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Unraveling the hidden expenses of free delivery services: a cross-sectional analysis of the public health facilities of the Harari Region, Ethiopia

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Abstract

Background Facility-based delivery services are a critical intervention for improving maternal and infant health and reducing mortalities. However, in Ethiopia, high costs have been reported to hinder access to care, particularly for low-income families. Despite the importance of institutional delivery services, little is known about the true cost of using these services in public health facilities. As such, there is a pressing need for evidence to shed light on this issue and identify potential solutions to improve access to care for all women and infants in need. This study aims to estimates the cost of delivery services and associated factors on women attending public health facilities in the Harari Region, Eastern Ethiopia.

Methods A facility-based cross-sectional study design was used to collect data from January 01, 2022, to February 15, 2022, among 446 randomly selected mothers who delivered at selected facilities. A pretested and structured questionnaire was used to collect data through face-to-face interviews and participant record reviews. The total median cost of delivery services was estimated from the patient perspective using microcosting and human capital approaches and predictors of median costs was identified using a quantile regression model considering skewed cost data.

Results The current study revealed that the median cost of delivery services was US\$ 27.3 (with an interquartile range, IQR, of 14.1 to 61.8 US\$). Among these costs, direct nonmedical expenses held notable significance, constituting 77.46% of the direct costs. This proportion was largely influenced by food-related expenses, with a median cost of US\$ 15.16 (IQR: 6.97–32.34). Direct medical costs accounted for 22.54% of the direct costs, primarily attributed to pharmaceutical expenses, forming the majority of the medical expenditure (IQR, US\$ 0.00–8.49). The median indirect cost of delivery services was US\$ 0.79 (IQR, 0.00–4.49US\$). Types of facility visited (β = 30.17; 95% CI: 21.71, 38.62), distance from facility (β = 0.58; 95% CI: 0.26, 0.91), pharmaceutical providers (β = 20.42; 95% CI: 7.93,

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32.90), modes of delivery (β = 16.53; 95% CI: 7.54, 25.53), length of stay (β = 7.21; 95% CI: 0.29, 14.14), and number of accompanying persons (β = 4.48; 95% CI: 2.61, 6.35) were predictors of the median total cost of delivery service.

Conclusions This study highlights the considerable out-of-pockets payments that families incur when delivering in public health facilities. Despite the policy of providing delivery services free of charge in public facilities, significant out-of-pocket costs were incurred by women, with direct non-medical expenses accounting for a substantial portion of the total cost, underscoring the need for evidence-based policies to address this challenge. Ensuring the financial risk protection of women is a critical step toward achieving universal health coverage.

Keywords Cost, Delivery service, Quantile regression, Harari Region, Eastern Ethiopia

Background

The Sustainable Development Goals (SDGs) underscore the need to curtail maternal and newborn morbidity and mortality during pregnancy and childbirth, which remain a pressing concern [1]. One promising strategy to reduce child mortality, especially neonatal mortality, is the provision of skilled birth care [2]. Notably, a crucial intervention to enhance maternal health and well-being and reduce maternal mortality is the utilization of delivery services. This approach guarantees safe delivery and minimizes birth-related complications that could arise during labor and delivery [3].

Providing access to skilled birth attendants during delivery and emergency obstetric care could potentially save three-fourths of maternal lives [4]. The availability of skilled birth attendants and postnatal care plays a crucial role in lowering maternal mortality rates. Regrettably, in low- and middle-income nations, the prevalence of extreme poverty worsens healthcare inequalities and renders care financially inaccessible for numerous women [5]. This issue is particularly pronounced among the poorest women, who account for a staggering 80% of maternal deaths [6].

In many developing countries, financial health protection is a priority, particularly as they strive for universal health coverage [7]. This involves implementing various pricing policies for delivery care, ranging from free services as in Ethiopia and Nepal to paying some amount of money as in Guatemala, Tanzania, and Sierra Leone, varying from a flat rate to payment per day [8–13].

Efforts to enhance maternal service quality and utilization through various health-financing strategies, such as no-fee-for-service policies, pay-for-performance, and voucher packages, have not yielded sufficient maternal health coverage [14]. The overarching goal of universal healthcare coverage is to ensure equitable access to highquality care while avoiding catastrophic health expenditures [15]. However, pregnant women from low-income families often face hidden costs, leading to catastrophic out-of-pocket payments that discourage the use of skilled attendance for childbirth [16].

Despite efforts made by the Ethiopian government, such as expanding free maternity services at public health

facilities, maternal health service utilization remains low, with only 48% of pregnant women opting for institutional delivery services [17, 18]. A systematic review and meta-analysis of delivery service utilization in Ethiopia revealed a combined prevalence of only 31% for institutional delivery service utilization, underscoring the need for more effective and sustainable approaches to improve maternal health coverage and delivery service utilization in the country [19]. One potential reason for the low usage of public health facility delivery services among Ethiopia's poor and rural populations is families' outof-pocket spending for services or travel to a healthcare facility [20, 21].

