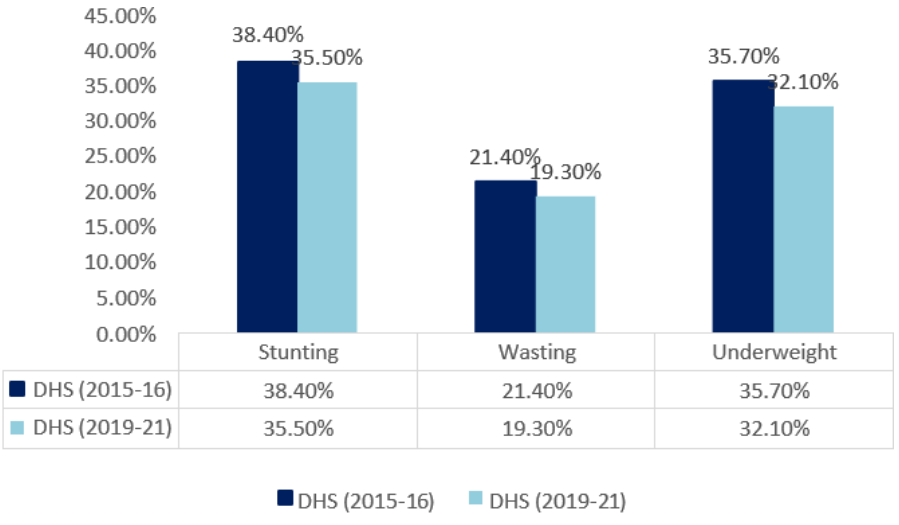
$$Y = \beta_0 + \delta_0 * t + \beta_1 x_1 + \cdots \beta_n x_n + \delta_1 (x_1 * t) + \cdots \delta_n (x_n * t) + \varepsilon \qquad (5.2)$$

where Y is the dependent variables, t is the time, δ_n is a vector of interaction terms of explanatory variables and time factor t, and ε is the error term (Khan et al., 2019). Model 3 identifies the impact of the availability of water and sanitation facilities, MHCSU and breastfeeding practices on CHOs considering the changes in the explanatory variables from DHS (2015-16) to DHS (2019-21) (Khan et al., 2019). The regression coefficients can be interpreted using estimated log odds ratio (ORs) with 95% confidence intervals (CIs). We have also provided p- values in the results tables, in order to figure out if a variable is statistically significant at alternate levels (1% or 10%) or not. The analysis was performed using STATA version 12.0 StataCorp LP, College Station, TX, USA).

5.3 Data analysis and results

5.3.1 Descriptive statistics

Fig. 5.1 demonstrates the temporal variation in under-five CHOs namely stunting, wasting and underweight during DHS (2015-16) and DHS (2019-21) in India. We observed improvement in all CHOs in India, though the improvement was limited in quantitative value. The most notable improvement was observed in the reduction of underweight prevalence among children under the age of five years in India, decreasing from 35.7% (2015–16) to 32.10% (2019–21), showing a 3.6% improvement. Conversely, the least improvement was seen in wasting, which decreased from 21.4% (2015-16) to 19.3% (2019-21), reflecting a 2.1% improvement. Furthermore, the prevalence of under-five stunting reduced from 38.4% (2015-16) to 35.5% (2019-21) in India.



Source: Authors' calculations based on DHS (2015-16) and DHS (2019-21) survey data

Fig. 5.1 Temporal variation in stunting, wasting and underweight among children under the age of five years in India during DHS (2015-16) and DHS (2019-21)

Table 5.1 presents the characteristics of respondents in the two survey rounds. More than 5% of the respondents had no access to a protected source of drinking water and notably, no significant improvement occurred between the two survey rounds. The prevalence of improved sanitation increased from 85.50% in (2015-16) to 89.94% in (2019-21). However, 7.34% of the respondents practised open defecation in (2019-21). Moreover, the proportion of respondents who used shared toilet facilities with other households increased from 14.78% (2015-16) to 16.62% (2019-21). Though the number of women who have received at least four ANC visits, consumed IFA tablets for at least 180 days and, have received PNC has increased, India's performance is still unsatisfactory in terms of adequate MHCSU. It's profoundly concerning that 84% of the respondents lacked exclusive breastfeeding practices while 57.02% lacked early initiation of breastfeeding in (2019-21).

Table 5.1. Socio-economic and demographic characteristics of women aged 15–49 years from DHS (2015-16) and DHS (2019-21) in India

Variables	2015-16	2019-21
	73,502	107,831
	Frequency (Percentage)	Frequency (Percentage)
Source of drinking water		
Protected source (Ref.)	69,330 (94.32)	102,393 (94.96)
Unprotected source	4,172 (5.68)	5,438 (5.04)
Toilet facilities		
Improved sanitation (Ref.)	62,846 (85.50)	96,978 (89.94)
Unimproved sanitation	3,447 (4.69)	2,937 (2.72)
Open defecation	7,209 (9.81)	7,916 (7.34)
Toilet facilities shared with other households		
No (Ref.)	62,642 (85.22)	89,907 (83.38)
Yes	10,860 (14.78)	17,924 (16.62)
Attended 4+ ANC visits		
Yes (Ref.)	42,991 (58.49)	69,328 (64.29)
No	30,511 (41.51)	38,503 (35.71)
Number of days IFA consumed		
Atleast 180IFA (Ref.)	14,484 (19.71)	32,895 (30.51)
Less than 180 IFA	59,018 (80.29)	74,936 (69.49)
Mother's received PNC		
Yes (Ref.)	59,807 (81.37)	95,745 (88.79)
No	13,695 (18.63)	12,086 (11.21)
Early initiation of breastfeeding		
Yes (Ref.)	27,930 (38)	46,345 (42.98)
No	45,572 (62)	61,486 (57.02)
Exclusive breastfeeding		

Yes (Ref.)	11,051 (15.04)	17,258 (16)
No	62,451 (84.96)	90,573 (84)
Maternal age (years)		
15-24 (Ref.)	23,266 (31.65)	32,166 (29.83)
25-34	43,616 (59.34)	65,047 (60.32)
35-49	6,620 (9.01)	10,618 (9.85)
Maternal education		
No education (Ref.)	7,696 (10.47)	13,253 (12.29)
Primary	7,273 (9.89)	10,811 (10.03)
Secondary	43,281 (58.88)	61,513 (57.05)
Higher	15,252 (20.75)	22,254 (20.64)
Place of residence		
Urban (Ref.)	30,238 (41.14)	29,143 (27.03)
Rural	43,264 (58.86)	78,688 (72.97)
Religion		
Hindu (Ref.)	51,309 (71.17)	81,476 (75.56)
Muslim	9,788 (13.32)	12,893 (11.96)
Others	11,405 (15.52)	13,462 (12.48)
Caste		
None of them (Ref.)	20,452 (27.82)	22,922 (21.25)
Scheduled Caste	11,746 (15.98)	21,545 (19.98)
Scheduled Tribe	11,802 (16.06)	18,841 (17.47)
Other Backward Class	29,502 (40.14)	44,523 (41.29)
Wealth Quintile		
Poorest (Ref.)	3,081 (4.19)	14,853 (13.77)
Poorer	9,603 (13.06)	21,307 (19.76)

Middle	16,356 (22.25)	24,441 (22.67)
Richer	21,744 (29.58)	25,262 (23.43)
Richest	22,718 (30.91)	21,968 (20.37)

Source: Authors' calculations based on DHS (2015-16) and DHS (2019-21) survey data

5.3.3 Estimating the temporal Impact of Socioeconomic Deprivation on under- five CHOs in India

Table 5.2-5.4 present the results of multivariate logistic regression for estimating the impact of the availability of water and sanitation facilities, MHCSU and breastfeeding practices on under-five CHOs in India for DHS (2015-16) and DHS (2019-21) along with changes between the two survey rounds.

Model 1 shows that in (2015-16), the unimproved sanitation facilities were associated with increased odds of under-five stunting [OR = 1.17] and wasting [OR = 1.20] at a 10% level, and underweight [OR = 1.50] at a 1% level. Open defecation was associated with higher odds of stunting [OR = 1.20; $p<0.05$] and underweight [OR = 1.35; $p<0.05$] among children. The shared sanitation facilities were associated with increased odds of under-five wasting [OR = 1.15; $p<0.05$] among children. Mothers who have not received at least four ANC visits were more likely to have stunted [OR = 1.13; $p<0.05$], wasted [OR = 1.06; $p<0.05$] and underweight [OR = 1.16; $p<0.05$] children. Consumption of IFA tablets for less than 180 days by mothers during pregnancy was associated with increased odds of stunting [OR = 1.11 $p<0.05$] and underweight [OR = 1.11; $p<0.05$] among children under the age of five years. Mothers who have not received PNC were more likely to have children who were stunted [OR = 1.05; $p<0.05$], wasted [OR = 1.11; $p<0.05$] and underweight [OR = 1.09; $p<0.05$]. The absence of exclusive breastfeeding for the initial six months was associated with increased odds of stunting [OR = 1.91; $p<0.05$] and underweight [OR = 1.35; $p<0.05$] among children. By contrast, the absence of exclusive breastfeeding was associated with decreased odds of wasting [OR = 0.60; $p<0.05$]. Mothers of mature age (35-49 years) were less likely to have children who were wasted [OR = 0.78; $p<0.05$] compared to mothers belonging to the age group of 15-24 years. Higher educational attainment among mothers was likely to reduce the odds of under-five stunting [OR = 0.49; $p<0.05$], wasting [OR = 0.79; $p<0.05$] and underweight [OR = 0.47; $p<0.05$]. Children residing in rural areas were more likely to be stunted [OR = 1.04; $p<0.05$], wasted [OR = 1.06; $p<0.05$] and underweight [OR = 1.09; $p<0.05$] in comparison to the children residing in urban areas. The prevalence of stunting [OR = 1.09; $p<0.05$] was likely to be higher among children belonging to the Muslim religion compared to those belonging to the Hindu religion. Children belonging to the Scheduled Caste were more likely to be stunted [OR = 1.26; $p<0.05$], wasted [OR = 1.16; $p<0.05$] and underweight [OR = 1.29; $p<0.05$] in comparison to children belonging to non- deprived castes. The likelihood of stunting [OR = 1.24; $p<0.05$], wasting [OR = 1.08; $p<0.05$] and underweight [OR = 1.16; $p<0.05$] was higher among children belonging to the Scheduled Tribe. Children

belonging to the Other Backward Class were more likely to be stunted [OR = 1.19; p<0.05], wasted [OR = 1.15; p<0.05] and underweight [OR = 1.22; p<0.05] in comparison to children who do not belong to any of the above caste groups.

Children belonging to the richest wealth quintile were less likely to be stunted [OR = 0.60; p<0.05], wasted [OR = 0.82; p<0.05] and underweight [OR = 0.61; p<0.05] in comparison to children belonging to the poorest wealth quintile.

Table 5.2. Multivariate logistic regressions for analysing the impact of water and sanitation facilities, MHCSU and breastfeeding practices on stunting using DHS (2015-16), DHS (2019-21) and changes from 2015-16 to 2019-21 in India

Dependent Variable →	Model 1: DHS (2015 - 16)			Model 2: DHS (2019 - 21)			Difference Model 3: Changes from DHS (2015 - 16) to DHS (2019 - 21)		
Independent Variables↓	OR	P>|z|	CI (95%)	OR	P>|z|	CI (95%)	OR	P>|z|	CI (95%)
Source of drinking water									
Protected source (Ref.)	1.00			1.00			1.00		
Unprotected source	1.03	0.43	(0.95- 1.11)	1.05	0.12	(0.98- 1.12)	1.02	0.68	(0.92- 1.12)
Toilet facilities									
Improved sanitation (Ref.)	1.00			1.00			1.00		
Unimproved sanitation	1.17	0.06*	(0.99- 1.37)	1.13	0.05*	(0.99- 1.28)	0.96	0.76	(0.78- 1.19)
Open defecation	1.20	0.04**	(1.00- 1.43)	1.10	0.19	(0.95- 1.28)	0.92	0.48	(0.72- 1.16)
Toilet facilities shared with other households									
No (Ref.)	1.00			1.00			1.00		
Yes	0.94	0.02**	(0.90- 0.99)	1.00	0.97	(0.95- 1.04)	1.05	0.09*	(0.99- 1.12)
Attended 4+ ANC visits									
Yes (Ref.)	1.00			1.00			1.00		
No	1.13	0.00***	(1.09- 1.17)	1.04	0.00***	(1.01- 1.07)	0.92	0.00***	(0.87- 0.96)
Number of days IFA consumed									
Atleast 180IFA (Ref.)	1.00			1.00			1.00		
Less than 180 IFA	1.11	0.00***	(1.06- 1.16)	1.08	0.00***	(1.04- 1.11)	0.96	0.26	(0.91- 1.02)
Mother's received PNC									
Yes (Ref.)	1.00			1.00			1.00		
No	1.05	0.02**	(1.00- 1.09)	1.03	0.08*	(0.99- 1.08)	0.98	0.69	(0.92- 1.05)

Early initiation of breastfeeding									
Yes (Ref.)	1.00			1.00			1.00		
No	1.00	0.99	(0.96- 1.03)	0.98	0.37	(0.96- 1.01)	0.98	0.57	(0.94- 1.03)
Exclusive breastfeeding									
Yes (Ref.)	1.00			1.00			1.00		
No	1.91	0.00***	(1.76- 2.08)	1.56	0.00***	(1.49- 1.64)	0.81	0.00***	(0.74- 0.89)
Maternal age (years)									
15-24 (Ref.)	1.00			1.00			1.00		
25-34	0.98	0.36	(0.94- 1.02)	0.94	0.00***	(0.91- 0.97)	0.96	0.11	(0.91- 1.00)
35-49	1.00	0.77	(0.94- 1.07)	0.90	0.00***	(0.85- 0.95)	0.89	0.01**	(0.82- 0.97)
Maternal education									
No education (Ref.)	1.00			1.00			1.00		
Primary	0.87	0.00***	(0.81- 0.94)	0.96	0.19	(0.91- 1.01)	1.09	0.04**	(1.00- 1.20)
Secondary	0.66	0.00***	(0.63- 0.70)	0.77	0.00***	(0.74- 0.80)	1.16	0.00***	(1.08- 1.24)
Higher	0.49	0.00***	(0.46- 0.53)	0.60	0.00***	(0.57- 0.64)	1.21	0.00***	(1.11- 1.33)
Place of residence									
Urban (Ref.)	1.00			1.00			1.00		
Rural	1.04	0.03**	(1.00- 1.08)	0.99	0.76	(0.96- 1.03)	0.95	0.07*	(0.90- 1.00)
Religion									
Hindu (Ref.)	1.00			1.00			1.00		
Muslim	1.09	0.00***	(1.04- 1.15)	1.09	0.00***	(1.05- 1.15)	1.00	0.93	(0.93- 1.07)
Others	0.75	0.00***	(0.71- 0.80)	0.80	0.00***	(0.76- 0.84)	1.06	0.12	(0.98- 1.14)
Caste									
None of them (Ref.)	1.00			1.00			1.00		
Scheduled Caste	1.26	0.00***	(1.19- 1.33)	1.35	0.00***	(1.29- 1.41)	1.06	0.07*	(0.99- 1.14)
Scheduled Tribe	1.24	0.00***	(1.16- 1.32)	1.36	0.00***	(1.30- 1.44)	1.10	0.01**	(1.01- 1.19)
Other Backward Class	1.19	0.00***	(1.14- 1.25)	1.25	0.00***	(1.20- 1.30)	1.04	0.11	(0.98- 1.11)

Wealth Quintile									
Poorest (Ref.)	1.00			1.00			1.00		
Poorer	0.89	0.00***	(0.83- 0.96)	0.88	0.00***	(0.84- 0.93)	0.99	0.84	(0.90- 1.08)
Middle	0.82	0.00***	(0.76- 0.88)	0.79	0.00***	(0.75- 0.83)	0.96	0.88	(0.88- 1.05)
Richer	0.74	0.00***	(0.69- 0.79)	0.70	0.00***	(0.67- 0.74)	0.95	0.87	(0.87- 1.03)
Richest	0.60	0.00***	(0.56- 0.65)	0.58	0.00***	(0.55- 0.61)	0.95	0.87	(0.99- 1.05)

Notes: Level of significance for logistic model: *** Significant at 1 percent level; ** Significant at 5 percent level; * Significant at 10 percent level; OR, Odds ratio; CI, Confidence interval; Ref.: Reference category of the variable.

Source: Authors' calculations based on DHS (2015-16) and DHS (2019-21) survey data

Table 5.3. Multivariate logistic regressions for analysing the impact of water and sanitation facilities, MHCSU and breastfeeding practices on wasting using DHS (2015-16), DHS (2019-21) and changes from 2015-16 to 2019-21 in India

Dependent Variable →	Model 1: DHS (2015 - 16)			Model 2: DHS (2019 - 21)			Difference Model 3: Changes from DHS (2015 - 16) to DHS (2019 - 21)		
Independent Variables↓	OR	P>|z|	CI (95%)	OR	P>|z|	CI (95%)	OR	P>|z|	CI (95%)
Source of drinking water									
Protected source (Ref.)	1.00			1.00			1.00		
Unprotected source	1.03	0.39	(0.95- 1.13)	1.02	0.05*	(0.99- 1.07)	0.89	0.05*	(0.79- 1.00)
Toilet facilities									
Improved sanitation (Ref.)	1.00			1.00			1.00		
Unimproved sanitation	1.20	0.07*	(0.98- 1.47)	0.95	0.52	(0.82- 1.10)	0.79	0.06*	(0.61- 1.01)
Open defecation	1.07	0.50	(0.86- 1.34)	1.01	0.90	(0.84- 1.20)	0.93	0.65	(0.70- 1.24)
Toilet facilities shared with other households									

No (Ref.)	1.00			1.00			1.00		
Yes	1.15	0.00***	(1.08- 1.21)	1.08	0.00***	(1.02- 1.14)	0.94	0.14	(0.87- 1.02)
Attended 4+ ANC visits									
Yes (Ref.)	1.00			1.00			1.00		
No	1.06	0.00***	(1.02- 1.11)	0.99	0.99	(0.96- 1.03)	0.93	0.02**	(0.88- 0.99)
Number of days IFA consumed									
Atleast 180IFA (Ref.)	1.00			1.00			1.00		
Less than 180 IFA	1.01	0.73	(0.95- 1.06)	1.04	0.01**	(1.01- 1.08)	1.03	0.22	(0.97- 1.10)
Mother's received PNC									
Yes (Ref.)	1.00			1.00			1.00		
No	1.11	0.00***	(1.06- 1.17)	1.01	0.67	(0.95- 1.06)	0.90	0.00***	(0.84- 0.97)
Early initiation of breastfeeding									
Yes (Ref.)	1.00			1.00			1.00		
No	1.01	0.63	(0.97- 1.05)	1.05	0.00***	(1.02- 1.09)	1.04	0.08*	(0.99- 1.10)
Exclusive breastfeeding									
Yes (Ref.)	1.00			1.00			1.00		
No	0.60	0.00***	(0.56- 0.64)	0.65	0.00***	(0.62- 0.68)	1.08	0.07*	(0.99- 1.18)
Maternal age (years)									
15-24 (Ref.)	1.00			1.00			1.00		
25-34	0.88	0.00***	(0.85- 0.92)	0.92	0.00***	(0.89- 0.96)	1.04	0.13	(0.98- 1.10)
35-49	0.78	0.00***	(0.72- 0.84)	0.87	0.00***	(0.81- 0.93)	1.11	0.03**	(1.00- 1.23)
Maternal education									
No education (Ref.)	1.00			1.00			1.00		
Primary	0.90	0.01**	(0.82- 0.98)	0.91	0.01**	(0.85- 0.97)	1.01	0.79	(0.91- 1.12)
Secondary	0.85	0.00***	(0.79- 0.91)	0.85	0.00***	(0.80- 0.89)	0.99	0.99	(0.91- 1.08)
Higher	0.79	0.00***	(0.73- 0.86)	0.77	0.00***	(0.72- 0.82)	0.97	0.61	(0.87- 1.08)

Place of residence									
Urban (Ref.)	1.00			1.00			1.00		
Rural	1.06	0.00***	(1.01- 1.11)	1.06	0.00***	(1.01- 1.10)	0.99	0.94	(0.93- 1.05)
Religion									
Hindu (Ref.)	1.00			1.00			1.00		
Muslim	0.97	0.33	(0.91- 1.03)	1.15	0.00***	(1.09- 1.21)	1.18	0.00***	(1.09- 1.28)
Others	0.69	0.00***	(0.65- 0.74)	0.65	0.00***	(0.61- 0.69)	0.93	0.18	(0.85- 1.03)
Caste									
None of them (Ref.)	1.00			1.00			1.00		
Scheduled Caste	1.16	0.00***	(1.09- 1.24)	1.11	0.00***	(1.05- 1.18)	0.95	0.31	(0.88- 1.04)
Scheduled Tribe	1.08	0.03**	(1.00- 1.16)	1.27	0.00***	(1.20- 1.35)	1.18	0.00***	(1.07- 1.29)
Other Backward Class	1.15	0.00***	(1.09- 1.21)	1.12	0.00***	(1.07- 1.17)	0.97	0.41	(0.90- 1.04)
Wealth Quintile									
Poorest (Ref.)	1.00			1.00			1.00		
Poorer	0.94	0.21	(0.86- 1.03)	0.99	0.72	(0.93- 1.04)	1.04	0.39	(0.94- 1.15)
Middle	0.89	0.01**	(0.82- 0.97)	0.92	0.00***	(0.87- 0.97)	1.02	0.64	(0.92- 1.13)
Richer	0.88	0.00***	(0.81- 0.96)	0.87	0.00***	(0.82- 0.93)	0.99	0.89	(0.89- 1.09)
Richest	0.82	0.00***	(0.76- 0.90)	0.80	0.00***	(0.75- 0.86)	0.97	0.66	(0.87- 1.08)

Notes: Level of significance for logistic model: *** Significant at 1 percent level; ** Significant at 5 percent level; * Significant at 10 percent level; OR, Odds ratio; CI, Confidence interval; Ref.: Reference category of the variable

Source: Authors' calculations based on DHS (2015-16) and DHS (2019-21) survey data

Table 5.4. Multivariate logistic regressions for analysing the impact of water and sanitation facilities, MHCSU and breastfeeding practices on underweight using DHS (2015-16), DHS (2019-21) and changes from 2015-16 to 2019-21 in India

Dependent Variable →	Model 1: DHS (2015 - 16)			Model 2: DHS (2019 - 21)			Difference Model 3: Changes from DHS (2015 - 16) to DHS (2019 - 21)		
Independent Variables↓	OR	P>|z|	CI (95%)	OR	P>|z|	CI (95%)	OR	P>|z|	CI (95%)
Source of drinking water									
Protected source (Ref.)	1.00			1.00			1.00		
Unprotected source	1.06	0.12	(0.98- 1.15)	0.98	0.63	(0.92- 1.05)	0.92	0.13	(0.83- 1.02)
Toilet facilities									
Improved sanitation (Ref.)	1.00			1.00			1.00		
Unimproved sanitation	1.50	0.00***	(1.28- 1.81)	1.08	0.22	(0.95- 1.23)	0.71	0.00***	(0.57- 0.90)
Open defecation	1.35	0.00***	(1.11- 1.65)	1.04	0.58	(0.89- 1.21)	0.76	0.04**	(0.59- 0.98)
Toilet facilities shared with other households									
No (Ref.)	1.00			1.00			1.00		
Yes	1.02	0.38	(0.97- 1.07)	1.04	0.04**	(1.00- 1.09)	1.02	0.47	(0.95- 1.09)
Attended 4+ ANC visits									
Yes (Ref.)	1.00			1.00			1.00		
No	1.16	0.00***	(1.11- 1.20)	1.04	0.00***	(1.01- 1.07)	0.89	0.00***	(0.85- 0.94)
Number of days IFA consumed									
Atleast 180IFA (Ref.)	1.00			1.00			1.00		
Less than 180 IFA	1.11	0.00***	(1.06- 1.16)	1.06	0.00***	(1.03- 1.10)	0.96	0.19	(0.90- 1.01)
Mother’s received PNC									
Yes (Ref.)	1.00			1.00			1.00		

No	1.09	0.00***	(1.04- 1.14)	1.00	0.82	(0.96- 1.05)	0.92	0.01**	(0.86- 0.98)
Early initiation of breastfeeding									
Yes (Ref.)	1.00			1.00			1.00		
No	1.02	0.19	(0.98- 1.06)	1.05	0.00***	(1.02- 1.09)	1.03	0.16	(0.98- 1.08)
Exclusive breastfeeding									
Yes (Ref.)	1.00			1.00			1.00		
No	1.35	0.00***	(1.25- 1.46)	1.07	0.00***	(1.02- 1.12)	0.79	0.00***	(0.72- 0.86)
Maternal age (years)									
15-24 (Ref.)	1.00			1.00			1.00		
25-34	1.00	0.77	(0.96- 1.04)	0.99	0.77	(0.96- 1.02)	0.98	0.68	(0.93- 1.04)
35-49	0.95	0.20	(0.89- 1.02)	0.92	0.00***	(0.87- 0.97)	0.96	0.42	(0.88- 1.05)
Maternal education									
No education (Ref.)	1.00			1.00			1.00		
Primary	0.83	0.00***	(0.77- 0.90)	0.92	0.00***	(0.87- 0.97)	1.10	0.03**	(1.00- 1.20)
Secondary	0.67	0.00***	(0.63- 0.71)	0.72	0.00***	(0.69- 0.75)	1.07	0.04**	(1.00- 1.16)
Higher	0.47	0.00***	(0.43- 0.50)	0.53	0.00***	(0.50- 0.56)	1.14	0.00***	(1.04- 1.25)
Place of residence									
Urban (Ref.)	1.00			1.00			1.00		
Rural	1.09	0.00***	(1.05- 1.14)	1.03	0.06*	(0.99- 1.07)	0.94	0.03**	(0.89- 0.99)
Religion									
Hindu (Ref.)	1.00			1.00			1.00		
Muslim	0.98	0.33	(0.91- 1.03)	1.10	0.00***	(1.05- 1.15)	1.12	0.00***	(1.04- 1.20)
Others	0.55	0.00***	(0.65- 0.74)	0.56	0.00***	(0.54- 0.60)	1.02	0.53	(0.94- 1.11)
Caste									
None of them (Ref.)	1.00			1.00			1.00		
Scheduled Caste	1.29	0.00***	(1.22- 1.37)	1.33	0.00***	(1.27- 1.40)	1.02	0.44	(0.95- 1.10)
Scheduled Tribe	1.16	0.00***	(1.08- 1.24)	1.35	0.00***	(1.28- 1.42)	1.16	0.00***	(1.06- 1.26)

Other Backward Class	1.22	0.00***	(1.17- 1.28)	1.25	0.00***	(1.20- 1.31)	1.02	0.42	(0.96- 1.09)
Wealth Quintile									
Poorest (Ref.)	1.00			1.00			1.00		
Poorer	0.83	0.00***	(0.77- 0.89)	0.89	0.00***	(0.85- 0.94)	1.07	0.09*	(0.98- 1.18)
Middle	0.80	0.00***	(0.74- 0.86)	0.78	0.00***	(0.74- 0.82)	0.97	0.58	(0.89- 1.06)
Richer	0.72	0.00***	(0.67- 0.77)	0.69	0.00***	(0.66- 0.73)	0.96	0.37	(0.87- 1.04)
Richest	0.61	0.00***	(0.56- 0.66)	0.57	0.00***	(0.54- 0.61)	0.94	0.25	(0.85- 1.04)

Notes: Level of significance for logistic model: *** Significant at 1 percent level; ** Significant at 5 percent level; * Significant at 10 percent level; OR, Odds ratio; CI, Confidence interval; Ref.: Reference category of the variable

Source: Authors' calculations based on DHS (2015-16) and DHS (2019-21) survey data

Model 2 shows that in (2019-21), unprotected sources of drinking water were associated with increased odds of under-five wasting [OR = 1.02] at a 10% level and had no statistically significant impact on wasting in (2015-16). Unimproved sanitation facilities were associated with increased odds of under-five stunting [OR = 1.13] at a 10% level; however, unlike in the DHS (2015-16), it had no statistically significant effect on wasting and underweight in (2019-21). Moreover, open defecation had no statistically significant impact on CHOs in (2019-21). The shared sanitation facilities were associated with increased odds of under-five wasting [OR = 1.08; $p<0.05$] and underweight [OR = 1.04; $p<0.05$] among children. Mothers who have not received at least four ANC visits were more likely to be stunted [OR = 1.04; $p<0.05$] and underweight [OR = 1.04; $p<0.05$] children; however, the association between ANC visits and CHOs diminished between the two survey rounds. Consumption of IFA tablets for less than 180 days by mothers during pregnancy was associated with increased odds of stunting [OR = 1.08; $p<0.05$], wasting [OR = 1.04; $p<0.05$] and underweight [OR = 1.06; $p<0.05$], among children under the age of five years.

