

Equity and Determinants of Optimal Maternal Continuum of Care in Cambodia: Evidence from
the 2000–2022 Demographic and Health Surveys

by

Jingyi Wei

DKU Global Health Program
Duke University

Defense Date: July 18, 2025

Approved:

Qian Long, Co-Chair

Fujie Xu, Co-Chair

Xinyu Zhang

Thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in
the DKU Global Health Program in The Graduate School of
Duke University
2025

ABSTRACT

Equity and Determinants of Optimal Maternal Continuum of Care in Cambodia: Evidence from
the 2000–2022 Demographic and Health Surveys

by

Jingyi Wei

DKU Global Health Program
Duke University

Defense Date: July 18, 2025

Approved:

Qian Long, Co-Chair

Fujie Xu, Co-Chair

Xinyu Zhang

An abstract of a thesis submitted in partial fulfillment of the requirements for the degree of
Master of Science in the DKU Global Health Program in The Graduate School of
Duke University
2025

Copyright by
Jingyi Wei
2025

Abstract

Background: The maternal continuum of care (CoC), including antenatal care (ANC), facility-based delivery, and postnatal care (PNC), is essential for improving maternal and newborn outcomes. In Cambodia, while service coverage has improved over the past two decades, significant gaps remain in the completion of the full continuum of care (CoC), especially among disadvantaged groups. This study assessed trends in CoC coverage, identified socio-demographic determinants of service utilization, and examined gaps by urban and non-urban residence and socioeconomic class across survey years from 2000 to 2022.

Methods: This study used repeated cross-sectional data from five rounds of the Cambodia Demographic and Health Survey (DHS), covering 2000 to 2022. Descriptive statistics were used to examine trends in the utilization of ANC, facility-based delivery, PNC, and optimal CoC. Disparity analyses were conducted to evaluate service utilization gaps between urban–rural and wealth subgroups. Multivariable logistic regression models were applied to identify factors associated with service completion, using both single-year (2021–2022) and pooled-year (2010–2022) datasets.

Results: Utilization of maternity care improved significantly between 2000 and 2022. The proportion of women receiving ≥ 4 ANC visits increased from 6.72% to 82.23%, facility-based delivery from 5.79% to 96.54% and optimal CoC rose from 1.6% in 2000 to a peak of 68.9% in 2014, before declining to 46.3% in 2021. However, disparities by educational level and household wealth remained persistent across all services. For example, in 2021, 56.59% of women from the richest households had optimal CoC, comparing to only 30.83% from the poorest group. While urban–rural gaps have narrowed, women with higher socioeconomic status—including higher education, greater household wealth, and health insurance coverage—were significantly more likely to receive optimal ANC and CoC. Wealth-related disparities remained persistent across these services. The notably low PNC proportion in 2021–2022

contributed to the decline in full CoC coverage, underscoring the postnatal stage as a crucial point of dropout within the continuum. Insurance coverage was also a significant predictor of optimal CoC. In 2021–2022, 53.7% of insured women completed the full CoC, compared to 44.3% of uninsured women, highlighting the advantage associated with insurance coverage. Logistic regression analysis also showed that lower parity, older maternal age, and formal employment were significantly associated with higher odds of optimal CoC.

Conclusions: Despite significant progress since the year 2000, inequities in utilization of maternity care persisted by socio-economic factors. The results underscore the need for more targeted strategies to support underserved populations, particularly women with low education, income and with no insurance. Future policies should prioritize improving postnatal care uptake and addressing structural barriers to achieving full continuum of maternal care.

Contents

Abstract.....	iv
List of Tables	viii
List of figures.....	ix
List of Abbreviations	x
Acknowledgements.....	xi
1. Introduction.....	1
2. Methods	6
2.1 Data source and study population.....	6
2.2 Measurements.....	6
2.2.1 Dependent variable.....	6
2.2.2 Independent variable	8
2.3 Data Analysis	9
2.4 Ethical approval.....	11
3. Results.....	13
3.1 Demographic Characteristics.....	13
3.1.1 Characteristics of study population.	13
3.1.2 Maternal Healthcare Utilization by Subgroup.....	15
3.1.3 Disparity Analysis	22
3.2 Regression Analysis	24
3.2.1 Relationship between sociodemographic characteristics and optimal CoC utilization	24
3.2.2 Relationship between sociodemographic characteristics and optimal ANC utilization	27
3.2.3 Relationship between sociodemographic characteristics and facility-based delivery service utilization	29
3.2.4 Relationship between sociodemographic characteristics and optimal PNC utilization	31
3.2.5 Determinants of Both Optimal ANC and Facility-Based Delivery Utilization (2010– 2022)	33

4. Discussion.....	36
4.1 Limitations and Value Provided.....	43
5. Conclusion	45
References.....	46

List of Tables

Table 1 : Demographic characteristics of women who had a live birth in the three years preceding the survey, Cambodia 2000-2022	14
Table 2 : Proportion of women received optimal ANC by socio-demographic subgroups in Cambodia from 2000 to 2022	17
Table 3 : Proportion of women received facility-based delivery by socio-demographic subgroups in Cambodia from 2000 to 2022	19
Table 4 : Proportion of women received optimal PNC by socio-demographic subgroups in Cambodia, 2021-2022.....	20
Table 5 : Proportion of women received optimal CoC by socio-demographic subgroups in Cambodia from 2000 to 2022	21
Table 6 : Absolute difference and relative ratio in optimal ANC utilization between wealth groups and residence groups from 2000 to 2022.....	23
Table 7 : Absolute difference and relative ratio in facility-based delivery utilization between wealth groups and residence groups from 2000 to 2022.....	24
Table 8 : Absolute difference and relative ratio in optimal PNC utilization between wealth groups and residence groups from 2021 to 2022	24
Table 9 : Absolute difference and relative ratio in optimal CoC utilization between wealth groups and residence groups from 2021 to 2022	24
Table 10 : Multivariable logistic regression of factors associated with optimal CoC utilization among women from 2021 to 2022	26
Table 11 : Multivariable logistic regression of factors associated with optimal ANC (≥ 4 visits) utilization from 2010 to 2022	28
Table 12 : Multivariable logistic regression of factors associated with facility-based delivery utilization from 2010 to 2022	30
Table 13 : Multivariable logistic regression of factors associated with optimal PNC utilization from 2021 to 2022.....	32
Table 14 : Logistic regression assessing the effect of survey year on ANC and facility-based delivery utilization from 2010 to 2022	34

List of figures

Figure 1: Trends in maternal health utilization in Cambodia, 2000-2022	16
--	----

List of Abbreviations

Abbreviation	Full Term
ANC	Antenatal Care
AOR	Adjusted Odds Ratio
CoC	Continuum of Care
DHS	Demographic and Health Survey
FBD	Facility-Based Delivery
HEF	Health Equity Fund
MDG	Millennium Development Goals
MMR	Maternal Mortality Ratio
MoH	Ministry of Health
NGO	Non-Governmental Organization
OR	Odds Ratio
PNC	Postnatal Care
SDG	Sustainable Development Goals
WHO	World Health Organization

Acknowledgements

I would like to express my gratitude to my committee members — Dr. Qian Long, Dr. Fujie Xu, and Dr. Xinyu Zhang — for their invaluable support throughout the development of this thesis.

I am especially grateful to Dr. Qian Long, my primary supervisor, whose consistent guidance and tireless support throughout each stage of this project have been instrumental to both the structure and substance of this work. Her encouragement, patience, and thoughtful feedback kept me on track and motivated during the most challenging moments.

I also extend my sincere thanks to Dr. Fujie Xu, whose detailed and insightful comments significantly enhanced the academic rigor of this thesis. Her advice helped me improve the clarity of language, refine the structure, and sharpen the overall research logic.

I am likewise deeply thankful to Dr. Xinyu Zhang, whose meticulous review of my data analysis and formatting of tables and figures greatly improved the precision and presentation quality of this thesis.

1. Introduction

Cambodia, a lower-middle-income country in Southeast Asia, has made remarkable progress in rebuilding its healthcare system following decades of conflict and social upheaval in the late 20th century (Opiyo et al. 2022). According to data from the Cambodia Demographic and Health Surveys (CDHS), the maternal mortality ratio (MMR) in Cambodia dropped from 437 deaths per 100,000 live births in 2000 to 218 deaths per 100,000 in 2021 (National Institute of Statistics, Ministry of Health, and ICF 2023), reflecting the country's ongoing commitment to strengthening maternal and child health.

Over the past two decades, Cambodia has implemented a series of national policies to improve maternal health, targeting both demand- and supply-side barriers.

Health Equity Funds (HEF), initiated in the early 2000s and covering approximately one-fifth of the national population, about 3 million people, and primarily the poorest groups, provide exemptions from user fees at public health centers and referral hospitals, along with transport and food subsidies. Evidence shows HEF led to a significant uptick in consultations about 15.6 % and facility deliveries around 5.3 % in the first year of implementation, especially among the poorest households (Pheakdey et al. 2020).

Community-Based Health Insurance (CBHI) and the National Social Security Fund (NSSF) extend financial coverage to near-poor households and formal sector workers, aiming to reduce out-of-pocket expenditures and encourage use of public maternal health services (Annear et al. 2019).

On the supply side, the Government Midwifery Incentive Scheme (GMIS), introduced in 2007, provides performance-based payments to midwives and facility staff—offering 15 US dollars per birth at health centers and 10 US dollars at hospitals (Strachan et al. 2023). This financial incentive aims to promote facility-based deliveries and enhance coverage of skilled birth attendance.

Midwifery training programs, supported by WHO and MOH, have equipped personnel to deliver ANC, intrapartum and postnatal care even in remote areas; deployment ensures that remote health centers are staffed by at least one skilled attendant (Pheakdey et al. 2020).

Maternity Waiting Homes (MWHs) were introduced in rural areas to bring women close to health facilities near term (Blizzard et al. 2023). These homes aim to reduce geographical delays and have shown promise in increasing institutional births in some settings. However, their effectiveness depends critically on enrollment uptake, referral linkages and quality of infrastructure. In Cambodia, the actual impact of MWHs remains under-evaluated and context dependent. The ‘1000 Days’ package was introduced to promote adherence to WHO-recommended maternal care standards. However, given its recent rollout, its impact remains to be fully assessed (Ir et al. 2015).

Together, these combined demand- and supply-side interventions—including HEF, CBHI/NSSF, midwifery incentives and training, and MWHs—form a multi-pronged strategy designed to enhance access to and utilization of facility-based maternal care across wealth quintiles in Cambodia (Alzate et al. 2019).

However, despite the overall progress, the pace of MMR reduction has slowed in recent years. According to the 2021–2022 Cambodia DHS, the maternal mortality ratio (MMR) was estimated at 218 deaths per 100,000 live births, which is slightly below the global average of 223 in 2020 but remains substantially higher than the SDG target of 70 per 100,000 by 2030 (National Institute of Statistics, Ministry of Health, and ICF 2022). This signals that Cambodia still faces challenges in achieving global health development targets, particularly in addressing structural inequalities in service quality, resource allocation, and coverage for vulnerable populations highlighting the importance of evaluating which policy interventions — including financial subsidies, health equity schemes, and service decentralization — have contributed most significantly to reducing inequities in maternal care access (Kitila et al. 2022).