Assessment of costs is a crucial aspect of healthcare evaluation, facilitating the identification of areas for improvement in quality care for women [15]. Furthermore, cost analyses play an essential role in guiding effective health policy decisions [22]. In the current study area, there is a limited understanding of the costs associated with delivery services across varying levels of public healthcare facilities in Ethiopia. Previous investigations have focused solely on the out-of-pocket spending of delivery services at the hospital level [23]. This study aims to estimate the direct, indirect, and total costs of delivery services among women utilizing various public healthcare facilities in the Harari regional state of Eastern Ethiopia. Additionally, this study seeks to identify potential predictors of total delivery service costs and coping mechanisms to manage the financial burden of delivery care coping employed. These findings will help policymakers and stakeholders devise strategies to alleviate the financial burden on women and their families when accessing delivery services in Ethiopia.

Methods

Study design, setting and participants

This was a facility-based cross-sectional study conducted from January 1, 2022 to February 15, 2022 across public health facilities at the primary, secondary, and tertiary levels in Harari Regional State, Eastern Ethiopia. The Harari Regional State has two public hospitals—Hiwot Fana Specialized University Hospital (HFSUH) and Jugal Hospital, as well as eight health centers (four rural and four urban) [24]. HFSUH is a tertiary referral center affiliated with Haramaya University's College of Health and Medical Sciences. It provides general and specialized services to 5.2 million people in Harari Regional State and the East Hararghe zone of Oromia Regional State. The 233-bed hospital has a maternity unit that attends to approximately 5,808 deliveries annually, Jugal Hospital is a 95-bed secondary-level regional referral hospital for Harari. Its maternity unit averages 3,000 deliveries per year, the region's four rural and four urban public health centers are classified as primary healthcare facilities offering basic emergency obstetric and newborn care services [25]. It is noteworthy that in Ethiopia, maternity services, including delivery, are rendered free of charge at public health facilities [17]. All women utilizing delivery services at selected public health facilities during the data collection period were eligible to participate in the study.

Sample size and sampling method

The sample size for this study was determined using a single population mean formula, considering a previous report from the Bale Zone, Southeast Ethiopia, which provided information on the median and range costs of delivery services, which were US \$32.03 and (5.98-93.50 US\$) [23]. As no previous studies on the cost of delivery services with information on standard deviation existed in Ethiopia, the standard deviation was estimated using one-fourth of the range, following established guidelines from previous literature [26-28]. A sample size of 385 participants was calculated at a 95% confidence interval and 5% margin of error, to which a 10% contingency was added, resulting in a total sample size of 424 participants. However, considering factors previously associated with the cost of delivery services, including factors such as length of stay, distance, and mode of delivery among women utilizing public health facilities for delivery services [23], this study opted for a larger sample size of 446 participants.

To recruit the required number of participants, we undertook a comprehensive recruitment strategy that included all publicly available healthcare facilities. This encompassed two public hospitals and eight health centers. To ensure a representative sample, a methodologically robust approach of simple random sampling was employed. This method involved the selection of eligible participants from each facility based on the delivery registration book. Additionally, participants were included if they had given birth at the selected facilities during the data collection period and were still present at the facility. Eligible participants who were discharged before the data collection team arrived were not included in the study. The selection of the study population was conducted in adherence to predetermined eligibility criteria. The initial participant was chosen through a process of random selection. Subsequent participants were then sequentially included until the desired sample size was achieved. The determination of the required sample size was carried out with careful consideration of statistical calculations and proportions. This calculated sample size was then distributed proportionally across each study facility based on the average number of monthly deliveries recorded at each facility [29].

Data collection tool and methods

A structured and pretested questionnaire were adopted from the National Health Accounts Household Health Service Utilization and Expenditure Survey [30]. Was used to collect the data using face-to-face interviews and a review of participant documents. The questionnaire covered topics such as participants' sociodemographic profile, healthcare utilization and costs, income, and wealth classification based on household items. Participants also shared their healthcare payment strategies. The questionnaire was translated into local languages for consistency checks, and pretests were conducted before the main data collection to refine the questionnaire (Refer to Supplementary file 1 for details). Trained data collectors conducted face-to-face interviews with study participants, who were closely monitored by the principal investigator for data quality. Any errors or issues were addressed promptly to ensure data accuracy.

Measurement

This study examines the cost estimation of delivery service utilization from the patient perspective and their caretakers. The main outcome variable, the total cost of delivery services utilization, includes both direct and indirect costs associated with delivery services. Valuations of these costs were based on a comprehensive record review and participant recall.

Direct cost refers to the opportunity cost of resources used for utilizing delivery services, including both direct medical and direct nonmedical costs. The direct cost of delivery services was estimated using microcosting and bottom-up approaches [31]. Healthcare expenditure was collected at the individual level, and direct medical cost includes any expenditure due to medication, operation, laboratory investigation, hospital stay, and commodities used in healthcare and other drugs bought outside the hospital. The cost of laboratory investigation or testing and the cost of drugs were calculated using unit prices. Direct nonmedical costs refer to the amount of money paid for transportation, food, and accommodations for women and their caregivers to attend delivery care at health facilities. The cost of transportation was estimated based on the number of round trips from home to the care provider, while lodging or accommodation cost was

estimated based on the number of days of stay at health facilities.