Mothers who had not received PNC were more likely to have stunted children [OR = 1.03] at a 10% level, though between the two survey rounds, the association between PNC visits and CHOs decreased. The absence of early initiation of breastfeeding was associated with the higher odds of under-five wasting [OR = 1.05; $p<0.05$] and underweight [OR = 1.05; $p<0.05$] in (2019-21) but did not influence CHOs in (2015-16). The absence of exclusive breastfeeding for the initial six months was associated with increased odds of stunting [OR = 1.56; $p<0.05$] and underweight [OR = 1.07; $p<0.05$] among children; however, the significance of exclusive breastfeeding in reducing poor CHOs diminished between the two survey rounds. However, the absence of exclusive breastfeeding was associated with decreased odds of wasting [OR = 0.65; $p<0.05$] in (2019-21). The children residing in rural areas were more likely to be wasted [OR = 1.06] at a 1% level and underweight [OR = 1.03] at a 10% level. Mothers of mature age (35-49 years), belonging to the richest wealth quintile, and with higher educational attainment were less likely to have children with poor CHOs. In contrast, women who belonged to the Muslim religion, Scheduled Caste, Scheduled Tribe and Other Backward Class had higher odds of having children with adverse CHOs.

Model-3 examined the factors that influenced the changes in under-five stunting, wasting and underweight between two survey rounds. The decline in the prevalence of under-five stunting was likely to be greater among children whose mothers had higher educational attainment [OR = 1.21; $p<0.05$], belonged to Scheduled Caste [OR = 1.06; $p<0.10$] and Scheduled Tribe [OR = 1.10; $p<0.05$]. However, the decline in the prevalence of stunting was less likely among children who lacked exclusive breastfeeding [OR = 0.81; $p<0.05$], resided in rural areas [OR
= 0.95; $p<0.10$], whose mothers have not received at least four ANC visits [OR = 0.92; $p<0.05$], and belonged to the mature age category (35-49 years) [OR = 0.89; $p<0.05$]. The decline in the prevalence of under-five wasting between the

two survey rounds was likely to be lower among children who consumed unprotected sources of drinking water [OR = 0.89; p<0.10], used unimproved sanitation facilities [OR = 0.79; p<0.10] and whose mothers neither received at least four ANC check-ups [OR = 0.93; p<0.05] and PNC visits [OR = 0.90; p<0.05]. However, the decline in under-five wasting was likely to be higher among children who lacked early initiation of breastfeeding [OR = 1.04; p<0.10] and exclusive breastfeeding [OR = 1.08; p<0.10]. Likewise, children belonging to the Muslim religion [OR = 1.18; p<0.05], Scheduled Tribe [OR = 1.18; p<0.05], and with a mother in the mature age group (35-49 years) [OR = 1.11; p<0.05] had a higher likelihood of a decline in the incidence of wasting. The decline in the prevalence of underweight was likely to be lesser for children who used unimproved sanitation facilities [OR = 0.71; p<0.05], practiced open defecation [OR = 0.76; p<0.05], absence of exclusive breastfeeding [OR = 0.79; p<0.05], belonged to a rural region [OR = 0.94; p<0.05] and whose mothers have neither received at least four ANC check-ups [OR = 0.89; p<0.05] nor PNC visits [OR = 0.92; p<0.05]. However, the decline in the prevalence of underweight was likely to be greater for children whose mother had higher educational attainment [OR = 1.14; p<0.05) and who belonged to Muslim religion [OR = 1.12; p<0.05]-, Scheduled Tribe [OR = 1.16; p<0.05], or to a household with poorer wealth quintile [OR = 1.07; p<0.10].

5.4 Discussion

In this paper, we investigated the temporal change in under-five CHOs in India, and we also examined the impact of accessibility of water and sanitation facilities, MHCSU and breastfeeding practices on CHOs in India using two rounds of DHS. Our study outlines several important points. Firstly, India is grappling with a triple burden of the dismally low prevalence of clean water and sanitation facilities, MHCSU and breastfeeding practices, with no significant improvement occurring between 2015-16 to 2019-21. Secondly, the decline in the prevalence of poor CHOs between the two survey rounds was less pronounced among children who used unimproved sanitation facilities, and engaged in open defecation, as well as among those children whose mothers had neither received at least four ANC check-ups nor PNC visits. Third, poor CHOs- stunting, wasting and underweight among children remain high and coexist in India. However, there were variations in CHOs among children belonging to different socio-economic backgrounds between the two survey rounds.

In tandem with a previous study in Ethiopia (Van Cooten et al., 2018), we found that unprotected sources of drinking water increased the prevalence of under- five wasting among children. Moreover, the decline in the prevalence of under-five poor CHOs between DHS (2015-16) and DHS (2019-21) was lower among children who used unprotected drinking water facilities. Contaminated drinking water increases the possibility of water-related diseases

such as diarrhoea, cholera, hepatitis, dengue and other related deadly infectious diseases among the most vulnerable group (children below the age of five years), proving detrimental for child survival and impairing their nutritional status (White et al., 2002). Aneesh (2021) argues that "Clean water is a key factor for economic growth" as unprotected sources of drinking water have severe negative ramifications in the form of poor health conditions, exacerbating poverty and increasing mortality and morbidity. In India, health costs related to unprotected sources of drinking water are enormous, estimated at $6.7- 8.7 billion per year, mostly associated with diarrheal mortality and morbidity (World Economic Forum, 2020). It is perturbing that 35 million people in India still lack access to protected sources of drinking water (Water.org, 2024), with individuals from economically weaker sections having disproportionately lower access to clean water (Aneesh, 2021). Notably, in 2015, an estimated 117,000 children under the age of five years died due to waterborne diseases, representing 13% of all deaths among children (United Nations, 2022).

Recently, the Ministry of Housing and Urban Affairs under the central government of India announced socio- political scheme, named "Jal Jeevan Mission" in 2019, fully aligned with Sustainable Development Goals criteria to provide piped water supply (Har Ghar Jal) to all households by 2024 (PIB, 2022). However, by 2022, clean drinking water could be provided to only 48.4% of the households in the country (PIB, 2022). Along with the government's efforts, capacity building, targeted intervention and tight monitoring are required to show the desired improvement in protected drinking water facilities in India, which will further improve child health in India (Jose & Khurana.,2022). Since both India and Bangladesh are characterised by similar monsoon climates, abundant monsoon precipitation and long coastal lines, India may draw lessons from the low-cost aquifer storage and recovery (ASR) scheme in Bangladesh, ensuring year-round clean water supply (Sultana et al., 2015).

Additionally, we found that children belonging to a particular faith-based group (Muslim religion) or socially marginalized sections of society (Scheduled Caste, Scheduled Tribe and Other Backward Class communities) had poor CHOs in India. Historically, Scheduled Castes, Scheduled Tribes, and Other Backward Classes are the most backward and downtrodden sections in the society (Aneesh, 2021). Chakravarty and colleagues (2019) in their research study posit that access to nutritional supplements during pregnancy is influenced by the societal status, religion, and caste of the mother, especially in rural India. It's unsettling that some community health centres, often operated by individuals from upper castes, deny access to women belonging to lower castes; thereby, compromising the nutritional requirement of both mother and child (Chakravarty et al., 2019). Furthermore, the pervasiveness of casteism within Indian society is evident from the fact that the problematic combination of Hinduism, caste and cleanliness existed since the Vedic period (Bathran, 2011). The Vedic literature called Manusmrti emphasised the importance of maintaining cleanliness and hygiene; however, it assigned these

unclean/menial duties to individuals belonging to socially marginalised sections of the society (Bathran, 2011). It is dismaying that, owing to caste politics, manual scavenging was decided by birth and generally got assigned to particular castes (Bathran, 2011), significantly limiting their income opportunities, and further impacting their child's health. Such socio-political inequalities preached in the Vedic period still exist in some parts of present-day Indian societies, especially in Indian villages. Bathran (2011) views safe sanitation as a matter of convenience, privacy and pride. The adolescent girls and women aged 15-49 years encounter gender disparities exacerbated by the practice of open defecation, particularly evident during menstruation (UNICEF, 2023b). Notably, 678 million people lack access to improved sanitation in India (Water.org, 2024). This leads to the addition of tonnes of faeces into the environment, producing greenhouse house gases like carbon dioxide and methane resulting in global warming (Bathran, 2011) and exposing children to excrement through direct contact, causing child mortality (UNICEF, 2023c).

In line with previous studies conducted in 70 low and middle-income countries (Fink et al., 2011), Namibia (Abdelhady et al., 2021), Cambodia (Lai et al., 2022) and Pakistan (Haq et al., 2022), we found that unimproved sanitation increased the prevalence of under-five stunting, wasting and underweight, while open defecation increased the prevalence of stunting and underweight among children. We also found that under-five wasting and underweight were higher among children who used shared sanitation facilities. Few studies reiterate that open defecation is still widely practiced in India without any attached stigma despite having access to improved sanitation facilities (Banda et al., 2007; Routray et al., 2015). Chronic exposure to faecal pathogens leads to intestinal worm infection, acute respiratory infections and environmental enteropathy, harming the nutrient absorption capability of the child and leading to adverse health outcomes (Humphrey, 2009). Furthermore, the improvements in CHOs between (2015-16) and (2019-21) were lower among children who used unimproved sanitation facilities and practiced open defecation. In order to make India, open defecation-free, the Government of India initiated the Swachh Bharat Abhiyan (Clean India Mission) in 2014. However, even after five years since initiation, 19% of households do not even use any toilet facility in India (NFHS-5, 2022). Since, investment alone cannot be accountable for the success or failure of the sanitation improvement programme in India, strong political will, improved socio-economic environment, social pressure and prioritizing behavioural changes are also required (O'Reilly & Louis., 2014; UNICEF, 2023c). To improve the sanitation situation in India and promote their usage, lessons can be imbibed from schemes such as Sanitation and Hygiene Master Plan in Nepal (Budhathoki, 2019), introduction of National Sanitation Authority (NSA) and sanitation surcharges in Ghana (Appiah-Effah et al., 2019) and rainbow villages in Indonesia (Defi, 2022). The areas with poor sanitation facilities and lower usage in India, can draw lessons from areas such as Mawlynnong village of Meghalaya (an Indian state) which has been declared as the cleanest village in Asia due to its exemplary cleanliness and sanitation practices (Dwivedi et

al., 2019).

In addition to sanitation facilities, maternal health care services hold immense significance for improvements in child health. In tandem with previous studies conducted in Indonesia (Fentiana et al., 2022) and Nigeria (Adeyemi et al., 2022), we found that mothers who have not received at least four ANC visits were more likely to have stunted, wasted and underweight children. ANC during pregnancy aids in fetal health consultation, treating high-risk pregnancy complications, and providing post-natal guidance regarding breastfeeding, vaccination, and family planning, which reduces the possibility of malnutrition and birth defects in children (Imdad & Bhutta, 2012; Kuhnt & Vollmer, 2017). Notwithstanding the public health gains over past decades, the quality and timely availability of maternal health services remains a challenge (United Nations, 2022). Furthermore, access to reproductive health services is dismally lower among individuals residing in remote rural regions and belonging to economically weaker sections of society (United Nations, 2022). Moreover, India shoulders the burden of the highest number of stillbirths, nearly 0.34 million of the 1.9 million stillbirths globally (5%), happened in India in 2019 (United Nations, 2022).

In addition to ANC, we found that the consumption of IFA tablets for less than 180 days by mothers during pregnancy increased the odds of adverse CHOs among children under the age of five years. The prevalence of adverse pregnancy outcomes such as preeclampsia, facial clefts, spontaneous abortion, fetal death and fetal growth restriction increases due to a deficiency of folic acid during pregnancy (Sengpiel et al., 2014). Similar findings were observed in recent research studies conducted in the context of low-income and middle-income countries (Rai et al., 2021; Preeti et al., 2023).

Our study also revealed that PNC received by mothers reduced the prevalence of under-five stunting, wasting and underweight. Low maternal knowledge regarding complete immunization coverage, healthy supplementary feeding and, high risk of diarrhoea among infants increases the prevalence of stunting among children (Sartika et al., 2021). Additionally, the decline in the prevalence of under-five poor CHOs between the two survey rounds was lower among children whose mothers have neither availed at least four ANC visits nor PNC visits. The government schemes such as the Integrated Child Development Scheme (ICDS) and Janani Suraksha Yojana intend to promote ANC and PNC visits (Khatpe et al., 2021). However, these schemes are plagued by certain challenges such as the location of Anganwadi Centres in upper-caste localities acting as a barrier to access for women belonging to socially marginalized sections, poor quality of supplementary nutrition provided (Mehta & Pratap, 2014), understaffing, a lack of essential medications and delays in payment disbursement (Jennings et al., 2019). These challenges undermine the noble intentions of these schemes. However, to enhance the quality of maternal healthcare services in India lessons can also be learnt from the Focused Antenatal Care scheme, a client-based service in Ghana, where the site of its service is not limited to a health facility; allowing for the provision of tailored services at times and places most convenient to clients; especially

benefitting women residing in remote rural areas (Haruna et al., 2019). Additionally, valuable insights can be gleaned from the New Rural Cooperative Medical Scheme, which has successfully increased maternal healthcare services by providing financial compensation in China (You et al., 2016).

"Breastfeeding is the best gift a mother, rich or poor, can give her child, as well as herself" (UNICEF, 2018). Walters et al. (2017) argue that every $1 invested in breastfeeding practices is estimated to generate $35 in economic returns, rendering breastfeeding strategy one of the best investments a country can make. UNICEF views that breastmilk prevents child mortality, leads to better IQ and educational outcomes, and further protects both child and mother against deadly diseases (UNICEF, 2018). In line with the previous studies in Ethiopia (Anato, 2022) and Pakistan (Siddiqa et al., 2022), we found that the absence of early initiation of breastfeeding increased the prevalence of under-five wasting and underweight. Colostrum feeding provides natural immunity as colostrum reaches immunoglobulin and other bioactive molecules, imperative for the nutrition requirement and healthy growth of a child (Godhia & Patel, 2013). We found that the absence of exclusive breastfeeding for the initial six months increased the odds of stunting and underweight among children. Exclusive breastfeeding provides balanced nutrition, is easily digested, boosts the child's immune system and protects the child from germ infections (Tamiru et al., 2012). This result of the present study is also compatible with evidence from Indonesia (Lestari et al., 2018) and the Democratic Republic of Congo (Luzingu et al., 2022). Also, the lack of exclusive breastfeeding led to a lower decline in the prevalence of under-five poor CHOs between (2015-16) and (2019-21). Interestingly, the absence of exclusive breastfeeding decreased the odds of under-five wasting. The plausible explanation could be that the absence of exclusive breastfeeding may lead to inadequate nutrient intake by infants resulting in stunting and underweight. However, wasting, which refers to acute malnutrition, characterised by rapid weight loss, might not be directly influenced by breastfeeding practices. Lenters and colleagues (2016) argue that wasting primarily occurs between 6 to 24 months, the period during which exclusive breastfeeding is no longer recommended; instead, complementary feeding becomes necessary. Government schemes such as the National Nutrition Mission (POSHAN Abhiyan) and National Breastfeeding Promotion Programme aim to generate awareness about the importance of breastfeeding practices in India (Kapur & Suri., 2020). However, this aim is not free from challenges such as societal beliefs that encourage mixed feeding practices, inadequate lactation support, and aggressive promotion of breast milk substitutes (WHO, 2014). Notably, working mothers face striking challenges in breastfeeding; therefore, it is important to promote workplace breastfeeding practices, provide infrastructural support in public places and reduce the working hours per week during the post-partum period in India (Ranjitha et al., 2023). The Midwifery Incentive Scheme in Cambodia has been proven to effectively promote timely breastfeeding initiation (Harriott et al., 2022). Similarly, midwives can play an important role in India to promote breastfeeding practices and to provide lactation support to mothers.

Among other factors, our study highlighted that the prevalence of stunting, wasting and underweight was higher among children residing in rural areas. Rural areas have a greater number of out-of-hospital births and births in hospitals without obstetric units, which leads to an increase in adverse CHOs (Kozhimannil et al., 2018). Moreover, a woman giving birth to a child born at home or without an obstetric unit doesn't get adequate ANC, PNC and counselling regarding various health promoting practices for the child. Socio-political policies in rural areas/villages like community programming, welfare services and downsizing of health care influence child health (Maggi et al., 2010). Moreover, the decline in the prevalence of under-five poor CHOs between (2015-16) and (2019-21) was lower among children residing in rural areas. The National Rural Health Mission and Integrated Child Development Scheme (ICDS) scheme provided through Anganwadi workers ensures that high priority is given to the nutritional status among children residing in rural areas (Kapur & Suri., 2020; Khatpe et al., 2021).

We found that children belonging to the richest wealth quintile household were less likely to be stunted, wasted and underweight. Better CHOs among upper quintiles can be attributed to better access to medical care, non-food items such as hygiene products, a balanced diet and higher cash incomes (Chowdhury et al., 2020; Waghmare et al., 2022). The Indian government schemes such as Pradhan Mantri Matru Vandana Yojana, Anganwadi services and Nutritional Rehabilitation Centres aim to lower malnutrition among children and provide partial compensation for wage loss in terms of cash incentives to the mothers belonging to the economically disadvantaged section of society (Kapur & Suri., 2020; Khatpe et al., 2021). Therefore, women's financial well-being can result in improved child health and household nutrition.

5.5 Limitations of the study

The results of this study must be viewed in the light of a few limitations. First, the data included information about the availability of the toilet facilities in a household; however, it does not imply that women and children in the households are using that facility since people still prefer open defecation (Coffey et al., 2014). Second, the DHS survey questionnaire asks respondents about the 'main source' of drinking water, thus cannot observe other water sources used by household members (Fink et al., 2011). Third, the study used cross-sectional data, therefore, a causal association between water and sanitation facilities, MHCSU, breastfeeding practices and CHOs cannot be established (Patel et al., 2019). Fourth, there are certain potential data collection problems with DHS data, such as misreporting dates of birth, misreporting age at death, and underreporting of events since DHS data is collected retrospectively and is self-reported (Komakech et al., 2022; Paul and Saha, 2022). Lastly, the absence of panel data may limit the precision of analysing temporal changes in child health outcomes.

5.6 Conclusion and policy recommendations

In summary, we found that unprotected sources of drinking water increased the prevalence of under-five wasting among children. Furthermore, unimproved sanitation, open defecation and shared sanitation facilities led to poor CHOs in India. Inadequate MHCSU increased the prevalence of under-five stunting, wasting and underweight. The absence of early initiation of breastfeeding increased the prevalence of under-five wasting and underweight, while the absence of exclusive breastfeeding for the initial six months increased the odds of stunting and underweight among children. Therefore, policymakers must adopt a multi-pronged strategy to improve child health in India. They should focus on investing more financial, material and, human resources in providing hygiene education on proper water treatment methods, safe disposal of faeces, and good hygiene practices along with soft knowledge in terms of socio-cultural and behavioural changes to lower the prevalence of poor CHOs. In terms of preventive strategies, policymakers can direct energies towards socio-political schemes such as POSHAN Abhiyan, Jal Jeevan Mission, Swachh Bharat Mission, Janani Suraksha Yojana, Pradhan Mantri Matru Vandana Yojana and Janani Shishu Suraksha Karyakaram to promote improved water and sanitation facilities, MHCSU and breastfeeding practices in India. Lastly, without strong political will, persistent groundwork, awareness generation and behavioural change, the improvements in child health would be slower than envisaged by sustainable development goals and towards socio- economic development of low and middle-income countries such as India. Furthermore, direct engagement with frontline health workers, provision of lactation rooms in public places, addressing urban-rural health inequalities, maternal education, equitable household wealth distribution and empowering women hold potential towards improving child health in India.

5.7 References

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CHAPTER 6

ASSOCIATION BETWEEN WOMEN'S AUTONOMY AND REPRODUCTIVE HEALTH OUTCOMES IN INDIA

6.1 Introduction

Universal access to sexual and reproductive healthcare services is one of the goals envisaged in the United Nations' Sustainable Development Goals (SDG-3.7), including family planning, information, and education (WHO, 2024). However, it is concerning that contraceptive use in India is still suboptimal (NFHS-5, 2022). According to the National Family Health Survey (NFHS), only 67.9 % of married women aged 15–49 years use modern contraceptive methods, leaving a considerable unmet need for the family planning services (NFHS-5, 2022). According to the United Nations Population Fund report 2022, unsafe abortions are the third leading cause of maternal mortality in India, with nearly eight women dying each day due to complications related to unsafe procedures (United Nations Population Fund, 2022). In 2022, India accounted for one in seven unintended pregnancies globally, and these pregnancies, along with the resulting abortions, are closely linked to the country's overall development (United Nations Population Fund, 2022). Furthermore, reproductive healthcare services are crucial for reducing the maternal mortality ratio (MMR), which was 97 per 100,000 live births in India in 2020, which needs to be reduced to meet the SDG target of reducing maternal mortality to 70 per 100,000 live births by 2030 (UNICEF, 2025).