At the global level, improving maternal health has long been a central priority for governments and international organizations. The Millennium Development Goals (MDGs) committed to reducing the global MMR by three-quarters by 2015 (Jiwani et al. 2020). This target was reaffirmed in the Sustainable Development Goals (SDGs), launched in 2016, with Goal 3.1 calling for a reduction in the global MMR to fewer than 70 deaths per 100,000 live births by 2030 (Kaiser et al. 2023). In pursuit of this goal, organizations such as the World Health Organization (WHO) and UNICEF have advocated for comprehensive maternal healthcare systems, highlighting the “Continuum of Care” (CoC) as a core strategy (Kassie et al. 2024). The CoC model emphasizes the need for integrated and timely healthcare services across the antenatal, delivery, and postpartum periods to ensure optimal maternal and neonatal outcomes (Wang and Hong 2013).

The Continuum of Care is both a temporal and spatial concept: it refers to the provision of essential services during pregnancy, childbirth, and the postnatal period, and spans across households, communities, primary health centers, and hospitals (Sisay et al. 2019). According to WHO guidelines, pregnant women should receive at least four antenatal care (ANC) visits, skilled birth attendants, and undergo a postnatal checkup after delivery. While this study adopts the three-stage framework of antenatal care, delivery, and postnatal care as outlined by the WHO, operational definitions were slightly modified to ensure temporal consistency and data comparability across survey years. Specifically, facility-based delivery was used as a proxy for skilled birth attendance. Since although DHS surveys include variables on skilled attendants, these data contain substantial missing values in earlier rounds, making FBD a more reliable and consistently available indicator throughout the 2000–2022 period. In addition, postnatal care (PNC) was defined as at least one follow-up visit occurring after discharge from a health facility, among women who delivered in an institution. This definition was chosen to better reflect the continuity of care beyond delivery and to identify gaps in post-discharge follow-up, which often represents a critical but overlooked stage in maternal health service utilization. Women who

complete the full CoC sequence are more likely to experience better health outcomes, such as reduced birth complications, higher newborn survival rates, and improved early breastfeeding practices(Kerber et al. 2007). However, studies have shown that the CoC completion rate remains low in many low- and middle-income countries (LMICs), with significant service “dropouts” occurring between stages(Khatri et al. 2022). Previous research has identified multiple barriers contributing to these dropouts, including limited access to health facilities, lack of awareness, sociocultural norms and so on(Laksono et al. 2023). In some contexts, for example, women may begin ANC but fail to continue with facility-based delivery or postnatal care, undermining the overall effectiveness of maternal health interventions(Mallick, Allen, and Hong 2017).

In Cambodia, existing research has primarily focused on individual components of maternal health—such as ANC coverage or facility-based delivery—but lacks a systematic assessment of service continuity across all stages (Chham et al. 2021). Moreover, while global health initiatives emphasize the importance of equity in achieving Universal Health Coverage (UHC), few empirical studies have examined disparities in CoC utilization across socio-demographic subgroups in the Cambodian context. Some research suggests that factors such as educational level, household wealth, and place of residence significantly influence access to maternal health services, contributing to inequity in health outcomes.(Ghose et al. 2017)

Therefore, the aim of this study is to examine maternal service utilization across three key components of the continuum of care (CoC)—antenatal care (ANC), facility-based delivery, and postnatal care (PNC)—using five rounds of nationally representative Cambodia Demographic and Health Survey (CDHS) data collected between 2000 and 2022(Kenney et al. 2020). This study explores how the completion rates of each service component have changed over time, investigates the socio-demographic factors associated with complete CoC utilization, and assesses disparities in service coverage across subgroups defined by residence, education, wealth, and other relevant characteristics (Kikuchi et al. 2015). By integrating trend analysis with cross-

sectional equity assessments, the study aims to fill critical gaps in Cambodia's maternal health research and provide policy-relevant insights to promote more integrated, equitable, and sustainable maternal healthcare services under the SDG framework.

2. Methods

2.1 Data source and study population

The data used in this study were obtained from the Cambodia Demographic Health Survey (CDHS) conducted between 2000 and 2022. This nationally representative household survey employed a stratified multistage random sampling method, which included two stages: first, clusters were randomly selected from the national sample frame based on size proportions, and then households were systematically selected from the list of households in each sampled cluster (Hassan et al. 2025). Within the selected sample households, all women aged 15–49 who had experienced a live birth in the past five years were interviewed. The questionnaire covered topics such as demographics, health, nutrition, and HIV/AIDS. During the selected period from 2000 to 2022, a total of 88,002 women completed the questionnaire survey and were included in the CDHS database. According to the definitions in the “DHS Survey Indicators” section of the DHS official website, the collection of variables such as antenatal care, place of delivery, and postpartum visits primarily focuses on the most recent childbirth of the respondent woman and is often limited to live births within the three to five years prior to the survey. To ensure the availability and temporal consistency of variables, this study restricted the analysis to women aged 15–49 years who had one or more live births within the three years prior to the survey (n = 20,981).

2.2 Measurements

2.2.1 Dependent variable

There are four key outcome measurements in this study: optimal antenatal care (ANC), facility-based delivery, optimal postnatal care (PNC), and optimal continuum of care (COC). These four virtual variables are defined according to the guidelines of the World Health Organization (WHO) and the Cambodian Ministry of Health (Fekadu et al. 2018).

Based on the Cambodian Ministry of Health's recommendations for the number of antenatal care visits and WHO's antenatal care guidelines, this study defines Optimal ANC as pregnant women receiving at least four pregnancy-related health care check-ups either at a health facility or at home during pregnancy (Saad-Haddad et al. 2016). Although the WHO released new guidelines in 2016 recommending that pregnant women receive at least eight antenatal care (ANC) contacts, this study adopted the ≥ 4 visits standard to ensure comparability across survey rounds and alignment with prior research. ANC8+ was not used due to the limited number of women who reported eight or more visits, especially in earlier DHS rounds (Gitsels-van der Wal et al. 2014). Earlier survey rounds lack complete and comparable data on the timing of the first ANC visit. Therefore, to ensure consistency across the 2000–2022 and maximize sample inclusion, the ≥ 4 visits threshold was selected for “optimal ANC” and defined as a binary variable, where code 1 represents women who met the criteria (at least four visits) and code 0 represents women who did not meet the criteria.

Facility-based delivery (FBD) in this study is defined as childbirth that occurred in a recognized health facility, including public hospitals, health centers, clinics, or private medical institutions and so on (National Institute of Statistics, Ministry of Health, and ICF 2022). This indicator is based on the standard DHS classification derived from the respondent's answer to the question regarding place of delivery. This study defines “facility-based delivery” as a binary variable, where code 1 represents women who gave birth in a facility, and code 0 represents women who gave birth at home or in other non-facility locations, or women who could not recall the place of delivery. Note that in this study, pregnant women who gave birth at home with the assistance of a midwife were still considered to have had a non-institutional birth.

Optimal PNC is defined as receiving at least one postnatal care visit after delivery at home, or receiving at least one additional check-up after discharge (Tessema et al. 2020). This is because this period is critical for identifying and managing postpartum hemorrhage to reduce maternal mortality rates and aligns with WHO guidelines and the DHS standard indicator for

maternal PNC (Sisay et al. 2019). Therefore, this variable is categorized as a binary variable “optimal PNC,” where code 1 indicates women who meet standards, and code 0 indicates women who do not meet the recommended standards (Tessema et al. 2020).

In this study, optimal CoC was constructed as a binary variable using different variable construction definitions for two time periods, based on data availability and completeness across survey years.

For survey years 2000 to 2020, optimal CoC was defined as receiving both optimal ANC (≥ 4 ANC visits) and facility-based delivery. This definition reflects the core components consistently measured across all five survey years and captures the continuity between pregnancy and childbirth care.

For the 2021–2022 survey, optimal CoC additionally required receipt of optimal PNC. Although PNC-related questions were included in earlier DHS rounds, a high proportion of missing values raised concerns about data quality, which led to the exclusion of PNC from the CoC definition from 2000-2020 (Wondim et al. 2023). The inclusion of PNC in the CoC indicator for the most recent round aligns more closely with WHO standards emphasized in current global health frameworks. Accordingly, the optimal CoC variable was coded as 1 (complete) if a woman met the criteria for all components in her respective period, and 0 (incomplete) otherwise.

2.2.2 Independent variable

Independent variables included a range of socio-demographic and socio-economic characteristics that have been commonly associated with maternal health service utilization in previous studies (Korachais et al. 2019).

Socio-demographic factors included maternal age at the most recent birth, parity, and place of residence. Maternal age was grouped into four categories: younger than 20 years, 20–29 years, 30–34 years, and 35 years or older, with the eldest group separated to highlight service utilization among women with advanced maternal age. Parity was classified into four groups

based on the number of lifetime births: 1, 2, 3, and 4 or more. Residence was categorized as either urban or rural.

Socio-economic characteristics included educational level, household wealth status, employment status, and health insurance coverage. Education was classified into four levels: no education, primary education, secondary education, and higher education. Household wealth index generated by the DHS team quintile-based classification: poorest, poorer, middle, richer, and richest. Employment status was coded as a binary indicator reflecting whether the woman was currently working at the time of the survey. Insurance coverage was also treated as a binary variable, distinguishing insured from uninsured women (Um et al. 2024).

Except for maternal age, which was regrouped to meet analytical requirements, all variable classifications adhered to DHS standard definitions. Variables with partial missingness, such as insurance, were carefully evaluated, and their exclusion did not substantially affect the stability or interpretability of the results. All data processing and variable construction were conducted using the R programming environment.

2.3 Data Analysis

This study employed a repeated cross-sectional design based on data from CDHS conducted between 2000 and 2022. To account for the complex survey design and ensure valid variance estimation, all analyses incorporated sampling weights, clustering, and stratification information as provided in the DHS datasets. This study began with descriptive analysis to examine the overall levels of CoC service utilization over time, as well as disparities across key socio-demographic subgroups (Kumar et al. 2021). The descriptive analysis focused on the coverage of optimal ANC, facility-based delivery, optimal PNC, and the completion of the full CoC (Hunie Asratie and Belay 2022). For each survey round, the proportion of women completing each component of care was calculated and stratified by residence, household wealth, educational level, maternal age group, parity, health insurance coverage, and employment status,

allowing for the identification of utilization gaps among subpopulations(Jithitikulchai et al. 2021).

Building upon the descriptive findings, the study further assessed equity in service utilization by calculating absolute difference and relative ratio between urban and rural residents and between the richest and poorest wealth quintiles. Equity analysis was conducted for key service indicators, including optimal ANC, facility-based delivery, optimal PNC, and optimal CoC completion. To capture changes in disparities over time, the equity trends for ANC and facility-based delivery were assessed using data from 2000 to 2022. In contrast, the analysis for PNC was based on the most recent cross-sectional data from 2021 to 2022.

To further examine the associations between socio-demographic characteristics and the utilization of both the overall maternal Continuum of Care (CoC) and its key components, this study conducted a series of multivariable logistic regression analyses. The outcomes of interest included the utilization of optimal ANC, facility-based delivery, PNC, and optimal CoC. The primary objective was to assess the associations between service utilization and key subgroup characteristics, including residence, maternal age group, parity, educational level, household wealth status, working status and insurance.

