Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Propensity Score Matching Analysis of the effect of healthcare Insurance on Institutional Delivery in Tanzania

Jovin R. Tibenderana

jovintibe@gmail.com

St. Francis University College of Health and Allied Sciences,Ifakara, Tanzania

Sanun Ally Kessy

Africa Academy for Public Health

Loveness John Kimaro

Africa Academy for Public Health

Erick Luta

St. Francis University College of Health and Allied Sciences,Ifakara, Tanzania

Albino Kalolo

St. Francis University College of Health and Allied Sciences,Ifakara, Tanzania

Research Article

Keywords: Healthcare Insurance, hospital delivery, Propensity score matching, maternal, new-born

Posted Date: June 1st, 2026

DOI: https://doi.org/10.21203/rs.3.rs-9518942/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License. Read Full License

Additional Declarations: No competing interests reported.

Abstract

Background

Universal Health Coverage (UHC) aims to ensure that all individuals have access to essential healthcare services without financial hardship, including institutional childbirth which is key component for reducing maternal and neonatal mortality. Studies investigating effects of health insurance on institutional child birth are scarce. This study assessed the effect of healthcare insurance on institutional delivery in Tanzania using propensity score matching (PSM) analysis.

Methods

This study used secondary data from the 2022 Tanzania Demographic and Health Survey (TDHS) involving 15,254 women of reproductive age. PSM was conducted in STATA using a probit model and *psmatch2* to estimate average treatment effect on the treated (ATT), untreated (ATU) and the population (ATE). Common support was assessed, and robustness was tested using Mantel-Haenszel sensitivity analysis.

Results

A total of 15,254 participants were included in this study. Healthcare insurance coverage was 5.82%, while institutional delivery was 82.68% (95% CI: 80.18–84.92), more common among insured women (93.34%). WRA who were insured had 10% higher likelihood of institutional delivery, however after matching women with similar characteristics, healthcare insurance showed no statistically significant effect on institutional delivery (ATT: 1%, 95% CI: −3% to 4%, p = 0.64). The observed difference before matching was largely explained by socioeconomic factors, including education, wealth status, residence, and media exposure. Sensitivity analysis confirmed the robustness of these findings.

Conclusion

While healthcare insurance is central to UHC, it does not independently affect institutional delivery in Tanzania. The higher utilization observed among insured women was largely explained by factors such as education, wealth, residence, and media exposure rather than insurance itself. Achieving equitable maternal and neonatal health outcomes requires addressing broader social and structural barriers beyond health insurance ownership.

Introduction

Institutional delivery is among the most effective public health strategies for decreasing maternal and neonatal morbidity and mortality rates [1, 2]. On a global scale, maternal mortality fell from about 532,000 deaths in 1990 to around 287,000 deaths in 2020, primarily as a result of enhanced access to skilled birth attendants and facility-based delivery services [3]. However, low-income settings such as Sub-Saharan Africa (SSA) continue to face health system challenges that hinder the achievement of the 2030 Sustainable Development Goals (SDGs) target of lowering the global maternal mortality ratio to below 70 per 100,000 [4].

In Tanzania, while there have been notable improvements in maternal health outcomes over the years, the rate of maternal mortality remains significant at approximately 104 deaths for every 100,000 live births [5]. To tackle this challenge, the government of Tanzania, through the Ministry of Health (MoH) have adapted and implemented a number

of strategies to promote institutional deliveries [6]. These strategies include the expansion of healthcare financing programs like the National Health Insurance Fund (NHIF) and the Community Health Fund (CHF), to diminish financial obstacles to obtaining maternal health services [7]. Yet, only about 81% of births in Tanzania take place in health facilities, with significant variations seen across different socioeconomic and demographic groups [5, 8].

The use of institutional delivery services is impacted by a variety of factors such as socioeconomic status, level of education, place of residence, and availability of healthcare information[8–10]. Research indicates that women with health insurance are more inclined to use maternal health services, including giving birth in a healthcare facility [1, 11, 12]. However, simply being enrolled in health insurance may not have a direct effect on the choice to deliver in an institution, as insured women may exhibit differences from those who are uninsured in both observable and unobservable traits [13].For instance, women with insurance tend to have higher incomes, more education, and greater knowledge of health services, all of which affect their chances of delivering in a healthcare setting independent of owning health insurance [9, 14].

In Tanzania, maternal and child health services such as institutional delivery in public facilities are officially exempt from user fees at the point of care[15, 16], a longstanding policy designed to eliminate direct financial barriers and promote equitable access. This mandate is further supported by complementary arrangements, including community-based health financing schemes, expanded emergency referral networks, and proactive outreach by community health workers[17]. Nevertheless, the extent to which insurance mitigates persistent hidden costs, supply-side constraints and non-financial barriers remains unclear.

Analytical models, particularly regression techniques, have commonly been applied to adjust for potential confounders when examining how health insurance influences the likelihood of delivering in a healthcare facility. However, these methods account only for measured factors, leaving potential bias from unobserved differences between insured and uninsured women[18]. Even with controls for socioeconomic and demographic characteristics, hidden influences like cultural norms or personal views about healthcare can vary between insured and uninsured women, potentially distorting the estimated effect of insurance on giving birth in a health facility [19, 20].

Propensity Score Matching (PSM) offers a suitable approach for assessing the causal effect of health insurance on delivery in health facilities. PSM helps limit selection bias by pairing insured women with uninsured counterparts who have comparable likelihoods of being enrolled in health insurance, as estimated from their observed characteristics [21]. In this study, uninsured women were matched to insured women with similar propensity scores. This approach improves comparability between the groups, increasing the likelihood that observed differences in facility-based delivery are attributable to insurance status rather than underlying characteristics.

To date, no studies in Tanzania have applied propensity score matching to assess the impact of health insurance on delivery in health facilities. Thus, our study employed the PSM approach to quantify the association between healthcare insurance and institutional delivery among women in Tanzania. Findings from this study will generate policy-relevant evidence to support progress toward the SDGs, particularly SDG 3: Good Health and Well-being (with emphasis on reducing maternal mortality and improving access to quality maternal care) and SDG 3.8: Universal Health Coverage, by informing strategies to expand health insurance coverage and increase utilization of facility-based delivery services

Methodology

Study setting and period.