Numerous scholars contend that due to the existence of gendered power inequalities, women had limited control over their reproductive health, including contraception methods, abortion, and fertility (Humble, 1995). In India, gender-based privileges that reinforce male dominance, kinship structures, and other cultural factors undermine women's autonomy in reproductive healthcare decisions (Gaikwad, 2023). Idris and colleagues (2023) suggest that ensuring women's autonomy in healthcare decision-making is imperative for fostering overall improvements in sexual and reproductive health. The possible association between women's autonomy in healthcare decision-making and access to reproductive healthcare services can be elucidated using the gender and power theory (Connell, 2014). The theory suggests that the patriarchal social structure often compels women to accept unequal power relations based on gender, undermining their autonomy in fertility choices, contraceptive use, refusal of intimacy, and pregnancy decisions (Connell, 2014). Only a few studies have so far focused on the role that women's autonomy plays in access to reproductive healthcare services in

India. A study using previous Demographic and Health Survey (DHS) data (Ram et al., 2022) and a state- specific study in Mumbai (Dasgupta et al., 2018) explored the association between women's autonomy and unwanted pregnancy. Similarly, the role of women's autonomy in contraceptive use has been examined using previous DHS data (Singh et al., 2018; Vishwakarma & Shekhar, 2022) and in a study from Uttar Pradesh (Tomar et al., 2020). Additionally, women's autonomy has been studied in relation to caesarean sections (Singh et al., 2019) and broader reproductive healthcare services (Patel, 2018; Mejía-Guevara et al., 2021; Roy et al., 2021).

Against this backdrop, the main objective of this study is to examine the underexplored impact of women's autonomy in managing one's healthcare on abortion history, knowledge of contraceptive methods, wanted pregnancy, and delivery by caesarean section using the latest two rounds of DHS in India. Furthermore, to the best of the authors' knowledge, the temporal impact of women's autonomy in managing their healthcare on a comprehensive set of reproductive healthcare services has not been explored. Additionally, the results of our study can be highly generalized in India, as data was extracted from a high-quality nationally representative survey of Indian households conducted during the latest two rounds of DHS (2015–16) and (2019–21). Lastly, despite socio-political government policies and measures, poor maternal reproductive healthcare decision making remains a persistent problem in India, requiring immediate attention (United Nations Population Fund, 2022; NFHS-5, 2022; WHO, 2024; UNICEF, 2025). This holistic assessment is expected to contribute to the existing literature on reproductive healthcare decision making and aims to provide crucial insights for evidence- based policymaking as well as tailored policy interventions to enhance women's health in India.

6.2 Data and Methodology

6.2.1 Data Source

This study employed data extracted from the latest two rounds of DHS (2015–16) and (2019–21), known as the National Family Health Survey (NFHS-4 and 5). The International Institute for Population Sciences (IIPS), under the stewardship of the Ministry of Health and Family Welfare (MoHFW) conducts this nationally representative survey of Indian households (NFHS-5, 2022). Since the framework, the questions asked, and their language are similar in both NFHS-4 and NFHS-5, a comparative analysis of these two surveys can be conducted (Das et al., 2021). This survey uses information gathered via face-to-face interviews and medical examinations. The sampled households included women aged 15–49 years, men aged 15–54 years, and children under the age of five years. The sample is drawn using stratified random sampling (NFHS-5, 2022). The details of sampling procedures for the survey are available online at https://dhsprogram.co m/data/available-datasets.cfm. The final study participants comprised 30,152 respondents in 2015–16 and 24,361 respondents in 2019–21, after excluding respondents with missing responses to

the selected relevant variables.

6.2.2 Outcome variables

To evaluate the impact of women's autonomy in healthcare decision-making on access to reproductive healthcare services in India, four key indicators were examined: abortion history, knowledge of contraceptive methods, wanted pregnancy, and delivery by caesarean section. Abortion history was proxied by the healthcare professionals who performed the abortion, with respondents who had undergone an abortion coded as '1' and those who had not as '0'. Similarly, respondents who had knowledge of contraceptive methods, reported a wanted pregnancy, or delivered via caesarean section were coded as '1', while others were coded as '0'.

6.2.3 Explanatory variables

To evaluate the impact of women's autonomy in healthcare decision-making on access to reproductive. The decision-making autonomy in managing one's healthcare variable was estimated based on the woman's response to the following question: "Who usually makes decisions regarding the respondent's healthcare?" The responses were captured by four categories; such as respondent alone, respondent and husband/partner together, husband/ partner alone or someone else. The outcome variable was coded as "1" if the woman alone made healthcare decisions, "2" if decisions were made jointly with the husband/partner, "3" if the husband/partner made decisions alone, and "4" if someone else did.

In addition to this, there may be some other factors which might affect the decisions relating to reproductive health, these variables were selected based on their theoretical relevance and practical significance. These include women's age at the time of childbirth (14–24, 25–34, 35–49 years), women's educational attainment (no education, primary, secondary, higher education), women currently working (yes/no), covered by health insurance (yes/no), gender of household head (male/ female), caste (Scheduled Caste, Scheduled Tribe, Other Backward Class, none of them), religion (Hindu, Muslim, other religions), place of residence (rural/urban), household wealth quintile (poorest, poorer, middle, richer, and richest). Husband characteristics include educational attainment (no education, primary, secondary, higher education) and age at the time of childbirth (11–24, 25–34, 35–49, above 50 years).

6.2.4 Analytical Strategy

Descriptive statistics were used to illustrate the respondent characteristics using percentages and frequency distribution at the univariate level. The following section describes the methodology applied to investigate the impact of women's autonomy in managing one's healthcare on access to reproductive healthcare services in India.

6.2.4.1 Multivariable logistic regression

Since the outcomes variables namely, abortion history, knowledge of contraceptive methods, wanted pregnancy and delivery by caesarean section are dichotomous, logistic regression is employed to investigate the association between women's autonomy in managing one's healthcare and reproductive healthcare services.

The specific form of the logistic regression model is as follows.

$$\ln \frac{P1}{1-P1} = \alpha_1 + \beta_i \mathrm{X}i \qquad (6.1)$$

In the above equation, P_1 refers to the likelihood of occurrence of outcome variables. The parameter α_1 measures the log odds of outcome variables concerning the base category, and β_i estimates the maximum likelihood estimator for X_i (Cabrera, 1994). The maximum likelihood estimation of β is interpreted as the differential log of outcome variables, associated with covariates X, compared to the base category (Cabrera, 1994).

6.2.4.2 Time-interaction regression model

The impact of women's autonomy in managing one's healthcare on reproductive health outcomes, namely, abortion history, knowledge of contraceptive methods, wanted pregnancy and delivery by caesarean section considering the changes in the explanatory variables from DHS (2015-16) to DHS (2019-21) is measured using an adjusted time-interaction regression model (Model 3) (Khan et al., 2019).

The specific form of the time-interaction regression model is as follows.

$$Y = \beta_0 + \delta_0 * t + \beta_1 x_1 + \cdots \beta_n x_n + \delta_1 (x_1 * t) + \cdots \delta_n (x_n * t) + \varepsilon \qquad (6.2)$$

In above specification, Y denote the dependent variable and t represents time (representing years of DHS surveys). The term δ_n refers to a vector of interaction effects between the explanatory variables and the time factor t, with ε capturing the error term (Khan et al., 2019). The regression coefficients are interpreted using the estimated log odds ratio (ORs) with 95% confidence intervals (CIs). We have also provided p-values in the results tables, in order to figure out if a variable is statistically significant at alternate levels (1% or 10%) or not. The analysis was conducted using STATA version 12.0 StataCorp LP, College Station, TX, USA). The validity of the statistical models employed was tested using the Hosmer-Lemeshow test and likelihood-ratio test (Supplementary Table IV.1).

6.3 Data analysis and results

6.3.1 Descriptive statistics

A summary of the socio-economic and demographic characteristics of women aged 14–49 years who had at least one live birth in the five years preceding the survey and men aged 11–54 years in India is presented in Table 6.1. In both the 2015–16 and 2019–21 survey rounds, less than 3 % of women had an abortion history, while knowledge of contraceptive methods remained almost universal (more than 99 %).

Table 6.1 Socio-economic and demographic characteristics of women aged 14-49 years and men aged 11-54 years who had at least one live birth in the past five years preceding the survey, from DHS (2015-16) and DHS (2019-21) in India

Variables	2015-16	2019-21
	30,152	24,361
	Frequency (Percentage)	Frequency (Percentage)
Abortion History		
No	29,276 (97.09)	23,744 (97.47)
Yes	876 (2.91)	617 (2.53)
Knowledge of contraceptive methods		
No	243 (0.81)	70 (0.29)
Yes	29,909 (99.19)	24,291 (99.71)
Wanted Pregnancy		
No	2,643 (8.77)	1,776 (7.29)
Yes	27,509 (91.23)	22,585 (92.71)
Delivery by caesarean section		
No	25,180 (83.51)	19,078 (78.31)
Yes	4,972 (16.49)	5,283 (21.69)
Women autonomy in managing one's own healthcare		
Women alone	2,748 (9.11)	1,913 (7.85)
women and partner	19,349 (64.17)	17,624 (72.35)
husband/partner alone	6,824 (22.63)	4,224 (17.34)
someone else	1,231 (4.08)	600 (2.46)
Women age at childbirth		
14-24	13,900	10,982

	(46.10)	(45.08)
25-34	14,341 (47.56)	11,973 (49.15)
35-49	1,911 (6.34)	1,406 (5.77)
Women education		
No education	8,157 (27.05)	4,884 (20.05)
Primary	4,048 (13.43)	2,974 (12.21)
Secondary	14,394 (47.74)	12,683 (52.06)
Higher	3,553 (11.78)	3,820 (15.68)
Women currently working		
No	24,888 (82.54)	19,511 (80.09)
Yes	5,264 (17.46)	4,850 (19.91)
Health insurance		
No	25,508 (84.60)	17,621 (72.33)
Yes	4,644 (15.40)	6,740 (27.67)
Gender of household head		
Male	26,117 (86.62)	20,647 (84.75)
Female	4,035 (13.38)	3,714 (15.25)
Caste		
Scheduled Caste	5,657 (18.76)	5,095 (20.91)
Scheduled Tribe	6,220 (20.63)	5,177 (21.25)
Other Backward Class	12,287 (40.75)	9,871 (40.52)
None of them	5,988 (19.86)	4,218 (17.31)
Religion		
Hindu	22,578 (74.88)	18,333 (75.26)
Muslim	3,985 (13.22)	2,914 (11.96)
Others	3,589 (11.90)	3,114 (12.78)
Type of residence		

Urban	7,960 (26.40)	5,285 (21.69)
Rural	22,192 (73.60)	19,076 (78.31)
Wealth Quintile		
Poorest	6,934 (23)	5,901 (24.22)
Poorer	6,605 (21.91)	5,514 (22.63)
Middle	6,152 (20.40)	4,871 (20.00)
Richer	5,424 (17.99)	4,401 (18.07)
Richest	5,037 (16.71)	3,674 (15.08)
Husband education		
No education	4,863 (16.13)	3,321 (13.63)
Primary	4,141 (13.73)	2,957 (12.14)
Secondary	16,731 (55.49)	13,781 (56.57)
Higher	4,417 (14.65)	4,302 (17.66)
Husband age at childbirth		
11-24	4,791 (15.89)	3,802 (15.61)
25-34	18,976 (62.93)	15,587 (63.98)
35-49	6,113 (20.27)	4,827 (19.81)
Above 50	272 (0.90)	145 (0.60)

Source: Authors' calculations based on DHS survey data

Notably, wanted pregnancies increased slightly (91.23–92.71 %), and caesarean deliveries rose significantly (16.49–21.69 %). It is alarming that only
9.11 % of women in 2015–16 and a mere 7.85 % in 2019–21 had the autonomy to make healthcare decisions independently. However, it is important to note that the percentage of women whose healthcare decisions were made jointly with their husband/ partner increased from 64.17 % in 2015– 16 to 72.35 % in 2019–21. Furthermore, in 2019–21, almost half of the women (49.15 %) belonged to the 25–34 years age category, had attained secondary education

(52.06 %), and the majority lived in male-headed households (84.75%). It is deeply concerning that 80 % of women were not employed, 72 % lacked health insurance, and 23 % belonged to the poorest wealth quintile household, with very little improvement observed from 2015– 16 to 2019–21. More than three-quarters of the women resided in rural areas and belonged to the Hindu religion. The majority of husbands had also attained secondary education (55.49 %), and belonged to the 25–34 years age category (62.93 %).

6.3.2 Association between women's autonomy and reproductive health outcomes

Tables 6.2–6.4 present the results of multivariate logistic regression for estimating the impact of women's autonomy in healthcare decision-making on abortion history, knowledge of contraceptive methods, wanted pregnancy, and delivery by caesarean section in India for DHS (2015–16) and DHS (2019–21) along with changes between the two survey rounds.

Table 6.2 Multivariate logistic regressions for analysing the impact of women's autonomy in managing one's healthcare on abortion history, knowledge of contraceptive methods, wanted pregnancy and delivery by caesarean section using DHS (2015-16) conducted in India

Variables	Abortion History	Knowledge of contraceptive methods	Wanted Pregnancy	Delivery by caesarean section
	OR CI (95%)	OR CI (95%)	OR CI (95%)	OR CI (95%)
Women autonomy in managing one's own healthcare				
Women alone (ref.)				
women and partner	0.79 (0.56-1.11)	0.93 (0.47-1.87)	1.64*** (1.35-2)	0.79** (0.66-0.93)
husband/partner alone	0.74 (0.5-1.1)	0.48** (0.24-0.96)	1.26** (1.02-1.56)	0.86 (0.72-1.04)
someone else	0.7 (0.42-1.15)	0.49 (0.17-1.37)	1.02 (0.77-1.35)	0.57*** (0.43-0.75)
Women age at childbirth				
14-24 (ref.)				
25-34	0.91 (0.73-1.12)	1.33 (0.83-2.12)	0.74*** (0.64-0.85)	0.96 (0.87-1.08)
35-49	1.07 (0.61-1.9)	1.89 (0.77-3.62)	0.45*** (0.35-0.58)	1.01 (0.77-1.31)
Women education				
No education (ref.)				
Primary	1.54**	1.63*	1.04	1.28**

Variables	Abortion History	Knowledge of contraceptive methods	Wanted Pregnancy	Delivery by caesarean section
	OR CI (95%)	OR CI (95%)	OR CI (95%)	OR CI (95%)
	(1.05-2.25)	(0.95-2.78)	(0.86-1.26)	(1.05-1.56)
Secondary	1.47** (1.08-2)	1.02 (0.93-1.11)	1.21** (1.04-1.42)	1.73*** (1.48-2.03)
Higher	1.41 (0.92-2.17)	1.06 (0.96-1.19)	1.04 (0.78-1.39)	2.47*** (2.02-3.02)
Women currently working				
No (ref.)				
Yes	1.44** (1.13-1.84)	1.2 (0.75-1.94)	0.92 (0.79-1.06)	0.88* (0.76-1.01)
Health insurance				
No (ref.)				
Yes	1.03 (0.79-1.34)	1.28 (0.72-2.29)	1.33** (1.1-1.6)	1.6*** (1.42-1.8)
Gender of household head				
Male (ref.)				
Female	1.11 (0.86-1.45)	0.77 (0.45-1.32)	0.99 (0.83-1.19)	0.93 (0.81-1.07)
Caste				
Scheduled Caste (ref.)				
Scheduled Tribe	0.48***	0.31***	1.41**	0.75**

Variables	Abortion History	Knowledge of contraceptive methods	Wanted Pregnancy	Delivery by caesarean section
	OR CI (95%)	OR CI (95%)	OR CI (95%)	OR CI (95%)
	(0.32-0.72)	(0.17-0.56)	(1.16-1.7)	(0.61-0.93)
Other Backward Class	0.78** (0.61-1)	0.63 (0.35-1.14)	1.14* (0.99-1.31)	1.09 (0.96-1.24)
None of them	1 (0.73-1.36)	0.5 (0.21-1.18)	0.83* (0.68-1)	1.13 (0.97-1.33)
Religion				
Hindu (ref.)				
Muslim	1.33* (1-1.78)	0.98 (0.51-1.88)	0.91 (0.76-1.09)	0.7*** (0.6-0.81)
Others	0.52** (0.34-0.8)	0.96 (0.51-1.8)	1.17 (0.88-1.55)	1.12 (0.92-1.38)
Type of residence				
Urban (ref.)				
Rural	0.79** (0.63-0.99)	1.11 (0.64-1.92)	1.11 (0.94-1.32)	0.78*** (0.69-0.87)
Wealth Quintile				
Poorest (ref.)				
Poorer	1.22 (0.86-1.73)	1.7 (0.99-2.93)	1.03 (0.88-1.2)	1.77*** (1.43-2.18)
Middle	1.63** (1.15-2.3)	1.06 (0.92-1.22)	1.31** (1.09-1.57)	3.48*** (2.83-4.28)
Richer	1.53**	1.05	1.81***	4.63***

Variables	Abortion History	Knowledge of contraceptive methods	Wanted Pregnancy	Delivery by caesarean section
	OR CI (95%)	OR CI (95%)	OR CI (95%)	OR CI (95%)
	(1.08-2.17)	(0.89-1.24)	(1.46-2.25)	(3.74-5.72)
Richest	1.24 (0.81-1.88)	1.16 (0.93-1.45)	2.11*** (1.6-2.78)	5.23*** (4.17-6.57)
Husband education				
No education (ref.)				
Primary	1.21 (0.78-1.88)	1.8** (1.02-3.18)	0.83* (0.68-1)	1.12 (0.9-1.4)
Secondary	1.27 (0.86-1.87)	1.09 (0.68-1.76)	0.81** (0.69-0.96)	1.21* (0.99-1.47)
Higher	1.24 (0.78-1.98)	1.62 (0.85-2.83)	0.93 (0.69-1.25)	1.19 (0.94-1.49)
Husband age at childbirth				
11-24 (ref.)				
25-34	0.9 (0.66-1.22)	1.6** (1.01-2.54)	0.92 (0.74-1.14)	1.13 (0.95-1.34)
35-49	0.88 (0.59-1.3)	1.55 (0.77-3.1)	0.74** (0.57-0.97)	1.5*** (1.21-1.85)
Above 50	0.04*** (0.01-0.18)	0.6 (0.19-1.95)	0.75 (0.43-1.28)	2.01** (1.08-3.75)

Note: Level of significance for mixed-effect logistic regression model: *** Significant at 1 percent level; ** Significant at 5 percent level; * Significant at 10 percent level; OR-Odds ratio; CI-Confidence interval; ref.: Reference category of the variable

Source: Authors' calculations based on DHS survey data

Table 6.3 Multivariate logistic regressions for analysing the impact of women's autonomy in managing one's healthcare on abortion history, knowledge of contraceptive methods, wanted pregnancy and delivery by caesarean section using DHS (2019-21) conducted in India

Variables	Abortion History	Knowledge of contraceptive methods	Wanted Pregnancy	Delivery by caesarean section
	OR CI (95%)	OR CI (95%)	OR CI (95%)	OR CI (95%)
Women autonomy in managing one's own healthcare				
Women alone (ref.)				
women and partner	1.12 [0.7-1.79]	1.13 [0.43-2.94]	1.29* [1.00-1.66]	0.99 [0.82-1.20]
husband/partner alone	0.98 [0.59-1.63]	0.39 [0.14-1.05]	1.02 [0.78-1.33]	1.06 [0.85-1.30]
someone else	1.66 [0.76-3.65]	0.85(0.61-1.18)	0.86 [0.56-1.32]	0.94 [0.68-1.29]
Women age at childbirth				
14-24 (ref.)				
25-34	0.94 [0.73-1.22]	0.88 [0.78-0.99]	0.88 [0.75-1.03]	1.07 [0.96-1.19]
35-49	1.02 [0.54-1.91]	0.53 [0.42-0.67]	0.55*** [0.41-0.74]	1.33* [1.05-1.69]
Women education				
No education (ref.)				
Primary	1.57*	0.88	0.9	1.54***

Variables	Abortion History	Knowledge of contraceptive methods	Wanted Pregnancy	Delivery by caesarean section
	OR CI (95%)	OR CI (95%)	OR CI (95%)	OR CI (95%)
	[1.02-2.4]	[0.73-1.04]	[0.72-1.12]	[1.24-1.92]
Secondary	1.46* [1.0-2.12]	0.96 [0.83-1.12]	0.89 [0.74-1.08]	2.57*** [2.15-3.07]
Higher	1.58 [0.89-2.82]	0.99 [0.79-1.22]	0.97 [0.73-1.29]	3.54*** [2.84-4.41]
Women currently working				
No (ref.)				
Yes	1.17 [0.87-1.58]	1.06 [0.93-1.20]	1.08 [0.91-1.28]	1.03 [0.91-1.16]
Health insurance				
No (ref.)				
Yes	0.9 [0.7-1.16]	1.32 [1.17-1.48]	1.3*** [1.11-1.53]	1.0 [0.90-1.11]
Gender of household head				
Male (ref.)				
Female	0.96 [0.71-1.3]	1.02 [0.89-1.17]	1.02 [0.85-1.22]	0.93 [0.82-1.06]
Caste				
Scheduled Caste (ref.)				
Scheduled Tribe	0.66* [0.45-0.97]	1.49 [1.25-1.76]	1.29* [1.00-1.67]	0.65*** [0.54-0.80]
Other Backward Class	1.06 [0.79-1.42]	1.06 [0.97-1.25]	1.03 [0.87-1.22]	1.05 [0.93-1.18]

Variables	Abortion History	Knowledge of contraceptive methods	Wanted Pregnancy	Delivery by caesarean section
	OR CI (95%)	OR CI (95%)	OR CI (95%)	OR CI (95%)
None of them	1.2 [0.79-1.82]	1.01 [0.85-1.18]	0.96 [0.75-1.23]	1.2* [1.04-1.39]
Religion				
Hindu (ref.)				
Muslim	0.54*** [0.35-0.84]	0.31*** [0.13-0.74]	1.01 [0.80-1.29]	0.94 [0.80-1.11]
Others	0.82 [0.53-1.28]	0.99 [0.83-1.18]	1.0 [0.73-1.37]	1.41*** [1.18-1.69]
Type of residence				
Urban (ref.)				
Rural	0.68** [0.5-0.93]	1.03 [0.90-1.18]	1.1 [0.90-1.35]	0.83*** [0.74-0.92]
Wealth Quintile				
Poorest (ref.)				
Poorer	1.08 [0.77-1.52]	1.06 [0.92-1.22]	1.15 [0.95-1.39]	2.02*** [1.68-2.43]
Middle	1.49* [1.04-2.13]	1.22* [1.04-1.43]	1.34** [1.07-1.68]	3.1*** [2.56-3.74]
Richer	1.96*** [1.32-2.91]	1.35** [1.12-1.61]	1.57*** [1.23-1.99]	3.54*** [2.92-4.30]
Richest	1.41 [0.84-2.36]	1.47*** [1.19-1.82]	1.76*** [1.31-2.37]	3.65*** [2.95-4.52]
Husband education				

Variables	Abortion History	Knowledge of contraceptive methods	Wanted Pregnancy	Delivery by caesarean section
	OR CI (95%)	OR CI (95%)	OR CI (95%)	OR CI (95%)
No education (ref.)				
Primary	0.96 [0.58-1.57]	0.96 [0.79-1.16]	0.95 [0.73-1.22]	1.16 [0.93-1.44]
Secondary	0.92 [0.58-1.44]	1.05 [0.89-1.23]	1.09 [0.88-1.34]	1.0 [0.83-1.21]
Higher	0.76 [0.43-1.35]	1.16 [0.93-1.45]	1.14 [0.85-1.54]	1.08 [0.87-1.34]
Husband age at childbirth				
11-24 (ref.)				
25-34	1.05 [0.7-1.59]	0.91 [0.78-1.06]	0.91 [0.74-1.13]	1.32*** [1.14-1.53]
35-49	0.85 [0.49-1.45]	0.85 [0.69-1.05]	0.86 [0.66-1.12]	1.64*** [1.36-1.98]
Above 50	0.26 [0.05-1.35]	1.33 [0.52-3.43]	1.52 [0.62-3.72]	1.18 [0.59-2.33]

Note: Level of significance for mixed-effect logistic regression model: *** Significant at 1 percent level; ** Significant at 5 percent level; * Significant at 10 percent level; OR-Odds ratio; CI-Confidence interval; ref.: Reference category of the variable

Source: Authors' calculations based on DHS survey data

Table 6.4 Time interaction model for analysing the impact of women's autonomy in managing one's healthcare on abortion history, knowledge of contraceptive methods, wanted pregnancy and delivery by caesarean section in India (2015-16 to 2019-21)

Variables	Difference Model 3: Changes from DHS (2015 - 16) to DHS (2019 - 21) in abortion history	Difference Model 3: Changes from DHS (2015 - 16) to DHS (2019 - 21) in knowledge of contraceptive methods	Difference Model 3: Changes from DHS (2015 - 16) to DHS (2019 - 21) in wanted pregnancy	Difference Model 3: Changes from DHS (2015 - 16) to DHS (2019 - 21) in delivery by caesarean section
	OR CI (95%)	OR CI (95%)	OR CI (95%)	OR CI (95%)
Women autonomy in managing one's own healthcare				
Women alone (ref.)				
women and partner	1.27 (0.86-1.9)	1.07 (0.36-3.1)	0.86 (0.69-1.1)	1.01 (0.86-1.2)
husband/partner alone	1.29 (0.83-2)	0.68 (0.22-2.1)	0.76** (0.59-1)	1.12 (0.93-1.3)
someone else	1.7 (0.87-3.3)	1.26 (0.86-1.87)	0.93 (0.63-1.4)	1.14 (0.84-1.5)
Women age at childbirth				