Indirect cost refers to the productivity loss due to delivery services utilization and was estimated in terms of the productive time lost by women and their caregivers. The human capital approach was used to value the productivity time losses, and the daily wage rate of women and companions was estimated based on their annual income report.

The study did not consider the opportunity cost of time for unemployed women and those who were not in the labor force, as according to the human capital approach, the value of their time is nil [31]. All direct and indirect costs were collected in Ethiopian currency and converted to US\$ using the currency exchange rate of 1 US\$=49.471 Ethiopian Birr as of February 2022 during the analysis.

Data processing and analysis

The study employed rigorous measures to ensure data quality, including double entry of paper-based data into Epi-Data version 4.6, followed by comparison of the two datasets to eliminate errors and missing data. Consistency and range checks were used to ensure data completeness. After data cleaning and analysis using STATA version 16.0, descriptive statistics were conducted to analyze the characteristics of women and the costs of delivery services. The cost data were checked for normality and outliers.

The study found that the total costs of delivery services were skewed and departed from normality and constant variance assumptions, even after transformation (Figs. 1 and 2). To address this, quantile regression analysis was used to identify predictors of total cost, which is robust to outliers and can model nonnormal distributions [32-34]. The quantile regression approach is advantageous over traditional mean-based regression models, as it allows for accurate estimation of zero-inflated models, captures heterogeneity in the outcome distribution and is robust to outliers [35-37].

In the regression model, independent variables with a significant p value (<0.05) were included in the final model, and coefficients and marginal effects with 95% confidence intervals were reported to describe the strength of associations. In addition, the study employed principal component analysis to group participants into three wealth regression based on their responses regarding the availability of household assets. The analytical timeframe encompassed the period from when women left their homes to use delivery services until they were discharged from the facility.

Results

Sociodemographic and socioeconomic characteristics

A total of 423 data points were analyzed, yielding a response rate of 94.84%. Nearly half of the participants (47.52%) were in the age range of 25 to 34 years. More than three-fifths (60.52%) of the participants were from rural areas, and the majority (82.27%) were Muslim religion followers. Almost all participants were married (92.67%), and over one-third had never attended primary education (34.28%). The mean family size was 4.73 (SD \pm 2.36), with more than half engaged in formal or informal work (56.74%), mainly farming (45.38%). Most households (45.71%) fell into the second quintile for wealth status. The median annual income of the respondents was US\$727.69 (IQR = 303.20–1414.97 US\$) (refer to Table 1 for details).



Fig. 1 Histogram distribution of the total cost of delivery services among women attending a public health facility in the Harari region, Eastern Ethiopia from 01 January 2022 to 15 February 2022



Fig. 2 Histogram of the transformation of the total cost of delivery services among women attending public health facilities in the Harari region, Eastern Ethiopia, from 01 January 2022 to 15 February 2022

Institutional characteristics

Approximately half of the women, 48.94%, used health centers for delivery, while 51.07% opted for hospitals. The median distance traveled to reach a healthcare facility was 8 km. Over 56.74% of women used an ambulance, and 24.11% chose private taxis or Bajaj's. About 57% visited healthcare facilities that were not the closest, and 71.49% were referred from other facilities. Most women, 63.12%, relied on public health facilities for medication, while 25.06% used both public and private clinics. One-third of the women (33.3%) expressed dissatisfaction with the availability of medicine and/or diagnostics, with 78.06% citing a lack of drugs as the primary concern (See Table 2 for details).

Maternal and delivery characteristics of women

Of the 423 women who participated in the study, 69.98% underwent normal vaginal delivery, and 16.08% opted for cesarean section. A significant portion (58.39%) of the mothers spent more than 24 h in the healthcare facility following admission. Approximately two-thirds were multiparous, and 96.45% had companions present. The

average size of accompanying individuals ranged from one to nine, with a mean of $3.48 \text{ (SD} \pm 1.58)$ (Refer to Table 3 for details).

Cost of delivery services

The cost analysis of delivery services encompasses several dimensions, including direct medical costs, direct nonmedical costs, and indirect costs. The findings are summarized as follows:

Direct medical costs

The median direct medical cost for delivery services was calculated at US\$ 0.00 (IQR = 0.00-9.99 US\$) (0.00 to 494.22 ETB). Notably, no expenses were reported for registration/consultation or bed services. This suggests that a significant number of respondents, possibly the majority, did not pay for registration/consultation or bed services, as these were reported to have no expenses. However, it's crucial to highlight that despite the median direct medical cost being zero, certain expenses were reported by some respondents. Notably the predominant driver of direct medical costs was drug and medicine

Table 1 The demographic and socioeconomic characteristics of women attending delivery services at public health facilities in the Harari region, Eastern Ethiopia, from 01 January to 15 February 2022. (*n* = 423)