Tanzania Demographic and Health Survey (TDHS) 2022 data were used, this is a national cross-sectional survey carried out every five years [22]. Tanzania spans around 940,000 square kilometers and it is said to be the biggest country in East African which also include 60,000 square kilometers of inland water with a population of at 61,741,120 as of 2022 census [5, 23] .

Study design and data source.

This was a secondary analysis of the 2022 TDHS. TDHS employed a cross-sectional where household surveys were conducted in all administrative regions in Tanzania mainland and Zanzibar. TDHS is funded by the U.S. Agency for International Development, with implementation led by the Ministry of Health (MoH) in both Mainland Tanzania and Zanzibar, as well as the National Bureau of Statistics (NBS) and the Office of the Chief Government Statistician (OCGS), with technical assistance from ICF International [5, 23–25].

Data collection procedure.

The TDHS collected data using a standardized questionnaire through face-to-face interviews to obtain information from women aged 15–49. This tool was translated to Swahili, the Tanzanian national language. According to DHS procedures, both the translated versions and the original English questionnaire are pretested to ensure clarity and accuracy. During the pretesting phase, field staff actively review and discuss each question, offering suggestions to improve all versions of the tool. Following field practice, a debriefing session is held with the pretest team, and necessary revisions are made to the questionnaires based on the feedback received [22].

Sampling procedure and size

The TDHS applied a stratified, multistage cluster sampling design. It gathered information on population health status, neonatal mortality, health behaviors, nutritional status, family planning, and demographic characteristics. In the first stage, 629 clusters were selected, followed by the systematic selection of 26 households from each cluster, yielding a total sample of 16,354 households. Eligible participants included all women aged 15–49 years who were present in the selected households on the night preceding the interview. For this study, a total of 15,254 women with complete data on all variables of interest were included. Detailed descriptions of the sampling design and procedures are available elsewhere [22]. DHS data are publicly accessible and can be downloaded from the DHS Program website[26].

Study Variables

Outcome variable

In this study, the dependent variable was institutional delivery among women of reproductive age (WRA). It was treated as a binary variable, with “1” assigned when mother delivered in a health facility and “0” when delivery happened in a non-facility setting. Institutional Delivery is defined as childbirth occurring within a health facility under the care and supervision of trained health care providers [27]

Treatment variable

The treatment variable for this secondary analysis was health insurance ownership. Data on healthcare insurance coverage was obtained from the question “are you covered by any health insurance?”. The final model was employed with the variable coded as 0 = “No” and 1 = “Yes”.

Matching variables

Matching variables which can affect the exposure and treatment variables, Healthcare Insurance and Institutional delivery respectively, were selected based on the available literature [28–31]. The selected variables were education, wealth index, media exposure, age, occupation, marital status, visited by health facility worker, sex of household age, visited health facility for the past 12 months and residence.

Data management and analysis

Because participants in non-experimental studies are not randomly allocated to treatment and comparison groups, differences in baseline characteristics can introduce systematic bias that complicates causal interpretation of effects. To mitigate this challenge, PSM is commonly applied as a quasi-experimental method. It works by pairing insured and uninsured women who share similar probabilities of having health insurance, allowing for a more balanced comparison and a more reliable estimation of the effect of health insurance on institutional delivery outcomes. [32]. Matched pairs were constructed by linking uninsured women with insured women who exhibited similar probabilities of enrolling in health insurance based on their observed characteristics. This balancing process improves comparability between the two groups, making it more reasonable to interpret differences in institutional delivery as an effect of health insurance status rather than differences in background characteristics.

The analysis focused on measuring the Average Treatment Effect on the Treated (ATT) to assess the influence of health insurance on institutional delivery. Propensity scores were generated using a probit model, and kernel-based matching was adopted to pair comparable individuals. Initially, participants' socio-demographic profiles were summarized using frequencies and percentages. This was followed by chi-square tests to examine the distribution of covariates across insured and uninsured groups. The propensity score model was iteratively refined through variable recoding to achieve adequate covariate balance. To improve the quality of matches, a common support restriction was imposed, excluding cases without overlapping propensity scores. Different matching techniques were also evaluated, and the final model was chosen based on achieving the smallest standardized differences between groups.

To evaluate how well the matching procedure performed, we relied on several diagnostic indicators, including standardized differences, pseudo R-squared values, and likelihood ratio (LR) tests. For each covariate, we also examined the level of bias before and after matching, as well as the proportion of bias reduction achieved, to determine the extent of covariate balance improvement. After completing the matching process, we estimated 95% confidence intervals were computed for all estimated treatment effects to facilitate interpretation and enhance the robustness of the results. To enhance the reliability of the estimates, we used a bootstrap procedure with 1,000 replications to compute standard errors for the ATT. This approach helps capture sampling variability and strengthens the precision of the estimated treatment effects.

To check the robustness of the findings (sensitivity analysis), the Mantel-Haenszel (MH) bounding method was applied. This explored how strongly the estimated effects might change if the assumption that all confounding factors are observed does not fully hold. In particular, we assessed whether unmeasured variables could meaningfully alter the conclusions drawn from the PSM results. The Γ (gamma) parameter quantifies how much an unmeasured factor could shift the likelihood of being insured when comparing two otherwise similar individuals. To explore the stability of the results under different degrees of hidden bias, Γ was varied from 1.0 up to 2.0 in steps of 0.05. This allowed systematically assessment of how the estimated treatment effects would behave as the influence of potential unobserved confounding gradually increases.