Variables	Difference Model 3: Changes from DHS (2015 - 16) to DHS (2019 - 21) in abortion history	Difference Model 3: Changes from DHS (2015 - 16) to DHS (2019 - 21) in knowledge of contraceptive methods	Difference Model 3: Changes from DHS (2015 - 16) to DHS (2019 - 21) in wanted pregnancy	Difference Model 3: Changes from DHS (2015 - 16) to DHS (2019 - 21) in delivery by caesarean section
	OR CI (95%)	OR CI (95%)	OR CI (95%)	OR CI (95%)
14-24 (ref.)				
25-34	0.94 (0.73-1.2)	1.19 (0.58-2.5)	1.13 (0.97-1.3)	1.04 (0.93-1.2)
35-49	1.25 (0.68-2.3)	0.35* (0.1-1.2)	1.14 (0.85-1.5)	1.17 (0.92-1.5)
Women education				
No education (ref.)				
Primary	0.98 (0.63-1.5)	0.52* (0.25-1.1)	0.8** (0.64-1)	1.05 (0.85-1.3)
Secondary	0.97 (0.67-1.4)	0.6 (0.28-1.3)	0.91 (0.75-1.1)	1.2** (1.01-1.4)
Higher	1.03 (0.64-1.7)	0.22 (0.01-4.2)	0.87 (0.65-1.2)	1.14 (0.92-1.4)
Women currently working				
No (ref.)				
Yes	0.75**	1.11	1.17*	1.17**

Variables	Difference Model 3: Changes from DHS (2015 - 16) to DHS (2019 - 21) in abortion history	Difference Model 3: Changes from DHS (2015 - 16) to DHS (2019 - 21) in knowledge of contraceptive methods	Difference Model 3: Changes from DHS (2015 - 16) to DHS (2019 - 21) in wanted pregnancy	Difference Model 3: Changes from DHS (2015 - 16) to DHS (2019 - 21) in delivery by caesarean section
	OR CI (95%)	OR CI (95%)	OR CI (95%)	OR CI (95%)
	(0.57-1)	(0.56-2.2)	(0.99-1.4)	(1.04-1.3)
Health insurance				
No (ref.)				
Yes	0.96 (0.73-1.3)	0.94 (0.77-1.14)	1.17* (0.99-1.4)	0.71*** (0.63-0.8)
Gender of household head				
Male (ref.)				
Female	1.01 (0.75-1.4)	0.75 (0.39-1.5)	0.98 (0.82-1.2)	1.05 (0.92-1.2)
Caste				
Scheduled Caste (ref.)				
Scheduled Tribe	1.64** (1.08-2.5)	1.04 (0.91-1.19)	0.93 (0.75-1.2)	0.94 (0.78-1.1)
Other Backward Class	1.12 (0.84-1.5)	1.02 (0.93-1.12)	0.9 (0.76-1.1)	0.99 (0.87-1.1)
None of them	1.18	1.05	0.95	1.02

Variables	Difference Model 3: Changes from DHS (2015 - 16) to DHS (2019 - 21) in abortion history	Difference Model 3: Changes from DHS (2015 - 16) to DHS (2019 - 21) in knowledge of contraceptive methods	Difference Model 3: Changes from DHS (2015 - 16) to DHS (2019 - 21) in wanted pregnancy	Difference Model 3: Changes from DHS (2015 - 16) to DHS (2019 - 21) in delivery by caesarean section
	OR CI (95%)	OR CI (95%)	OR CI (95%)	OR CI (95%)
	(0.85-1.6)	(0.95-1416)	(0.77-1.2)	(0.88-1.2)
Religion				
Hindu (ref.)				
Muslim	0.52*** (0.36-0.7)	0.25** (0.1-0.6)	1.42** (1.16-1.7)	1.18** (1.02-1.4)
Others	0.94 (0.61-1.4)	0.53* (0.26-1.1)	0.99 (0.79-1.3)	1.2** (1.01-1.4)
Type of residence				
Urban (ref.)				
Rural	1.02 (0.79-1.3)	0.87 (0.27-2.8)	1.01 (0.85-1.2)	1.16** (1.04-1.3)
Wealth Quintile				
Poorest (ref.)				
Poorer	0.85 (0.59-1.2)	1.01 (0.87-1.17)	1.03 (0.86-1.2)	1.09 (0.89-1.3)
Middle	0.77	0.99	1.11	0.95

Variables	Difference Model 3: Changes from DHS (2015 - 16) to DHS (2019 - 21) in abortion history	Difference Model 3: Changes from DHS (2015 - 16) to DHS (2019 - 21) in knowledge of contraceptive methods	Difference Model 3: Changes from DHS (2015 - 16) to DHS (2019 - 21) in wanted pregnancy	Difference Model 3: Changes from DHS (2015 - 16) to DHS (2019 - 21) in delivery by caesarean section
	OR CI (95%)	OR CI (95%)	OR CI (95%)	OR CI (95%)
	(0.53-1.1)	(0.87-1.13)	(0.9-1.4)	(0.78-1.2)
Richer	1.06 (0.7-1.6)	1.01 (0.87-1.17)	0.93 (0.73-1.2)	0.83* (0.68-1)
Richest	1.17 (0.74-1.9)	1.04 (0.91-1.19)	0.91 (0.68-1.2)	0.78** (0.62-1)
Husband education				
No education (ref.)				
Primary	0.91 (0.56-1.5)	0.92 (0.41-2.1)	1.07 (0.84-1.4)	0.86 (0.68-1.1)
Secondary	0.75 (0.49-1.2)	1.04 (0.51-2.1)	1.15 (0.94-1.4)	0.75** (0.62-0.9)
Higher	0.67 (0.4-1.1)	0.34 (0.07-1.6)	1.17 (0.87-1.6)	0.87 (0.69-1.1)
Husband age at childbirth				
11-24 (ref.)				
25-34	1.12	1.05	1.03	1.09

Variables	Difference Model 3: Changes from DHS (2015 - 16) to DHS (2019 - 21) in abortion history	Difference Model 3: Changes from DHS (2015 - 16) to DHS (2019 - 21) in knowledge of contraceptive methods	Difference Model 3: Changes from DHS (2015 - 16) to DHS (2019 - 21) in wanted pregnancy	Difference Model 3: Changes from DHS (2015 - 16) to DHS (2019 - 21) in delivery by caesarean section
	OR CI (95%)	OR CI (95%)	OR CI (95%)	OR CI (95%)
	(0.81-1.6)	(0.5-2.2)	(0.84-1.3)	(0.94-1.3)
35-49	1.11 (0.72-1.7)	1.17 (0.41-3.4)	1.13 (0.87-1.5)	0.98 (0.81-1.2)
Above 50	1.08 (0.93-1.26)	1.12 (0.85-1.46)	1.55 (0.76-3.2)	0.95 (0.5-1.8)

Note: Level of significance for mixed-effect logistic regression model: *** Significant at 1 percent level; ** Significant at 5 percent level; * Significant at 10 percent level; OR-Odds ratio; CI-Confidence interval; ref.: Reference category of the variable

Source: Authors' calculations based on DHS (2015-16) and DHS (2019-21) survey data

Model 1 and Model 2 are adjusted models that estimate the impact of women's autonomy in managing their healthcare on access to reproductive healthcare services in India, using DHS data from 2015–16 and 2019–21, respectively. Additionally, Model 3 estimates the adjusted time-interaction regression model. Model 1 (Table 6.2) shows that in DHS (2015–16), the odds of delivery via caesarean section were lower when women managed their healthcare jointly with their partner [OR = 0.79; p<0.05] or when someone else made healthcare decisions for them [OR= 0.57; p<0.01] compared to women who managed healthcare decisions alone. Additionally, when healthcare decisions were made solely by the husband/partner, women had significantly lower odds of knowing contraceptive methods [OR = 0.48; p<0.05] compared to when women alone managed healthcare decisions. On the contrary, women who managed their healthcare decisions jointly with their partner [OR = 1.64; p<0.01] or whose healthcare decisions were made by the husband/partner alone [OR = 1.26; p<0.05] had higher odds of having a wanted pregnancy compared to women who managed healthcare decisions alone. Women of mature age at the time of childbirth (35–49 years) had lower odds of having a wanted pregnancy [OR = 0.45; p<0.01] compared to women belonging to the age group of 14–24 years. Educated women had higher odds of having an abortion history [OR = 1.47; p<0.05], knowledge of contraceptive methods [OR = 1.63; p<0.10], wanted pregnancy [OR =
1.21; p<0.05], and delivery via caesarean section [OR = 2.47; p<0.01] compared to uneducated women. Working women were more likely to have an abortion history [OR = 1.44; p<0.05] but were less likely to deliver via caesarean section [OR = 0.88; p<0.10] compared to unemployed women. Access to health insurance increased the likelihood of a wanted pregnancy [OR = 1.33; p<0.05] and caesarean section deliveries [OR = 1.6; p<0.01] compared to women with no health insurance coverage.

Additionally, living in rural areas reduced the likelihood of an abortion history [OR = 0.79; p<0.05] and caesarean section delivery [OR = 0.78; p<0.01] in comparison to women residing in urban areas. Women belonging to Scheduled Tribes had significantly lower odds of having an abortion history [OR = 0.48; p<0.01], knowing contraceptive methods [OR =0.31; p<0.01], and delivering by caesarean section [OR = 0.75; p<0.05], but higher odds of wanting a pregnancy [OR = 1.41; p<0.05]. Women from Other Backward Classes were more likely to want a pregnancy [OR = 1.14; p<0.10] and had lower odds of an abortion history [OR = 0.78; p<0.05] compared to women belonging to Scheduled Castes. Women of the Muslim religion had higher odds of an abortion history [OR = 1.33; p<0.10] but lower odds of delivery via caesarean section [OR = 0.7; p<0.01] compared to those from the Hindu religion. Women from richer households had higher odds of having an abortion history [OR = 1.53; p<0.05], wanting a pregnancy [OR = 1.81; p<0.01], and delivering by caesarean section [OR = 4.63; p<0.01] in comparison to women belonging to the poorest households. Women with educated partners had higher odds of knowing contraceptive methods [OR = 1.8; p<0.05] and

delivering via caesarean section [OR =1.21; p<0.10] compared to women with uneducated partners. Similarly, women whose husbands were of mature age at the time of childbirth (25– 34 years) had higher odds of knowing contraceptive methods [OR =1.6; p<0.05] and delivering via caesarean section [OR = 1.5; p<0.01] compared to women whose husbands belonged to the age group of 11–24 years.

Similarly, to examine the association in 2019–21, Model 2 assesses the impact of women's autonomy in managing their healthcare on access to reproductive healthcare services in India, using DHS 2019–21 data. Table 6.3 shows that in (2019–21), women who managed their healthcare jointly with their partner [OR = 1.29; p<0.10] had higher odds of having a wanted pregnancy compared to women who managed healthcare decisions alone. However, the significance of shared healthcare decision-making in predicting a wan- ted pregnancy diminished between 2015– 16 and 2019–21. Women with higher levels of education, health insurance coverage, from wealthier households, and those whose husbands were older at the time of childbirth had better reproductive healthcare decision making in India. In contrast, women who belonged to the Muslim religion and resided in rural areas had lower access to reproductive healthcare services.

Model 3 (Table 6.4) examined the factors that influenced the changes in abortion history, knowledge of contraceptive methods, wanted pregnancy and delivery by caesarean section between two survey rounds. The decline in abortion history was less for women who were working [OR = 0.75; p<0.05] and belonged to the Muslim religion [OR= 0.52; p<0.01]. The decline in abortion history was greater among Scheduled Tribe women [OR = 1.64; p<0.05]. The decline in knowledge of contraceptive methods was less for women who belonged to mature age at the time of childbirth (35–49 years) [OR = 0.35; p<0.10], were educated [OR = 0.52; p<0.10] and belonged to the Muslim religion [OR= 0.25; p<0.05]. The decline in wanted pregnancy was less for women whose healthcare decisions were managed jointly with their partner [OR= 0.76; p<0.05] and who were educated [OR = 0.80; p<0.05]. However, the decline in wanted pregnancy was greater among women who were working [OR = 1.17; p<0.10], had health insurance coverage [OR= 1.17; p<0.10] and belonged to the Muslim religion [OR = 1.42; p<0.05]. The decline in delivery by caesarean section was greater among women who were educated [OR = 1.2; p<0.05], working [OR =1.17; p<0.05], belonged to the Muslim religion [OR = 1.18; p<0.05] and resided in rural areas [OR = 1.16; p<0.05]. The decline in delivery by caesarean section was less for women with health insurance coverage [OR = 0.71; p<0.01], those from the richest households [OR = 0.78; p<0.05], and women whose husbands had secondary education [OR = 0.75; p<0.05].

6.4 Discussion

In this paper, we assessed India's progress toward achieving the United Nations' SDG 3.7, which aims for universal access to sexual and reproductive

healthcare services, by examining temporal changes in reproductive healthcare decision making, including abortion history, contraceptive knowledge, unwanted pregnancies, and deliveries by caesarean section. We found that only 9.11 % of women in 2015–16 and a mere 7.85 % in 2019–21 had the autonomy to make healthcare decisions independently. However, it is important to note that the percentage of women whose healthcare decisions were made jointly with their husband/partner increased from 64.17 % in 2015–16 to 72.35 % in 2019–21. Furthermore, our study found that only 2.91 % of women in 2015–16 and 2.53 % in 2019–21 reported an abortion history. However, the limited reporting of abortion history could be due to financial constraints, underreporting, restricted access to safe abortion services and legal challenges in India (Stillman et al., 2022).

We found that women whose healthcare decisions were made by the husband/partner alone had lower odds of knowing contraceptive methods compared to women who made healthcare decisions alone. This finding aligns with Connell's gender and power theory (Connell, 2014), which states that unequal power relations based on gender undermine women's autonomy in contraceptive usage, fertility choices, and pregnancy decisions. A similar finding was observed in India using previous DHS data (Vishwakarma & Shekhar, 2022) and in the case of Bangladesh (Khatun et al., 2020). A possible explanation is that the husband's control over women's reproductive health choices can limit women's intention to seek contraceptive knowledge (Mboane & Bhatta, 2015; Forrest et al., 2017). It may also reduce their fortitude to consult healthcare professionals without their partner's consent (Mboane & Bhatta, 2015; Forrest et al., 2017). In contrast, women whose healthcare decisions were managed by the husband/partner alone or jointly with their husband/partner had higher odds of having a wanted pregnancy. A study conducted in India using DHS (2015–16) found that women with higher autonomy had 16% lower adjusted odds of having an unintended pregnancy than women with lower autonomy (Ram et al., 2022). Osamor and Grady (2018) contended that joint healthcare decision-making enhances access to reproductive healthcare services by fostering partner cooperation. Since reproductive choices often align with the husband's or partner's preferences, this leads to fewer unplanned pregnancies (Dixit et al., 2021). Furthermore, we found that delivery via caesarean section was lower when healthcare decisions were made by someone else or jointly with the husband/partner, compared to when decisions were made independently by women alone. Nnaji and colleagues (2013) found similar results in Sub-Saharan Africa, where physician influence and husband's presence were the most significant factors in the decision-making process. Women's involvement in decision-making regarding caesarean deliveries remained minimal, with paternalism still widely practiced (Nnaji et al., 2013; Wondimu et al., 2023). Many women reported that their husbands made the final healthcare decisions due to their financial and cultural influence (Alemayehu & Meskele, 2017).

In line with previous studies conducted in Brazil (Ferrari et al., 2016), Punjab (a state in India) (Abbas & Amir-Ud-Din, 2019), Ghana (Oyediran &

Davis, 2023) and Iran (Zandian et al., 2023) we found that women who were educated, employed, belonged to wealthier households, and had health insurance coverage accessed better reproductive healthcare services. Higher education levels enhance knowledge about reproductive health, leading to fewer unplanned pregnancies and better pregnancy management (Ahmed et al., 2010; Yadav et al., 2020). Employment provides access to healthcare benefits and promotes financial stability, thereby improving the utilization of reproductive health services (Ahmed et al., 2010; Yadav et al., 2020). Additionally, health insurance coverage improves access to preventive care and timely medical interventions, contributing to better access to reproductive healthcare services (Oyediran & Davis, 2023; Kazibwe et al., 2024). Furthermore, we found that women who resided in rural regions and belonged to the Muslim religion were less likely to have poor reproductive healthcare decision making. A study conducted in Karnataka, India found that Muslim women in rural Karnataka have reasonable knowledge of contraception but low usage, suggesting a need for outreach and education programs (Nasreen et al., 2024). Our study found that urban women had a higher likelihood of having an abortion compared to rural women. A similar finding was observed in India using previous DHS data (Dongarwar & Salihu, 2019). Further research is required to elucidate the reasons for higher abortion rates in urban areas, which could include unwanted pregnancies, sex- specific factors, legal issues, or medical emergencies. We found that women whose husbands were educated and were of mature age (35–49 years) at childbirth were more likely to make better reproductive healthcare decisions. Adjiwanou and colleagues (2018), found that higher levels of education among partners are linked to increased use of modern contraceptives, more frequent antenatal care visits, and higher rates of skilled birth attendance among their spouses in developing countries. Educated and mature husbands are more likely to be informed about reproductive health, support joint decision-making, and provide financial stability, leading to greater access of reproductive healthcare services (Seifu et al., 2020).

Furthermore, to improve women's reproductive healthcare decision making in India, policymakers could consider scaling up the Mission Parivar Vikas scheme on a national level. This government initiative focuses on increasing access to contraceptives and family planning services in 146 high fertility districts with a total fertility rate of 3 or above across seven high focus states namely, Uttar Pradesh, Bihar, Rajasthan, Madhya Pradesh, Chhattisgarh, Jharkhand, and Assam (PIB, 2019). This initiative can be strengthened by ensuring that women receive comprehensive education on a variety of contraceptive methods, fostering an environment where they feel confident in choosing the option best suited to them (PIB, 2019). Additionally, the "SAHELI" scheme- Scheme to Aware, Help, and Empower Ladies in India, was successful in changing women's attitude and knowledge regarding modern reproductive and sexual health care, including abortion and managing unwanted pregnancies (Chandrasekhar et al., 2018). Hence, it should be actively implemented, with a particular focus on rural women facing low literacy rates and poor economic conditions (Chandrasekhar et al., 2018).

Lastly, and importantly, the scope of schemes such as Pradhan Mantri Matru Vandana Yojana, Janani Suraksha Yojana, and National Family Planning Indemnity Scheme should be broadened to enhance women autonomy in fertility decisions across India (PIB, 2019; Sahu & Mehta, 2023).

6.5 Limitations of the study

The results of this study must be viewed in the light of a few limitations. First, the use of cross-sectional data limits the ability to establish a causal relationship between women's decision-making power and access to reproductive healthcare services (Patel et al., 2019). For instance, while the results suggest that women with decision-making autonomy may be more likely to experience better access to reproductive healthcare services, it is equally possible that better access to reproductive healthcare services enhance women's decision-making autonomy. Second, women were only asked about their current decision-making patterns, whereas most of their childbearing occurred in the past (Hindin, 2000). This raises concerns about the direction of the relationship, and whether current decision- making patterns accurately reflect past behaviors (Hindin, 2000). Lastly, there are certain potential data collection problems with DHS data such as misreporting the dates of births, misreporting of abortion history, and underreporting of events since DHS data is collected retrospectively and is self-reported (Paul and Saha, 2022).

6.6 Conclusion and policy recommendations

In summary, women who jointly managed their healthcare with their partner had lower odds of delivery via caesarean section and higher likelihood of having a wanted pregnancy compared to women who made healthcare decisions alone. Furthermore, when healthcare decisions were made solely by the husband or partner, women had significantly lower odds of being knowledgeable about contraceptive methods. To achieve SDG 3.7, which calls for universal access to sexual and reproductive healthcare services, empowering women through reproductive health education is crucial. Schemes like Mission Parivar Vikas and SAHELI can play a pivotal role in filing the gaps by promoting informed reproductive choices, enhancing contraceptive knowledge, and increasing access to safe abortion services. Policymakers must adopt a multi-pronged strategy to improve access to reproductive healthcare services in India. This strategy should prioritize female education, encourage joint healthcare decision-making, actively engage frontline health workers, address urban-rural health disparities, and expand access to comprehensive reproductive healthcare services.

6.7 References

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6.8 Appendix

Supplementary Table IV.1. Validity of the statistical models

Results of Hosmer-Lemeshow test

IV. 1a. Multivariate logistic regressions for analysing the impact of women's autonomy in managing one's healthcare on abortion history, knowledge of contraceptive methods, wanted pregnancy and delivery by caesarean section using DHS (2015-16) conducted in India

Outcome variables	Abortion history	Knowledge of contraceptive methods	Wanted pregnancy	Delivery by caesarean section
Hosmer-Lemeshow chi^2	1.15	4.22	15.3	2.98
P > chi^2	0.99	0.84	0.06	0.93

Note: P-value > 0.05 shows that the model is correctly specified

IV.1b. Multivariate logistic regressions for analysing the impact of women's autonomy in managing one's healthcare on abortion history, knowledge of contraceptive methods, wanted pregnancy and delivery by caesarean section using DHS (2019-21) conducted in India

Outcome variables	Abortion history	Knowledge of contraceptive methods	Wanted pregnancy	Delivery by caesarean section
Hosmer-Lemeshow chi^2	6.99	6.97	3.44	4.72
P > chi^2	0.54	0.54	0.90	0.79

Note: P-value > 0.05 shows that the model is correctly specified

Source: Authors' calculations based on DHS survey data

Results of Likelihood-ratio test

IV.1c. Time interaction model for analysing the impact of women's autonomy in managing one's healthcare on abortion history, knowledge of contraceptive methods, wanted pregnancy and delivery by caesarean section in India (2015-16 to 2019-21)

Outcome variables	Abortion history	Knowledge of contraceptive methods	Wanted pregnancy	Delivery by caesarean section
LR chi^2	44.38	48.22	61.98	305.82
P > chi^2	0.02	0.00	0.00	0.00

Note: P-value < 0.05 indicates that the model is a significantly better-fit model
Source: Authors' calculations based on DHS survey data

CHAPTER 7

IMPACT OF COERCIVE CONTROL EXPERIENCED BY MOTHERS ON CHILD HEALTH IN SOUTH ASIAN COUNTRIES: EVIDENCE FROM MIXED-EFFECTS LOGISTIC REGRESSION

7.1 Introduction

Intimate partner violence (IPV) against women is a 'global hidden epidemic', as it not only represents a violation of human rights but also a major public health concern requiring immediate attention (WHO, 2021a). Furthermore, eliminating all forms of IPV against women is one of the goals envisaged in the United Nations' sustainable development goals (SDG-5.2) (United Nations, 2020). Globally, one in three women experience either physical and/or sexual IPV or non-partner sexual violence in their lifetime (WHO, 2021a). Yount and colleagues (2011) contend that domestic violence against women is predominantly perpetrated by an intimate partner, involving a multifaceted pattern of physical aggression, sexual coercion, emotional and psychological abuse, and controlling behaviors. It is disconcerting that the prevalence of IPV is the highest in Southeast Asia (33%) much higher than in developed regions such as Western-Pacific (20%) (WHO, 2021b). Numerous scholars have put forth various definitions of IPV, the idea of 'coercive control' is considered to be most effective in understanding violence against women in a patriarchal context prevailing in South Asia (Mondal and Paul, 2021). Stark (2008) defines coercive control as the multi-faceted forms of oppression that intend to harm the autonomy, dignity, and equality of women within the patriarchal social structure, while simultaneously perpetuating gender-based privileges that reinforce male domination.

IPV has several negative ramifications on women's physical, emotional and psychological health; including depression, dysthymia, anxiety, psychoactive drug dependence, lifetime post-traumatic stress disorder, sexually transmitted infections, addiction to drugs and alcohol, diabetes mellitus and other chronic diseases, affecting women's overall quality of life (Roberts et al., 1998; Stubbs and Szoeke, 2021). Furthermore, IPV intensifies pregnancy complications (Huth-Bocks et al., 2002; Yost et al., 2005), as well as morbidity and mortality among women (Davis, 2010; Walker-Descartes et al., 2021). Alongside, it undermines a woman's economic opportunities and employability, exacerbating issues such as absenteeism, tardiness, job leaving, and terminations (Swanberg and Logan, 2005).

Research has identified that IPV has social and emotional sequelae for the individual, family, community and society at large (Kaur and Suneela,

2008). IPV against women disproportionately affects child health, as young children are likely to be exposed due to their reliance on their mothers as primary caretakers (Yount et al., 2011). The possible association between IPV experienced by mothers and the nutritional status of a child can be elucidated using two models. The risky family environment model (Repetti et al., 2002) suggests that in-utero or infancy exposure to family conflict or 'recurrent episodes of anger and aggression' distorts a child's stress-responsive biological regulatory systems, imperative for maintaining physical and mental well-being (Yount et al., 2011). Furthermore, such exposure could directly affect the child's intellect, behavior, health and stature (Huth-Bocks et al., 2002; Repetti et al., 2002; Yount et al., 2011). On the other hand, the family disruption model suggests that IPV may indirectly impact children through 'spillover' effects on other family processes (Margolin, 2005; Yount et al., 2011). Women's exposure to IPV might trigger behavioral risks (smoking, alcohol, drug use) as well as psychological (anxiety, depression), physical (injury, disability, fatigue), and nutritional symptoms (anemia, poor weight gain) in the child (Campbell, 2002; Yount et al., 2011), which may lead to poor stress-responsive biological regulatory systems of the child. Since mothers typically serve as young children's primary caregivers, any maternal impairments resulting from the aforementioned reasons may lead to early growth impairment and malnutrition in the child (Yount et al., 2011). This can be due to negligence in maternal, prenatal and delivery care, infant and toddler care in the form of improper feeding practices, exposure to infection, and inadequate psychosocial care (Yount et al. 2011).