Variables	Category	Frequency	Percentage (%)
Place of residence	Urban	167	39.48
	Rural	256	60.52
Age (in years)	15–24	149	35.22
	25–34	201	47.52
	35–49	73	17.26
Religion	Muslim	348	82.27
	Christian	75	17.73
Marital status	Currently married	392	92.67
	Currently unmarried	28	7.33
Mother's educational level	No formal education	145	34.28
	Primary education	147	34.75
	Secondary education	68	16.08
	College and above	63	14.9
Father's educational level	No formal education	94	22.22
	Primary education	121	28.6
	Secondary education	81	19.15
	College and above	127	30.03
Employment status	Formal/informal employment"	240	56.74
	Seeking work	9	2.13
	Homemaker/housewife	160	37.83
	Student	14	3.31
Formal/informal employment type	Farmer	108	45.38
	Employed (payroll paid)	58	24.37
	Merchant	74	30.25
Wealth index	1st quintile (Poor)	171	40.71
	2nd quintile (Average)	192	45.71
	3rd quintile (Wealthiest)	57	13.57

Christian: includes orthodox, protestant and Catholic; currently unmarried: includes never married, divorced, and separated

expenses, accounting for 96.9% of the medical cost at IQR = 0.00-8.49 US\$ (0.00 to 420.01 ETB). The cost of laboratory tests and other medical services constituted only 3.1% of the total medical cost and was exceedingly low, with a median cost close to zero (Refer to Table 4 for details).

Direct nonmedical costs

Direct nonmedical expenses encompassed transportation, food, lodging, and related costs. The median total direct nonmedical expenditure was 19.71 US\$ (975.07 ETB) (IQR = 10.01 - 40.93 US\$ or 495.20 to 2043.63 ETB). The significant contributors to nonmedical costs were food and lodging expenses, representing 77.56% of the total cost. Food expenses alone accounted for the largest portion. Transportation and other related expenses collectively made up 7.61% of nonmedical costs (Refer to Table 5 for details).

Indirect costs

The median total time lost due to delivery services was 2 days, primarily attributed to the duration of the stay at healthcare facilities. The corresponding monetary value

of time lost was assessed at a median of 0.79 US\$ (39.08 ETB) (IQR = 0.00-4.49 USD) (0.00 to 222.13 ETB).

Summary of total costs

The median total cost of delivery services was US\$ 27.3 (IQR, 14.1-61.8), with direct costs accounting for 90.61% or US\$ 22.99 (IQR, 11.62-55.59). Within direct costs, 77.46% was attributed to nonmedical expenditures, mainly driven by the cost of food (median cost, US\$ 15.16; IQR, 6.97-32.34). Transportation and related expenses accounted for 7.61% (median cost, US\$ 0.00; IQR, 0.00-2.73) and 14.83% (median cost, US\$ 0.00; IQR, 0.00-6.01), respectively. Direct medical costs constituted 22.54% of direct costs, with pharmaceutical expenses accounting for the majority, 96.9%, of the medical cost (median cost, US\$ 0.00; IQR, 0.00-8.49). In contrast, expenses related to laboratory tests and diagnostic investigations comprised 3.1% (median cost, US\$ 0.00; IQR, 0.00–0.00) of the direct medical cost. Indirect costs were summarized by a median value of US\$ 0.79 (IQR, 0.00-4.49), along with a median time loss of 2 days.

The median total cost of delivery services varies across different healthcare settings. For women receiving care

 Table 2
 Institutional characteristics of public health facilities visited by women for delivery services in the Harari region of Eastern

 Ethiopia from 01 January to 15 February 2022

Variables		Frequency	Percentage
Levels of facilitiesattended	Health center (HC)	207	48.94
	General Hospitals (GH)	76	17.97
	Specialized hospitals (SH)	140	33.10
Mode of transportation	Ambulance	240	56.74
	Public transport	54	12.77
	Private (own means)	19	4.49
	Taxi (private)/Bajaj/Gari	102	24.11
	Walked	8	1.89
Visited nearest health facility	Yes	181	42.79
	No	242	57.21
Reasons of bypassing nearest facility	Referral	173	71.49
	Unfriendly staff	22	9.09
	Medicine unavailable	17	7.02
	Other ¹	30	12.40
Reasons of visiting this facility	Close to home	81	44.75
	Staff give good advice	38	20.99
	Exempted service	31	17.13
	Other ²	31	20.13
Obtaining medicines and/or diagnostic services from the visited facility	Yes (all)	240	56.74
	Yes (some)	155	36.64
	No	28	6.62
Reasons for not getting some medicine/drugs	Drugs not available	121	78.06
	Other ³	34	21.94
Reasons for not getting medicine at all	Wanted to buy drug from elsewhere	22	78.57
	Did not have enough money	6	21.43
Providers of drugs and pharmaceuticals	By health facilities	267	63.12
	Purchase from outside	50	11.82
	Both	106	25.06

Other¹: more expensive services, dirty facilities, etc.