All analyses were conducted using STATA version 18 (Stata Corp, College Station, Texas, USA). Propensity scores were generated using a probit model specification implemented through the command "*pscore*". Matching was then performed using the "*psmatch2*" routine with a kernel-based algorithm to estimate the Average Treatment Effect on the Treated (ATT), the Untreated (ATU), and the overall Average Treatment Effect (ATE). Assessment of covariate balance and matching performance was carried out using the pstest command, considering standardized mean differences, pseudo R^2, t-statistics, and likelihood ratio tests. To improve inference reliability, standard errors were obtained through bootstrapping with 1,000 replications. In addition, a sensitivity analysis for unobserved confounding was undertaken using the "*mhbounds*" coammand. This involved varying the gamma (Γ) parameter from 1.0 to 2.0 in increments of 0.05 to examine how robust the estimated effects were to potential hidden

RESULTS

The study analyzed 15,254 women of reproductive age, with a small proportion of 888 (5.82%) reporting health insurance coverage, while 14,366 (94.18%) had no insurance. Overall, institutional delivery was reported by 82.68% of the participants (95% CI: 80.18–84.92). When stratified by insurance status, a substantially higher proportion of insured women delivered in health facilities, accounting for 93.34%. Pre-matching comparisons showed that insured and uninsured women differed significantly across most background characteristics ($p < 0.05$). As displayed in Table 1, **t**he only variable that did not show a statistically significant difference was the age of the household head, suggesting notable baseline disparities between the two groups prior to adjustment.

Estimation of propensity score

On average, the estimated propensity score was 0.058 with a standard deviation of 0.057, reflecting noticeable variation in the likelihood of treatment assignment between the intervention and comparison groups. The matching procedure resulted in five distinct strata (blocks) for the analysis. The distribution of propensity scores between the treated (insured) and untreated (uninsured) groups is presented in Fig. 1. Individuals positioned above the reference line correspond to the treated group, whereas those below it represent the untreated group. The estimated propensity scores spanned roughly from 0.00 to 0.32, demonstrating heterogeneity in treatment likelihood across the sample. A clear clustering of untreated participants was observed at the lower end of the distribution, mainly below 0.10, while treated individuals were spread across a broader range, reaching up to about 0.30. Importantly, both groups shared a substantial overlap between approximately 0.05 and 0.25, indicating sufficient common support for valid comparison. This shared region suggests that comparable individuals existed in both the treated and untreated groups, enabling reliable matching. Cases located outside this overlapping range were removed prior to the final analysis to maintain comparability and improve the validity of the estimated effects.

Effect of healthcare insurance on institutional delivery

To address potential selection bias and enhance comparability between insured and uninsured women of reproductive age, PSM was employed. This method allowed for a more reliable estimation of the effect of health insurance on institutional delivery by creating more balanced groups. Prior to matching, the unadjusted results showed that women with health insurance had a 10% higher probability of delivering in a health facility compared to those without insurance. Following the implementation of PSM, the estimated Average Treatment Effect on the Treated (ATT) was reduced and did not reach statistical significance. *(ATT: 1%, p = 0.64; 95% CI: -3% to 4%)*, indicating that the observed difference in the unmatched analysis was likely due to confounding factors rather than a true effect of health insurance (Table 2).

Quality of matching

Standardized percentage bias across all covariates was graphically assessed to evaluate balance between insured and uninsured groups after propensity score matching (Fig. 2). The results show that covariate distributions became much more comparable following matching. Before adjustment, notable imbalances were observed, particularly for education level and wealth index, which exhibited the highest standardized differences. After matching, however, all covariates showed a marked reduction in bias and were concentrated close to zero, indicating strong covariate balance between the two groups. The figure also illustrates substantial overlap in characteristics between treated and control groups, supporting the assumption of common support. To further improve comparability, observations lying outside the region of overlap were excluded from the final analytic sample, thereby reducing potential bias in the estimated effects.

Balance test

A t-test was used to compare differences between unmatched and matched samples, with emphasis on statistical significance. Prior to matching, most covariates (seven out of ten) exhibited significant mean differences between the two groups ($p < 0.05$), indicating substantial baseline imbalance. However, after the matching procedure, these differences were no longer statistically significant across all covariates, suggesting that the matching process successfully achieved balance between the groups (Table 3).

Standardized bias

Results from the *pstest* output show a clear improvement in covariate balance following propensity score matching. Both mean and median standardized biases declined markedly after matching compared to the initial unmatched sample. Specifically, the average absolute bias dropped from 40.7% before matching to 6.1% afterward, falling well below the commonly accepted 25% threshold and indicating strong improvement in group comparability. Similarly, overall standardized bias across covariates was reduced from 112.7% in the unmatched data to 19.4% after matching (Table 3). These reductions demonstrate that the matching procedure was effective in aligning the observed characteristics of insured and uninsured WRA, resulting in well-balanced groups for subsequent analysis.

Significance of the model

Evidence from the likelihood ratio (LR) test and pseudo-R^2 strongly suggests that the matching procedure achieved good balance. After matching, the LR test was no longer significant ($\chi^2 = 4.91$, $p = 0.897$), implying that the covariates collectively did not differentiate between the treated and control groups. Consistently, the pseudo-R^2 declined markedly from 0.140 before matching to 0.007 afterward (Table 3), showing that the covariates had minimal explanatory power in predicting treatment status post-matching. This pattern confirms that kernel matching effectively removed systematic differences in observed characteristics between insured and uninsured women.

Sensitivity analysis

To examine how robust the findings were to potential unmeasured confounding, a sensitivity analysis was conducted using the Mantel-Haenszel approach. This method assessed whether hidden bias from unobserved factors could meaningfully alter the estimated effect of health insurance on institutional delivery. Across all specified levels of Γ, ranging from 1 to 2, the treatment effect consistently remained statistically significant ($p_MH < 0.001$). This stability suggests that the observed positive impact of health insurance on institutional delivery is not easily influenced by moderate levels of hidden bias within the tested range (Table 4).

Table 1
Baseline characteristics of women of reproductive age by healthcare insurance before matching.