A child exposed to IPV or marital conflict may feel emotionally insecure, experience hypervigilance, dysregulated stress response (Afolabi, 2014), leading to a higher proclivity towards suicide attempts and crimes (Kaur and Suneela, 2008), lower motor skills, communication abilities and cognitive development (Neamah et al., 2018), higher risk of perinatal, neonatal mortality and child mortality (Ahmed et al., 2006; Ackerson and Subramanian, 2008), higher risks of posttraumatic stress disorder and serious anger issues and psychological dysfunction (Chemtob and Carlson, 2004). Furthermore, IPV negatively affects a child's school attendance; thereby, IPV against mother can impede economic development of child in the future (Assaad et al., 2016).

Over the years, many socioeconomic and demographic factors influencing anthropometric indicators of child health have been identified in the research literature like water, sanitation and hygiene (Momberg et al., 2020), rural-urban disparities (Quansah et al., 2016), climate change (Helldén et al., 2021), exposure to mass media (Kim et al., 2019) and effect of government schemes (Kipo-Sunyehzi et al., 2019). However, the impact of coercive control faced by mothers on child health in South Asia remains understudied. Notably more than half of the stunted and three- quarters of the wasted children live in Asia (WHO, 2023). Given the global burden of child malnutrition and its long-term impact on human capital formation, coupled with the high prevalence of patriarchal social structure in South Asia, it is crucial to investigate the effects of coercive control on child health. Moreover,

to the best of our knowledge, no research has explored the impact of domestic violence (physical violence) during pregnancy on anthropometric indicators in South Asian countries.

Khatoon and colleagues (2021), conducted 270 interviews in Uttar Pradesh (a state in India) and found that the relative risk of hypertensive disorders, antepartum haemorrhage, preterm labour, premature prelabour rupture of membranes and recurrent urinary tract infections was found to be higher in women who were subjected to domestic violence during pregnancy. Moreover, the child of a mother who was exposed to IPV had lower Apgar scores and greater neonatal intensive care unit (NICU) admissions (Khatoon et al., 2021). In Vietnam, repeated interviews of 1276 pregnant women were performed for 30-34 weeks, and it was found that exposure to physical violence during pregnancy increased the prevalence of preterm birth or low birth weight of the child (Hoang et al., 2016). However, these studies lack the population representativeness. There are few studies, which found that exposure to IPV during pregnancy is associated with low birth weight of a child in Taiwan (Yang et al., 2006), Tigray (Berhanie et al., 2019) and South Africa (Barnett et al., 2021); however, to our knowledge, no study explored the impact of domestic violence (physical violence) during pregnancy on under- five stunting and wasting.

Johnson (1995) argues that due to the existence of 'patriarchal terrorism', men are positioned higher in social order and family structure, and often exercise power and control over women in several ways. Subservience, subordination, compliance, and passivity have been expected and imposed on women by their husbands and in-laws (Kamimura et al., 2015). Stark (2008) vehemently argues that women are intentionally kept captive in an unreal world created by the abuser, entrapped in a world of confusion, contradiction, and fear. For decades, women have been subverted to accept differential power relations based on gender and believe that men have the right to discipline and abuse them, suggesting intergenerational transmission of violence (Hines and Saudino, 2002; Mondal and Paul, 2021). In this regard, it also becomes important to examine whether interference by the husband or any adult family member during a woman's interview has any bearing on the child health. This is because they may feel insecure about the husband's actions being revealed or reported, and thus may try to interrupt his wife's interview. In this regard, our study is the first to investigate the effect of an adult's interruption during interviews about domestic violence, the intergenerational impact of violence, and fear of husband/partner on child health in South Asia.

Furthermore, our study examines the impact of women's attitude towards IPV and spousal-controlling behavior on child health, areas which have largely been understudied in South Asian countries. Studies have found that women's attitude towards domestic violence acceptance leads to child undernutrition in Bangladesh (Bhagowalia et al., 2010), Nigeria (Agu et al., 2019) and Ethiopia (Mekonnen et al., 2021), in contrast, had an insignificant impact on child health in South-central Asian countries (Onah, 2021). Moreover, research in Zambia found that spousal controlling behaviors led to

delayed breastfeeding practices, which might impact child health (Walters et al., 2021). Against this background, this is a pioneer study examining comprehensively the impact of coercive control on child health in the South Asian context.

As addressing IPV is essential for the well-being, and future prospects of mother-child dyads; this research, therefore, is expected to provide valuable insights for policymakers, healthcare providers, and stakeholders to formulate effective policies and strategies to prevent coercive control and enhance child health in South Asia.

7.2 Data and Methodology

7.2.1 Data Source

This study employed data extracted from the latest round of DHS conducted in three South Asian countries, namely India (2019-21), Maldives (2016-17) and Pakistan (2017-2018). However, Afghanistan (2015), Bangladesh (2017-2018) and Nepal (2022) were excluded from this study due unavailability of relevant selected variables, while Sri Lanka (1987) was excluded due to a lack of recent data. DHS is a nationally representative survey encompassing data on domestic violence, fertility preferences, nutrition, mortality, morbidity, maternal and child health. This survey uses information gathered via face-to-face interviews and medical examinations. DHS covered a population-representative sample survey of 636,699 households in India, 6,050 in Maldives and 14,540 households in Pakistan. Through interviews, women aged 15-49 years, men aged 15-54 years, and children aged less than five years were covered in the sampled households. The domestic violence module was administered to only one eligible woman randomly selected in each selected household, contrary to the women's questionnaire, which was given to every woman in the selected households. Moreover, to ensure the representativeness of the sub- sample of women selected for the domestic violence module, domestic violence weights were devised. Therefore, the final study participants for this research comprises of 12,795 women from India, 455 women from Maldives, and 808 women from Pakistan, after exclusion of respondents with missing response to the selected relevant variables. In all three selected countries, multistage stratified sampling was adopted and relevant survey weights provided by the DHS were employed, where applicable.

7.2.2 Outcome variables

To assess the impact of coercive control on CHOs, three anthropometric indicators in the context of under-five child health outcomes were considered: stunting, wasting and underweight among children. Each of these indicators captures varying information about a child's growth and body composition. As per WHO recommendations, a child is considered to be stunted, wasted and

underweight if the height-for-age z-score, weight-for- height z-score and weight-for-age z-score, respectively, of a child is 2 standard deviations (-2.0) below the median on the WHO Child Growth Standards (WHO, 2006). Outcome variables were dichotomized into two categories: not stunted/ not wasted/ not underweight were coded as '0' and stunted/wasted/underweight among children under the age of five years were coded as '1'.

7.2.3 Explanatory variables

After defining the key outcome variables used in this study, we now focus variables of interest. i.e., variables that capture the incidence of coercive control inflicted upon women by their husband/partner.

Physical violence during pregnancy: The physical violence during pregnancy variable is constructed based on a woman's response to the following question 'Now if you will permit me, I need to ask some more questions about your relationship with your (last) husband/partner: Has your husband/partner ever hit, slapped, kicked, or done anything else to hurt you physically while you were pregnant?' The physical violence during pregnancy variable takes the value of 1 if the respondent says yes and 0 otherwise.

Emotional Violence: The verbal or emotional abuse variable is constructed based on the woman's responses to the following questions 'Now if you will permit me, I need to ask some more questions about your relationship with your (last) husband/partner: (Does/did) your (last) husband/partner ever: (a) say or do something to humiliate you in front of others? (b) threaten to hurt or harm you or someone else close to you? (c) insult you or make you feel bad about yourself?' Based on the responses, 0-1 dummy was created, which captured whether the woman has ever faced emotional violence at the hands of her (last) husband/partner. This variable can also be interpreted as physiological abuse as verbal insults may lead to psychological issues in females.

Sexual Violence: The sexual violence variable is constructed based on the woman's responses to the following questions 'Now if you will permit me, I need to ask some more questions about your relationship with your (last) husband/partner: (Does/did) your (last) husband/partner ever do any of the following things to you: (a) physically force you to have sexual intercourse with him even when you did not want to? (b) Physically force you to perform any other sexual acts you did not want to? and (c) physically forced to perform sexual acts the respondent didn't want to?' The sexual violence variable takes a value of 1 if the respondent says yes to ever experiencing any of these and 0 otherwise.

Physical Violence: Similarly, the physical violence variable is constructed based on woman's responses to the following seven questions: 'Now if you will permit me, I need to ask some more questions about your relationship with your (last) husband/partner. (Does/did) your (last) husband//partner ever do any of the following things to you: (a) push you, shake

you or throw something at you? (b) slap you? (c) punch you with his fist or with something that could hurt you? (d) twist your arm or pull your hair? (e) kick you, drag you or beat you up? (f) try to choke you or burn you on purpose? and (g) threaten or attack you with a knife, gun or any other weapon?' The physical violence variable takes the value of 1 if the respondent says yes to ever experiencing any of these and 0 otherwise. First variable deals with physical violence during pregnancy whereas this variable deals with physical violence experienced ever by the woman irrespective of pregnancy.

Women's attitude towards IPV: Women's attitude towards IPV variable is constructed to measure woman's justification of wife beating based on women's responses to the following circumstances: (a) beating justified if wife goes out without telling husband (b) beating justified if wife neglects the children (c) beating justified if wife refuses to have sexual intercourse with husband. The women's attitude towards IPV variable thus takes a value of 1 if the respondent agrees that the husband is justified in hitting or beating her in any of the above-mentioned situations and 0 otherwise.

Intergenerational Impact: The intergenerational impact variable is constructed based on woman's response to the following question 'As far as you know, did your father ever beat your mother?' The intergenerational impact variable takes a value of 1 if the respondent says yes and 0 otherwise.

Spousal Controlling Behavior: The spousal controlling behavior variable is constructed based on a woman's responses to the following questions 'Now I am going to ask you about some situations which happen to some women. Please tell me if these apply to your relationship with your (last) husband/partner: (a) he (is/was) jealous or angry if you (talk/talked) to other men? (b) he frequently (accuses/accused) you of being unfaithful? (c) he (does/did) not permit you to meet your female friends? (d) he (tries/tried) to limit your contact with your family? (e) he (insists/insisted) on knowing where you (are/were) at all times?' The spousal controlling behavior variable takes a value of 1 if the respondent says yes and 0 otherwise.

Interviews were interrupted by an adult: The interviews were interrupted by an adult variable is constructed based on the interviewee's response to the following question 'Did you have to interrupt the interview because (a) the husband was trying to listen, or came into the room, or interfered in any other way? (b) an adult male was trying to listen, or came into the room, or interfered in any other way? (c) an adult female was trying to listen, or came into the room, or interfered in any other way?' The interviews were interrupted by an adult variable takes a value of 1 if the domestic violence interview was interrupted once, 2 if the domestic violence interview was interrupted more than once and 0 otherwise.

Husband/partner drinks alcohol: The husband/partner drinks alcohol variable is constructed based on a woman's response to the following question: Does (did) your husband/partner drink (alcohol)? The husband/partner drinks alcohol variable takes a value of 1 if the respondent says yes and 0 otherwise.

Respondent afraid of husband/partner: The respondent afraid of

husband/partner variable is constructed based on a woman's response to the following question: Are you afraid of your husband/partner? The 'respondent afraid of husband/partner' variable takes a value of 1 if the respondent is sometimes afraid of the husband/partner, 2 if the respondent is most of the time afraid of the husband/partner and 0 otherwise.

Decision-making autonomy: The decision-making autonomy in managing one's healthcare variable was estimated based on woman's response to the following question: who usually makes decisions regarding respondent's health care? The responses were captured by four categories; such as respondent alone, respondent and husband/partner together, husband/partner alone or someone else.

In addition to these key predictors, the confounding variables were selected based on their theoretical relevance and practical significance. These include antenatal care (ANC) visits (<8 ANC visits and ≥ 8 ANC visits), number of days iron folic acid (IFA) tablets consumed (<180 days and ≥180 days), number of months pregnant at the time of first ANC check-up (<4 months and ≥4 months), postnatal care (PNC) received by mothers (yes/no), early initiation of breastfeeding i.e. children who were breastfed within 1 hour of birth (yes/no), exclusive breastfeeding for the initial six months (yes/no), child's gender (male/female), childbirth order (firstborn, 2nd-4th, 5th or more), maternal age at the time of childbirth (14–24, 25– 34, 35–49 years), mother's educational attainment (no education, primary, secondary, higher education), mother currently working (yes/no), mother covered by health insurance (yes/no), exposure/reads the newspaper (not at all, less than once a week, at least once a week), exposure/listens to radio (not at all, less than once a week, at least once a week), exposure/watches TV (not at all, less than once a week, at least once a week), place of residence (rural/urban) and household wealth quintile (poorest, poorer, middle, richer, and richest).

7.2.4 Analytical Strategy

Descriptive statistics were used to illustrate the respondent characteristics using percentages and frequency distribution at the univariate level. The following section describes the methodology applied to investigate the impact of various measures of coercive control on child health outcomes.

7.2.4.1 Mixed-effect logistic regression analysis

The DHS data has a hierarchical nature; hence respondents are nested within a cluster, implying that we may expect respondents within the same cluster may be more similar to each other than respondents in another cluster (Tesema et al., 2020), which violates the assumptions of the traditional logistic regression model of independence of observations and equal variance across clusters (Tesema et al., 2020). Therefore, a mixed-effect logistic regression model was fitted using a cluster variable (country level) as a random variable

to take into account the between- cluster variability to get a reliable standard error and unbiased estimate (Tesema et al., 2020).

The specific form of the mixed-effect logistic model is as follows.

$$pr(Y_{ij} = 1 | X_{ij}, Z_{ij}, R_i) = \frac{\exp(X_{ij}^T\beta + Z_{ij}^T R_i)}{1 + \exp(X_{ij}^T\beta + Z_{ij}^T R_i)}, j = 1, \ldots, m, i = 1, \ldots, n \quad (7.1)$$

The observed data are ($_{ij}, X_{ij}, Z_{ij}$), j= 1,…, m_i and i= 1,…, n, where $_{ij}$ is the binary response variable, X_{ij} is a p-vector that exerts a fixed effect and Z_{ij} is a q- dimensional random variable that has a random effect $R_i \in \Re^q$ (Wei et al., 2019). Within this framework, i and j denote the index for clusters and the subject within a cluster, respectively (Wei et al., 2019). The random effect is completely unobserved and we assume m_i > q for identifiability for all i (Wei et al., 2019). The main objective of mixed-effect logistic model is to consistently estimate the p-dimensional regression coefficient β in the presence of the unobserved random effect.

Firstly, unadjusted odds ratio (UOR) was obtained by separately analyzing the impact of each key predictor variable on child anthropometric indicators. In the second model, confounding variables were introduced in the mixed effect logistic regression model and the ORs such obtained after adjusting for confounders are referred to as adjusted odds ratio (AOR).

7.2.4.2 Random effect analysis

The fixed effects of the mixed-effect logistic model can be interpreted using estimated log odds ratio, while the presence of random effects (clustering effect) was tested using intra-cluster correlation (ICC), median odds ratio (MOR) and cluster variance. Lastly, the likelihood Ratio (LR) test was employed to examine the model adequacy.

The ICC measures the degree of heterogeneity of child health outcomes between clusters (the proportion of observed individual variation in child health outcomes that can be attributed to between cluster variations) (RodríGuez and Elo, 2003).

$$\text{ICC} = \frac{\sigma_u^2}{(\sigma_u^2 + \pi^2/_3)} \quad (2)$$

where, σ_u^2 denotes the variance of the random effect

MOR quantifies the variation or heterogeneity in child health outcomes between clusters and is defined as the median value of the odds ratio between the cluster at highest risk and the cluster at the lowest risk while picking out from clusters randomly (Merlo et al., 2006).

$$\text{MOR} = \exp\left(\sqrt{2 * \partial^2 * 0.6745}\right) \sim MOR = \exp(0.95 * \partial) \quad (7.3)$$

In the above equation, ∂^2 indicates cluster variance.

Likelihood ratio (LR) test was employed to examine the model adequacy. The regression coefficients can be interpreted using the estimated log OR with 95% confidence intervals (CIs). If the 95% CI includes 1, then the OR must be interpreted as statistically insignificant at 5% level. Although we focus on statistical significance at 5% level, we also show in the results tables whether a coefficient or OR is statistically significant at 1% and 10% level after interpreting the p-value associated with the coefficient or OR. The analysis was performed using STATA version 17.0 StataCorp LLC, College Station, TX, USA).

7.3 Data analysis and results

7.3.1 Descriptive statistics

Fig. 7.1 demonstrates the prevalence of stunting, wasting and underweight among children under the age of five years in India, Maldives and Pakistan. The prevalence of stunting was the highest in India at (32.2%), followed by Maldives (12.09%) and Pakistan (7.55%). Moreover, it is dismaying that the prevalence of wasting (19.76%) and underweight (27.31%) is also the highest in India, followed by Pakistan, where both wasting and underweight are at (14.73%). In Maldives, the prevalence of underweight (12.97%) was the highest among children, followed by wasting (10.55%).

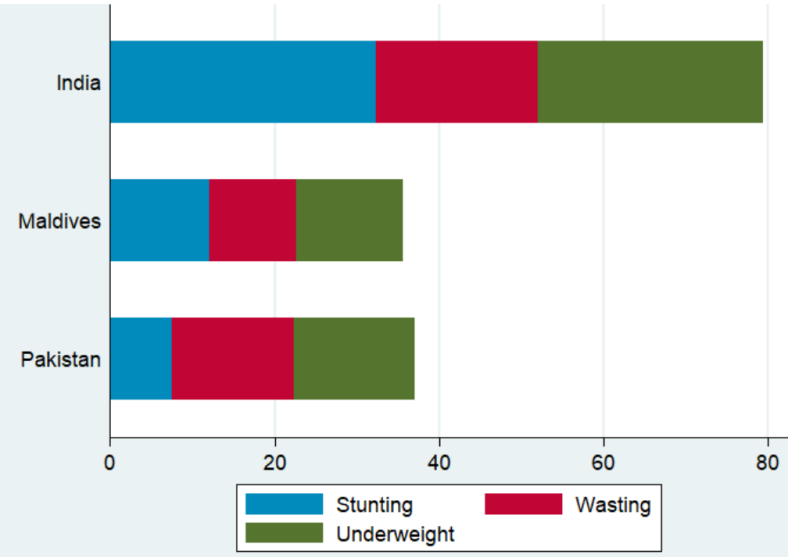

Fig. 7.1 Prevalence of stunting, wasting and underweight (in percentage) among children under the age of five years

Source: Authors' calculations based on DHS survey data

Table 7.1. Characteristics of mother-child dyads in India, Maldives and Pakistan

	India	Maldives	Pakistan
	12,795	455	808
	Frequency (Percentage)	Frequency (Percentage)	Frequency (Percentage)
Physical violence during pregnancy			
No (ref.)	12,584 (98.35)	449 (98.68)	749 (92.70)
Yes	211 (1.65)	6 (1.32)	59 (7.30)
Experienced Emotional			

	India	Maldives	Pakistan
	12,795	455	808
	Frequency (Percentage)	Frequency (Percentage)	Frequency (Percentage)
Violence			
No (ref.)	11,430 (89.33)	323 (70.99)	582 (72.03)
Yes	1,365 (10.67)	132 (29.01)	226 (27.97)
Experienced Sexual Violence			
No (ref.)	12,213 (95.45)	451 (99.12)	772 (95.54)
Yes	582 (4.55)	4 (0.88)	36 (4.46)
Experienced Physical Violence			
No (ref.)	9,709 (75.88)	405 (89.01)	632 (78.22)
Yes	3,086 (24.12)	50 (10.99)	176 (21.78)
Respondent's attitude towards IPV			
Not justified (ref.)	9,039 (70.64)	83.52 (380)	514 (63.61)
Justified	3,756 (29.36)	75 (16.48)	294 (36.39)
Intergenerational Impact			
Respondent's mother was never beaten (ref.)	10,435 (81.56)	388 (85.27)	631 (78.09)
Respondent's mother was beaten	2,360 (18.44)	67 (14.73)	177 (21.91)
Spousal controlling behavior			
No (ref.)	7,741 (60.50)	291 (63.96)	582 (72.03)
Yes	5,054 (39.50)	164 (36.04)	226 (27.97)
Interviews were interrupted by an adult			
No (ref.)	10,625 (83.04)	439 (96.48)	733 (90.72)
Yes, once	948 (7.41)	1 (0.22)	38 (4.70)
Yes, more than once	1,222 (9.55)	15 (3.30)	37 (4.58)

	India	Maldives	Pakistan
	12,795	455	808
	Frequency (Percentage)	Frequency (Percentage)	Frequency (Percentage)
Husband/partner drinks alcohol			
No (ref.)	9,651 (75.43)	449 (98.68)	786 (97.28)
Yes	3,144 (24.57)	6 (1.32)	22 (2.72)
Respondent afraid of husband/partner			
Never (ref.)	2,973 (23.24)	378 (83.08)	467 (57.80)
Sometimes afraid	8,614 (67.32)	66 (14.51)	263 (32.55)
Most of the time afraid	1,208 (9.44)	11 (2.42)	78 (9.65)
Person who usually decides on respondent's health care			
Respondent alone (ref.)	1,025 (8.01)	98 (21.54)	72 (8.91)
Respondent and partner	9,433 (73.72)	326 (71.65)	374 (46.29)
Husband/partner alone	2,068 (16.16)	30 (6.59)	286 (35.40)
Someone else	269 (2.1)	1 (0.22)	76 (9.41)
Attended 8+ ANC visits			
No (ref.)	9,792 (76.53)	83 (18.24)	627 (77.60)
Yes	3,003 (23.47)	372 (81.76)	181 (22.40)
Number of days IFA consumed			
Less than 180 IFA (ref.)	8,736 (68.28)	260 (57.14)	635 (78.59)
Atleast 180 IFA	4,059 (31.72)	195 (42.86)	173 (21.41)
Number of months pregnant at time of first ANC visit			
<4 months (ref.)	9,943 (77.71)	441 (96.92)	597 (73.89)
≥4 months	2,852 (22.29)	14 (3.08)	211 (26.11)
Mother’s received PNC			

	India	Maldives	Pakistan
	12,795	455	808
	Frequency (Percentage)	Frequency (Percentage)	Frequency (Percentage)
No (ref.)	1,326 (10.36)	19 (4.18)	148 (18.32)
Yes	11,469 (89.64)	436 (95.82)	660 (81.68)
Early initiation of breastfeeding			
No (ref.)	7,102 (55.51)	152 (33.41)	600 (74.26)
Yes	5,693 (44.49)	303 (66.59)	208 (25.74)
Exclusive breastfeeding			
No (ref.)	11,638 (90.96)	423 (92.97)	772 (95.54)
Yes	1,157 (9.04)	32 (7.03)	36 (4.46)
Child gender			
Male (ref.)	6,816 (53.27)	231 (50.77)	412 (50.99)
Female	5,979 (46.73)	224 (49.23)	396 (49.01)
Maternal age at the time of childbirth			
14-24 (ref.)	5,499 (42.98)	106 (23.30)	222 (27.48)
25-34	6,601 (51.59)	289 (63.52)	463 (57.30)
35-49	695 (5.43)	60 (13.19)	123 (15.22)
Maternal education			
No education (ref.)	2,043 (15.97)	5 (1.10)	247 (30.57)
Primary	1,454 (11.36)	102 (22.42)	104 (12.87)
Secondary	7,093 (55.44)	258 (56.70)	232 (28.71)
Higher	2,205 (17.23)	90 (19.78)	225 (27.85)
Mother currently working			
No (ref.)	10,206 (79.77)	302 (66.37)	701 (86.76)
Yes	2,589 (20.23)	153 (33.63)	107 (13.24)

	India	Maldives	Pakistan
	12,795	455	808
	Frequency (Percentage)	Frequency (Percentage)	Frequency (Percentage)
Childbirth order			
First born (ref.)	4,298 (33.59)	149 (32.75)	178 (22.03)
2^{nd}- 4^{th} born	7,884 (61.62)	285 (62.64)	453 (56.06)
5^{th} or higher birth order	613 (4.79)	21 (4.62)	177 (21.91)
Health Insurance			
No (ref.)	8,914 (69.67)	435 (95.60)	781 (96.66)
Yes	3,881 (30.33)	20 (4.40)	27 (3.34)
Mother reads newspaper			
Not at all (ref.)	8,814 (68.89)	112 (24.62)	601 (74.38)
Less than once a week	2,490 (19.46)	94 (20.66)	127 (15.72)
At least once a week	1,491 (11.65)	249 (54.73)	80 (9.90)
Mother listens to radio			
Not at all (ref.)	11,065 (86.48)	200 (43.96)	719 (88.99)
Less than once a week	1,215 (9.50)	76 (16.70)	47 (5.82)
At least once a week	515 (4.03)	179 (39.34)	42 (5.20)
Mother watches TV			
Not at all (ref.)	3,374 (26.37)	25 (5.49)	232 (28.71)
Less than once a week	2,713 (21.20)	39 (8.57)	92 (11.39)
At least once a week	6,708 (52.43)	391 (85.93)	484 (59.90)
Type of residence			
Urban (ref.)	3,048 (23.82)	38 (8.35)	465 (57.55)
Rural	9,747 (76.18)	417 (91.65)	343 (42.45)
Wealth quintile			
Poorest (ref.)	2,640 (20.63)	154 (33.85)	81 (10.02)
Poorer	2,868	131	159

	India	Maldives	Pakistan
	12,795	455	808
	Frequency (Percentage)	Frequency (Percentage)	Frequency (Percentage)
	(22.42)	(28.79)	(19.68)
Middle	2,677 (20.92)	114 (25.05)	175 (21.66)
Richer	2,509 (19.61)	37 (8.13)	173 (21.41)
Richest	2,101 (16.42)	19 (4.18)	220 (27.23)

Source: Authors' calculations based on DHS survey data

A summary of the characteristics of mother-child dyads in India, Maldives and Pakistan is presented in Table 7.1. The prevalence of physical violence during pregnancy was the highest in Pakistan (7.30%), followed by India (1.65%) and Maldives (1.32%). It is deeply concerning that the incidence of emotional violence was notably high in South Asia, with the most prevalent instances noted in Maldives (29.01%) followed by Pakistan (27.97%) and India (10.67%). The prevalence of sexual violence in India and Pakistan was almost 5%. The proportion of women who have experienced physical violence ever in life in South Asia is substantial, with the highest prevalence observed in India (24.12%), followed by Pakistan (21.78%) and Maldives (10.99%). It's perturbing that 36.39% of respondents in Pakistan themselves justify IPV, followed by India (29.36%) and Maldives (16.48%). It is worth noting that 21.91% of the female respondents in Pakistan have witnessed inter-parental violence, followed by India (18.44%) and Maldives (14.73%). The highest spousal controlling behavior was observed in India (39.50%), followed by Maldives (36.04%) and Pakistan (27.97%), reflecting male domination in South Asian countries. In India, 9.55% of the respondents faced interview interruption more than once by an adult, followed by 4.58% in Pakistan and 3.30% in Maldives, suggesting a lack of independence or fear among adults regarding household matters getting revealed by these women in the household. Almost 25% of the female respondents in India acknowledged that their husbands drink alcohol, by contrast, the husband's alcohol consumption is less than 3% in Pakistan and Maldives. Almost 10% of the respondents in India and Pakistan were afraid of their husbands most of the time. The decision- making autonomy of respondents in managing their healthcare is the lowest in Pakistan wherein 35.4% of cases involving healthcare decisions were taken by husband/partner alone, followed by 16.2% in India and 6.6% in Maldives.