In the main analysis section, the association between the probability of completing the full CoC and the characteristics of different subgroups based on data from 2021–2022 was firstly assessed. After completing the regression analysis of the optimal CoC, the study further conducted multivariate regression analysis on three key components—optimal ANC, facility-based delivery, and optimal PNC separately. Given that the covariate “insurance” was a structurally missing variable in the 2005–2009 surveys, as it was not collected in the early survey rounds, forcing the inclusion of this year would prevent the model from controlling for insurance, a key confounding factor, and could introduce bias. Therefore, this study adopted a complete case analysis, using data from 2010 to 2022, and set 2010 as the reference group to ensure that all

regression independent variables were fully available for each observation record. These independent variables of the regression analysis model are based on the sociodemographic variables included in the descriptive analysis.(Mallick, Allen, and Hong 2017).

To further analyze whether there is a significant time trend in the overall completion rate of ANC and institutional delivery services, this study constructed a time trend regression model with “completion of both ANC and institutional delivery” as the dependent variable, incorporating data from 2010 to 2022, with survey year as the core explanatory variable, while controlling for sociodemographic characteristics, to assess whether service coverage has changed significantly over time. The year 2010 was chosen as the starting point for the following considerations: firstly, many of Cambodia’s key maternal and child health interventions—including the Health Equity Fund expansion, midwifery incentive schemes, and community-based health insurance, were introduced between 2007 and 2008. Starting from 2010 allows sufficient time for policy implementation and facilitates the evaluation of their potential impact. Secondly, consistent and adequate data on health insurance coverage, a key explanatory variable in this study, are only available from 2010 onward.

All regression models use the most disadvantaged group among each variable as the reference group to enhance the analysis's ability to identify inequality patterns. Model results are presented using adjusted odds ratios (AOR), 95% confidence intervals, and significance levels to identify significant associations between subgroup characteristics and their mechanisms of action at different service stages.

2.4 Ethical approval

Ethical approval was granted by the Duke Kunshan University Institutional Review Board (IRB) in Kunshan, Jiangsu, China in May 2025. In addition, the Demographic and Health Surveys (DHS) data used in this study are publicly available and fully anonymized. The researcher applied for access to the Cambodia DHS datasets through the official DHS Program

website in September 2024 and received approval to download the survey datasets, final reports, and related documentation for analytical purposes.

3. Results

3.1 Demographic Characteristics

3.1.1 Characteristics of study population.

Table 1 presents the trends in sociodemographic and socioeconomic characteristics of the study population from 2000 to 2022. The results show that most women were aged 20–34 at their most recent childbirth, with the proportion of the 20–29 age group increasing steadily over time, peaking at 52.3% in 2005, slightly decreasing to 50.6% in 2021. Meanwhile, the proportion of women aged 35 and above showed a declining trend.

In terms of fertility patterns, the distribution of parity changed significantly over time., with the proportion of first-time mothers rising from 16.6% in 2000 to 38.9% in 2014, and 31.9% in 2021;The proportion of women giving birth to multiple children (four or more) has continued to decline, dropping from 48.6% in 2000 to 11.3% in 2021, reflecting significant changes in the birth structure.

The educational level has also improved significantly. The proportion of women with no education decreased from 38.0% in 2000 to 12.4% in 2021. Meanwhile, the proportion of women with a secondary education or higher increased from 11.2% in 2000to 45.6%in 2021. Although the proportion of women with a higher education remains relatively low overall, it has been steadily increasing.

In terms of place of residence, the proportion of the rural population has gradually decreased, from 86.8% in 2000 to 67.3% in 2021, indicating that the urbanization process has accelerated over the past two decades. In terms of household wealth, although the sample distribution was relatively balanced across survey years, the proportion of the “poorest” group was slightly higher in 2021 (29.8%), suggesting that economic disparities persist within the social structure.

In terms of employment status, the labor force participation rate for women fluctuated significantly, reaching a peak of 63.3% in 2014 and 42.9% in 2021. In terms of medical insurance coverage, this variable was only available in surveys conducted in 2010 and thereafter. The data shows that medical insurance coverage remains relatively low, at 21.4% in 2021, though slightly higher than in 2010 (17.6%), indicating that the public social security system still requires further strengthening.

Table 1 : Demographic characteristics of women who had a live birth in the three years preceding the survey, Cambodia 2000-2022

Subgroup Variable	Category	2000 (%)	2005 (%)	2010 (%)	2014 (%)	2021 (%)
Residence	Urban	13.21	20.97	26.05	28.25	32.74
	Rural	86.79	79.03	73.95	71.75	67.26
Age group	<20	4.86	4.77	4.58	5.56	4.83
	20–29	42.89	52.28	59.08	59.22	50.58
	30–34	23.37	19.37	18.5	22.61	23.97
	35+	28.88	23.72	17.85	12.61	20.62
Parity group	1	16.58	24.77	32.26	38.92	31.94
	2	17.44	22.97	27.17	30.47	36.34
	3	17.37	17.32	17.92	15.39	20.41
	4+	48.61	34.94	22.66	15.21	11.30
Wealth group	Poorest	NA	29.10	25.73	23.29	29.76
	Poorer		23.18	19.38	18.36	19.18
	Middle		18.37	16.66	15.97	17.63
	Richer		15.15	17.34	17.41	19.78
	Richest		14.20	20.89	24.97	13.65
Educational level	No education	38.01	28.05	20.45	13.09	12.42

	Primary education	50.79	56.73	52.08	47.57	41.95
	Secondary education	11.15	14.73	25.40	35.12	39.90
	Higher education	0.05	0.49	2.07	4.22	5.74
Insurance	Insured	NA	NA	17.55	15.08	21.37
	Not insured			82.45	84.92	78.63
Working status	Working	26.70	44.20	34.58	63.26	42.95
	Not working	73.30	55.80	65.42	36.74	57.05

3.1.2 Maternal Healthcare Utilization by Subgroup

Figure 1 presents the trends in utilization of key maternal health services in Cambodia from 2000 to 2022, including optimal antenatal care (ANC), facility-based delivery, optimal postnatal care (PNC), and utilization of optimal CoC. All services showed substantial increases from 2000 to 2014, particularly between 2005 and 2010. For example, the proportion of women receiving optimal ANC rose from 6.7% in 2000 to 74.4% in 2014, while facility-based delivery coverage surged from 5.8% to 85.7% over the same period. Optimal PNC and full CoC completion also peaked in 2014 at 68.4% and 68.9%, respectively. However, a notable decline in both PNC (to 54.3%) and CoC (to 46.3%) was observed in 2021, indicating persistent drop-offs in PNC despite continued improvements in antenatal and delivery services.

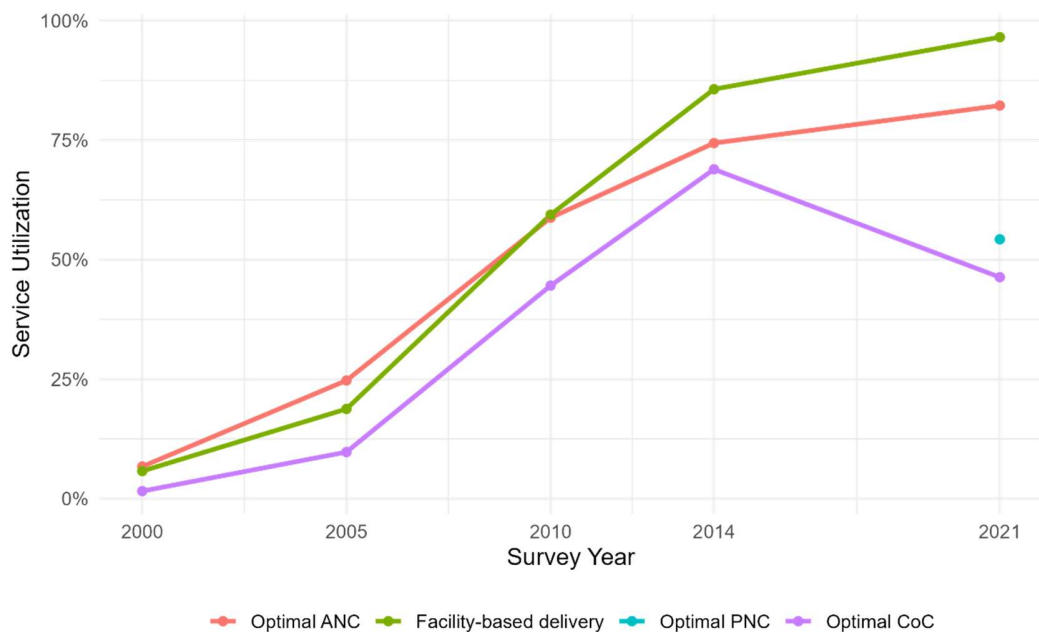


Figure 1: Trends in maternal health utilization in Cambodia, 2000-2022

Tables 2 to 5 present the utilization for maternal health services in Cambodia from 2000 to 2022. Overall, Cambodia has made significant progress in maternal health service coverage, particularly in optimal ANC and facility-based delivery. As shown in Table 2, the proportion of women receiving at least four ANC visits increased rapidly from 6.7% in 2000 to 82.2% in 2021, representing an absolute increase of 75.5 percentage points. Among these, women in urban areas consistently had higher coverage rates than those in rural areas (89.0% and 78.9%, respectively, in 2021), and differences in educational levels and household wealth also significantly influenced ANC utilization.

The improvement in facility-based delivery was even more pronounced. As shown in Table 3, only 5.8% of women gave birth in healthcare facilities in 2000, while this proportion reached 96.5% in 2021, approaching a universal coverage. The proportion of women giving birth in healthcare facilities was nearly 100% in urban areas and 95.7% in rural areas. Similarly, women with higher education levels and better economic conditions are more likely to give birth in institutional settings.

PNC coverage remains relatively low. Data from 2021 show that only 54.3% of women received optimal postnatal checkup, with significant disparities persisting across urban-rural, educational, and economic groups. For example, the optimal PNC completion rate for urban women was 59.4%, while that for rural women was 51.7%; the completion rate among women with higher education reached 57.9%, while those with no education was only 40.6% (Table 4).

Table 5 shows that for optimal CoC, the completion rate peaked at 68.9% in 2014 but declined to 46.3% in 2021. This decline may reflect service disruptions during the COVID-19 pandemic. With significant differences persisting across groups: in 2021, the CoC completion rate for urban women was 53.1%, higher than the 43.0% in rural areas; women with higher education achieved a completion rate of 55.9%, while those with no education had only 28.4%.

There are significant disparities in service utilization across different socioeconomic groups. In 2021, over half (56.6%) of women from the “richest” households completed the full continuum of care, while only 30.8% of those from the “poorest” group did so. This gap highlights structural inequalities in access to resources, health behaviors, and accessibility. Similarly, educational level is also a significant factor, with a CoC completion rate of 55.9% among women with higher education, compared to 28.4% among those with no education.

Overall, while Cambodia has made significant progress in the utilization of antenatal and childbirth services, there remain shortcomings in postnatal service coverage and the overall completion rate for continuum of care, with significant disparities persisting between urban and rural areas, as well as across educational and economic groups.