Other²: cleaner facilities

Other³: decided to do without drugs

"Reasons of visiting this facility" is that this question was applicable only to those participants who did not visit the nearest healthcare facility

Table 3	Maternal and delivery characteristics of	of women attending	delivery serv	vices at public ł	nealthcare facilitie	es in the Harari region
of Easter	n Ethiopia from 01 January to February	[,] 15, 2022				

Variables	Category	Frequency	Percentage
Parity	Primipara	105	24.82
	Multiparous	318	75.18
Mode of delivery	Normal vaginal delivery	296	69.98
	Instrumental assisted vaginal delivery	59	13.95
	Cesarean section	68	16.08
Length of stay	< 24 Hrs	176	41.61
	≥24 Hrs	247	58.39
Having accompany	Yes	408	96.45
	No	15	3.55
Source of funding	Cash available	208	52.53
	Family members assistance	120	30.30
	Neighborhood contribution	2	0.51
	Borrowed money	66	16.67

Table 4 Direct medical costs incurred by women attending delivery services at public health facilities in the Harari region of Eastern Ethiopia from 01 January to February 15, 2022. (*N*=423) in US\$

Cost type	Median	IQR
Diagnostics/investigations	0.00	0.00-0.00
Drugs/vaccines (including outside purchase)	0.00	0.00-8.49
Total (US\$)	0.00	0.00–9.90

The median of zero in direct medical costs for delivery services suggests that a portion of respondents did not incur any expenses

Table 5 Direct nonmedical costs incurred by women, for attending delivery services at public healthcare in the Harari region of Eastern Ethiopia from 01 January to February 15, 2022. (N=423) in US\$

Cost type	Median	IQR
Transport	0.00	0.00- 2.728875
Food	15.16035	6.9737-32.3422
Other ¹	0.00	0.00- 6.01363
Total US\$	19.71	10.01 - 40.93
1		

¹Other commodities used in the hospital

The median of zero in direct non-medical costs for delivery services suggests that a portion of respondents did not incur any expenses

Table 6 Total cost, direct cost, and indirect cost of delivery services by women attending delivery services at public health facility in the Harari region of Eastern Ethiopia from 01 January to February 15, 2022 (US\$))

Cost Category	Median (IQR)	95% CI for Median
Total cost by level of facility		
Health center	17.97(9.70–27.96)	15.54-20.47
General Hospital	22.95(12.18-40.33)	16.02-31.48
Specialized Hospitals	68.22(41.66-100.82)	61.82-81.37
Total cost by mode of delivery		
Normal vaginal delivery	20.78(11.22-40.93)	18.06-23.25
Instrumental assisted vaginal delivery	31.83(19.45–77.63)	22.02–51.69
Cesarean section Complication	88.36(60.38–118.7)	69.88–98.53
Total Direct medical cost	0(0.00-9.9)	0.00
Total Direct nonmedical cost	19.71(10.0-40.93)	17.64-22.74
Total Direct cost	22.99(11.62-55.59)	19.79–27.33
Total Indirect cost	0.78(0.00-4.49)	0.31-1.35
Total cost(overall)	27.28(14.11–61.82)	23.27-32.53

at health centers, the median cost is US\$17.97 (IQR: 9.7–27.96), while at general hospitals, it rises to US\$22.95 (IQR: 12.18–40.33). Notably, a significant portion (58.92%) of the median cost of delivery services is attributed to women choosing specialized hospitals, where the median cost is US\$68.22 (IQR: 41.7–100.82).

When considering the mode of delivery, women who underwent cesarean sections (cs) incurred the highest median cost for delivery services, accounting for 56.51% of the total median cost. For this group, the median cost is US\$88.4 (IQR: 60.4–118.7).

These findings, along with a detailed breakdown of costs by component, are presented in Table 6.

Coping mechanisms to manage the financial burden of delivery care

According to the results of our survey, of 423 participants, 93.96% of mothers reported engaging in distressing coping mechanisms to manage the financial burden of delivery care. Specifically, a majority of 52.53% relied on their personal funds, including savings and salary, while 30.3% depended on support from their family and relatives, and 16.67% resorted to borrowing from external sources (Refer to Table 3).

Factors associated with the cost of delivery services

Based on the results of quantile regression, our study found significant associations between sociodemographic and economic factors such as residency, family size, father's education, and wealth index; institutional factors including types of healthcare facilities, modes of transportation, proximity and accessibility to healthcare facilities, availability of prescribed medications, and pharmaceutical providers; and maternal factors such as mode of delivery, length of stay, and number of accompanying persons with the median total cost of delivery services in the unadjusted regression models. However, after adjusting for other covariates, the types of healthcare facilities visited, distances from healthcare facilities, providers of drugs, modes of delivery, length of stay, and number of accompanying persons remained statistically significant predictors of the median total cost of delivery services. Our regression model explained 49% of the variability in the median total cost of delivery services.