Variables	Before Matching		
	Insured (%)	Not Insurance (%)	p-value
Age (years)			
15–24	263 (4.53)	5,547(95.47)	< 0.001
25–34	273 (5.92)	4,336(94.08)	
35–49	352 (7.28)	4,483(92.72)	
Marital status			
unmarried	435 (5.04)	8,189(94.96)	< 0.001
married	452 (6.82)	6,178(93.18)	
Education			
No education	39 (1.59)	2411(98.41)	< 0.001
Primary	239 (2.94)	7,884(97.06)	
Sec/higher	610 (13.03)	4,071(86.97)	
Occupation			
Not working	277 (5.08)	5,175(94.92)	0.032
Working	610 (6.22)	9,192(93.78)	
Residence			
Urban	476 (8.74)	4,970(91.26)	< 0.001
Rural	411 (4.19)	9,397(95.81)	
Wealth index			
Poor	102 (2.02)	4,942(97.98)	< 0.001
Middle	69 (2.39)	2,811(97.61)	
Rich	717 (9.78)	6,613(90.22)	
Sex of household head			
Male	595 (5.45)	10,323(94.55)	0.017
Female	292 (6.73)	4,044(93.27)	
Household head age			
15–24	20 (3.71)	519(96.29)	0.089
25–34	172 (5.30)	3,073(94.70)	
35–49	423 (6.49)	6,093(93.51)	
50+	273 (5.51)	4,681(94.49)	

Variables	Before Matching		
	Insured (%)	Not Insurance (%)	p-value
Age (years)			
Media Exposure			
No	191 (2.87)	6,462(97.13)	< 0.001
Yes	696 (8.09)	7,905(91.91)	

Table 1: **Baseline characteristics of women of reproductive age by healthcare insurance before matching.**

Variables	Before Matching		
	Insured (%)	Not Insurance (%)	p-value
Visited by fieldworker in last 12 months			
No	844 (5.71)	13,937(94.29)	0.017
Yes	43 (9.09)	430(90.91)	
Visited health facility last 12 months			
No	329 (4.59)	6,838(95.41)	< 0.001
Yes	558 (6.89)	7,529(93.11)	

Table 2
The effect of healthcare insurance on institutional delivery using PSM method in TDHS.

The effect of Insurance on Institutional delivery	Treated	Controls	Difference	SE	t-stat	Average treatment effect with cluster-robust standard errors				
						Treatment effect	Robust SE	z	p > |z|	95% CI
Unmatched	0.92	0.82	0.10	0.23	4.24	-	-	-	-	-
ATT	0.92	0.95	-0.03	0.42	-0.81	0.01	0.17	0.47	0.64	-0.03-0.04
ATU	0.83	0.83	0.00			-	-	-	-	-
ATE			-0.05			-0.04	0.05	-0.81	0.42	-0.14, 0.06

ATT: Average treatment effect on the treated, ATU: Average treatment effect on the untreated, ATE: Average treatment effect on the population, SE: Standard Error, T-stat: T-Statistic, CI: Confidence Interval, Z: z-statistic:

Table 3
Performance of the propensity score matching: quality measurements.

Variable	Sample	Mean		%Bias	% Bias Reduction	t-statistics	P-Value
		Treatment	Control				
Age (years)	Unmatched	1.16	0.90	37.50		5.58	< 0.001
	Matched	1.16	1.15	1.10	97.1	0.13	0.894
Marital status	Unmatched	0.74	0.59	31.60		4.76	< 0.001
	Matched	0.74	0.74	-1.60	94.8	-0.20	0.842
Education	Unmatched	1.63	1.07	89.60		13.17	< 0.001
	Matched	1.63	1.62	1.80	98	0.23	0.822
Occupation	Unmatched	0.79	0.64	32.70		4.83	< 0.001
	Matched	0.79	0.81	-4.30	86.9	-0.54	0.586
Residence	Unmatched	1.50	1.73	-47.90		-8.02	< 0.001
	Matched	1.50	1.49	1.60	96.6	0.17	0.862
Wealth index	Unmatched	1.65	0.97	83.90		12.07	< 0.001
	Matched	1.65	1.65	-0.50	99.4	-0.06	0.951
Sex of household head	Unmatched	1.25	1.21	8.60		1.39	0.165
	Matched	1.25	1.24	2.70	68.2	0.31	0.76
Media Exposure	Unmatched	0.75	0.51	51.30		7.64	< 0.001
	Matched	0.75	0.71	9.20	82.1	1.10	0.270
Visited by fieldworker in last 12 months	Unmatched	0.06	0.04	5.60		0.94	0.348
	Matched	0.06	0.05	3.50	38.2	0.39	0.698
Visited health facility last 12 months	Unmatched	0.78	0.70	19.00		2.87	0.004
	Matched	0.78	0.79	-3.50	81.6	-0.43	0.671
Matching approach Kernel matching							
Mean bias Unmatched = 40.7; Matched = 6.1							
Median bias Unmatched = 35.1; Matched = 2.3							
Pseudo R2 Unmatched = 0.140; Matched = 0.007							
LR χ 2 Unmatched = 300.05; Matched = 4.91							
Percentage of variance Unmatched 60; Matched 0							

Variable	Sample	Mean		%Bias	% Bias Reduction	t-statistics	P-Value
		Treatment	Control				
P-value Unmatched = < 0.001; Matched = 0.897							
Standardized bias Unmatched = 112.7; Matched = 19.4							
R Unmatched = 0.92; Matched = 0.82							
Percentage of variance Unmatched 60; Matched 0							

Table 4
Sensitivity analysis using Mantel-Haenszel bounds

Gamma (Γ)	Test statistics		Significance level	
	Over-estimation (Q_mh+)	Under-estimation(Q_mh−)	(Over-estimation) p_mh+	(Under-estimation) p_mh−
1	19.6856	19.6856	<0.001	<0.001
1.05	19.4192	19.9569	<0.001	<0.001
1.1	19.1694	20.2201	<0.001	<0.001
1.15	18.9346	20.4760	<0.001	<0.001
1.2	18.7133	20.7250	<0.001	<0.001
1.25	18.5040	20.9677	<0.001	<0.001
1.3	18.3057	21.2045	<0.001	<0.001
1.35	18.1174	21.4358	<0.001	<0.001
1.4	17.9383	21.6619	<0.001	<0.001
1.45	17.7675	21.8832	<0.001	<0.001
1.5	17.6044	22.1000	<0.001	<0.001
1.55	17.4484	22.3126	<0.001	<0.001
1.6	17.2989	22.5211	<0.001	<0.001
1.65	17.1555	22.7258	<0.001	<0.001
1.7	17.0178	22.9268	<0.001	<0.001
1.75	16.8853	23.1245	<0.001	<0.001
1.8	16.7577	23.3189	<0.001	<0.001
1.85	16.6348	23.5102	<0.001	<0.001
1.9	16.5161	23.6986	<0.001	<0.001
1.95	16.4015	23.8842	<0.001	<0.001
2	16.2907	24.0670	<0.001	<0.001

DISCUSSION

Health policy analysis often focuses on determining whether interventions produce meaningful changes among the populations exposed to them. In this context, the study assessed the influence of health insurance coverage on institutional delivery using PSM. Since random assignment is rarely possible in real-world health settings, PSM provides a valuable analytical framework for drawing more credible causal inferences from observational data by addressing selection bias and enhancing the comparability of study groups.