Table 2 : Proportion of women received optimal ANC by socio-demographic subgroups in Cambodia from 2000 to 2022

Subgroup Variable	Category	2000 (%)	2005 (%)	2010 (%)	2014 (%)	2021 (%)
Total		6.72	24.72	58.77	74.38	82.23
Residence	Urban	15.04	34.63	77.97	83.10	89.00

	Rural	5.46	22.09	52.01	70.94	78.93
Age group	<20	8.37	25.13	59.90	61.79	71.32
	20–29	7.31	29.03	64.00	77.02	82.66
	30–34	6.65	22.60	57.04	76.22	86.22
	35+	5.63	16.88	42.97	64.24	79.12
Parity group	1	9.52	36.56	71.83	79.78	83.74
	2	10.01	30.29	62.87	79.09	85.14
	3	6.75	22.45	56.03	72.57	82.03
	4+	4.58	13.79	37.44	52.93	68.95
Wealth group	Poorest	NA	12.80	38.21	56.53	69.14
	Poorer		18.78	49.28	65.86	84.92
	Middle		22.18	60.67	76.78	84.50
	Richer		30.41	69.84	86.75	88.82
	Richest		56.07	82.20	87.18	94.49
Educational level	No education	3.40	13.94	33.98	49.70	66.61
	Primary education	5.98	23.27	58.23	71.66	79.79
	Secondary education	21.24	48.97	76.94	84.84	87.82
	Higher education	50.00	80.95	94.38	94.41	94.84
Insurance	Insured	NA	NA	47.55	70.96	88.27
	Not insured			61.16	74.98	80.59
Working status	Working	7.08	23.43	60.42	74.88	84.54
	Not working	6.59	25.74	57.90	73.52	79.15

Table 3 : Proportion of women received facility-based delivery by socio-demographic subgroups in Cambodia from 2000 to 2022

Subgroup Variable	Category	2000 (%)	2005 (%)	2010 (%)	2014 (%)	2021 (%)
Total		5.77	18.76	59.40	85.65	96.54
Residence	Urban	21.74	38.40	83.76	95.73	98.33
	Rural	3.34	13.55	50.82	81.69	95.66
Age group	<20	9.36	18.09	60.91	79.25	93.87
	20–29	6.58	19.81	63.18	87.38	97.16
	30–34	5.94	19.47	55.53	88.52	96.39
	35+	3.81	16.00	50.52	75.26	95.80
Parity group	1	11.40	29.04	72.48	91.24	97.93
	2	9.05	20.26	61.68	88.04	97.05
	3	4.96	16.94	53.96	82.45	96.76
	4+	2.95	11.39	42.36	69.83	90.52
Wealth group	Poorest	NA	6.00	37.13	67.79	91.12
	Poorer		8.84	45.92	80.71	97.98
	Middle		13.05	58.44	89.98	98.84
	Richer		24.27	73.06	94.13	99.19
	Richest		62.62	88.77	97.27	99.50
Educational level	No education	2.08	7.30	33.98	65.13	86.97
	Primary education	5.28	17.64	57.52	84.12	96.52
	Secondary education	20.39	42.97	80.60	93.73	99.09
	Higher education	50.00	76.19	97.75	99.38	99.60
Insurance	Insured	NA	NA	50.60	87.48	98.08
	Not insured			61.27	85.33	96.12
Working status	Working	4.93	18.82	57.23	84.04	96.77
	Not	8.06	18.69	63.51	88.44	96.23

working

Table 4 : Proportion of women received optimal PNC by socio-demographic subgroups in Cambodia, 2021-2022

Subgroup Variable	Category	2021 (%)
Overall		54.25
Residence	Urban	59.43
	Rural	51.73
Age group	<20	40.09
	20–29	53.51
	30–34	56.41
	35+	54.75
Parity group	1	54.35
	2	55.85
	3	54.02
	4+	49.19
Wealth group	Poorest	41.39
	Poorer	58.55
	Middle	58.19
	Richer	61.98
	Richest	59.93
Educational level	No education	40.55
	Primary education	53.31
	Secondary education	58.96
	Higher education	57.94
Insurance	Insured	60.02
	Not insured	52.68
Working status	Working	56.03
	Not working	51.88

Table 5 : Proportion of women received optimal CoC by socio-demographic subgroups in Cambodia from 2000 to 2022

Subgroup Variable	Category	2000 (%)	2005 (%)	2010 (%)	2014 (%)	2021 (%)
Total		1.58	9.75	44.57	68.90	46.32
Residence	Urban	7.43	22.64	69.13	81.06	53.10
	Rural	0.69	6.33	35.92	64.11	43.03
Age group	<20	3.94	10.55	48.22	56.60	38.68
	20–29	1.90	11.58	49.57	71.83	46.31
	30–34	1.33	9.38	40.2	71.81	50.14
	35+	0.91	5.89	31.64	55.30	43.71
Parity group	1	3.61	17.95	59.37	76.42	47.65
	2	3.70	11.96	47.31	73.15	49.09
	3	1.10	7.93	38.78	64.57	45.98
	4+	0.30	3.40	24.82	45.52	34.27
Wealth group	Poorest	NA	1.68	23.22	47.30	30.83
	Poorer		3.21	32.13	59.14	48.81
	Middle		5.58	43.51	71.10	50.84
	Richer		9.68	55.76	82.53	56.11
	Richest		42.46	73.97	85.29	56.59
Educational level	No education	0.31	2.49	20.45	41.88	28.44
	Primary education	1.22	8.08	41.86	65.27	44.14
	Secondary education	7.30	28.28	65.69	80.88	52.80
	Higher education	50%	61.90	92.13	93.79	55.95
Insurance	Insured	NA	NA	33.77	67.83	53.73
	Not			46.87	69.09	44.31

		insured				
Working status	Working	1.17	10.05	47.38	68.74	48.72
	Not working	2.69	9.37	43.09	69.16	43.14

Note: From 2000 to 2020, optimal CoC utilization is defined as receiving at least four antenatal care (ANC) visits and achieving facility-based delivery. From 2021 to 2022, optimal CoC utilization additionally includes receipt of optimal PNC.

3.1.3 Disparity Analysis

This study further assessed the disparities in the utilization of various service components of CoC between urban and rural areas and different wealth groups from 2000 to 2022 using two indicators: absolute differences and relative ratios (Opiyo et al. 2022).

As Table 6 indicates, in terms of ANC, the absolute difference between urban and rural women reached its peak in 2010 (25.96 percentage points, pp) and then narrowed, decreasing to 10.07 pp in 2021. The relative ratio also decreased from 2.75 in 2000 to 1.13 in 2021, indicating that the urban-rural gap has significantly narrowed over the past decade. Income disparities also exist, with the largest gap in ANC completion rates between the “richest” and “poorest” groups in 2010, with an absolute difference of 43.99 pp. This gap gradually decreased to 25.35 pp by 2021, but the relative ratio remained at 1.37, suggesting that household economic conditions still significantly influence ANC service utilization.

In terms of facility-based delivery, table 7 displays a significant disparity in service utilization between urban and rural areas in 2000, with an absolute difference of 18.4pp, and this completion rate for urban women was 6.5 times that of rural women. As service coverage and accessibility improved overall, this gap narrowed rapidly, with the absolute difference between urban and rural areas decreasing to 2.67 pp by 2021, and the relative ratio dropping to 1.02, indicating that urban and rural areas have nearly achieved equality in the utilization of childbirth services. While disparities between the rich and poor have narrowed, they remain a concern: in 2005, the difference in FBD completion rates between the wealthiest and poorest groups was as

high as 62.56pp, and although this decreased to 8.38 pp by 2021, the relative ratio remained at 1.09.

A cross-sectional analysis of PNC and CoC from 2021 to 2022 revealed that disparities in service utilization remain significant. In PNC services, urban women had a completion rate 7.7 pp higher than rural women (RR = 1.15), while the richest group had a completion rate 18.5 pp higher than the poorest group (RR = 1.45) according to table 8. In terms of complete CoC, the urban-rural gap was 10.07 pp (RR = 1.23), with even more pronounced wealth disparities, with an absolute difference of 25.76 pp, and the completion rate in the richest group was 1.84 times that of the poorest group as table 9 summarizes.

Overall, as service coverage has improved, urban-rural disparities have shown significant improvement in multiple stages, particularly in facility-based delivery, where disparities have nearly been eliminated (Mallick, Allen, and Hong 2017). However, disparities driven by household wealth remain significant, especially in ANC and CoC services. This structural inequality highlights the need for future policies to focus more on economically disadvantaged groups to enhance their ability to access and sustain maternal health services.

Table 6 : Absolute difference and relative ratio in optimal ANC utilization between wealth groups and residence groups from 2000 to 2022.

		2000	2005	2010	2014	2021
Urban vs. Rural	Absolute difference (%)	9.58	12.54	25.96	12.16	10.07
	Relative ratio	2.75	1.57	1.50	1.17	1.13
Richest vs. Poorest	Absolute difference (%)	NA	43.27	43.99	30.65	25.35
	Relative ratio		4.38	2.15	1.54	1.37

Table 7 : Absolute difference and relative ratio in facility-based delivery utilization between wealth groups and residence groups from 2000 to 2022

		2000	2005	2010	2014	2021
Urban vs. Rural	Absolute difference	18.4	24.85	32.94	14.04	2.67
	(%)					
	Relative ratio	6.50	2.83	1.65	1.17	1.02
Richest vs. Poorest	Absolute difference	NA	62.56	51.64	29.48	8.38
	(%)					
	Relative ratio		10.43	2.39	1.43	1.09

Table 8 : Absolute difference and relative ratio in optimal PNC utilization between wealth groups and residence groups from 2021 to 2022

Group Type	Group Comparison	Absolute Difference (%)	Relative Ratio
Residence	Urban vs Rural	7.7	1.15
Wealth	Richest vs Poorest	18.54	1.45

Table 9 : Absolute difference and relative ratio in optimal CoC utilization between wealth groups and residence groups from 2021 to 2022

Group Type	Group Comparison	Absolute Difference (%)	Relative Ratio
Residence	Urban vs Rural	10.07	1.23
Wealth	Richest vs Poorest	25.76	1.84

3.2 Regression Analysis

3.2.1 Relationship between sociodemographic characteristics and optimal CoC utilization

Table 10 presents the results of a multivariate logistic regression analysis of the 2021–2022 Cambodia DHS data on women who completed optimal CoC (i.e., all three services:

optimal ANC, facility-based delivery, and optimal PNC). The model included core sociodemographic variables such as place of residence, maternal age group, parity, educational level, household wealth status, employment status and insurance.

The results indicate that, during the 2021–2022 period, there was no significant association between place of residence and completion of CoC. Although women residing in urban areas had a slightly higher probability of completion compared to those in rural areas (AOR = 1.04, 95% CI: [0.90, 1.21]), the difference was not statistically significant ($p = 0.566$). Regarding age, women aged 30–34 (AOR = 1.54, 95% CI: [1.10, 2.17], $p = 0.012$) and those aged 35 and older (AOR = 1.39, 95% CI: [0.98, 1.98], $p = 0.067$) were significantly higher than those under 20 years old, indicating that older women were more likely to complete the entire care process.

Educational level has a significant positive impact on CoC completion. Compared with women with no education, those with a high school education or higher were significantly more likely to complete the CoC (AOR = 1.58, 95% CI: [1.11, 2.25], $p = 0.011$). Household wealth status is also an important determinant. Compared to the poorest group, women in the “richer group” (AOR = 2.27, 95% CI: [1.86, 2.77], $p < 0.001$) and “richest” (AOR = 2.19, 95% CI: [1.72, 2.79], $p < 0.001$) were more likely to complete optimal CoC, reflecting the structural role of economic conditions in service access.