Accordingly, women attending delivery services at specialized facilities had a higher median total cost of delivery services than those attending health centers $(\beta = 30.17; 95\%$ CI: 21.71, 38.62). The total cost of delivery services also increased with increasing distance to healthcare facilities, with each unit increase in distance resulting in an increase of approximately US\$0.58 $(\beta = 0.58; 95\% \text{ CI: } 0.26, 0.91)$. Moreover, the total cost of delivery services was associated with the place where drugs are purchased, with women who purchase parts of drugs outside the facility incurring higher median costs than those who obtain all drugs from the facility (β = 20.42; 95% CI: 7.93, 32.90). Cesarean section delivery also leads to higher median total costs compared to spontaneous vaginal delivery ($\beta = 16.53$; 95% CI: 7.54, 25.53). In addition, the median total cost of delivery services increased with longer hospital stays exceeding 24 h $(\beta = 7.21; 95\% \text{ CI: } 0.29, 14.14)$, and those accompanied by more individuals while utilizing delivery services tended to incur higher total costs of delivery services; with an increase in accompaniment, the total cost of delivery

services increased by approximately US\$ 4.48 (β = 4.48; 95% CI: 2.61, 6.35) after controlling for other variables (see Table 7 for details and Fig. 3).

Discussion

In the current study, the cost of delivery services among women attending delivery services at public health facilities was estimated. The median total cost of delivery service was US\$ 27.3 (95% CI: 23.27, 32.53). The median direct and indirect costs were US\$ 22.99 and US\$ 0.79, respectively. Types of facility visited, distances from facility, pharmaceutical providers, modes of delivery, length of stay, and number of accompanying persons were found to predict median total cost of delivery service.

Our investigation has demonstrated that women who utilized delivery services incurred a median total cost of US\$ 27.3, which is consistent with previous studies conducted in India that reported a median cost of US\$ 26 [38]. This is comparable to the findings from Bale, Ethiopia, where the reported cost was US\$ 32.03 [23]. Nevertheless, the cost of delivery services varied across countries. For instance, our cost estimate was lower than that found in Nepal and India, US\$281.2 and US\$156 [39, 40] On the other hand, other studies from India reported higher median costs of US\$ 39 [41] and US\$56 [42] Notably, our findings were also higher than those of a report from three African countries, Burkina Faso, Kenya, and Tanzania, which reported costs ranging from US\$ 5 to US\$ 18 and from India, US\$ 11.48 [43]. These cost discrepancies are likely due to variations in the study context, setting, period, exchange rates, health-financing schemes, socioeconomic status of mothers, and cost estimation methods used. We also found that mothers who delivered in public health facilities incurred significant costs for services that should have been free, highlighting the challenges women face in accessing delivery care. Our results indicate that mothers often resort to unsustainable coping mechanisms to meet the financial burden of delivery care, emphasizing the need for effective policy interventions to alleviate the economic burden faced by women and their families.

Our analysis shows that direct costs, including medical and nonmedical costs, account for a substantial portion (90.61%) of all costs incurred by women and their companions. Food, lodging, and drug expenses are the most significant contributors to direct costs, indicating potential hidden costs incurred by women and their companions in healthcare facilities. Interestingly, similar outcomes have been reported in previous studies conducted in Nepal, Nigeria, and Islamabad in different settings [39, 44–46]. However, variations in study outcomes could be attributed to differences in the scope of cost estimation, number of cases, length of stay, and women's socioeconomic status, which may influence nonmedical spending.

Most of the costs incurred by using delivery services were direct costs, indicating that women and their families who give birth at a public health facility may face high out-of-pocket costs. Therefore, financial planning and preparation for unexpected costs are crucial. Our findings support expanding free maternity care by providing financial incentives to mothers who attend deliveries to alleviate the burden of catastrophic expenditures on mothers and families, which could be an effective strategy to improve delivery service utilization [47].

Furthermore, our study reveals significantly lower median costs of lost workdays for women and their companions in the context of delivery services when compared to previous studies conducted in Lao PDR and Ethiopia [23, 48, 49]. The differences in study results may be attributed to variations in socioeconomic status, contextual differences, and differences in cost estimation scope. Income disparities among the study population were found to be a significant contributor to the gap between the research conducted in Lao PDR and Ethiopia. It is essential to note that our study only considers indirect costs for economically active populations based on the principle of the human capital approach, which could partly explain the difference in findings from the study conducted in Ethiopia. Our findings call for a national evaluation of the free maternity care continuum to better inform policymakers and ensure financial security for pregnant women and their families.

In the current study, types of facility visited, distances from facility, pharmaceutical provider, modes of delivery, length of stay, and accompanied number were statistically associated with the cost of delivery services. These findings are comparable to other reports elsewhere [23, 38, 48–54].

Our findings reveal that women who utilized specialized facilities incurred higher median total costs than those who attended health centers, which aligns with studies conducted in Mali and Burkina Faso. The cost disparity is attributable to increased travel, food, and living expenses associated with urban hospitals compared to rural health facilities. Furthermore, the availability of medications and investigative techniques at specialized facilities contributes to the higher costs [52, 53]. Our study highlights the potential cost savings for women and their families who utilize health centers for delivery services, as direct medical and nonmedical costs were lower than those incurred at specialized hospitals. Additionally, we observed that the median total cost of delivery services increased with distance to healthcare facilities, which was consistent with findings from studies conducted in Ethiopia, Islamabad, and Nepal [23, 39, 45, 49]. More than half of the women used an ambulance, which

Table 7 Predictors of the total cost of delivery services among women at public healthcare of Harari Regional State, Ethiopia (01 January to 15 Feb 2022 (US\$)