Although Tanzania's national policy exempts pregnant women and children under five from user fees at the point of care in public facilities[16], this study found that, a very small proportion (5.82%) of WRA had subscribed for healthcare insurance indicating low coverage in Tanzania. Despite the low coverage the overall institutional delivery was relatively high at 82.68% with marked significantly higher among insured women. These descriptive findings suggest a potential positive role of health insurance in promoting facility-based delivery, similar patterns have been reported in other low- and middle-income countries where financial protection mechanisms increase access to maternal health services [33–36]. These findings send a clear message that that free care does not fully eliminate costs, hidden expenses such as transport, medicines, unofficial fees and non-financial barriers such as distance, quality of care, socio-cultural norms continue to shape access. Strengthening fee-exemption enforcement, expanding inclusive insurance schemes, improving facility readiness and scaling community-based support systems represent complementary strategies to ensure that policy commitments translate into equitable and sustained access to institutional delivery for all women.

However, the differed significance of baseline characteristics of the study participants suggested strong selection bias, something that reinforce the need for advanced analytical approaches such as PSM to isolate the true effect of health insurance on institutional delivery.

The estimated propensity score had mean of 0.058(SD = 0.057) reflecting a low overall probability of being insured within the study population. The distribution showed that uninsured women were concentrated a lower propensity score, while insured ones were spread across a wider range indicating heterogeneity in access to insurance. Importantly, there was a clear region of support (0.05–0.25), suggesting sufficient overlap between insured and uninsured groups. This overlap is critical, as it ensures that comparable individuals exist across groups, allowing valid estimation of treatment effects after matching [21].

In the unmatched analysis, insured women had a 10% higher likelihood of institutional delivery, suggesting a strong positive association between health insurance and facility-based delivery supported by existing literatures [33, 34]. However, this apparent effect disappeared after matching. ATT was small (1%) and not statistically significant, indicating healthcare insurance did not have meaningful independent effect on institutional delivery after controlling for observed confounders. This finding suggest that the observed advantage in institutional delivery among insured women in the crude analysis was largely driven by underlying socioeconomic and demographic differences rather than insurance itself, in other words women who are wealthier, more educated, urban residents and more exposed to health information are more likely to be insured and more likely to deliver in health facilities as supported by previous findings [28, 31]. Wealthier and educated women are more likely to recognize the benefits of skilled birth attendants[37, 38], afford indirect costs such as transport and navigate healthcare systems more effectively [36, 39]. Likewise urban residence improve physical access to health facilities [33, 40], while media exposure enhances awareness of maternal services in their totality [41]. Therefore, the higher institutional delivery observed among insured women before matching likely reflects these advantages rather than the effect of insurance itself.

Once these factors are balanced, the independent contribution of insurance becomes negligible, suggesting that once women are comparable in terms of socioeconomic status, access and awareness, insurance does not independently influence the decision to deliver in a health facility[42], that is to say, woman’s circumstances and socio-demographic background appears to matter than whether she is insurance or not. In contrast to other previous findings which

supported the fact that there is positive effect of health insurance on maternal services utilization [33, 34], the difference may be explained by differences in methodological approaches. Many previous studies relied on conventional regression techniques which may not fully account for selection bias. Something that points out the importance of using advanced analytical methods when evaluating health interventions in observational data.

The other possible reasons is that, financial barriers may not be primary constraint to institutional delivery in Tanzania but rather other factors such as cultural norms [43], perceived quality of care [44], previous birth experiences [45], as well as health system readiness [40, 44]. Even in the absence of insurance women may still access delivery services due to good Tanzanian policies promoting maternal health and community level interventions.

From a policy perspective, our findings suggest that expanding voluntary, fragmented health insurance schemes as characterized Tanzania's pre-2023 financing landscape may have limited population-level impact on institutional delivery rates [40]. Our data were collected in 2022, prior to the enactment of the Universal Health Insurance (UHI) Act, 2023[46], a period when health insurance coverage remained low and policy emphasis on insurance expansion was constrained by the voluntary nature of existing schemes. The UHI Act represents a fundamental policy shift by mandating coverage for all citizens, consolidating risk pools and introducing targeted subsidies for vulnerable populations. However, as implementation is still in its early phases (with the initial rollout commencing in 2026), the full impact of this reform on maternal health service utilization remains to be empirically evaluated. Therefore, while our results indicate that standalone expansion of voluntary insurance may not substantially increase institutional delivery, they do not preclude the possibility that a mandatory, universally accessible financing framework when integrated with supply-side quality improvements and strict enforcement of fee-exemption policies could meaningfully improve access.

The strengths of this study lie in the fact that it utilized national representative data and robust analytical approach that enhanced causal interpretation. Additionally, we included a large number of covariates to estimate the propensity score. Despite its strengths, the analysis is subject to certain limitations. As with all observational studies, the possibility of residual confounding cannot be ruled out, since unmeasured factors may still influence the estimated effects, potentially leading to an overstatement of the impact of the intervention. In particular, important influences such as cultural norms, perceptions of healthcare quality, and intra-household decision-making processes were not available in the DHS data, even though they may play a role in both health insurance uptake and the choice of delivery location.

Conclusion and Recommendations

Health insurance by itself does not significantly increase facility births in Tanzania. When we account for wealth, education and location, the apparent benefit of insurance fades because the real drivers of where women deliver are broader including affordability beyond user fees, quality of care, distance and cultural trust. To make meaningful progress, policymakers should strictly enforce fee exemption policies to eliminate hidden costs, invest in rural facility readiness including staffing and respectful care, integrate insurance enrollment with antenatal visits, launch community led education campaigns that address cultural norms and closely monitor the new Universal Health Insurance rollout with a focus on maternal outcomes.

Declarations

Acknowledgements

We would like to acknowledge MEASURE DHS for providing data set that was used for this secondary analysis.