In terms of birth order, women who had two or more children were significantly less likely to complete CoC than others, particularly in the group with four or more births, where the likelihood of completion decreased significantly (AOR = 0.67, 95% CI: [0.51, 0.86], $p = 0.002$), suggesting that women with higher parity face a notable risk of dropout in continuous service utilization. Employment status did not show a significant association. In summary, this model indicates that, after controlling other factors, educational level, economic status, and maternal age are key variables in predicting the completion of a complete CoC, while higher parity may hinder the continuous utilization of services. In terms of insurance coverage, women who were insured

were significantly more likely to complete the full CoC compared to those without insurance. Specifically, having health insurance was associated with a 31% increase in the odds of CoC completion (AOR = 1.31, 95% CI: [1.13, 1.53], p = 0.001), suggesting that access to insurance may facilitate continued service use across stages. As shown in Table 10, this analysis helps identify high-risk groups and provides targeted support for policy formulation.

Table 10 : Multivariable logistic regression of factors associated with optimal CoC utilization among women from 2021 to 2022

Variable	Category	AOR	95% CI	p-value
Residence	Rural (Ref)	1	Ref	Ref
	Urban	1.04	[0.9, 1.21]	0.566
Age group	<20 (Ref)	1	Ref	Ref
	20–29	1.19	[0.88, 1.62]	0.268
	30–34	1.54	[1.10, 2.17]	0.012
	35+	1.39	[0.98, 1.98]	0.067
Parity group	1 (Ref)	1	Ref	Ref
	2	1.02	[0.86, 1.17]	0.984
	3	0.89	[0.73, 1.08]	0.239
	4+	0.67	[0.51, 0.86]	0.002
Wealth group	Poorest (Ref)	1	Ref	Ref
	Poorer	1.85	[1.54, 2.23]	<0.001
	Middle	1.94	[1.6, 2.35]	<0.001
	Richer	2.27	[1.86, 2.77]	<0.001
	Richest	2.19	[1.72, 2.79]	<0.001
Educational level	No education (Ref)	1	Ref	Ref
	Primary education	1.60	[1.29, 1.99]	<0.001
	Secondary education	1.90	[1.51, 2.40]	<0.001
	Higher education	1.58	[1.11, 2.25]	0.011

Working status	Not working (Ref)	1	Ref	Ref
	Working	1.05	[0.93, 1.2]	0.42
Insurance	Not insured	1	Ref	Ref
	Insured	1.31	[1.13, 1.53]	0.001

3.2.2 Relationship between sociodemographic characteristics and optimal ANC utilization

Table 11 presents the results of a multivariate logistic regression analysis based on data from 2010 to 2022, showing the proportion of women who completed at least four antenatal care visits (optimal ANC). The model included key explanatory variables such as survey year, place of residence, age group, parity, educational level, household wealth status, and employment status.

The results indicate that the utilization rate of antenatal care services has increased significantly over time. Compared with 2010, the likelihood of women completing ANC was significantly higher in 2014 (AOR = 1.81, 95% CI: [1.64, 2.01]) and 2021 (AOR = 3.13, 95% CI: [2.81, 3.5]) were significantly higher ($p < 0.001$), further indicating that the coverage of antenatal health services has continued to improve over the past decade.

In terms of socioeconomic characteristics, educational level and household wealth remain key determinants. Compared to women with no education, those with at least a secondary education are more likely to complete ANC (AOR = 2.49, 95% CI: [2.16, 2.97], $p < 0.001$). In wealth groups, women in the “richest” group were more likely to complete at least four ANC visits than those in the “poorest” group (AOR = 3.43, 95% CI: [2.86, 4.11], $p < 0.001$), highlighting the decisive role of economic capacity in accessing services. Women with health insurance were more likely to complete antenatal care compared to those without coverage (AOR = 1.15, 95% CI: [1.03, 1.29], $p = 0.014$), indicating a modest but significant positive association between insurance status and ANC utilization.

In terms of age, women aged 30–34 years (AOR = 2.66, 95% CI: [2.13, 3.32]) and those aged 35 years and older (AOR = 2.15, 95% CI: [1.70, 2.72]) were more likely to complete ANC compared to women under 20 years of age. Results for birth order also showed a clear trend, with women with higher parity having a significantly lower likelihood of completing ANC, particularly those with four or more births (AOR = 0.34, 95% CI: [0.29, 0.40], $p < 0.001$). Residence and employment status did not have significant effects.

As shown in Table 11, the model results emphasize the critical role of education, economic status, and age in the utilization of ANC services. They also indicate that optimal ANC services have improved significantly over time, but women with high parity and low socioeconomic status still require public attention.

Table 11 : Multivariable logistic regression of factors associated with optimal ANC (≥ 4 visits) utilization from 2010 to 2022

Variable	Category	AOR	95% CI	p-value
Survey year	Year 2010(Ref)	1	Ref	Ref
	Year 2014	1.81	[1.64, 2.01]	<0.001
	Year 2021	3.13	[2.81, 3.5]	<0.001
Residence	Rural (Ref)	1	Ref	Ref
	Urban	1.19	[1.05, 1.35]	0.007
Age group	<20 (Ref)	1	Ref	Ref
	20–29	1.89	[1.56, 2.28]	<0.001
	30–34	2.66	[2.13, 3.32]	<0.001
	35+	2.15	[1.70, 2.72]	<0.001
Parity group	1 (Ref)	1	Ref	Ref
	2	0.81	[0.72, 0.91]	<0.001
	3	0.60	[0.52, 0.69]	<0.001
	4+	0.34	[0.29, 0.40]	<0.001
Wealth group	Poorest (Ref)	1	Ref	Ref
	Poorer	1.50	[1.34, 1.69]	<0.001
	Middle	1.89	[1.66, 2.15]	<0.001

	Richer	2.68	[2.32, 3.1]	<0.001
	Richest	3.43	[2.86, 4.11]	<0.001
Educational level	No education (Ref)	1	Ref	Ref
	Primary education	1.82	[1.63, 2.04]	<0.001
	Secondary education	2.49	[2.16, 2.87]	<0.001
	Higher education	4.33	[2.9, 6.72]	<0.001
Working status	Not working (Ref)	1	Ref	Ref
	Working	1.02	[0.93, 1.11]	0.694
Insurance	Not Insured (Ref)	1	Ref	Ref
	Insured	1.15	[1.03, 1.29]	0.014

3.2.3 Relationship between sociodemographic characteristics and facility-based delivery service utilization

Table 12 presents the results of a multivariate logistic regression analysis of facility-based delivery service utilization among women in Cambodia from 2010 to 2022, incorporating the survey year and core sociodemographic variables as explanatory factors.

The impact of the survey year on facility-based delivery was particularly significant. Compared with 2010, the adjusted odds ratio for women giving birth in a health facility in 2014 (AOR = 4.29, 95% CI: [3.79, 4.85]) and 2021 (AOR = 23.20, 95% CI: [19.29, 28.09]), indicating that this service has been widely expanded under national intervention.

Compared with women living in rural areas, urban women are more likely to have institutional deliveries (AOR = 1.66, 95% CI: [1.37, 1.98], $p < 0.001$), indicating that disparities in access to services between urban and rural areas persist. In terms of education level, women with at least a secondary education were more likely to choose institutional childbirth compared

to those with no education (AOR = 3.21, 95% CI: [2.67, 3.85], $p < 0.001$), suggesting the important role of education in enhancing awareness and accessibility of services.

Economic conditions continue to demonstrate their critical influence ("Mapping development and health effects of cooking with solid fuels in low-income and middle-income countries, 2000-18: a geospatial modelling study" 2022). Women from the “richest” households are 6.43 times more likely to have an institutional delivery than women from the “poorest” households (AOR = 6.43, 95% CI: [5.03, 8.27], $p < 0.001$), and the middle-income group also shows a significant advantage. In terms of parities, the likelihood of facility-based delivery decreases with increasing parity, particularly among women with four or more births, whose utilization rate is notably lower (AOR = 0.31, 95% CI: [0.26, 0.38], $p < 0.001$), potentially reflecting issues related to reduced access to resources or reduced perception of childbirth risks among mothers. Health insurance was strongly associated with increased odds of delivering in a health facility (AOR = 1.51, 95% CI: [1.31, 1.74], $p < 0.001$), highlighting its significant role in promoting institutional births.

In summary, the utilization facility-based delivery has made significant progress over the past two decades, particularly among women with higher levels of education and better economic conditions. However, structural disparities between different residences and income groups remain, and there are still obvious shortcomings in service coverage for women with high parities, which urgently requires policy intervention to ensure fairness.

Table 12 : Multivariable logistic regression of factors associated with facility-based delivery utilization from 2010 to 2022

Variable	Category	AOR	95% CI	p-value
Survey year	Year 2010(Ref)	1	Ref	Ref
	Year 2014	4.29	[3.79, 4.85]	<0.001
	Year 2021	23.2	[19.29, 28.09]	<0.001
Residence	Rural (Ref)	1	Ref	Ref
	Urban	1.66	[1.39, 1.98]	<0.001

Age group	<20 (Ref)	1	Ref	Ref
	20–29	1.98	[1.54, 2.53]	<0.001
	30–34	2.63	[1.98, 3.5]	<0.001
	35+	2.39	[1.77, 3.23]	<0.001
Parity group	1 (Ref)	1	Ref	Ref
	2	0.61	[0.52, 0.71]	<0.001
	3	0.43	[0.36, 0.52]	<0.001
	4+	0.31	[0.26, 0.38]	<0.001
Wealth group	Poorest (Ref)	1	Ref	Ref
	Poorer	1.63	[1.42, 1.88]	<0.001
	Middle	2.33	[1.98, 2.75]	<0.001
	Richer	3.6	[3, 4.33]	<0.001
	Richest	6.43	[5.03, 8.27]	<0.001
Educational level	No education (Ref)	1	Ref	Ref
	Primary education	2.06	[1.8, 2.35]	<0.001
	Secondary education	3.21	[2.67, 3.85]	<0.001
	Higher education	10.69	[4.41, 35.25]	<0.001
Working status	Not working (Ref)	1	Ref	Ref
	Working	0.74	[0.66, 0.83]	<0.001
Insurance	Not insured (Ref)	1	Ref	Ref
	Insured	1.51	[1.31, 1.74]	<0.01

3.2.4 Relationship between sociodemographic characteristics and optimal PNC utilization

Table 13 presents the results of a multivariate logistic regression analysis on women who completed at least one postpartum check-up within 48 hours after delivery (optimal PNC), using

data from 2021 to 2022. The model controls key variables such as place of residence, maternal age, parity, educational level, household wealth status and employment.

In terms of educational level, compared with women with no education, those with primary education (AOR = 1.45, 95% CI: [1.18, 1.78], $p < 0.001$), secondary education (AOR = 1.63, 95% CI: [1.30, 2.03], $p < 0.001$), and higher education (AOR = 1.29, 95% CI: [0.91, 1.82], $p = 0.155$) were slightly higher, showing a trend of increasing optimal PNC completion rates with higher educational level.

Household wealth also significantly influences the utilization of postnatal services. Compared with the “poorest” group, the ‘middle’ (AOR = 1.73, 95% CI: [1.43, 2.10], $p < 0.001$), and “richest” (AOR = 1.76, 95% CI: [1.39, 2.25], $p < 0.001$) women indicating that in higher income groups, wealth is not an important factor influencing the use of PNC.

In terms of parity, the results showed that women with a higher number of previous births were less likely to complete PNC. However, since the p-values are all greater than 0.05, their significance cannot be verified. Women with health insurance had significantly higher odds of receiving postnatal care compared to those without insurance (AOR = 1.25, 95% CI: [1.07, 1.46], $p = 0.005$), suggesting insurance coverage may help reduce service dropout after delivery.