Quantile regression (median regression) of total cost						
Variables	Unadjusted β-Coefficient (95% Cl)	P value	Adjusted β-Coefficient (95% Cl)	P value		
Types of facility						
Health center	Ref		Ref			
General Hospital	4.99 (-3.97, 13.95)	0.274	1.87 (-5.61, 9.35)	0.623		
Specialized Hospital	51.77 (44.45, 59.08) ***	0.000	30.17 (21.71, 38.62) ***	0.000		
Residences						
Urban	Ref		Ref			
Rural	13.14 (3.67 22.61) **	0.007	2.08 (-3.97 8.14)	0.499		
Family size	2.65 (0.81 4.49) **	0.005	0.61 (-0.70 1.92)	0.362		
Father Education						
No formal education	Ref		Ref			
Primary education	-9.49 (-22.29 3.31)	0.146	-1.71 (-9.47 6.05)	0.665		
Secondary education	-10.9 (-25.0 3.21)	0.130	0.41 (-8.35 9.18)	0.926		
College and above	-19.48 (-32.15 -6.82) *	0.003	3.66 (-5.12 12.45)	0.412		
Wealth Index						
1st quintile (Poor)	12.89 (3.58 22.19) *	0.007	1.12 (-4.9 7.13)	0.715		
2nd quintile (Average)	Ref		Ref			
3rd quintile (Wealthiest)	-2.97(-16.31 10.34)	0.661	- 5.35 (-3.10 13.81)	0.214		
Mode of transportation						
Ambulance	Ref		Ref			
Public transport	-8.99 (-23.27 5.28)	0.216	-0.01 (-8.36 8.34)	0.999		
Private (own means)	-20.49 (-43.08 2.09)	0.075	8.92 (-3.82 21.67)	0.169		
Taxi (private)/Bajaj/Gari	-23.35 (-34.55 -12.14) ***	0.000	3.68 (-3.49 10.85)	0.313		
Walked	-29.82 (-63.87 4.25)	0.086	2.67 (-18.53 23.88)	0.804		
Nearest health care facility						
Yes	Ref		Ref			
No	36.64 (30.06 43.21) ***	0.000	-2.83 (-10.02 4.35)	0.438		
Distances in KMs	1.81 (1.47 2.14) ***	0.000	0.58 (0.26 0.91) ***	0.000		
Time to reach health facility in Hour	11.93 (9.30 14.55) ***	0.000	1.38 (-0.82 3.59)	0.218		
Obtaining medicines and/or diagnostic ser	vices					
Yes (all)	Ref		Ref			
Yes (some)	34.03 (27.66 40.39) ***	0.000	-4.95 (-16.37 6.47)	0.394		
No	25.22 (12.88 37.55) ***	0.000	4.91 (-11.47 21.31)	0.556		
Providers of drugs and pharmaceuticals						
By Health facilities	Ref		Ref			
Purchase from outside	30.32 (21.67 38.97) ***	0.000	4.47 (-9.94 18.88)	0.543		
Both (health facilities and outside)	43.63 (37.18 50.07) ***	0.000	20.42 (7.93 32.90) **	0.001		
Mode of delivery						
Normal vaginal delivery	Ref		Ref			
Instrumental assisted vaginal delivery	10.97 (0.97 20.98) *	0.032	-2.95 (-11.41 5.50)	0.492		
Cesarean section Complication	67.70 (58.25 77.15) ***	0.000	16.53 (7.54 25.53) ***	0.000		
Length of stay						
<24 Hrs	Ref		Ref			
≥24 Hrs	37.73 (31.62 43.85) ***	0.000	7.21 (0.29 14.14) *	0.041		
number of accompanied	11.63 (8.97 14.28 ***	0.000	4.48 (2.61 6.35) ***	0.000		

 β coefficient of parameter, CI confidence interval, ref reference category

*: *p* value < 0.05

**: *p* value < 0.01

***: *p* value < 0.001



Fig. 3 Plot of covariate effects on quantiles from multivariable quantile regression (red line) and their associated 95% confidence interval (cyan shaded regions). The solid black lines are the ordinary least square regression lines with their 95% confidence interval (CI)

may explain the lower costs in our study than in another study.

Moreover, women who utilized both public and private facilities for prescribed drugs had higher median total costs than those who used the visited facility alone, as reported in studies done in Burkina Faso and Ethiopia [49, 52]. Our findings suggest that health facilities should ensure the availability of necessary medications to prevent unnecessary medical costs. While the private sector plays a critical role in providing drugs, the government may need to regulate their costs if public health facility pharmacies run out of drug supplies. In addition, women who gave birth through cesarean section incurred higher median total costs of delivery services than those who gave birth through spontaneous vaginal delivery, which aligns with studies conducted in Nigeria, Lao PDR, India, and Ethiopia [23, 41, 44, 46, 48, 51]. The higher costs for cesarean section births can be attributed to longer hospitalization periods, increased costs for food, transportation, productivity loss, delivery complications, and specialty drugs purchased at private pharmacies [46, 48].