Authors' contributions

JRT: Conceptualization, Data curation, Formal analysis, Methodology, Visualization, Writing – original draft, Writing – review & editing. SAK, LJK, EL: Writing – original draft, Writing – review & editing and Visualization. AK- Supervision, Writing – review & editing

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Data availability

Data is publicly available in DHS measure open access repository free of charge[26]

Ethics approval

This secondary analysis used data from the TDHS. Ethical clearance for the original survey was secured from the National Institute for Medical Research (NIMR) and the ICF International Institutional Review Board, with written informed consent obtained from all participants. All data were anonymized to protect participant privacy and confidentiality. Access to the TDHS dataset for this study was authorized by The DHS Program. Further methodological and ethical details are documented in the official TDHS reports[22,26]. All methods were conducted in accordance with the Declaration of Helsinki.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

References

1. Comfort AB, Peterson LA, Hatt LE. Effect of Health Insurance on the Use and Provision of Maternal Health Services and Maternal and Neonatal Health Outcomes : A Systematic Review. 2013;31.
2. Montagu D, Yamey G, Visconti A, Harding A, Yoong J. Where Do Poor Women in Developing Countries Give Birth ? A Multi-Country Analysis of Demographic and Health Survey Data. 2015;6. 10.1371/journal.pone.0017155
3. WHO. Trends in maternal mortality 2000 to 2020: estimates. WHO, Geneva. 2021. Available: https://www.who.int/reproductivehealth/publications/maternal-mortality-2000-2017/en/
4. Nations U. Transforming our world: the 2030 agenda for sustainable development. 2016.
5. NBS Tanzania. National Bureau of Statistics. In: Manufacturing Index [Internet]. 2023 [cited 16 Dec 2023] pp. 4–7. Available: https://www.nbs.go.tz/index.php/en/%0Ahttp://www.nigerianstat.gov.ng/
6. Medium H, Plan S. MINISTRY OF HEALTH. 2025.
7. Mulligan J. Community Health Funds in Tanzania : A literature review. 2007.
8. Kruk ME, Rockers PC, Mbaruku G, Paczkowski MM, Galea S. Community and health system factors associated with facility delivery in rural Tanzania : A multilevel analysis. Health Policy (New York). 2010;97:209–16. 10.1016/j.healthpol.2010.05.002.

9. Fotso J, Ezeh AC, Essendi H. Maternal health in resource-poor urban settings : how does women ' s autonomy influence the utilization of obstetric care services ? 2009;8: 1–8. 10.1186/1742-4755-6-9
10. Fagbamigbe AF, Idemudia ES. Barriers to antenatal care use in Nigeria : evidences from non-users and implications for maternal health programming. ??? 2015;1–10. 10.1186/s12884-015-0527-y.
11. Wang W, Temsah G, Carter E. Levels and Determinants of Out DHS ANALYTICAL. 2016.
12. Escobar M, Griffin CC, Shaw RP. The Impact of Health Insurance in Low- and Middle-Income Countries.
13. Wang W, Temsah G, Mallick L. The impact of health insurance on maternal health care utilization: Evidence from Ghana, Indonesia and Rwanda. Health Policy Plan. 2017;32:366–75. 10.1093/heapol/czw135.
14. Mekonnen Y, Mekonnen A. Factors Influencing the Use of Maternal Healthcare Services in Ethiopia : Linked references are available on JSTOR for this article Factors Influencing the Use of Maternal Healthcare Services in Ethiopia. 2003;21: 374–82.
15. Mollel D, Kagashe GA, Asingizwe D. Barriers to access of maternal health commodities among pregnant women in public health facilities in Ubungo Municipal Council, Tanzania. J Pharm Policy Pract. 2024;17:306–22. 10.1080/20523211.2023.2300457.
16. Channa AH, Ndunguru MJ. Perceptions of the Exemption Policy on Maternal Mothers Healthcare Service Delivery in Iringa Municipality, Tanzania. Tanzanian J Popul Stud Dev. 2022;29:79–97.
17. Geldsetzer P, Mboggo E, Larson E, Lema IA, Magesa L, Machumi L, et al. Community health workers to improve uptake of maternal healthcare services : A cluster- randomized pragmatic trial in Dar es Salaam, Tanzania. PLoS Med. 2019;10:1–27.
18. Austin PC. An Introduction to Propensity Score Methods for Reducing the Effects of Confounding in Observational Studies. 2011; 399–424. 10.1080/00273171.2011.568786
19. Heckman JJ, Ichimura H, Todd P. Matching As Econometric Evaluation Estimator. 2007;65:261–94.
20. Rosenbaum BYPR, Rubin DB. The central role of the propensity score in observational studies for causal effects. 1979; 41–55.
21. Stuart EA. Matching methods for causal inference: A review and a look forward. Stat Sci. 2010;25:1–21. 10.1214/09-STS313.Matching.
22. Demographic and Health Surveys. Demographic and Health Survey and Malaria Indicator Survey (TDHS-MIS). 2022.
23. Ministry of Health. Tanzania Ministry of Health. 2023 [cited 16 Dec 2023]. Available: https://www.moh.go.tz/
24. Ministry of Health Zanzibar. Ministry of Health Zanzibar. 2023 [cited 16 Dec 2023] pp. 1–184. Available: http://coastalforests.tfcg.org/pubs/Jozani biodiversity inventory report 2002.pdf.
25. Macro International Inc, Measure DHS. The DHS Program - Protecting the Privacy of DHS Survey Respondents. In: DHS [Internet]. 2021 [cited 16 Dec 2023]. Available: https://dhsprogram.com/methodology/Protecting-the-Privacy-of-DHS-Survey-Respondents.cfm
26. Macro International Inc, Measure DHS. The DHS Program - Available Datasets. [cited 26 Mar 2026]. Available: https://dhsprogram.com/data/available-datasets.cfm
27. World Health Organization(WHO). Births delivered in a health facility (facility/institutional births), proportion (%). In: WHO Guidelines [Internet]. [cited 20 Mar 2026]. Available: https://www.who.int/data/gho/indicator-metadata-registry/imr-details/institutional-birth
28. Kessy SA, Tibenderana JR, Gimonge J, Moshi FV. Determinants of healthcare insurance coverage among women of reproductive age in Tanzania: A multilevel mixed effect analysis. PLoS ONE. 2024;19:1–13. 10.1371/journal.pone.0302806.