Age-related differences were not significant, although the service completion rate for women aged 30–34 was slightly higher than that for women under 20 (AOR = 1.24, 95% CI: [0.89, 1.73]), but this difference did not reach statistical significance ($p = 0.197$). Additionally, employment status and place of residence did not show significant associations ($p > 0.05$), indicating that the utilization of PNC among women in urban and rural areas and those with different employment statuses has become relatively balanced.

Table 13 : Multivariable logistic regression of factors associated with optimal PNC utilization from 2021 to 2022

Variable	Category	AOR	95% CI	p-value
Residence	Rural (Ref)	1	Ref	Ref

	Urban	1.05	[0.91, 1.22]	0.507
Age group	<20 (Ref)	1	Ref	Ref
	20–29	1.05	[0.78, 1.42]	0.738
	30–34	1.24	[0.89, 1.73]	0.197
	35+	1.26	[0.89, 1.78]	0.187
	Parity group	1 (Ref)	1	Ref
	2	1.03	[0.88, 1.2]	0.733
	3	0.94	[0.77, 1.15]	0.577
	4+	0.91	[0.71, 1.17]	0.462
Wealth group	Poorest (Ref)	1	Ref	Ref
	Poorer	1.81	[1.51, 2.17]	<0.001
	Middle	1.73	[1.43, 2.1]	<0.001
	Richer	1.95	[1.6, 2.38]	<0.001
	Richest	1.76	[1.39, 2.25]	<0.001
Educational level	No education (Ref)	1	Ref	Ref
	Primary education	1.45	[1.18, 1.78]	<0.001
	Secondary education	1.63	[1.3, 2.03]	<0.001
	Higher education	1.29	[0.91, 1.82]	0.155
Working status	Not working (Ref)	1	Ref	Ref
	Working	1.05	[0.93, 1.19]	0.444
Insurance	Not insured (Ref)	1	Ref	Ref
	Insured	1.25	[1.07, 1.46]	0.005

3.2.5 Determinants of Both Optimal ANC and Facility-Based Delivery Utilization (2010–2022)

To assess the validity of modeling the complete care pathway (CoC) using only 2021–2022 data in the main analysis, this study constructed a time trend regression model with

“completion of optimal ANC and facility-based delivery” as the dependent variable (Table 14) incorporating all rounds of data from 2010 to 2022 and using the survey year as the primary explanatory variable. The results showed that compared with 2010, the completion rates in 2014 and 2021 significantly increased (AOR = 2.64 and 5.22, respectively; $p < 0.001$), demonstrating a clear and highly significant time-trend increase. This trend remained significant even after controlling for variables such as place of residence, education level, household wealth, and parity, suggesting that the utilization of CoC in Cambodia has significantly improved over the past decade. Therefore, although the main analysis uses 2021-22 as the primary data source, it should be acknowledged in the discussion that it represents structural relationships under conditions of high service coverage, and there is a certain risk of overestimation.

Table 14 : Logistic regression assessing the effect of survey year on ANC and facility-based delivery utilization from 2010 to 2022

Variable	Category	AOR	95% CI	p-value
Survey year	Year 2010(Ref)	1	Ref	Ref
	Year 2014	2.64	[2.39, 2.93]	<0.001
	Year 2021	5.62	[5.03, 6.28]	<0.001
Residence	Rural (Ref)	1	Ref	Ref
	urban	1.30	[1.16, 1.47]	<0.001
Age group	<20 (Ref)	1	Ref	Ref
	20–29	1.83	[1.51, 2.22]	<0.001
	30–34	2.54	[2.04, 3.17]	<0.001
	35+	2.13	[1.69, 2.69]	<0.001
Parity group	1 (Ref)	1	Ref	Ref
	2	0.72	[0.65, 0.81]	<0.001
	3	0.52	[0.45, 0.6]	<0.001
	4+	0.32	[0.27, 0.37]	<0.001
Wealth group	Poorest (Ref)	1	Ref	Ref
	Poorer	1.58	[1.4, 1.78]	<0.001
	Middle	1.98	[1.74, 2.26]	<0.001

	Richer	2.91	[2.53, 3.35]	<0.001
	Richest	4.11	[3.46, 4.89]	<0.001
Educational level	No education (Ref)	1	Ref	Ref
	Primary education	1.83	[1.63, 2.06]	<0.001
	Secondary education	2.58	[2.24, 2.97]	<0.001
	Higher education	4.83	[3.29, 7.33]	<0.001
Working status	Not working (Ref)	1	Ref	Ref
	Working	0.92	[0.84, 1.00]	0.057
Insurance	Not insured (Ref)	1	Ref	Ref
	Insured	1.3	[1.16, 1.45]	<0.001

4. Discussion

This study found a substantial improvement in maternal continuum of care (CoC) service coverage in Cambodia between 2005 and 2022, particularly in antenatal care (ANC) and facility-based delivery (FBD). The logistic regression results indicate a nearly 6-folds increase in the odds of completing both ANC and FBD in 2021 compared to 2010 (AOR =5.62), reflecting a clear upward trend over time. Subgroup analyses further show that most socio-demographic groups experienced improved service utilization, and disparities between urban and rural areas have gradually narrowed in certain stages.

These trends may be closely linked to a series of maternal health policy initiatives launched by the Cambodian government since the early 2000s (Wang and Hong 2013). The Health Equity Fund (HEF), expanded nationwide in 2003, eliminated user fees and provided transportation and subsistence subsidies for the poorest populations, significantly lowering financial barriers to care. In 2007, the Government Midwifery Incentive Scheme (GMIS) introduced performance-based bonuses for midwives, which effectively increased the rate of FBD at primary health centers (World Health ; Zhou et al. 2020).

In addition to the Health Equity Fund and the Midwifery Incentive Scheme, this study also identifies Community-Based Health Insurance (CBHI), the National Social Security Fund (NSSF), and the “1000 Days” package as policies that have played a positive role in enhancing service accessibility and equity. Among these, CBHI and NSSF have expanded the scope of service coverage by providing medical expense coverage to near-poor populations and formally employed individuals, thereby helping to narrow the gaps between urban and rural areas and among different economic groups. The “1000 Days” package explicitly includes maternal and child health services in the national priority support program, reflecting the government's emphasis on building a comprehensive care system. These multi-dimensional policies collectively form a relatively comprehensive maternal care intervention system, serving as a crucial foundation for driving sustained increases in service utilization and narrowing disparities.

Despite these achievements in improving overall service accessibility (Fekadu et al. 2018), coverage of PNC and completion of optimal CoC remains relatively lagging. This highlights important structural limitations that will be further explored in the following sections (Mallick, Allen, and Hong 2017). Overall, the findings of this study confirm the remarkable progress in maternal health service utilization in Cambodia over the past two decades, while also underscoring the need for more balanced development across the different stages of CoC.

Although Cambodia has made remarkable progress in expanding the overall coverage of maternal health services (National Institute of Statistics, Ministry of Health, and ICF 2022), this study finds that women's educational attainment and household economic status remain key determinants of service utilization (Yoseph et al. 2020). Regression results consistently show that both education level and wealth group are significantly associated with the completion of optimal ANC, facility-based delivery, optimal PNC, and optimal CoC. Compared with women who received no education, those with secondary or higher education were more likely to complete each component of the care continuum. Similarly, women from wealthier households demonstrated greater service uptake, with a clear socioeconomic gradient observed across all models.

These disparities may reflect underlying structural inequalities (Laksono et al. 2023). Educated women often have greater awareness of health services, better access to information, and a stronger ability to act on that information—factors that increase the likelihood of utilizing available care (Um et al. 2024). In contrast, women with limited financial resources may still face substantial barriers despite the presence of financial assistance policies such as the Health Equity Fund. These may include transportation costs, competing responsibilities, or limited exposure to health information, all of which constrain their ability to seek and complete care (Ghose et al. 2017). The observed dose-response relationship between wealth level and service completion further highlights the persistent impact of economic disparity on access to maternal care.

This study found that whether a mother has health insurance is significantly associated with her likelihood of receiving key maternal health services. Women with insurance were more likely to complete all three services, and this trend remained significant in the full CoC model (AOR = 1.31, 95% CI: [1.13, 1.53], $p = 0.001$). Specifically, insured women had a particularly pronounced advantage in accessing facility-based delivery (AOR = 1.51, 95% CI: [1.31, 1.74], $p < 0.001$), which may be related to the higher economic burden of this service, which causes greater reliance on insurance coverage (Ghose et al. 2017). This finding suggests that greater attention should be paid to incorporating insurance coverage into interventions targeting service accessibility, since the overall insurance coverage is relatively low. It should also be noted that the structure of medical expense payments for Cambodian mothers in actual service delivery is complex. According to the DHS report, approximately 60% of maternal health expenses are still borne by families, with only a portion of the population eligible for insurance compensation. Current insurance plans primarily cover formally employed individuals, leaving many women in rural areas or the informal economy excluded from the coverage system. In this context, while regression models indicate that insurance significantly promotes service completion rates, its limited coverage scope may result in policy outcomes falling short of expectations. Therefore, future policies should aim to expand health insurance coverage while also considering direct subsidy mechanisms or need-based funding strategies for uninsured populations, thereby enhancing service accessibility and equity on a broader scale (Sinai et al. 2017).

It is also noteworthy that education and wealth do not operate independently. In some cases, higher levels of education appear to partially mitigate the disadvantages associated with low household income. This finding suggests that future policy efforts should not only continue to support the poorest groups but also identify and prioritize “double-vulnerable” populations—women who face the dual disadvantage of low education and low income—for more targeted interventions (Yehualashet et al. 2022).

This study further assessed disparities in the completion of maternal CoC services across urban–rural and wealth groups from 2000 to 2022. The results show that the gap between urban and rural areas has significantly narrowed over time, particularly for facility-based delivery, where disparities have nearly disappeared in recent years. In contrast, inequities based on household wealth remain persistent and are especially pronounced in certain stages of care.

For instance, in 2000, urban women were nearly three times (Relative ratio=2.75) more likely to complete optimal ANC compared to their rural counterparts. By 2021, this ratio had decreased to 1.13(RR=1.13), indicating substantial progress in bridging the geographic gap. The disparity in facility-based delivery was even more striking in earlier years, with urban women being more than six times as likely to complete the service in 2000(Misu, Gasbarro, and Alam 2025). However, this difference dropped to a relative ratio of 1.02 in 2021, suggesting that investments in rural health infrastructure and the expansion of primary care networks have significantly improved service accessibility across geographic locations.

In contrast, wealth-related disparities have persisted. Although there has been some narrowing in recent years, the richest households continue to exhibit substantially higher completion rates for optimal ANC, PNC, and CoC compared to the poorest. In 2021, the absolute difference in CoC completion between the richest and poorest groups remained at 25 percentage points, with the richest women being 1.84 times more likely to complete the full continuum of care. These findings indicate that financial status continues to play a critical role in service utilization and suggest that poverty-line-based targeting may fail to reach near-poor populations who also face considerable barriers to access (Lukwa et al. 2022).

Women's educational level consistently demonstrated a significant positive impact in regression models at different stages. Compared with women with no education, women with primary, secondary, and higher education were significantly more likely to complete all the services. For example, in the model for completing optimal CoC, women with secondary education were about 2 times more likely to complete the service than those with no education

(AOR = 1.90, 95% CI: [1.51, 2.40]), while the advantage for women with higher education was even more pronounced. This trend was highly consistent in the models for ANC and PNC, indicating that education not only enhances awareness and acceptance of health services but may also improve women's ability to seek care proactively and sustain service utilization through enhanced communication skills and a sense of empowerment.