7.3.2 Mixed-effect logistic regression

The likelihood ratio test ($p < 0.0000$) suggested that for the purpose of this study, the mixed effect logistic regression model is a better model than the traditional logistic regression model (Table 7.2).

Table 7.2. Random effect analysis/ results

Parameter	Mixed-effect logistic regression analysis (GLMM)		
	Stunting	Wasting	Underweight
LLR	-8971.856	-6933.156	-8682.476
ICC	0.07 (0.01, 0.29)	0.06 (0.01, 0.25)	0.05 (0.01, 0.20)
LR- test LR test vs. logistic regression:	$\chi2 = 61.93$, $p < 0.0000$	$\chi2 = 75.85$, $p < 0.0000$	$\chi2 = 84.16$, $p < 0.0000$
MOR	1.61	1.54	1.46
Cluster variance	0.50 [95% CI: 0.21, 1.17]	0.45 [95% CI: 0.19, 1.05]	0.39 [95% CI: 0.17, 0.91]

Notes: LLR; log-likelihood ratio, ICC; Intra-class Correlation Coefficient, MOR; Median Odds Ratio, LR-test; Likelihood Ratio test

Source: Authors' calculations based on DHS survey data

Table 7.3. Unadjusted mixed-effect logistic regression results of the impact of coercive control on child health outcomes

	Stunting	Wasting	Underweight
	OR CI (95%)	OR CI (95%)	OR CI (95%)
Physical violence during pregnancy			
No (ref.)			
Yes	1.51***	1.13	1.24**

	Stunting	Wasting	Underweight
	OR CI (95%)	OR CI (95%)	OR CI (95%)
	(1.25-1.84)	(0.89-1.45)	(1.01-1.52)
Experienced Emotional Violence			
No (ref.)			
Yes	1.26*** (1.15-1.38)	1.19*** (1.07-1.32)	1.23*** (1.12-1.34)
Experienced Sexual Violence			
No (ref.)			
Yes	1.23*** (1.08-1.40)	1.16* (0.99-1.36)	1.28*** (1.12-1.46)
Experienced Physical Violence			
No (ref.)			
Yes	1.34*** (1.25-1.43)	1.13 *** (1.04-1.22)	1.31*** (1.22-1.40)
Respondent's attitude towards IPV			
Not justified (ref.)			
Justified	1.11*** (1.04-1.19)	0.99 (0.92-1.07)	1.10*** (1.03-1.18)
Intergenerational Impact			
Respondent's mother was never beaten (ref.)			
Respondent's mother was beaten	1.09** (1.01-1.17)	0.99 (0.90-1.09)	1.13*** (1.04-1.22)
Spousal controlling behavior			

	Stunting	Wasting	Underweight
	OR CI (95%)	OR CI (95%)	OR CI (95%)
No (ref.)			
Yes	1.20*** (1.13-1.28)	1.13*** (1.05-1.22)	1.28*** (1.20-1.36)
Interviews were interrupted by an adult			
No (ref.)			
Yes, once	1.08 (0.97-1.21)	1.16** (1.02-1.33)	1.12* (0.99-1.25)
Yes, more than once	1.01 (0.91-1.11)	1.06 (0.94-1.19)	0.98 (0.88-1.08)
Husband/partner drinks alcohol			
No (ref.)			
Yes	1.13*** (1.05-1.21)	1.00 (0.92-1.09)	1.10*** (1.03-1.18)
Respondent afraid of husband/partner			
Never (ref.)			
Sometimes afraid	1.15*** (1.07-1.24)	1.11** (1.02-1.21)	1.19*** (1.10-1.28)
Most of the time afraid	1.33*** (1.20-1.48)	1.12 (0.97-1.28)	1.26*** (1.13-1.41)
Person who usually decides on respondent's health care			
Respondent alone (ref.)			

	Stunting	Wasting	Underweight
	OR CI (95%)	OR CI (95%)	OR CI (95%)
Respondent and partner	1.00 (0.90-1.12)	1.10 (0.96-1.26)	1.05 (0.94-1.18)
Husband/partner alone	1.11* (0.98-1.26)	1.27*** (1.09-1.48)	1.22*** (1.07-1.39)
Someone else	1.01 (0.78-1.31)	1.47** (1.08-2.01)	1.08 (0.83-1.43)

Notes: Level of significance for mixed-effect logistic regression model: *** Significant at 1 percent level; ** Significant at 5 percent level; * Significant at 10 percent level; OR, Odds ratio; CI, Confidence interval; ref.: Reference category of the variable

Source: Authors' calculations based on DHS survey data

Table 7.4. Adjusted mixed-effect logistic regression results of the impact of coercive control on child health outcomes

	Stunting	Wasting	Underweight
	OR CI (95%)	OR CI (95%)	OR CI (95%)
Physical violence during pregnancy			
No (ref.)			
Yes	1.20 (0.93-1.55)	0.91 (0.66-1.26)	0.9 (0.69-1.18)

	Stunting	Wasting	Underweight
	OR CI (95%)	OR CI (95%)	OR CI (95%)
Experienced Emotional Violence			
No (ref.)			
Yes	1.0 (0.92-1.18)	1.18** (1.02-1.36)	1.02 (0.9-1.16)
Experienced Sexual Violence			
No (ref.)			
Yes	1.02 (0.85-1.21)	1.03 (0.84-1.28)	1.01 (0.84-1.21)
Experienced Physical Violence			
No (ref.)			
Yes	1.08 (0.98-1.19)	1.05 (0.94-1.18)	1.06 (0.96-1.17)
Respondents's attitude towards IPV			
Not justified (ref.)			
Justified	1.02 (0.94-1.11)	0.97 (0.88-1.07)	1.02 (0.94-1.11)
Intergenerational Impact			
Respondent's mother was never beaten (ref.)			
Respondent's mother was beaten	1.01 (0.92-1.12)	0.94 (0.84-1.05)	1.06 (0.96-1.17)
Spousal controlling behavior			

	Stunting	Wasting	Underweight
	OR CI (95%)	OR CI (95%)	OR CI (95%)
No (ref.)			
Yes	1.04 (0.96-1.12)	1.02 (0.93-1.12)	1.07 (0.99-1.16)
Interviews were interrupted by an adult			
No (ref.)			
Yes, once	1.04 (0.91-1.19)	1.14* (0.97-1.34)	1.06 (0.92-1.22)
Yes, more than once	0.98 (0.86-1.11)	1.03 (0.89-1.18)	0.93 (0.82-1.06)
Husband/partner drinks alcohol			
No (ref.)			
Yes	0.95 (0.87-1.04)	0.95 (0.85-1.05)	0.93 (0.85-1.01)
Respondent afraid of husband/partner			
Never (ref.)			
Sometimes afraid	1 (0.92-1.1)	0.99 (0.89-1.1)	1 (0.91-1.1)
Most of the time afraid	0.96 (0.83-1.1)	0.9 (0.76-1.07)	0.90 (0.77-1.04)
Person who usually decides on respondent's health care			
Respondent alone (ref.)			
Respondent and partner	1.05	1.12	1.06

	Stunting	Wasting	Underweight
	OR CI (95%)	OR CI (95%)	OR CI (95%)
	(0.92-1.2)	(0.95-1.31)	(0.92-1.22)
Husband/partner alone	1.07 (0.92-1.25)	1.31*** (1.09-1.57)	1.17* (1.00-1.37)
Someone else	1.12 (0.83-1.51)	1.53** (1.07-2.19)	1.14 (0.83-1.57)
Attended 8+ ANC visits			
No (ref.)			
Yes	0.99 (0.9-1.08)	0.95 (0.85-1.05)	0.97 (0.88-1.06)
Number of days IFA consumed			
Less than 180 IFA (ref.)			
Atleast 180 IFA	0.92** (0.84-0.99)	1.05 (0.95-1.15)	0.95 (0.87-1.03)
Number of months pregnant at time of first ANC visit			
<4 months (ref.)			
≥4 months	1.02 (0.94-1.11)	0.99 (0.89-1.09)	1.01 (0.92-1.1)
Mother's received PNC			
No (ref.)			
Yes	1 (0.89-1.12)	0.93 (0.81-1.06)	0.98 (0.87-1.09)
Early initiation of breastfeeding			
No (ref.)			

	Stunting	Wasting	Underweight
	OR CI (95%)	OR CI (95%)	OR CI (95%)
Yes	1.05 (0.98-1.13)	0.9** (0.82-0.98)	0.95 (0.88-1.02)
Exclusive breastfeeding			
No (ref.)			
Yes	0.63*** (0.55-0.72)	1.47*** (1.29-1.69)	0.82*** (0.73-0.94)
Child gender			
Male (ref.)			
Female	0.83*** (0.78-0.9)	0.96 (0.89-1.05)	0.86*** (0.8-0.93)
Childbirth order			
First born (ref.)			
2^{nd}- 4^{th} born	1.31*** (1.2-1.42)	1.07 (0.97-1.18)	1.30*** (1.19-1.42)
5^{th} or higher birth order	1.64*** (1.38-1.96)	1.10 (0.89-1.37)	1.50*** (1.25-1.80)
Maternal age at the time of childbirth			
14-24 (ref.)			
25-34	0.86*** (0.8-0.94)	1 (0.91-1.1)	0.85*** (0.78-0.92)
35-49	0.76*** (0.65-0.91)	0.87 (0.71-1.07)	0.68*** (0.57-0.81)
Maternal education			
No education (ref.)			

	Stunting	Wasting	Underweight
	OR CI (95%)	OR CI (95%)	OR CI (95%)
Primary	0.92 (0.81-1.05)	0.99 (0.85-1.16)	0.89* (0.78-1.01)
Secondary	0.82*** (0.74-0.91)	0.99 (0.87-1.13)	0.81*** (0.73-0.91)
Higher	0.64*** (0.55-0.74)	0.84* (0.70-1.01)	0.62*** (0.53-0.73)
Mother currently working			
No (ref.)			
Yes	1.02 (0.93-1.11)	0.98 (0.88-1.09)	1.02 (0.93-1.12)
Health Insurance			
No (ref.)			
Yes	0.91** (0.84-0.99)	0.98 (0.89-1.08)	0.98 (0.9-1.06)
Mother reads newspaper			
Not at all (ref.)			
Less than once a week	0.98 (0.89-1.09)	1.07 (0.95-1.21)	0.96 (0.87-1.07)
At least once a week	0.98 (0.86-1.12)	1.09 (0.93-1.27)	0.93 (0.81-1.07)
Mother listens to radio			
Not at all (ref.)			
Less than once a week	1.05 (0.92-1.19)	1.09 (0.94-1.26)	0.99 (0.87-1.13)
At least once a week	0.83*	0.91	0.86

	Stunting	Wasting	Underweight
	OR CI (95%)	OR CI (95%)	OR CI (95%)
	(0.68-1)	(0.73-1.13)	(0.71-1.04)
Mother watches TV			
Not at all (ref.)			
Less than once a week	1.04 (0.94-1.16)	0.94 (0.83-1.07)	0.92 (0.83-1.03)
At least once a week	0.97 (0.88-1.07)	0.87** (0.78-0.98)	0.92* (0.83-1.01)
Type of residence			
Urban (ref.)			
Rural	0.93 (0.85-1.03)	1 (0.89-1.12)	0.93 (0.84-1.03)
Wealth quintile			
Poorest (ref.)			
Poorer	0.83*** (0.75-0.93)	0.76*** (0.67-0.86)	0.74*** (0.67-0.82)
Middle	0.72*** (0.64-0.81)	0.73*** (0.64-0.84)	0.66*** (0.59-0.74)
Richer	0.61*** (0.53-0.70)	0.7*** (0.6-0.82)	0.55*** (0.48-0.63)
Richest	0.52*** (0.44-0.61)	0.58*** (0.49-0.70)	0.42*** (0.36-0.50)

Notes: Level of significance for mixed-effect logistic regression model: *** Significant at 1 percent level; ** Significant at 5 percent level; * Significant at 10 percent level; OR, Odds ratio; CI, Confidence interval; ref.: Reference category of the variable

Source: Authors' calculations based on DHS survey data

Furthermore, the ICC value was 0.07 for stunting, 0.06 for wasting and 0.05 for underweight. The MOR value for stunting was 1.61. Similarly, the MOR value was 1.54 and 1.46 for wasting and underweight, respectively (Table 7.2). Table 7.3-7.4 demonstrates the results of the unadjusted and adjusted multivariable mixed- effect logistic regression model. Unadjusted mixed-effect logistic regression analysis indicated that a child whose mother has experienced physical violence during pregnancy was more likely to be stunted [UOR 1.51; CI (1.25 - 1.84); p<0.05)] and underweight [UOR 1.24; CI (1.01 - 1.52); p<0.05)] (Table 7.3).

Women who reported emotional violence were more likely to have stunted [UOR 1.26; CI (1.15 - 1.38); p<0.05], wasted [UOR 1.19; CI (1.07 - 1.32); p<0.05] and underweight [UOR 1.23; CI (1.12 - 1.34); p<0.05] children in comparison to those women who did not face emotional violence at the hands of their husband. The findings concerning wasting [AOR 1.18; CI (1.02 - 1.36); p<0.05] among children remained statistically significant after adjusting for other forms of coercive control and confounding variables. Additionally, a woman who was subjected to sexual violence by her husband was more likely to have a child who is stunted [UOR 1.23; CI (1.08 - 1.40); p<0.05], wasted [UOR 1.16; CI (0.99 - 1.36); p<0.10] and underweight [UOR 1.28; CI (1.12 - 1.46); p<0.05] compared to the woman who did not experience sexual violence. Moreover, the mother's exposure to physical violence increased the odds of child becoming stunted [UOR 1.34; CI (1.25 - 1.43); p<0.05], wasted [UOR 1.13; CI (1.04 - 1.22); p<0.05] and underweight [UOR 1.31; CI (1.22 - 1.40); p<0.05]. However, the influence of sexual and physical violence on child health outcomes became statistically insignificant after controlling for other mediating factors.

We found that women who justified wife beating by the husband were more likely to have a stunted [UOR 1.11; CI (1.04 - 1.19); p<0.05] and underweight child [UOR 1.10; CI (1.03 - 1.18); p<0.05] in comparison to women who did not justify wife beating. The prevalence of stunting [UOR 1.09; CI (1.01 - 1.17); p<0.05] and underweight [UOR 1.13; CI (1.04 - 1.22); p<0.05] was higher among children whose mothers have witnessed inter-parental violence. Women who reported their husband's high controlling behavior were more likely to have stunted [UOR 1.20; CI (1.13 - 1.28); p<0.05], wasted [UOR 1.13; CI (1.05 - 1.22); p<0.05] and underweight [UOR 1.28; CI (1.20 - 1.36); p<0.05); p<0.05] children in comparison to those women who did not experience high spousal controlling behavior. However, after adjusting for several other determinants of child health outcomes, the association between women's attitude towards IPV, intergenerational impact, spousal controlling behavior and child health outcomes became statistically insignificant. Furthermore, we found that women whose health care decisions were managed by husband alone had higher odds of having stunted [UOR 1.11; CI (0.98 - 1.26); p<0.10], wasted [UOR 1.27; CI (1.09 - 1.48); p<0.05] and underweight [UOR 1.22; CI (1.07 - 1.39); p<0.05] child compared to women whose health care decisions were managed by her own. Furthermore, the findings concerning underweight [AOR 1.17; CI

(1.00 - 1.37); p<0.10] and wasting [AOR 1.31; CI (1.09 - 1.57); p<0.05] among children remained statistically significant after adjusting for other forms of coercive control and confounding variables.

One of the most important findings of our study is that women whose domestic violence interviews were interrupted by an adult were more likely to have wasted [UOR 1.16; CI (1.02 - 1.33); p<0.05] and underweight [UOR 1.12; CI (0.99 - 1.25); p<0.10] child compared to women whose interviews were not interrupted. The result from the mixed effect model suggests that even after adjusting for other forms of coercive control and confounding variables, interview interruption by an adult increased the odds of child wasting [AOR 1.14; CI (0.97 - 1.34); p<0.10] in South Asian countries, although the strength of association decreased. Additionally, we found that a child whose father consumed alcohol had higher odds of becoming stunted [UOR 1.13; CI (1.05 - 1.21); p<0.05] and underweight [UOR 1.10; CI (1.03 - 1.18); p<0.05] in comparison to child whose father abstained from alcohol. Also, woman afraid of her husband most of the time was more likely to have a stunted [UOR 1.33; CI (1.20 - 1.48); p<0.05] and underweight [UOR 1.26; CI (1.13 - 1.41); p<0.05] child in comparison to women who were not afraid of their husband.

Among other determinants of child health, women who consumed at least 180 IFA tablets, practiced early initiation of breastfeeding and exclusive breastfeeding, had health insurance coverage and belonged to mature age (35-49 years) with higher educational attainment were more likely to have a child with better anthropometric indicators. Moreover, women who watched TV and listened to radio at least once a week, and belonged to the richer wealth quintile had higher odds of having a child with better child health. On the contrary, a child with second or higher birth order was more likely to have poor anthropometric indicators.

7.4 Discussion

Our study found that the ICC value was 0.07 for stunting, 0.06 for wasting and 0.05 for underweight. This suggests that 7%, 6% and 5% of the total variation in the prevalence of stunting, wasting and underweight, respectively, was attributed to the variance between clusters (country level). The MOR value for stunting was 1.61, which indicates that if two women from different clusters were chosen randomly, then a woman from a cluster with a higher stunting prevalence was 1.61 times more likely to have a child with high stunting than a woman from a cluster with a lower proportion of children with stunting. Additionally, the MOR value was 1.54 and 1.46 for wasting and underweight, respectively.

Unadjusted mixed-effect logistic regression analysis indicated that a child whose mother has experienced physical violence during pregnancy was more likely to be stunted and underweight. According to WHO, a particularly alarming form of aggression towards women is physically hurting women's abdomen during pregnancy, posing a dual threat by inflicting harm upon the

women and also jeopardizing the pregnancy (WHO, 2011). Moreover, domestic violence experienced during pregnancy increases the susceptibility of women to being killed by the intimate partner (WHO, 2011). It increases the level of stress, anxiety, depression, as well suicide attempts among pregnant women (Martin et al., 2006). Furthermore, exposure to domestic violence during pregnancy increases psychological stress, which results in dysregulation of the maternal hypothalamic-pituitary-adrenal (HPA) axis and sympatho-adrenal system of women (Mulder et al., 2002). This leads to an increased risk of abortion, preterm delivery, low birth weight and fetal malformations (Mulder et al., 2002). Ahmadabadi and colleagues (2018) argue that IPV may lead to bad living habits, such as alcoholism during pregnancy and child maltreatment, which hinders child's growth and development. Mothers who were abused during pregnancy are less likely to bond well with their fetus and consequently with their offspring thereafter, reducing the rates of breastfeeding (Zeitlin et al., 1999). A study conducted in Bangladesh found that children of women who experienced domestic violence during pregnancy had significantly lower height for age z-score at the age of 15 years (Ziaei et al., 2021). Tiwari and colleagues (2018) proposed that IPV screening can be one of the solutions to reduce domestic violence during pregnancy against women. These countries can leverage the antenatal care and counseling sessions for IPV screening, which can at least help reduce the incidence of violence during pregnancy.

We found that women who were exposed to emotional, sexual and physical violence were more likely to have children with poor child health outcomes. However, the influence of sexual and physical violence on child health outcomes became statistically insignificant after controlling for other mediating factors. Similar findings were observed in Nigeria (Issah et al., 2022), Turkey (Yalçın et al., 2022) and 29 Sub-Saharan African (SSA) countries (Kang et al., 2024). Pakrashi and Saha (2020) contend that emotional violence faced by a mother hampers the nutritional status of a child more than physical violence. Furthermore, friends, family or neighbours may intervene in the case of physical violence, however emotional abuse by husband/partner can continue within the boundaries of the house for years without intervention (Pakrashi and Saha, 2020). Similarly, the perpetuation of sexual violence in society is attributable to societal taboos surrounding the reporting of such acts (Sobkoviak et al., 2012). Emotional victimization of a mother not only increases her risk of depression but also deteriorates her child's health and temperament (McMahon et al., 2011). Furthermore, IPV hampers the mental and physical health of the mother, negatively impacting the caretaking capacities of women imperative for the healthy growth and development of a child (Ziaei et al., 2021). Mothers who have experienced IPV generally lack decision-making autonomy, which is important to improve child health (Tenkorang, 2018; Onah, 2021). One solution emphasized by a previous study (Saftlas et al., 2014) in this context is regarding motivational interviewing practices of nonjudgmental and empathetic listening, which served as a conduit for women to share their experiences of emotional, physical, and sexual abuse. Furthermore, field coordinators assisted women in identifying small steps that they could take to improve their physical health, emotional health, social

support, quality of work or home life, or relationships (Saftlas et al., 2014). In the United States, these practices effectively boosted self-efficacy and readiness for change, while reducing depressive symptoms in victims (Saftlas et al., 2014). A scheme like this could be devised and implemented in South Asian countries through frontline health workers or free online consultations.

South Asian countries are largely characterized by patriarchal, patrilocal, and patrilineal social structures, where women are considered 'inferior' and husbands assume that they have the right to dominate and control their wives (Mondal and Paul, 2021). This emergence of unequal power dynamics impedes women's decision- making abilities, thereby increasing their vulnerability to coercive control perpetrated by their husbands (Jejeebhoy, 2002). Women also suffer from the 'female guilt channel' where they themselves think that abuse is justified, leading to higher frequency and intensity of abuse (Pakrashi and Saha, 2023). Additionally, IPV tends to run in families, suggesting intergenerational transmission of violence (Hines and Saudino, 2002). This aligns with the social learning theory of aggression, which posits that children learn violent behaviors by observing their parents and receiving reinforcement for their own aggressive actions (Hines and Saudino, 2002). This paper further contributed by providing evidence for woman suppression in South Asia. We found that women who justified wife beating by the husband were more likely to have a child with poor child health outcomes in comparison to women who did not justify wife beating. The prevalence of stunting and underweight was higher among children whose mothers have witnessed inter-parental violence. Women who reported their husband's high controlling behavior were more likely to have stunted, wasted and underweight children in comparison to those women who did not experience high spousal controlling behavior. However, after adjusting for several other determinants of child health outcomes, the association between women's attitude towards IPV, intergenerational impact, spousal controlling behavior and child health outcomes became statistically insignificant. Furthermore, we found that women whose health care decisions were managed by husband alone had higher odds of having a child with poor health compared to women whose health care decisions were managed by her own. A study conducted in Bangladesh (Rahman et al., 2015) and Democratic Republic of the Congo (McKenna et al., 2019) found similar results.