29. Weldesenbet AB, Kebede SA, Ayele BH, Tusa BS. Health insurance coverage and its associated factors among reproductive-age women in east africa: A multilevel mixed-effects generalized linear model. Clin Outcomes Res. 2021;13: 693–701. doi:10.2147/CEOR.S322087.
30. Mtoro MJ, Stephano EE. Trends and determinants of healthcare insurance coverage among women of reproductive age in Tanzania (2010–2022): insights from demographic and health surveys. 2026;6.
31. Mwalingo TP, Stephano EE, Kessy SA, Tibenderana JR, Majengo VG, Oguma ED et al. Trends and determinants of institutional childbirth among women of reproductive age in Tanzania : evidence from four Demographic and Health Surveys (2004 / 05-2022). Discov Public Heal. 2025; 1–15.
32. Pourahmad S, Madadizadeh F. Propensity Score Matching in Non-Interventional Studies: A Step-by-Step Guide for Clinicians and Researchers. Iran J Med Sci. 2025;50:877–81. 10.30476/ijms.2025.105595.3947.
33. Were LPO, Were E, Wamai R, Hogan J, Galarraga O. The Association of Health Insurance with institutional delivery and access to skilled birth attendants : evidence from the Kenya Demographic and health survey 2008–09. 2017; 1–10. 10.1186/s12913-017-2397-7
34. Seid A, Ahmed M. Association between health insurance enrolment and maternal health care service utilization among women in Ethiopia. 2021; 1–10.
35. Browne JL, Kayode GA, Arhinful D, Fidder SAJ, Grobbee DE, Klipstein-grobusch K. Health insurance determines antenatal, delivery and postnatal care utilisation : evidence from the Ghana Demographic and Health Surveillance data. 2016; 13–8. 10.1136/bmjopen-2015-008175
36. Mcpake B, Witter S, Ensor T, Fustukian S, Newlands D, Martineau T. Removing financial barriers to access reproductive, maternal and newborn health services : the challenges and policy implications for human resources for health. 2013; 1–15.
37. Tibenderana JR, Kessy SA, Majengo VG. Trends and Determinants of Skilled Birth Attendants ' use among Women of Reproductive Age in Tanzania : Evidence from the 2004 / 05–2022 Demographic Health Surveys. PLoS ONE. 2025;1–12. 10.1371/journal.pone.0326279.
38. Endale HT, Asefa T, Mengstie TA, Getnet M, Endalew HL, Getahun AB, et al. Determinants of skilled birth attendant delivery among reproductive age women in Lesotho: A multilevel analysis of demographic and health survey data. PLoS ONE. 2026;21:e0340011. 10.1371/journal.pone.0340011.
39. Binyaruka P, Mori AT. Economic consequences of caesarean section delivery: evidence from a household survey in Tanzania. BMC Health Serv Res. 2021;21:1–11. 10.1186/s12913-021-07386-0.
40. Kibusi SM, Sunguya BF, Kimunai E, Hines CS. Health insurance is important in improving maternal health service utilization in Tanzania — analysis of the 2011 / 2012 Tanzania HIV / AIDS and malaria indicator survey. 2018; 1–10.
41. Sharma S, Adhikari B, Pandey AR, Karki S, Pratap SKC, Joshi D, et al. Association between media exposure and maternal health service use in Nepal: A further analysis of Nepal Demographic and Health Survey-2022. PLoS ONE. 2024;19:1–13. 10.1371/journal.pone.0297418.
42. Liabsuetrakul T, Oumudee N. Effect of health insurance on delivery care utilization and perceived delays and barriers among southern Thai women. BMC Public Health. 2011;11:510. 10.1186/1471-2458-11-510.
43. Exavery A, Kanté AM, Njozi M, Tani K, Doctor HV, Hingora A, et al. Access to institutional delivery care and reasons for home delivery in three districts of Tanzania. Int J Equity Health. 2014;13:1–11. 10.1186/1475-9276-13-48.
44. Mselle LT, Moland KM, Mvungi A, Evjen-olsen B, Kohi TW. Why give birth in health facility ? Users ' and providers ' accounts of poor quality of birth care in Tanzania. 2013.
45. Kuwawenaruwa A, Mtei G, Baraka J, Tani K. The effects of MCH insurance cards on improving equity in access and use of maternal and child health care services in Tanzania : a mixed methods analysis. J Heal Popul Nutr. 2016;1–

10. 10.1186/s41043-016-0075-8.
46. Osoro O, Mbuthia B, Nyawira L, Githinji J, Gikonyo S. Tanzania ' s Universal Health Insurance Act, 2023: Implications on Health Financing. 2024.