This finding aligns with existing research, which suggests that education possesses structural advantages in promoting the utilization of maternal health services and may indirectly influence service access through pathways such as improving health literacy, enhancing economic independence, and improving women's status in household decision-making processes (Ghose et al. 2017). Therefore, in future policy interventions, improving women's educational attainment, particularly by enhancing educational opportunities in rural areas and among vulnerable groups, should be considered a key pathway to advancing the coverage of CoC-aligned services.

Furthermore, although education was not included as a stratifying variable in the equity analysis, its influence remained significant in the regression models. This may point to an interaction or compounding effect between education and wealth ("Countdown to 2030: tracking progress towards universal coverage for reproductive, maternal, newborn, and child health" 2018). Overall, the results underscore the impact of structural socioeconomic factors on maternal health service use and highlight the importance of adopting multidimensional approaches in future equity-focused research and policymaking (Hailemariam et al. 2024).

According to the DHS 2021–22 report, the main barriers Cambodian women face in accessing maternal health services include: lack of family support, transportation difficulties, distance to healthcare facilities, inability to decide independently whether to seek medical care, lack of female doctors, and cost issues. The pathways through which these barriers operate vary depending on the stage of service. For example, the utilization of ANC is more influenced by access to information and decision-making capacity, FBD is more dependent on family decision-making and economic affordability, while PNC is constrained by the lack of follow-up

mechanisms in the healthcare system, insufficient outreach, and inadequate service integration. To address these stage-specific barriers, more targeted resource allocation and service process optimization should be implemented at the institutional design level.

Findings from this study also highlight the existence of clear dropout points along the continuum of care, particularly between earlier services such as optimal ANC and later stages like optimal PNC. While most women complete the initial components of care—namely ANC and facility-based delivery—the completion rates for PNC and the full CoC remain substantially lower. These dropouts are especially evident among multiparous women, who consistently show lower odds of completing all maternal health services compared to first-time mothers (Baten et al. 2025). This pattern may be attributed to perceived familiarity with childbirth, neglect of service fatigue, or competing household responsibilities, and reflects a lack of tailored outreach or follow-up mechanisms targeting higher-parity women (Tsala Dimbuene et al. 2018).

This study found that postnatal stages consistently exhibited the lowest completion rates across all maternal health services. This “last mile” gap suggests that, compared to antenatal and delivery care, postnatal health remains relatively marginalized within the health system. Although both the WHO and the Cambodian Ministry of Health have emphasized the importance of PNC in recent years, several challenges persist from policy design to on-the-ground implementation.

Notably, descriptive analyses revealed that disparities in PNC completion across socio-demographic subgroups were less pronounced than in earlier stages. Even among women from the most advantaged groups—those with the highest levels of education or household wealth—the advantage observed in ANC and facility-based delivery was not as evident in PNC utilization. This pattern implies that limitations in PNC coverage may stem less from individual or household characteristics, and more from systemic and structural barriers, such as weak follow-up systems, lack of public awareness, and inadequate integration of postnatal services into the broader maternal health continuum (Rashid and Antai 2014).

Although this study observed that the utilization rate of PNC was significantly lower than that of other services, this cannot simply be attributed to policy neglect. In fact, the Cambodian government has explicitly included postnatal care services as a national intervention priority through the “1000 Days” package, reflecting the high level of policy attention to improving PNC coverage. However, the policy has been in place for a relatively short period, and its implementation and acceptance still face challenges, which may explain the limited improvement in PNC service utilization rates. Therefore, future efforts should focus on strengthening the quality assessment of policy implementation and community health education to facilitate the transition of such interventions from policy response to service effectiveness.

Therefore, improving PNC utilization should not rely solely on empowering individuals or raising risk awareness. Rather, it requires stronger government-led interventions, including targeted policy investment, enhanced communication strategies, and the development of community-based follow-up mechanisms to ensure that all mothers receive timely and standardized postnatal care throughout this critical phase of recovery and newborn health monitoring.

It is worth noting that as Cambodia transitions from a low-income country to a lower-middle-income country, it faces increasing pressure from the gradual reduction of international aid. Some projects that previously relied on external funding, such as the Health Education Fund (HEF) or midwife training programs, may face ongoing challenges. Therefore, this study recommends that the government consider increasing the budget for maternal and child health services within the national basic public services budget, establish a dedicated fund linked to social health insurance, and explore cost-sharing mechanisms with local governments or businesses to ensure the sustainable implementation of key interventions during the transition period.

4.1 Limitations and Value Provided

This study has several limitations related to research design and data usage. First, as Cambodia has significantly expanded its maternal and child health services over the past two decades, the utilization of the maternal Continuum of Care services has shown a clear upward trend. This systematic increase may reflect the cumulative effects of policy interventions and improvements in the health system. In this context, the main regression models in this study focused solely on the most recent DHS round (2021–2022), which improves the timeliness and policy relevance of the analysis.

Second, to ensure variable consistency, survey rounds conducted between 2000 and 2005 were excluded due to the absence of data on household wealth and insurance. While this decision improved model comparability and analytical robustness, it also sacrificed the opportunity to explore policy impacts and historical evolution in the early phase of CoC development. Additionally, the DHS is a cross-sectional survey by design and therefore cannot capture individual behavioral transitions across the CoC stages. This limitation is particularly salient when analyzing service "drop-out points," as the lack of longitudinal tracking data prevents identification of causal pathways. Moreover, some potentially important variables—such as service quality, cultural beliefs, and household support structures—are either not included in the DHS or inconsistently available across survey years, thereby limiting the depth of interpretation regarding health inequality mechanisms.

Despite the limitations, this study offers important theoretical and practical value. First, it systematically examines the use of CoC services—including ANC, facility-based delivery, and postnatal care (PNC)—in Cambodia from 2000 to 2022, revealing substantial socio-demographic disparities in service completion. This contributes new insights to a research area where longitudinal analysis remains scarce. Second, the study identifies persistent service bottlenecks at the PNC stage and in achieving complete CoC, underscoring the need for renewed policy focus on the “last mile” of maternal health services (Sinai et al. 2017). These findings may inform

resource allocation and policy prioritization for greater equity and effectiveness in maternal health programming.

5. Conclusion

This study analyzed the utilization and disparities of maternal Continuum of Care services in Cambodia using DHS data from 2000 to 2022. The findings show significant improvements in service coverage over time, especially for antenatal care and facility-based delivery. However, disparity remains, particularly by household wealth. Postnatal care continues to be the weakest link in the CoC.

Despite progress, structural inequalities persist, suggesting that service availability alone is not enough. Both educational level and insurance coverage were significantly associated with higher odds of completing maternal CoC services. Targeted efforts are needed to support women with lower education, limited economic resources, and no insurance. Future policies should focus on ensuring that all women, regardless of background, can access and complete the full range of maternal health services.

References

- Alzate, M. M., D. Dongarwar, J. L. Matas, and H. M. Salihu. 2019. "Phenotypes and markers of cesarean delivery among Colombian women." *Int J Gynaecol Obstet* 147 (2): 187-194. <https://doi.org/10.1002/ijgo.12942>.
- Annear, P. L., J. Tayu Lee, K. Khim, P. Ir, E. Moscoe, T. Jordanwood, T. Bossert, M. Nachtnebel, and V. Lo. 2019. "Protecting the poor? Impact of the national health equity fund on utilization of government health services in Cambodia, 2006-2013." *BMJ Glob Health* 4 (6): e001679. <https://doi.org/10.1136/bmjgh-2019-001679>.
- Baten, A., R. K. Biswas, E. Kendal, and J. Bhowmik. 2025. "Utilization of maternal healthcare services in low- and middle-income countries: a systematic review and meta-analysis." *Syst Rev* 14 (1): 88. <https://doi.org/10.1186/s13643-025-02832-0>.
- Blizzard, S., M. Dennis, M. Subah, B. Z. Tehoungue, R. Zizi, J. D. Kraemer, E. White, and L. R. Hirschhorn. 2023. "A repeated cross-sectional study of the association of community health worker intervention with the maternal continuum of care in rural Liberian communities." *BMC Pregnancy Childbirth* 23 (1): 841. <https://doi.org/10.1186/s12884-023-06162-8>.
- Chham, S., E. Radovich, V. Buffel, P. Ir, and E. Wouters. 2021. "Determinants of the continuum of maternal health care in Cambodia: an analysis of the Cambodia demographic health survey 2014." *BMC Pregnancy Childbirth* 21 (1): 410. <https://doi.org/10.1186/s12884-021-03890-7>.
- "Countdown to 2030: tracking progress towards universal coverage for reproductive, maternal, newborn, and child health." 2018. *Lancet* 391 (10129): 1538-1548. [https://doi.org/10.1016/s0140-6736\(18\)30104-1](https://doi.org/10.1016/s0140-6736(18)30104-1).
- Fekadu, G. A., G. M. Kassa, A. K. Berhe, A. A. Muche, and N. A. Katiso. 2018. "The effect of antenatal care on use of institutional delivery service and postnatal care in Ethiopia: a systematic review and meta-analysis." *BMC Health Serv Res* 18 (1): 577. <https://doi.org/10.1186/s12913-018-3370-9>.
- Ghose, B., D. Feng, S. Tang, S. Yaya, Z. He, O. Udenigwe, S. Ghosh, and Z. Feng. 2017. "Women's decision-making autonomy and utilisation of maternal healthcare services: results from the Bangladesh Demographic and Health Survey." *BMJ Open* 7 (9): e017142. <https://doi.org/10.1136/bmjopen-2017-017142>.
- Gitsels-van der Wal, J. T., P. S. Verhoeven, J. Mannien, L. Martin, H. S. Reinders, E. Spelten, and E. K. Hutton. 2014. "Factors affecting the uptake of prenatal screening tests for congenital anomalies; a multicentre prospective cohort study." *BMC Pregnancy Childbirth* 14: 264. <https://doi.org/10.1186/1471-2393-14-264>.
- Hailemariam, T., A. Atnafu, L. D. Gezie, and B. Tilahun. 2024. "Effect of short message service reminders in improving optimal antenatal care, skilled birth attendance and postnatal care in low-and middle- income countries: a systematic review and meta-analysis." *BMC Med Inform Decis Mak* 25 (1): 1. <https://doi.org/10.1186/s12911-024-02836-1>.