Domestic violence has deep historical roots, where gender-based violence, justification of male dominance and the undermining of women's independence are considered non-exceptional and a normal part of societal norms (Tonsing and Tonsing, 2017). These cultural institutions, beliefs, and practices perpetuate a downward spiral of intergenerational violence, which ultimately affect child health. Moreover, women's limited decision-making power can compromise her own and child's health, potentially resulting in lower infant birth weight and affecting the quality of infant care and nutrition (Rahman et al., 2015). Moreover, a mother who manages her own healthcare decisions is more likely to make greater use of available health services such as antenatal care (Saaka, 2020). Saaka (2020) argues that maternal health care

decision-making autonomy, particularly mothers' involvement in decisions regarding their own healthcare, seeking medical attention, and caring for children during illness, emerged as the most significant factor influencing child growth.

One of the most important findings of our study is that women whose domestic violence interviews were interrupted by an adult were more likely to have wasted and underweight child compared to women whose interviews were not interrupted. The result from the mixed effect model suggests that even after adjusting for other forms of coercive control and confounding variables, interview interruption by an adult increased the odds of child wasting in South Asian countries, although the strength of association decreased. To the best of our knowledge, no research has looked into the impact of adult interruption during women's interviews about domestic violence on child health outcomes. Rabel and colleagues (2014) argue that women whose interviews were interrupted by an adult were significantly more likely to report physical and sexual violence. The plausible explanation might be that women who experience interruptions during interviews are more likely to have experienced violence, as interruptions can be a form of control. It may also be possible that males are afraid that their wife would reveal their wrongdoings to the interviewer. Constant surveillance or 'checking in' during interviews may also serve as a means of exerting coercive control (Rabel et al., 2014). Interview interruptions may indirectly affect child health through different pathways such as increased stress levels, disrupted caregiving practices, and an increased risk of adverse birth outcomes resulting from IPV as already discussed above. Furthermore, adult interruptions during interviews represent a violation of mothers' rights and family dominance, subjecting them to recurrent exposure to overt family conflict. This exposure may directly lead to disruptions in a child's psychosocial functioning (e.g., emotion processing and social competence), disruptions in stress-responsive biological regulatory systems, including sympathetic-adrenomedullary and hypothalamic-pituitary- adrenocortical functioning, and poor health behaviours, especially substance abuse (Repetti et al., 2002). In addition, it must further be noted that females are categorized as housewife (those who don't leave house for job) and those who go out for job. It must be noted that females who go out for job traditionally have more autonomy and freedom in decision-making. However, female labour force participation in South Asia is quite low such that females are mostly dependent on her husband or inlaws for financial and other decisions even relating to her own life. An effective policy intervention to lower coercive control, therefore, may focus on enhancing girl education and job opportunities for females, which will not only have positive effects on a country's economy but will also boost the child's health and enhance the child's education and earning potential in the future. Sarma (2022) contends that programs like Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) in India can mitigate the impact of income shocks, often associated with increased instances of abuse. More importantly, the authors' findings suggest that MGNREGS employment among females reduces IPV crimes against women at the district level by 8 to 22 percent (Sarma, 2022). Similarly, in South Africa women, who had access

to microfinance coupled with self-defense training experienced a 55% reduction in abuse (Pronyk et al., 2006).

Additionally, we found that a child whose father consumed alcohol and whose mother afraid of her husband most of the time had higher odds of having poor health. A study conducted in India found that children born in households that use tobacco or alcohol were less likely to be immunized, and more likely to have acute respiratory tract infection and malnutrition (Bonu et al., 2004). This finding could reasonably be explained by the fact that the husband's alcohol consumption instills fear in women due to the increased risk of IPV (Thompson and Kingree, 2004) and the unpredictability of the father's behaviour (Velleman, 2004), leading to concerns about the safety and well-being of both mother and her child. This results in neglect of the child's nutritional needs, inconsistent care and supervision, and financial constraints, potentially impeding the child's health. To address this issue, policymakers in South Asian countries can strategically advocate for alcohol rehabilitation programs aimed at mitigating male alcohol consumption, thereby enhancing protection measures for women against gender-based violence.

7.5 Limitations of the study

As with studies conducted using retrospective data, this study also has a few limitations. First, our findings are susceptible to social desirability bias and underreporting due to sensitive topics like IPV (Tenkorang, 2018). We are not completely sure if the females would be confident in telling whether she had faced domestic violence during pregnancy in culturally-sensitive and male-dominant areas. As we have also noticed that there are instances of interview interruptions, female respondents might reveal that she didn't experience violence fearing her husband or adult family member might be listening to the interview. Second, crucial variables like the father's involvement in childcare and feeding are missing (Chilinda et al., 2021). Moreover, we could not differentiate the biological father of the child from the mother's current partner while examining paternal characteristics, which can have implications on child health (Vollmer et al., 2016). Third, the data collection exclusively involved females, overlooking the perspectives of males, who might confirm or repudiate the claims made by the woman (Chilinda et al., 2021). Fourth, it cannot be ascertained from our study whether the male partner has inflicted violence on the female before pregnancy or continued violence after pregnancy. Moreover, it is also not clear from the data whether the child's father inflicted violence on the child alongside the mother. If the father has inflicted direct violence on the child, then the effects observed in our study might have been overstated as the effect of violence on the mothers during pregnancy. Lastly, the study used cross- sectional data, which precludes us from making any causal inferences (Kang et al., 2024).

7.6 Conclusion and policy recommendations

Through this study, we provide the most recent evidence of how

unequal power relations, coercive control and patriarchal social structure impact child health in South Asia. Our study highlights that violence inflicted on women, even only during pregnancy alone, can have enduring negative effects on child health. Notably, adult interruption during women's interviews about domestic violence increased the odds of child wasting even after adjusting for other forms of coercive control and confounding variables. For the purpose of mother-child health, IPV against women must decrease in these countries. Recent research has highlighted that IPV against women has been decreasing, but the pace of reduction is so low that it will require 173 years at the current pace to half the IPV against women from the current levels (Ma et al., 2023; Yount et al., 2024). Therefore, accelerated efforts are required to meet the SDG 5.2 target regarding IPV against women. Beyond socio-cultural dominance of male chauvinistic societies in South Asia, future studies should also explore what are the determinants of IPV on women, in general, and during pregnancy, in particular. In terms of preventive strategies, our study suggests that policymakers must adopt multi-pronged strategies including IPV screening especially during antenatal care visits, provision of microfinance, and motivational counseling sessions to decrease the incidence of coercive control in South Asia. Additionally, a robust legal framework is required to safeguard women against IPV. In summary, addressing domestic violence necessitates a multifaceted approach, encompassing women's empowerment (through education and employment opportunities), non- violent conflict resolution skills among individuals, as well as limited access to weapons and alcohol. Future research could explore the impact of violence initiated by the woman against her husband on child health.

7.7 References

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7.8 Appendix

Supplementary Table IV.1. Validity of the statistical models

Results of Hosmer-Lemeshow test

IV.1a. Multivariate logistic regressions for analysing the impact of women's autonomy in managing one's healthcare on abortion history, knowledge of contraceptive methods, wanted pregnancy and delivery by caesarean section using DHS (2015-16) conducted in India

Outcome variables	Abortion history	Knowledge of contraceptive methods	Wanted pregnancy	Delivery by caesarean section
Hosmer-Lemeshow chi^2	1.15	4.22	15.3	2.98
P > chi^2	0.99	0.84	0.06	0.93

Note: P-value > 0.05 shows that the model is correctly specified

IV.1b. Multivariate logistic regressions for analysing the impact of women's autonomy in managing one's healthcare on abortion history, knowledge of contraceptive methods, wanted pregnancy and delivery by caesarean section using DHS (2019-21) conducted in India

Outcome variables	Abortion history	Knowledge of contraceptive methods	Wanted pregnancy	Delivery by caesarean section
Hosmer-Lemeshow chi^2	6.99	6.97	3.44	4.72
P > chi^2	0.54	0.54	0.90	0.79

Note: P-value > 0.05 shows that the model is correctly specified

Results of Likelihood-ratio test

IV.1c. Time interaction model for analysing the impact of women's autonomy in managing one's healthcare on abortion history, knowledge of contraceptive methods, wanted pregnancy and delivery by caesarean section in India (2015-16 to 2019-21)

Outcome variables	Abortion history	Knowledge of contraceptive	Wanted pregnancy	Delivery by

		methods		caesarean section
LR chi^2	44.38	48.22	61.98	305.82
P > chi^2	0.02	0.00	0.00	0.00

Note: P-value < 0.05 indicates that the model is a significantly better-fit model
Source: Authors' calculations based on DHS survey data

CHAPTER 8

CONCLUSION, FUTURE SCOPE AND SOCIAL IMPACT

8.1 Conclusion, Social Impact and Policy Implications

This thesis comprehends the socio-economic and demographic determinants of maternal healthcare service utilization in India and other South Asian countries using the latest Demographic and Health survey rounds. This thesis also elaborated on the impact of community-level services (water and sanitation facilities) and individual-level health behaviour (maternal healthcare service utilization and breastfeeding practices) concurrently on child health outcomes namely under-five stunting, wasting and anaemia in India. This thesis also highlighted the pervasive patriarchal social structure and gendered power inequalities across South Asia, emphasizing their significant impact on maternal and child health. In this regard, the study examined the associations between women's autonomy in managing one's healthcare and reproductive health outcomes in India. Over and beyond, elaborated the impact of coercive control experienced by women on child health outcomes in South Asia.

The study demonstrates that while socio-economic factors like education and wealth have a foundational positive impact on mothers' utilization of maternal health care services. A woman's autonomy to make healthcare decisions is a powerful predictor of positive reproductive outcomes, including wanted pregnancies and knowledge of contraception. However, this autonomy is frequently undermined by coercive control, where decisions are usurped by husbands or in-laws. Most critically, IPV operates as a direct pathogen for child health, leading to intergenerational consequences like increased child stunting and wasting. Simultaneously, the public health system emerges as a vital counterforce. Frontline health workers and government schemes (e.g., for nutrition and sanitation) provide external leverage to bypass restrictive household norms. They empower women directly, facilitate joint decision-making, and improve crucial health behaviours like breastfeeding and service utilization. Therefore, improving maternal healthcare in India necessitates an integrated strategy that simultaneously strengthens women's socio-economic agency, transforms patriarchal household norms through male engagement and stringent IPV reduction, and optimizes the health system to act as a robust support structure for women.

In **Chapter 2**, we adopted the modified framework of Anderson's behavioural model of health service use to examine the socio-economic and demographic determinants of maternal healthcare service utilization in South Asian countries, namely Afghanistan, Bangladesh, India, Maldives, Nepal and Pakistan. The study found that women who were educated, working, had

decision-making autonomy, and were aware of family planning were more likely to avail of maternal healthcare services in South Asia. However, it is worth noting that working mothers had lower odds of receiving antenatal care in Afghanistan and delivery care in Bangladesh; despite being employed, decisions regarding their healthcare were predominantly made by their husband. Addressing this requires strengthening the role of frontline health workers, such as midwives in Afghanistan (Turkmani et al., 2013) and Shasthya Shebika and Shasthya Kormi in Bangladesh (Joardar et al., 2021), who are culturally compatible and can provide vital support while improving MHCSU in these countries. This can be achieved by providing funding, training, logistical supplies, and satisfactory work environments, as frontline health workers are often inadequately compensated and face unrealistically broad roles and responsibilities (Turkmani et al., 2013; Joardar et al., 2021).

Furthermore, we found that women who belonged to mature (35– 49 years) at the time of childbirth, wealthier households, and had access to mass media had higher odds of receiving maternal healthcare service utilization in South Asia. Negero and colleagues (2023) argue that adolescent mothers lack sufficient knowledge and are subjected to healthcare providers' judgmental attitudes, discouraging them from opting for maternal health services. In this regard, policymakers should aim at strict adherence to marriage age laws, prioritising comprehensive sex education, community sensitization, encouraging girls' school enrolment, and establishing adolescent- friendly health services at schools and healthcare centres to prevent adolescent pregnancies (Yakubu & Salisu, 2018). It is crucial to highlight that women who listened to the radio were less likely to receive antenatal care and postnatal care in Afghanistan which might be due to cultural influences and lower decision-making authority among mothers. In addition, women of mature age at the time of first birth and who resided in rural areas were less likely to receive adequate antenatal care. Notably, a higher likelihood of utilizing maternal healthcare services was observed among women whose husband was educated and mature (aged 35–49 years) at the time of childbirth. The WHO recommends men's involvement during pregnancy, childbirth, and postnatal care to facilitate and improve maternal health outcomes (WHO, 2015). However, Suandi and colleagues (2019) contend that husbands' involvement in MHCSU is limited in South Asia due to the region's patriarchal social structure. Numerous scholars have confirmed the abysmally low involvement and knowledge of husbands in maternal healthcare in Bangladesh (Rahman, et al., 2018) Nepal (Sharma et al., 2020), Pakistan (Nohri et al., 2022), India (Chattopadhyay & Govil, 2020), and Afghanistan (Alemi et al., 2020), demanding immediate policy attention. Policymakers can learn from program such as Suami SIAGA (Alert Husband) campaign, initiated in 1998 in Indonesia, which has significantly boosted MHCSU (Kurniati et al., 2017). It aims to promote male participation by educating men about the importance of their support during prenatal care, facilitating safe childbirth, and ensuring access to healthcare (Kurniati et al., 2017). A similar scheme is warranted in Bangladesh, Nepal, Pakistan, India, and Afghanistan to instil paternal responsibility and enhance husbands' active participation in maternal healthcare services and thereby boost maternal and

child health. To achieve Sustainable Development Goal 3.1 of reducing maternal deaths to 70 per 100,000 live births by 2030, policymakers must strengthen the role of frontline health workers, prioritize comprehensive sex education, establish adolescent-friendly health services and promote e-health communication. Furthermore, it is imperative to implement financial incentive schemes, especially targeting women residing in rural areas or those from the lower socio-economic strata. Lastly, enhancing women's decision- making power and encouraging men's involvement during pregnancy, childbirth, and postnatal care are crucial for improving maternal health in South Asia.

Chapter 3, detailed the concomitant factors influencing breastfeeding practices in India. The study found that the children belonging to 2nd-4th birth order had higher odds of early initiation of breastfeeding and exclusive breastfeeding but by contrast, shorter duration of breastfeeding compared to firstborn children. Remarkably, employed mothers had higher odds of longer durations of breastfeeding, but they had lower odds of exclusive breastfeeding as they could only breastfeed in the morning and at night due to working hours. Furthermore, they had to resort to complementary feeding practices. Mothers aged 35-49 years had lower odds of early initiation of breastfeeding and exclusive breastfeeding compared to women aged 15- 24 years. In addition, women with higher educational attainment, access to mass media, resided in rural areas, received maternal healthcare services, and received assistance from Anganwadi were more likely to have optimum breastfeeding practices. It is worth noting that wealthier households had lower odds of continuous breastfeeding and smaller duration of breastfeeding since they can afford commercial milk formula and breastmilk substitutes. To foster better breastfeeding practices in India, it is imperative to provide lactation rooms in public spaces, mandate paid maternity leave, instil positive behaviour in fathers towards breastfeeding practices, utilize information and communication technology tools tailored to local language and literacy levels, and regulate the breast milk substitute industry. India has made considerable efforts to protect the health of infants and young children through legislations such as The Infant Milk Substitutes, Feeding Bottles, and Infant Foods (Regulation of Production, Supply, and Dis tribution) Act 1992, and its Amendment Act 2003, which prohibit any advertising or promotion of infant formula, feeding bottles, and infant foods for children aged 0–2 years (Ganapathy & Sekaran, 2023). However, there have been issues relating to non-compliance with these regulations, raising concerns about the marketing tactics used by India's commercial formula milk industry (Ganapathy & Sekaran, 2023).

In **Chapter 4**, we examined the impact of maternal healthcare service utilization on under-five child health outcomes, namely stunting, wasting, anaemia, underweight and overweight in India. The study found abysmally low consumption of iron folic tablets (69.30 %) and a lower prevalence of at least four antenatal care visits (66.79 %) in India. Mothers who were more than three months pregnant at the time of the first antenatal care check-up were more likely to have underweight children. It is pertinent to point out that the mothers who attended at least four antenatal care visits were more likely to have an

overweight child due to prenatal nutritional guidance. The prevalence of wasting and anaemia was likely among a child whose mother received skilled assistance during delivery. The odds of under- five anaemia were lower among children whose mothers have received postnatal care. Remarkably, male children were more likely to be stunted, wasting and underweight in comparison to female children. Educated and mature-aged mothers were more likely to have a child with improved health outcomes. In contrast, children from Muslim families and those belonging to Scheduled Tribe were more likely to have poor health outcomes. Furthermore, we found that children belonging to the richest wealth quintile were more likely to be overweight. This is because, one the one hand, richest households have availability of high-quality nutrient supplements, more purchasing capacity and access to healthcare services which improve CHOs (Chowdhury et al., 2020; Waghmare et al., 2022). However, Fruhstorfer et al. (2016) contended that families belonging to wealthy households often adopt modern lifestyle conviniences, such as reduced physical activity, reliance on breastfeeding substitutes, and unhealthy dietary habits, which can lead to a higher propensity for over weight and obesity in children. In order to boost maternal healthcare service utilization in India, the following challenges need to be addressed first, including inadequate infrastructure, regular shortage of essential supplies, poor communication and transportation systems, lack of manpower, and negative sociocultural practices. This study aids in evidence-based policymaking towards improving child health outcomes in India.

In **Chapter 5,** we utilized the Fundamental Cause Theory derived from Geoffrey Rose's Cause of Causes to understand the impact of water and sanitation, maternal health care service utilization and breastfeeding practices on under-five child health outcomes, namely stunting, wasting and underweight in India using the two rounds of the Indian Demographic Health Survey [DHS (2015-16) and DHS (2019-21)]. The study found that in 2019-21, unprotected sources of drinking water were associated with increased odds of under-five wasting; there was no statistically significant impact on wasting in 2015-16. In 2015-16, unimproved sanitation facilities and open defecation increased the odds of poor child health outcomes. It is perturbing that 7.34 % of the respondents still practised open defecation in 2019-21. Remarkably, open defecation had no significant impact on child health outcomes in 2019-21. In order to make India, open defecation-free, the Government of India initiated the Swachh Bharat Abhiyan (Clean India Mission) in 2014. However, even after five years since initiation, 19% of households do not even use any toilet facility in India (NFHS-5, 2022). Since, investment alone cannot be accountable for the success or failure of the sanitation improvement programme in India, strong political will, improved socio-economic environment, social pressure and prioritizing behavioural changes are also required (O'Reilly & Louis., 2014; UNICEF, 2023c). To improve the sanitation situation in India and promote their usage, lessons can be imbibed from schemes such as Sanitation and Hygiene Master Plan in Nepal (Budhathoki, 2019), introduction of National Sanitation Authority (NSA) and sanitation surcharges in Ghana (Appiah-Effah et al., 2019) and rainbow villages in Indonesia (Defi, 2022). The

areas with poor sanitation facilities and lower usage in India, can draw lessons from areas such as Mawlynnong village of Meghalaya (an Indian state) which has been declared as the cleanest village in Asia due to its exemplary cleanliness and sanitation practices (Dwivedi et al., 2019). In addition, mothers who did not receive at least four antenatal care visits and postnatal care were more likely to have a child with poor health outcomes in 2015-16. In 2019-21, mothers who had not received at least four antenatal care visits were more likely to have stunted and underweight children; however, the association between antenatal care visits and child health outcomes diminished between the two survey rounds. In 2015-16, the absence of exclusive breastfeeding for the initial six months increased the odds of under-five stunting and underweight. However, it is worth noting that in both 2015-16 and 2019-21 the absence of exclusive breastfeeding decreased the odds of under-five wasting. In 2019-21, the absence of early initiation of breastfeeding increased the odds of under-five wasting and underweight but in 2015-16 did not influence child health outcomes.

Additionally, the decline in the prevalence of under-five wasting between the two survey rounds was likely to be lower among children who consumed unprotected sources of drinking water, used unimproved sanitation facilities, and whose mothers neither received at least four antenatal care check-ups nor postnatal care visits. The decline in the prevalence of stunting was less likely among children who lacked exclusive breastfeeding and whose mothers had not received at least four antenatal care visits. The decline in the prevalence of underweight was likely to be less for children who used unimproved sanitation facilities and practised open defecation and whose mothers have not received postnatal care visits. Strong political will, persistent groundwork, hygiene education, awareness generation and behavioural change are imperative to improve child health in India. The government schemes such as the Integrated Child Development Scheme (ICDS) and Janani Suraksha Yojana intend to promote ANC and PNC visits (Khatpe et al., 2021). However, these schemes are plagued by certain challenges such as the location of Anganwadi Centres in upper-caste localities acting as a barrier to access for women belonging to socially marginalized sections, poor quality of supplementary nutrition provided (Mehta & Pratap, 2014), understaffing, a lack of essential medications and delays in payment disbursement (Jennings et al., 2019). These challenges undermine the noble intentions of these schemes. However, to enhance the quality of maternal healthcare services in India lessons can also be learnt from the Focused Antenatal Care scheme, a client-based service in Ghana, where the site of its service is not limited to a health facility; allowing for the provision of tailored services at times and places most convenient to clients; especially benefitting women residing in remote rural areas (Haruna et al., 2019). Additionally, valuable insights can be gleaned from the New Rural Cooperative Medical Scheme, which has successfully increased maternal healthcare services by providing financial compensation in China (You et al., 2016).

Chapter 6 detailed the impact of women's autonomy in managing one's healthcare on abortion history, knowledge of contraceptive methods, wanted pregnancy and delivery via caesarean section in India, elucidated using Connell's gender and power theory. It is disconcerting that only 7.85 % in 2019–21 had the autonomy to make healthcare decisions independently. However, the proportion of women who made their healthcare decisions jointly with their husband/ partner increased from 64.17 % in 2015–16 to 72.35 % in 2019–21. The study found that in 2015-16, the odds of delivery via caesarean section were lower when someone else made healthcare decisions for them compared to women who managed healthcare decisions alone. The odds of knowing contraceptive methods were lower among women whose healthcare decisions were made solely by the husband/partner in 2015-16. In 2015-16 and 2019-21, the odds of wanted pregnancy were higher among women who managed their healthcare decisions jointly with their partner. Notably, the decline in wanted pregnancy was less for women whose healthcare decisions were managed jointly with their partner. To achieve SDG 3.7, which calls for universal access to sexual and reproductive healthcare services, empowering women through reproductive health education, increased access to safe abortion services and contraceptive methods is crucial. Furthermore, to improve women's reproductive healthcare decision making in India, policymakers could consider scaling up the Mission Parivar Vikas scheme on a national level. This government initiative focuses on increasing access to contraceptives and family planning services in 146 high fertility districts with a total fertility rate of 3 or above across seven high focus states namely, Uttar Pradesh, Bihar, Rajasthan, Madhya Pradesh, Chhattisgarh, Jharkhand, and Assam (PIB, 2019). This initiative can be strengthened by ensuring that women receive comprehensive education on a variety of contraceptive methods, fostering an environment where they feel confident in choosing the option best suited to them (PIB, 2019). Additionally, the "SAHELI" scheme- Scheme to Aware, Help, and Empower Ladies in India, was successful in changing women's attitude and knowledge regarding modern reproductive and sexual health care, including abortion and managing unwanted pregnancies (Chandrasekhar et al., 2018). Hence, it should be actively implemented, with a particular focus on rural women facing low literacy rates and poor economic conditions (Chandrasekhar et al., 2018).

In **Chapter 7**, we adopted the family disruption model to examine the impact of coercive control experienced by women on child health outcomes in South Asian countries namely, India, Maldives and Pakistan. The prevalence of under-five stunting (32.2 %), wasting (19.76 %) and underweight (27.31 %) was the highest in India in South Asia. Pakistan observed the highest cases of physical violence during pregnancy (7.30 %). In India, 9.55 % of the respondents faced interview interruption more than once by an adult, and 39.50 % of respondents reported spousal controlling behaviour. Emotional violence was the highest in Maldives at 29.01 %. This study found that a mother who has experienced physical violence during pregnancy was more likely to have a stunted and underweight child. Women who reported emotional violence, sexual violence, physical violence and high spousal controlling behaviour were

more likely to have a child with poor health outcomes. The odds of under-five stunting and underweight were higher among children whose mothers justified wife beating by the husband and who have witnessed inter-parental violence. It is significant to highlight that women whose domestic violence interviews were interrupted by an adult were more likely to have wasted and underweight children. The result from the mixed effect model suggests that even after adjusting for other forms of coercive control and confounding variables, interview interruption by an adult increased the odds of child wasting in South Asian countries, although the strength of association decreased. Furthermore, alcohol consumption by the father increased the odds of poor child health outcomes. To address this issue, policymakers in South Asian countries can strategically advocate for intimate partner violence screening during antenatal care visits, motivational interviewing practices involving nonjudgmental and empathetic listening, microfinance initiatives coupled with self- defence training, alcohol rehabilitation programs and a robust legal framework to safeguard women against intimate partner violence. Furthermore, one solution emphasized by a previous study (Saftlas et al., 2014) in this context is regarding motivational interviewing practices of nonjudgmental and empathetic listening, which served as a conduit for women to share their experiences of emotional, physical, and sexual abuse. Furthermore, field coordinators assisted women in identifying small steps that they could take to improve their physical health, emotional health, social support, quality of work or home life, or relationships (Saftlas et al., 2014). In the United States, these practices effectively boosted self-efficacy and readiness for change, while reducing depressive symptoms in victims (Saftlas et al., 2014). A scheme like this could be devised and implemented in South Asian countries through frontline health workers or free online consultations. Sarma (2022) contends that programs like Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) in India can mitigate the impact of income shocks, often associated with increased instances of abuse. More importantly, the authors' findings suggest that MGNREGS employment among females reduces IPV crimes against women at the district level by 8 to 22 percent (Sarma, 2022). Similarly, in South Africa women, who had access to microfinance coupled with self-defense training experienced a 55% reduction in abuse (Pronyk et al., 2006).