Figures

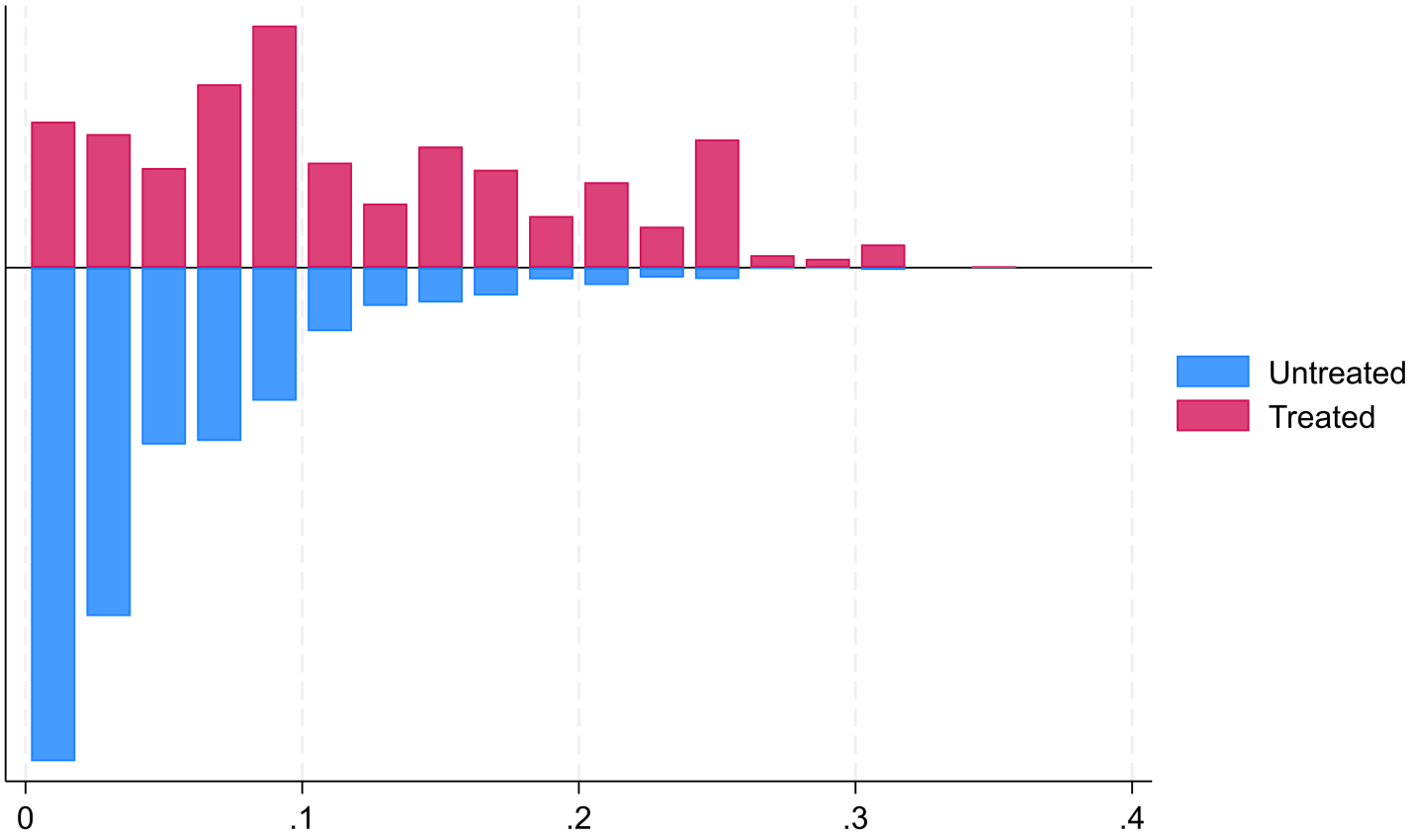


Figure 1

Propensity score histogram by healthcare insurance status

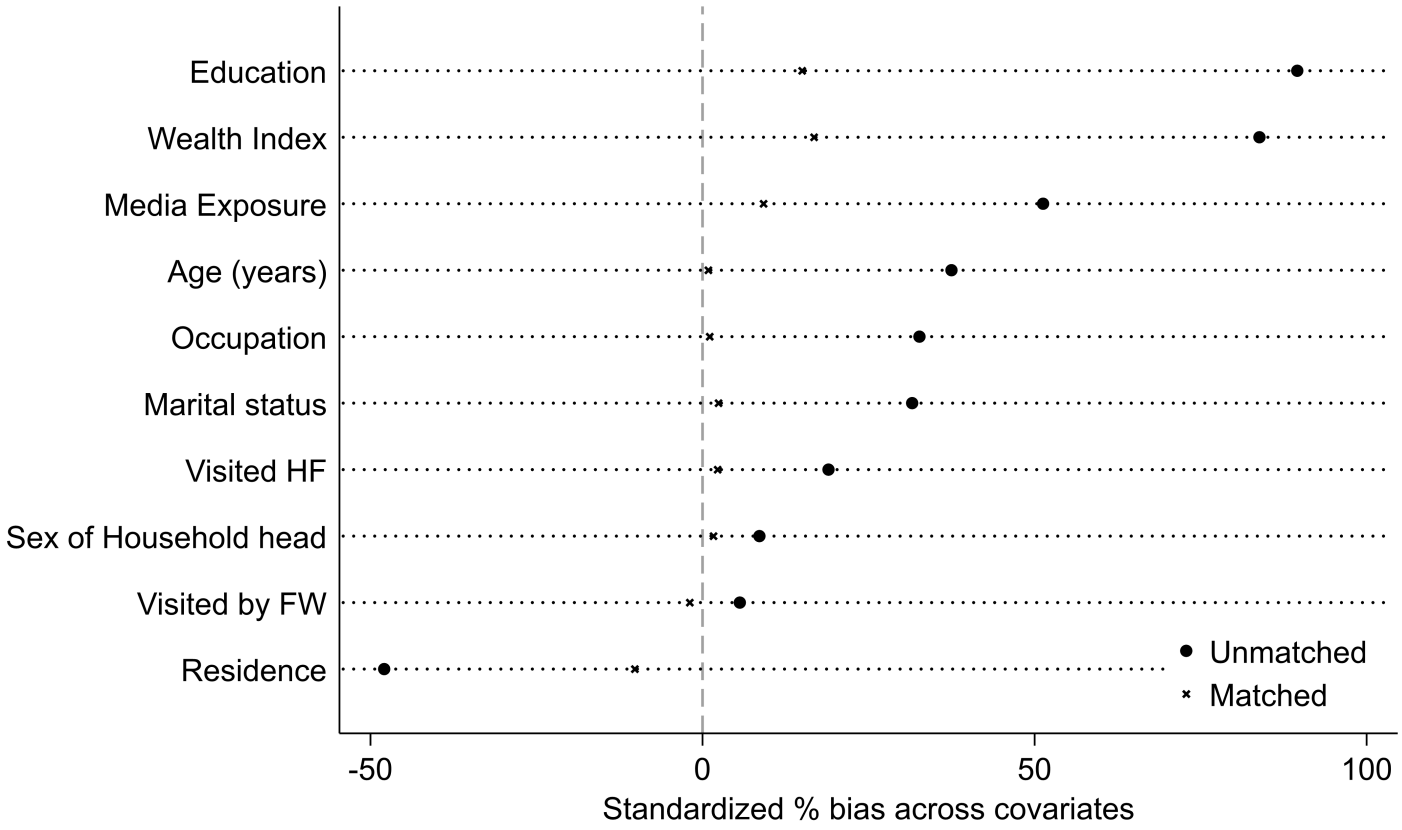


Figure 2

Quality of matching by propensity score distribution