- Hassan, R., M. J. Mahbub, M. Ali, T. Mbogori, and M. R. Amin. 2025. "Trends and associated factors of animal source foods consumption among children aged 6-23 months in Bangladesh: evidence from four consecutive national surveys." *J Nutr Sci* 14: e20. <https://doi.org/10.1017/jns.2025.7>.
- Hunie Asratie, M., and D. G. Belay. 2022. "Pooled Prevalence and Determinants of Completion of Maternity Continuum of Care in Sub-Saharan Africa: A Multi-Country Analysis of Recent Demographic and Health Surveys." *Front Glob Womens Health* 3: 869552. <https://doi.org/10.3389/fgwh.2022.869552>.
- Ir, P., C. Korachais, K. Chheng, D. Horemans, W. Van Damme, and B. Meessen. 2015. "Boosting facility deliveries with results-based financing: a mixed-methods evaluation of the government midwifery incentive scheme in Cambodia." *BMC Pregnancy Childbirth* 15: 170. <https://doi.org/10.1186/s12884-015-0589-x>.
- Jithitikulchai, T., I. Feldhaus, S. Bauhoff, and S. Nagpal. 2021. "Health equity funds as the pathway to universal coverage in Cambodia: care seeking and financial risk protection." *Health Policy Plan* 36 (1): 26-34. <https://doi.org/10.1093/heapol/czaa151>.
- Jiwani, S. S., A. Amouzou-Aguirre, L. Carvajal, D. Chou, Y. Keita, A. C. Moran, J. Requejo, S. Yaya, L. M. Vaz, and T. Boerma. 2020. "Timing and number of antenatal care contacts in low and middle-income countries: Analysis in the Countdown to 2030 priority countries." *J Glob Health* 10 (1): 010502. <https://doi.org/10.7189/jogh.10.010502>.
- Kaiser, A. H., O. Okorafor, B. Ekman, S. Chhim, S. Yem, and J. Sundewall. 2023. "Assessing progress towards universal health coverage in Cambodia: Evidence using survey data from 2009 to 2019." *Soc Sci Med* 321: 115792. <https://doi.org/10.1016/j.socscimed.2023.115792>.
- Kassie, Ayelign Mengesha, Elizabeth Eakin, Aklilu Endalamaw, Anteneh Zewdie, Eskinder Wolka, and Yibeltal Assefa. 2024. "Effective coverage of maternal and neonatal healthcare services in low-and middle-income countries: a scoping review." *BMC Health Services Research* 24 (1): 1601. <https://doi.org/10.1186/s12913-024-12085-7>. <https://doi.org/10.1186/s12913-024-12085-7>.
- Kenney, P. L., H. N. K. Agboh, F. A. Agyemang, S. S. Dadzie, H. O. Duah, and P. Agbadi. 2020. "Correlates of access to hand hygiene resources in Ghanaian households: An exploratory analysis of the 2014 demographic and health survey." *Heliyon* 6 (8): e04684. <https://doi.org/10.1016/j.heliyon.2020.e04684>.
- Kerber, K. J., J. E. de Graft-Johnson, Z. A. Bhutta, P. Okong, A. Starrs, and J. E. Lawn. 2007. "Continuum of care for maternal, newborn, and child health: from slogan to service delivery." *Lancet* 370 (9595): 1358-69. [https://doi.org/10.1016/s0140-6736\(07\)61578-5](https://doi.org/10.1016/s0140-6736(07)61578-5).
- Khatri, R. B., J. Durham, R. Karkee, and Y. Assefa. 2022. "High coverage but low quality of maternal and newborn health services in the coverage cascade: who is benefitted and left behind in accessing better quality health services in Nepal?" *Reprod Health* 19 (1): 163. <https://doi.org/10.1186/s12978-022-01465-z>.
- Kikuchi, K., E. K. Ansah, S. Okawa, Y. Enuameh, J. Yasuoka, K. Nanishi, A. Shibanuma, M. Gyapong, S. Owusu-Agyei, A. R. Oduro, G. Q. Asare, A. Hodgson, and M. Jimba. 2015.

- "Effective Linkages of Continuum of Care for Improving Neonatal, Perinatal, and Maternal Mortality: A Systematic Review and Meta-Analysis." *PLoS One* 10 (9): e0139288. <https://doi.org/10.1371/journal.pone.0139288>.
- Kitila, S. B., G. T. Feyissa, A. K. Olike, and M. A. Wordofa. 2022. "Maternal Healthcare in Low- and Middle-Income Countries: A Scoping Review." *Health Serv Insights* 15: 11786329221100310. <https://doi.org/10.1177/11786329221100310>.
- Korachais, C., P. Ir, E. Macouillard, and B. Meessen. 2019. "The impact of reimbursed user fee exemption of health centre outpatient consultations for the poor in pluralistic health systems: lessons from a quasi-experiment in two rural health districts in Cambodia." *Health Policy Plan* 34 (10): 740-751. <https://doi.org/10.1093/heapol/czz095>.
- Kumar, P., R. Rashmi, T. Muhammad, and S. Srivastava. 2021. "Factors contributing to the reduction in childhood stunting in Bangladesh: a pooled data analysis from the Bangladesh demographic and health surveys of 2004 and 2017-18." *BMC Public Health* 21 (1): 2101. <https://doi.org/10.1186/s12889-021-12178-6>.
- Laksono, A. D., R. D. Wulandari, N. Rohmah, R. Rukmini, and T. Tumaji. 2023. "Regional disparities in hospital utilisation in Indonesia: a cross-sectional analysis data from the 2018 Indonesian Basic Health Survey." *BMJ Open* 13 (1): e064532. <https://doi.org/10.1136/bmjopen-2022-064532>.
- Lukwa, A. T., A. Siya, F. A. Odunitan-Wayas, and O. Alaba. 2022. "Decomposing maternal socioeconomic inequalities in Zimbabwe; leaving no woman behind." *BMC Pregnancy Childbirth* 22 (1): 239. <https://doi.org/10.1186/s12884-022-04571-9>.
- Mallick, Lindsay, Courtney Allen, and Rathavuth Hong. 2017. "Trends and Inequalities in Maternal Health in Cambodia, 2000–2014."
- "Mapping development and health effects of cooking with solid fuels in low-income and middle-income countries, 2000-18: a geospatial modelling study." 2022. *Lancet Glob Health* 10 (10): e1395-e1411. [https://doi.org/10.1016/s2214-109x\(22\)00332-1](https://doi.org/10.1016/s2214-109x(22)00332-1).
- Misu, F., D. Gasbarro, and K. Alam. 2025. "Inequality in Utilization of Maternal Healthcare Services in Low and Middle Income Countries: A Scoping Review of the Literature." *Matern Child Health J* 29 (6): 741-766. <https://doi.org/10.1007/s10995-025-04111-9>.
- National Institute of Statistics, Ministry of Health, and ICF. 2022. "Cambodia Demographic and Health Survey 2021–22 Key Indicators Report."
- . 2023. "Cambodia Demographic and Health Survey 2021–22 Final Report."
- Opiyo, N., S. Bellizzi, M. R. Torloni, J. P. Souza, and A. P. Betran. 2022. "Association between prelabour caesarean section and perinatal outcomes: analysis of demographic and health surveys from 26 low-income and middle-income countries." *BMJ Open* 12 (1): e053049. <https://doi.org/10.1136/bmjopen-2021-053049>.
- Pheakdey, S., N. Chan, R. J. Kolesar, and C. Chak. 2020. "Improving Health Service Quality in the Kingdom of Cambodia: A Policy Perspective." *Asia Pac J Public Health* 32 (8): 426-429. <https://doi.org/10.1177/1010539520957841>.

- Rashid, M., and D. Antai. 2014. "Socioeconomic position as a determinant of maternal healthcare utilization: a population-based study in Namibia." *J Res Health Sci* 14 (3): 187-92.
- Saad-Haddad, G., J. DeJong, N. Terreri, M. C. Restrepo-Mendez, J. Perin, L. Vaz, H. Newby, A. Amouzou, A. J. Barros, and J. Bryce. 2016. "Patterns and determinants of antenatal care utilization: analysis of national survey data in seven countdown countries." *J Glob Health* 6 (1): 010404. <https://doi.org/10.7189/jogh.06.010404>.
- Sinai, I., J. Anyanti, M. Khan, R. Daroda, and O. Oguntunde. 2017. "Demand for Women's Health Services in Northern Nigeria: A Review of the Literature." *Afr J Reprod Health* 21 (2): 96-108. <https://doi.org/10.29063/ajrh2017/v21i2.11>.
- Sisay, M. M., T. T. Geremew, Y. W. Demlie, A. T. Alem, D. K. Beyene, M. F. Melak, K. A. Gelaye, T. A. Ayele, and A. A. Andargie. 2019. "Spatial patterns and determinants of postnatal care use in Ethiopia: findings from the 2016 demographic and health survey." *BMJ Open* 9 (6): e025066. <https://doi.org/10.1136/bmjopen-2018-025066>.
- Strachan, D. L., K. Teague, A. Asefa, P. L. Annear, A. Ghaffar, Z. C. Shroff, and B. McPake. 2023. "Using health policy and systems research to influence national health policies: lessons from Mexico, Cambodia and Ghana." *Health Policy Plan* 38 (1): 3-14. <https://doi.org/10.1093/heapol/czac083>.
- Tessema, Zemenu Tadesse, Lake Yazachew, Getayeneh Antehunegn Tesema, and Achamyeleh Birhanu Teshale. 2020. "Determinants of postnatal care utilization in sub-Saharan Africa: a meta and multilevel analysis of data from 36 sub-Saharan countries." *Italian Journal of Pediatrics* 46 (1): 175. <https://doi.org/10.1186/s13052-020-00944-y>. <https://doi.org/10.1186/s13052-020-00944-y>.
- Tsala Dimbuene, Z., J. Amo-Adjei, D. Amugsi, J. Mumah, C. O. Izugbara, and D. Beguy. 2018. "WOMEN'S EDUCATION AND UTILIZATION OF MATERNAL HEALTH SERVICES IN AFRICA: A MULTI-COUNTRY AND SOCIOECONOMIC STATUS ANALYSIS." *J Biosoc Sci* 50 (6): 725-748. <https://doi.org/10.1017/s0021932017000505>.
- Um, S., C. Phan, L. Dany, K. Vaha, S. Pay, and D. Chau. 2024. "The effect of health insurance coverage on antenatal care utilization in Cambodia: A secondary analysis of Cambodia Demographic and Health Survey 2021-2022." *PLOS Glob Public Health* 4 (11): e0002954. <https://doi.org/10.1371/journal.pgph.0002954>.
- Wang, Wenjuan, and Rathavuth Hong. 2013. "Completing the Continuum of Care for Maternal and Newborn Health in Cambodia: Who Drops Out?".
- Wondim, A., M. A. Techane, C. A. Wubneh, N. T. Assimamaw, G. M. Belay, T. T. Tamir, A. B. Muhye, D. G. Kassie, B. Terefe, B. T. Tarekegn, M. S. Ali, B. Fentie, A. T. Gonete, B. Tekeba, S. F. Kassa, B. K. Desta, A. D. Ayele, M. T. Dessie, K. A. Atalell, and T. G. Alemu. 2023. "Major maternal related determinants of non-breastfeeding among mothers in Ethiopia: A multilevel analysis from DHS Ethiopia 2016." *PLoS One* 18 (6): e0286662. <https://doi.org/10.1371/journal.pone.0286662>.
- World Health, Organization. "Reproductive, Maternal, Newborn and Child Health." <https://www.who.int/publications/i/item/9789241508483>.

- Yehualashet, D. E., B. T. Seboka, G. A. Tesfa, T. T. Mamo, and E. Seid. 2022. "Determinants of optimal antenatal care visit among pregnant women in Ethiopia: a multilevel analysis of Ethiopian mini demographic health survey 2019 data." *Reprod Health* 19 (1): 61. <https://doi.org/10.1186/s12978-022-01365-2>.
- Yoseph, M., S. M. Abebe, F. A. Mekonnen, M. Sisay, and K. A. Gonete. 2020. "Institutional delivery services utilization and its determinant factors among women who gave birth in the past 24 months in Southwest Ethiopia." *BMC Health Serv Res* 20 (1): 265. <https://doi.org/10.1186/s12913-020-05121-9>.
- Zhou, D., Z. Zhou, C. Yang, L. Ji, B. Ghose, and S. Tang. 2020. "Sociodemographic characteristics associated with the utilization of maternal health services in Cambodia." *BMC Health Serv Res* 20 (1): 781. <https://doi.org/10.1186/s12913-020-05652-1>.