Last, our study found that the median total cost of delivery services increased with longer stays at healthcare facilities and the number of accompanied women during the delivery process. This finding was consistent with reports from other studies conducted elsewhere [38, 39, 49, 54]. Longer stays and the presence of an accompanying person can increase the costs of food and transportation, thus contributing to the total cost of delivery services. Our findings suggest that reducing the length of stay at healthcare facilities and the need for accompanied persons can significantly reduce out-of-pocket expenditures for delivery services.

This study provides the first comprehensive estimation of delivery service costs and associated factors across different levels of public health facilities in Ethiopia. By adopting a patient perspective and utilizing participant records alongside inputs from women, we obtained a holistic view of the costs associated with delivery services. The use of quantile regression models enabled a nuanced understanding of how delivery service costs vary across the distribution of the study population. Notably, our findings shed light on the significant financial challenges faced by Ethiopian women during childbirth, despite the provision of free delivery services at public facilities. These insights are valuable for guiding future research and interventions aimed at alleviating the economic burden on women and promoting equitable access to maternal healthcare.

While our study offers important contributions, certain limitations should be acknowledged. Firstly, the reliance on self-reported household income and healthcare expenses may introduce potential biases due to over- or underreporting. Furthermore, our scope did not allow for the collection of detailed household income and expenditure data, which could provide a more comprehensive understanding of the economic implications. We recommend that future research endeavors explore these aspects in greater depth. Additionally, our productivity loss estimates were limited to the time spent at the healthcare facility, travel, and accompanying individuals. However, productivity losses may extend beyond the immediate period of care, as women may experience impact during post-discharge recovery phases. We acknowledge this as a limitation and suggest that further studies are needed to capture the full extent of productivity losses associated with delivery services. Despite these limitations, our study offers valuable insights into the economic costs of delivery services in Ethiopia, highlighting the need for policies and interventions to enhance affordability and access to maternal healthcare for women across all socioeconomic strata.

Conclusion

This study highlights the considerable out-of-pocket payments that families incur when delivering in public health facilities. Despite the policy of providing delivery services free of charge in these facilities, significant costs are incurred, including due to lack of drugs and supplies at public facilities, underscoring the urgent need for evidence-based policies to address this challenge. Ensuring the financial risk protection of women is a critical step toward achieving universal health coverage.

Based on the findings that direct non-medical costs, particularly food expenses, constituted a substantial portion (77.46%) of the total costs, we recommend exploring sustainable strategies to provide nutritious meals within health facilities. This could involve collaborating with local communities, utilizing locally sourced ingredients, and leveraging existing infrastructure to minimize costs while ensuring adequate nutritional intake for mothers during their stay.

Additionally, we propose enhancing accommodation facilities at rural health centers by renovating existing structures, constructing additional housing units, or exploring partnerships with local communities to provide temporary lodging solutions. This would help reduce transportation and associated costs, particularly for women residing in remote areas.

Furthermore, we suggest implementing targeted subsidies or voucher systems specifically designed to cover non-medical expenses such as food and accommodation for women from low-income households or those residing in remote areas. These subsidies could be funded through government initiatives or public-private partnerships.

Lastly, we recommend fostering and strengthening community-based support networks that can assist women and their families in managing non-medical costs during facility-based deliveries. This could involve mobilizing local resources, engaging community leaders, and leveraging existing social structures to provide temporary housing, meal preparation, or financial assistance.

Abbreviations

- CI Confidence Interval
- CS Cesarean Section
- EDHS Ethiopia Demographic and Health Survey
- EPHI Ethiopian Public Health Institute
- ETB Ethiopian Birr
- FMoH Federal Ministry of Health
- HFSUH Hiwot Fana Specialized University Hospital
- IHRERC Institutional Health Research Ethical Review Committee
- IQR Interquartile Range
- JH Jugal Hospital
- Ref Reference
- SDGs Sustainable Development Goals
- USD United States Dollar
- WHO World Health Organization

Supplementary Information

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Supplementary Material 1

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Authors' contributions

IAA, BHA, and GDD conceived and designed the study, analyzed the data, and interpreted the findings. IAA and BHA drafted the manuscript. IAA, AEH, and AAB adopted the data collection instrument and acquired data. IAA, BHA, AEH, and AAB managed the data. All authors, IAA, BHA, YDB, AEH, and AAB, critically revised the manuscript and approved the final version.

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Data availability

The datasets analyzed during the current study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate

This study strictly adhered to the ethical principles outlined in the Declaration of Helsinki. Ethical approval was obtained from the Haramaya University College of Health and Medical Sciences Institutional Health Research Ethical Review Committee (IHRERC) under reference number IHRERC/217/2021. All relevant parties were duly informed through an explanatory letter.

Comprehensive information about the study's objectives was provided to all women participants before seeking their informed consent. Written, informed, and signed consent was obtained from all the participants and their legal guardians, and utmost care was taken to ensure confidentiality, anonymity, and respect throughout the study. Participants retained the freedom to withdraw from the study at any stage. All protocols and procedures were approved by the Institutional Health Research Ethical Review Committee (IHRERC).

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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