8.2 Recommendations for future research

Our study used cross-sectional data; future studies may employ panel data to analyse temporal changes in maternal healthcare service utilization, child health outcomes, and maternal decision-making power. Panel data would aid in establishing causal associations and determining the long-term impact of maternal healthcare utilization on outcomes. Further investigation is warranted into several understudied factors. These include the role of the education level of in-laws in maternal healthcare services in South Asia, as well as the influence of cultural and religious norms on health-seeking behaviours.

Future studies should also explore the role of paternal characteristics, including fathers' involvement in maternal healthcare decisions. Additionally, research could examine whether the child's father inflicted violence on the child alongside the mother to more precisely estimate the impact of coercive control on child health. Studies could also investigate the impact of violence initiated by the woman against her husband on child health. Furthermore, women's perceptions of the quality of maternal healthcare services, including the skill level and quality of care and counselling provided during antenatal and postnatal visits, can be studied through qualitative research. Healthcare infrastructure, such as the availability of hospitals, beds, and facilities, can also be quantified to strengthen analysis. Moreover, the role of AI in improving maternal healthcare, along with the impacts of climate change on child nutrition in South Asia, represent important directions for future research.

LIST OF PUBLICATIONS AND THEIR PROOFS

INTERNATIONAL JOURNAL OF HEALTHCARE MANAGEMENT
https://doi.org/10.1080/20479700.2024.2430877

Evidence from maternal healthcare services in South Asia: Demography vs. healthcare

Charu Tayal[a], Rajesh Sharma [b] and Kusum Lata[b]

[a]University School of Management and Entrepreneurship, Delhi Technological University, New Delhi, India; [b]Humanities and Social Sciences, National Institute of Technology Kurukshetra, Kurukshetra, India

ABSTRACT

The maternal mortality ratio (MMR) remains alarmingly high in South Asian countries. However, maternal healthcare service utilization (MHCSU) can significantly reduce maternal mortality and morbidity, while improving child health. Therefore, this study identifies the socio-economic and demographic factors influencing MHCSU in Afghanistan, Bangladesh, India, Maldives, Nepal and Pakistan, using data from the Demographic and Health Survey (DHS). Women who were mature (35–49 years) at the time of childbirth were more likely to receive adequate antenatal care (ANC) in Pakistan and postnatal care (PNC) in Afghanistan. Additionally, women who were educated, working, belonged to wealthier households, were aware of family planning, and had mass media exposure had higher odds of receiving MHCSU in South Asia, except in Afghanistan, where listening to the radio reduced the odds of receiving standard ANC and PNC. Notably, working mothers had lower odds of receiving ANC in Afghanistan and delivery care in Bangladesh. Additionally, women with higher childbirth orders and those lacking decision-making autonomy were less likely to receive MHCSU. A woman whose husband was educated and mature at the time of childbirth was more likely to avail MHCSU. Based on our findings, policymakers should focus on regular health education, financial incentives, adolescent-friendly health services, and enhanced e-health communication to promote MHCSU in South Asia and thereby improve maternal and child health in the region.

ARTICLE HISTORY
Received 30 March 2024
Accepted 13 November 2024

KEYWORDS
Antenatal care; delivery care; postnatal care; south Asia; maternal healthcare; demographic health survey

1. Introduction

According to the World Health Organisation (WHO), maternal mortality remains unacceptably high worldwide, with one maternal death occurring every two minutes in 2020, representing a grave public health concern [1]. Despite an average annual decline of 2.1% in maternal mortality, this rate is significantly lower than the 6.4% required to meet Sustainable Development Goal 3.1, which aims to reduce maternal deaths to 70 per 100,000 live births by 2030 [2]. Kirigia and colleagues [3] contend that even a single maternal death could reduce per capita GDP by US$0.36 per year. Maternal mortality, caused by complications from pregnancy or childbirth [2], claimed about 287,000 women's lives in 2020, with almost 95% of maternal deaths occurring in low and middle-income countries (LMICs) [1]. Sub-Saharan Africa and Southern Asia disproportionately account for approximately 87% (253,000) of these deaths in 2020, highlighting the importance of utilising maternal healthcare services[1] [1].

This alarming burden of maternal mortality, particularly in LMICs underscores not only a pressing health crisis but also a siginificant impediment to economic development. As per endogenous growth model a country's per capita income in the long run inherently depends on human capital, emphasising that a country must strive for robust human health to sustain faster economic growth [4]. In this regard, maternal health[2] is fundamental for fostering a cycle of positive societal development, given its imperative role in child development, the production of future human capital, and overall development of a country [5]. However, despite proven evidence of the benefits of maternal health, it is dismaying that the maternal mortality ratio (MMR)[3] remains alarmingly high in South Asian countries; Afghanistan (620), Nepal (174), Pakistan (154), Bangladesh (123), India (103) and Maldives (57), while it is 12 in high-income countries [6]. Geremew and colleagues [7] argue that the provision of maternal healthcare services is crucial for reducing maternal mortality and morbidity. The utilization of maternal healthcare services has

CONTACT Rajesh Sharma rajesh.sharma@nitkkr.ac.in Humanities and Social Sciences, National Institute of Technology Kurukshetra, A328, Kurukshetra, Haryana, India

Supplemental data for this article can be accessed online at https://doi.org/10.1080/20479700.2024.2430877.

[1]Maternal healthcare services encompass access to high-quality care provided by skilled health professionals during pregnancy (antenatal care), childbirth (intrapartum care), and care and support in the weeks following childbirth (postnatal care).
[2]Maternal health refers to the health of women during pregnancy, childbirth and the postnatal period.
[3]Maternal mortality ratio refers to the number of maternal deaths per 100,000 live births.

Global Social Welfare
https://doi.org/10.1007/s40609-025-00380-y

Concomitant Factors Influencing Breastfeeding Practices in India: Evidence from Demographic and Health Survey 2019–21

Charu Tayal[1] · Rajesh Sharma[2] · Kusum Lata[1]

Accepted: 22 January 2025

Abstract

Background Breastfeeding is essential for enhancing a child's immunity, neurocognitive development, growth, and future economic prospects while offering substantial benefits to mothers. This study uses extensive nationally representative data to examine the determinants of breastfeeding practices in India.

Methods The study employed data from the latest round of the Indian demographic and health survey [DHS (2019–21)]. Logistic regression and negative binomial models were used to investigate the determinants of early initiation of breastfeeding (within 1 h), exclusive breastfeeding (under 6 months), continued breastfeeding (12–23 months), and duration (months) of breastfeeding among children under the age of 2 years/23 months.

Findings In India, a female child was more likely to be exclusively breastfed for the initial 6 months [odds ratio (OR) 1.13; confidence interval (CI) (1.03–1.23)] in comparison to a male child, while the duration of breastfeeding was shorter [incidence rate ratio (IRR) 0.96; CI (0.93–0.98)]. Children born with the average size at birth [OR 1.18; CI (1.10–1.27)] and belonging to second to fourth birth order [OR 1.19; CI (1.11–1.26)] had higher odds of early initiation of breastfeeding. Notably, higher paternal educational attainment was associated with lower odds of early initiation of breastfeeding [OR 0.88; CI (0.58–0.93)] and exclusive breastfeeding [OR 0.82; CI (0.70–0.96)]. Mothers who received PNC and breastfeeding counseling during the first 2 days had higher odds of early initiation of breastfeeding [OR 1.12; CI (1.04–1.21)] and exclusive breastfeeding [OR 1.16; CI (1.03–1.31)]. Furthermore, women who received assistance from Anganwadi while breastfeeding had a higher likelihood of early initiation of breastfeeding [OR 1.26; CI (1.19–1.34)] and continuous breastfeeding [OR 1.25; CI (1.16–1.36)].

Conclusion In summary, both maternal and paternal characteristics significantly influence breastfeeding practices in India. Policymakers must adopt a multi-pronged strategy that includes breastfeeding counseling, regulation of the breast milk substitute industry, provision of lactation rooms in public places, utilization of information and communication technology tools, increased paternal involvement in nursing, specialized training for health and nutrition professionals, and regular health education sessions.

Keywords Duration of breastfeeding · Early initiation of breastfeeding · Exclusive breastfeeding · Continued breastfeeding · India · Demographic health survey

Introduction

The late pediatrician Bo Vahlquist emphatically stated, "In all mammalian species, the reproductive cycle comprises both pregnancy and breast-feeding: in the absence of the latter, none of these species, man included, could have survived" (WHO, 1981). Mother's milk benefits a child's immunity, growth, and survival through its effects on microRNAs and epigenetic changes (Lawrence, 2022). Rich in essential nutrients like vitamins, proteins, antibodies, hormones, growth factors, and enzymes, it protects against various pathologies, including cholera, respiratory infections, and

✉ Rajesh Sharma
rajesh.sharma@nitkkr.ac.in

[1] University School of Management and Entrepreneurship, Delhi Technological University, Delhi, India

[2] Humanities and Social Sciences, National Institute of Technology Kurukshetra, A328 Kurukshetra, Haryana, India

Published online: 12 February 2025

CHILDREN'S HEALTH CARE
https://doi.org/10.1080/02739615.2025.2465305

Examining maternal healthcare service utilization as a determinant of child health outcomes in India: Demographic and Health Survey 2019–21

Charu Tayal[a], Rajesh Sharma[b], and Kusum Lata[a]

[a]University School of Management and Entrepreneurship, Delhi Technological University, New Delhi, India; [b]Humanities and Social Sciences, National Institute of Technology Kurukshetra, Kurukshetra, India

ABSTRACT

In India, poor child health outcomes (CHOs) is a longstanding issue. This study examines the impact of maternal healthcare service utilization (MHCSU) on under-five CHOs, including stunting, wasting, anemia, underweight, and overweight in India, using data from the 2019–21 Indian Demographic and Health Survey. In India, a mother who consumed iron folic acid (IFA) tablets for at least 180 days [OR 0.94; 95% CI 0.9–0.99] and who received postnatal care (PNC) [OR 0.91; 95% CI 0.85–0.98] had lower odds of having an anemic child. The odds of being underweight were higher among children [OR 1.05; 95% CI 1.0–1.1] whose mothers were more than three months pregnant at the time of their first antenatal care (ANC) checkup. The skilled assistance during delivery reduced the odds of wasting [OR 0.96; 95% CI 0.92–0.99] and anemia among children. Notably, mothers who attended at least four ANC visits were more likely to have an overweight child, as each additional ANC visit has been associated with an increase in the child's weight. In summary, our results demonstrate that MHCSU has a significant impact on CHOs in India. Pertinent public health programs, increased accessibility and affordability of maternal healthcare services, greater engagement with frontline health workers, and women's empowerment can further improve CHOs in India.

Introduction

The period from birth to five years is the most crucial period for critical growth and developmental processes (Baek et al., 2022; Oumer et al., 2022). Yaya et al. (2020) contend that adequate nutrition during this period plays a vital role in a child's cognitive, physical, emotional, and social development. Poor child health outcomes (CHOs) not only harm children's physical health but also adversely impact their emotional well-being and self-esteem (Komakech et al., 2022). Furthermore, early CHOs significantly affect later-life outcomes as children who perform poorly on health indicators are more

CONTACT Rajesh Sharma rajesh.sharma@nitkkr.ac.in Humanities and Social Sciences, National Institute of Technology Kurukshetra, A328, Kurukshetra, Haryana, India

Supplemental data for this article can be accessed online at https://doi.org/10.1080/02739615.2025.2465305.

Journal of Medicine, Surgery, and Public Health 4 (2024) 100156

Contents lists available at ScienceDirect

Journal of Medicine, Surgery, and Public Health

journal homepage: www.sciencedirect.com/journal/journal-of-medicine-surgery-and-public-health

Association between women's autonomy and reproductive health outcomes in India

Charu Tayal [a], Rajesh Sharma [b,*,1], Kusum Lata [a]

[a] University School of Management and Entrepreneurship, Delhi Technological University, India
[b] Humanities and Social Sciences, National Institute of Technology Kurukshetra, India

ARTICLE INFO

Keywords:
Women's autonomy
Abortion
Contraceptive methods
Wanted pregnancy
Caesarean delivery
Demographic and health survey
India

ABSTRACT

Background: In India, limited autonomy in maternal reproductive healthcare decision-making remains a persistent issue. This study investigates the impact of women's autonomy in managing their healthcare on abortion history, knowledge of contraceptive methods, wanted pregnancy, and delivery via caesarean section in India.
Data and methods: The data for this study were extracted from two rounds of the Indian Demographic and Health Survey [DHS (2015–16) and DHS (2019–21)]. Descriptive statistics, logistic regression and time interaction regression model were employed to investigate the association between women's autonomy in managing their healthcare and access to reproductive healthcare services.
Results: Women whose healthcare decisions were jointly managed with their husband/partner had higher odds of having a wanted pregnancy [OR = 1.64; $p<0.01$] in 2015–16 and [OR = 1.29; $p<0.10$] in 2019–21 compared to women who managed healthcare decisions alone. However, the significance of shared healthcare decision-making in predicting a wanted pregnancy diminished between 2015–16 and 2019–21. In 2015–16, the odds of delivery via caesarean section were lower for women who managed their healthcare jointly with their husband/partner [OR = 0.79; $p<0.05$] and for those whose healthcare decisions were made by someone else [OR = 0.57; $p<0.01$] compared to women who managed healthcare decisions alone. Additionally, in 2015–16 when healthcare decisions were made by the husband/partner alone, women had significantly lower odds of knowing contraceptive methods [OR = 0.48; $p<0.05$] compared to when women managed healthcare decisions alone. Furthermore, in each round, women with higher levels of education, health insurance coverage, from wealthier households, and those whose husbands were educated and older at the time of childbirth, had higher odds of having contraceptive knowledge and a wanted pregnancy in India.
Conclusion: In summary, we found that when healthcare decisions were made solely by the husband or partner, women had significantly lower odds of being knowledgeable about contraceptive methods. Furthermore, we found that the odds of delivery via caesarean section were lower when women jointly managed their healthcare with their partner. To achieve Sustainable Development Goal 3.7, which calls for universal access to sexual and reproductive healthcare services, it is crucial to promote informed reproductive choices, enhance contraceptive knowledge, and increase access to reproductive healthcare services in India.

1. Introduction

Universal access to sexual and reproductive healthcare services is one of the goals envisaged in the United Nations' Sustainable Development Goals (SDG-3.7), including family planning, information, and education [1]. However, it is disconcerting that contraceptive use in India is still suboptimal [2]. According to the National Family Health Survey (NFHS), only 67.9 % of married women aged 15–49 years use modern contraceptive methods, leaving a considerable unmet need for the family planning services [2]. According to the United Nations Population Fund report 2022, unsafe abortions are the third leading cause of maternal mortality in India, with nearly eight women dying each day due to complications related to unsafe procedures [3]. In 2022, India accounted for one in seven unintended pregnancies globally, and these pregnancies, along with the resulting abortions, are closely linked to the country's overall development [3]. Furthermore, reproductive

* Correspondence to: A328, Humanities and Social Sciences, National Institute of Technology Kurukshetra, Kurukshetra, Haryana, India
E-mail address: rajesh.sharma@nitkkr.ac.in (R. Sharma).
[1] **ORCID**- 0000–0001-7468–1249

https://doi.org/10.1016/j.glmedi.2024.100156
Received 19 September 2024; Received in revised form 13 November 2024; Accepted 13 November 2024
Available online 16 November 2024

Original Research Article

The Temporal Impact of Socioeconomic Deprivation on Child Health Outcomes in India: Evidence from the Demographic Health Survey 2015–2021

International Journal of Social Determinants of Health and Health Services
1–18

DOI: 10.1177/27551938251353008
journals.sagepub.com/home/joh
Sage

Charu Tayal[1], Rajesh Sharma[2] and Kusum Lata[1]

Abstract

In India, poor child health is a pertinacious issue. This article investigates the impact of water and sanitation, maternal health care service utilization (MHCSU) and breastfeeding practices on under-five child health outcomes (CHOs) in India using the two rounds of the Indian Demographic and Health Survey (DHS), 2015–2016 and 2019–2021. In 2019–2021, unprotected sources of drinking water were associated with an increased prevalence of under-five wasting. Unimproved sanitation facilities were likely to increase the prevalence of under-five stunting; however, unlike in DHS 2015–2016, it had no statistically significant effect on wasting and underweight (2019–2021). Mothers who had not received at least four antenatal care visits were more likely to have stunted and underweight children (2019–2021). The absence of early initiation of breastfeeding was associated with an increased prevalence of under-five wasting and underweight but did not influence CHOs (2015–2016). In 2019–2021, the absence of exclusive breastfeeding for the initial six months was associated with increased odds of stunting and underweight among children. To improve CHOs, policymakers must focus on providing financial, material, and human resources along with soft knowledge to provide hygiene education and promote MHCSU, breastfeeding practices, engagement with frontline health workers and women's empowerment.

Keywords

safe drinking water, hygiene, sanitation, maternal health care service utilization, breastfeeding, child stunting, child wasting, child underweight, demographic health survey, India

Globally, malnutrition contributes to nearly half of all deaths in children under the age of five years.[1] It is disconcerting that malnutrition is such an alarming predicament, with an estimated 149 million stunted children and 45 million wasted children worldwide.[1] The developmental, economic, social, and medical ramifications of the global burden of malnutrition are substantial and lasting, affecting individuals, families, communities, and nations on multiple levels.[1] Economically, malnutrition imposes a colossal burden of US$3 trillion a year in the form of productivity losses, ranging from 3 to 16 percent of gross domestic product in low-income countries.[2]

Child malnutrition has continued to remain a persistent problem in low and middle-income countries. The poor child health outcomes (CHOs) including stunting (low height for age), wasting (low weight for height), and underweight (low weight for age) impede the development of the child in terms of health and socioeconomic status.[3,4] Poor CHOs increase the child mortality and morbidity and lead to impaired physical and cognitive development, poor learning capacity, lower educational attainment and economic productivity in adulthood.[5–7]

Despite improvements achieved in the Millennium Development Goal era, malnutrition remains overwhelmingly high in India, with under-five stunting at 35.5 percent, underweight at 32.1 percent, and wasting being one of the highest in the world at 19.3 percent.[8,9] Furthermore, in terms of the global hunger index, India, ranked 111th, lags behind its South Asian peers, namely Pakistan at 102, Bangladesh at 81, Nepal at 69, and Sri

[1]University School of Management and Entrepreneurship, Delhi Technological University, Delhi, India
[2]Humanities and Social Sciences, National Institute of Technology Kurukshetra, Kurukshetra, India

Corresponding Author:
Rajesh Sharma, A328, Humanities and Social Sciences, National Institute of Technology Kurukshetra, Kurukshetra, Haryana, India.
Email: rajesh.sharma@nitkkr.ac.in

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Supervisor (s)

(1) Dr. Kusum Lata, Assistant Professor, University School of Management and Entrepreneurship, Delhi Technological University, New Delhi, India

(2) Dr. Rajesh Sharma, Assistant Professor, Department of Humanities and Social Sciences, National Institute of Technology Kurukshetra, Haryana, India

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(2K20/PHDUECO/504)
(Research Scholar)

Dr. Kusum Lata
(Supervisor)
Assistant Professor, USME, DTU

Dr. Rajesh Sharma
(Joint Supervisor)
Assistant Professor
Department of Humanities and Social Sciences, NIT Kurukshetra

CURRICULUM VITAE

Name **Ms. Charu Tayal**
Mobile 9899979525
E-mail charutayal20@gmail.com

Academic qualifications

- Ph. D. - Delhi Technological University, Delhi, India (2021-Present). **8.71 SGPA**
- M.A. (Economics) – Amity University, Uttar Pradesh, India 2018. **91.4%**
- B. A. (Economics) - Gargi College, University of Delhi, Delhi, India 2016. **79.23%**
- 12th (Commerce with Mathematics)- Central Board of Secondary Education, Delhi, India 2013. **93.25%**
- 10th - Central Board of Secondary Education, Delhi, India 2011. **10 CGPA**

Additional qualification

- Qualified **NET** UGC (Economics) 2018

PhD Research

Title: A Study on Maternal Health Care in India

- **Research Papers**

  - **Tayal, C.**, Sharma, R., & Lata, K. (2025). Temporal Impact of Socioeconomic Deprivation on Child Health Outcomes in India: Evidence from Demographic Health Survey 2015-21. *International Journal of Social Determinants of Health and Health Services.* Publisher: Sage, Indexation: **SCIE, SSCI, Scopus (Q1)**. IF: **3.4**, DOI: https://doi.org/10.1177/27551938251353008
  - **Tayal, C.**, Sharma, R., & Lata, K. (2025). Concomitant factors influencing breastfeeding practices in India: Evidence from Demographic and Health Survey 2019-21. *Global Social Welfare.* Publisher: Springer, Indexation:

ESCI, Scopus (Q1). IF: **1.3**, DOI: https://doi.org/10.1007/s40609-025-00380-y

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- **Tayal, C.**, Sharma, R., & Lata, K. (2025). Examining Maternal Healthcare Service Utilization as a Determinant of Child Health Outcomes in India: Demographic and Health Survey 2019-21. *Children's Health Care.* Publisher: Taylor & Francis, Indexation: **SSCI, Scopus (Q3).** IF: **1**, DOI: https://doi.org/10.1080/02739615.2025.2465305
- **Tayal, C.**, Sharma, R., & Lata, K. (2024). Association between women's autonomy and reproductive health outcomes in India. *Journal of Medicine Surgery and Public Health*, 1, 100009. Publisher: **Elsevier**, DOI: https://doi.org/10.1016/j.glmedi.2024.100156
- Does Coercive Control Experienced by Mothers Impact Child Health in South Asian Countries? Evidence from Mixed-Effects Logistic Regression Analysis. Revision submitted in *Journal of Gender Studies.* Publisher: Taylor & Francis, Indexation: SSCI, Scopus (Q1). IF: 2.2.

➢ **Papers presented at conferences**

- International conference (SFME 2022): Shaping the future of management education for sustainable emerging economies. November 20-22, 2022. Jointly organized by the Department of Management Studies, IIT Roorkee and Arizona State University, USA.

  Title of the paper: Impact of utilization of Maternal Healthcare Services on Child Health Outcomes in India: Demographic and Health Survey 2019-21.
- Twentieth AIMS International Conference on Management. December 28-31, 2022. Jointly organized by the IIM Kozhikode and Association of Indian Management Scholars International.

  Title of the paper: Impact of Maternal Healthcare Services on Double Burden of Malnutrition in Child.

- 1st International Conference on "Diversity, Equity and Inclusion: Cultures, Practices and Policies" Management, Entrepreneurship and Economics, (ICMEE). September 15-16,2023. Organized by the University School of Management and Entrepreneurship (USME), Delhi Technological University, Delhi, India.

  Title of the paper: The Effect of Water and Sanitation Facilities on Child Indicators in India: DHS 2019-21.
- 1st International Conference on Economics and Public Policy (ICEP-1): Resilience and Economy. September 30- October 1, 2023. Jointly organized by IIM Shillong and Universitas Gadjah Mada (UGM), Indonesia.

  Title of the paper: Determinants of child health outcomes in India: Demographic and Health Survey 2019-21.

Experience

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES, Assistant Professor (July 2019 – January 2021)

Subjects taught: Macroeconomics, International economics, Development economics, Econometrics and Statistics to undergraduate and postgraduate students.

Technical Skills

- STATA, EViews, Excel, Power point, Microsoft Office

Internships

- Data Analyst- Ministry of Karnataka, Rashtriya e-Market Services (ReMS), Bengaluru, India (May2017 – July 2017)
- Research Analyst- Federation of Indian Chambers of Commerce and Industry (FICCI), Delhi, India(December 2014 – January 2015)

Academic achievements

- M.A. (Economics) - Silver Medalist (2016-2018)
- M.A. (Economics)- Received 50% scholarship (2016-2018)
- B.A. (Economics)- Secured the highest scores in Statistical Methods in Economics II (99) and Introductory Econometrics (98) (2014-2016)
- Honored with Guru Vandan- Chatra Abhinandan Award for Outstanding Achievement 2012

Extra- Curriculum Activities

- Actively participated in sports (handball); (2008-2018)
- Appointed as Head Girl (2012-2013)
- Served as Vice President of the Rotary Club (2012-2013)

Professional References

- **Dr. Rajesh Sharma**, Assistant Professor, Humanities and Social Sciences, National Institute of Technology Kurukshetra
  Email address: rajesh.sharma@nitkkr.ac.in Contact Number: +91 9205815312
- **Dr. Kusum Lata**, Assistant Professor, University School of Management and Entrepreneurship, Delhi Technological University
  Email Address: kusumlata@dtu.ac.in
- **Prof. Amit Mookerjee,** HoD & Professor, Department of USME, Delhi Technological University, New Delhi Email Address: amookerjee@dtu.ac.in Contact Number: +91 9811373970
- **Dr. Naval Garg,** Assistant Professor, Department of USME, Delhi Technological University, New Delhi
  Email Address: naval.garg@dtu.ac.in Contact Number: +91 9930912054