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Original Article

Short-term Effects of Social Health Insurance Coverage of Assisted Reproductive Technologies on Pregnancies in Guangxi, China: An Interrupted Time Series Study

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Abstract

Background: Assisted reproductive technologies (ARTs) provide effective treatment for infertility but are underutilized due to high costs. In November 2023, Guangxi province of China incorporated a range of ART procedures into social health insurance (SHI) coverage. This study aimed to evaluate the short-term impacts of the policy.

Methods: We used aggregated claims data from the Guangxi Healthcare Security Administration between January 2022 and July 2024, including 22 months before and 9 months after policy implementation. The primary study population comprised women with newly recorded pregnancies achieved through ARTs, identified through ICD-10 (International Classification of Diseases, 10th Revision) codes. We employed an interrupted time series (ITS) design to estimate the policy impact on monthly number of ART pregnancies and multiple pregnancy proportion among ART pregnancies. Non-ART pregnancies were additionally examined as a comparison series in a robustness analysis.

Results: After policy implementation, monthly ART pregnancies increased significantly, with an immediate level increase of 0.693 ($P < .001$) and a trend increase of 0.050 per month ($P = .001$) for the nine post-policy months. Multiple pregnancy proportion among ART pregnancies showed no significant level or trend change. Subgroup analyses indicated stronger and more sustained increases among women <40 years and enrollees in the Urban and Rural Resident Basic Medical Insurance (URRBMI). Geographically, areas with no or only one ART facility had larger immediate increases, while regions with two or more facilities showed a significant sustained upward trend.

Conclusion: In the first nine months after implementation, the inclusion of ART in Guangxi's SHI program effectively increased pregnancies achieved through ARTs without raising multiple pregnancy proportion among ART pregnancies. These findings indicate that, in the short term, the policy improved access to ARTs and equity in access to reproductive healthcare among different population groups in a resource-constrained province in China.

Keywords: Assisted Reproductive Technologies, Infertility, Health Insurance Coverage, Interrupted Time Series, China

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Introduction

Assisted reproductive technologies (ARTs) are considered the primary and effective treatment option for infertility, which affects about one in six adults worldwide.[1] However, the high costs of ARTs pose a likely financial barrier, particularly in low- and middle-income countries (LMICs), where average out-of-pocket medical expenditure for one ART cycle alone exceeds annual income per capita.[2] Financial coverage for fertility care is integral to achieving universal health coverage, particularly in LMICs.[1]

While studies on the effects of public health insurance coverage on the utilization of ARTs and outcomes on pregnancies from LMICs are scarce, studies from high-income countries indicate that the coverage of ARTs enhances their utilization[3] and population fertility.[4] For instance, states in the US with insurance coverage for ARTs have significantly higher utilization of ARTs compared to those without.[3] Incorporating ARTs into public health insurance also led to an increase in birth rates in South Korea.[4] Previous studies also evaluated the effects of coverage for ARTs on multiple pregnancies, which are linked to adverse health outcomes and will be more likely if multiple embryos are implanted to boost the success rate of each cycle of ARTs.[5] While coverage for ARTs was associated with higher rates of multiple pregnancies among the population in South Korea,[4] studies in Canada,[6] and the US[3,7] revealed decreased proportion of multiple pregnancies among women who conceived with ARTs.

The applicability of these findings from high-income countries in LMICs is questionable, given their often limited access to fertility care,[8] different levels of coverage for people under different schemes, etc.[9] As of November 2023, Guangxi incorporated key ART services into SHI reimbursement,[10] and by mid-2025, 31 provincial-level regions in China had included ARTs in basic medical insurance coverage.[11] In

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Key Messages

Implications for policy makers

- This study represents the first policy evaluation in a low- and middle-income country (LMIC) to examine the effects of the inclusion of assisted reproductive technologies (ARTs) in social health insurance (SHI) coverage. The findings suggest that the coverage of ARTs under SHI can be viewed as a feasible policy approach to reducing the economic barriers to ART, leading to a substantial increase in ART pregnancies and helping to address the fertility needs of women with infertility.
- The results further highlight the importance of accounting for heterogeneous responses across different SHI schemes. Stronger and more sustained increases in ART pregnancies during the nine-month post-policy observation period were observed among enrollees in the Urban and Rural Residents Basic Medical Insurance (URRBMI), a population with relatively lower average income, indicating that the policy had a greater effect among lower-income groups. In addition, larger immediate increases were observed in areas with no or only one ART facility, suggesting that SHI coverage helped release previously suppressed demand, while the observed short-term post-policy trend remained closely related to local service capacity.
- Following the inclusion of ART in SHI coverage, no significant change was observed in multiple pregnancy proportion among ART pregnancies. This finding indicates that expanded access to ART through insurance coverage did not compromise pregnancy safety, supporting further policy expansion in resource-constrained settings.

Implications for the public

Infertility affects many women and families, yet the high cost of assisted reproductive technologies (ARTs) often limits access to treatment. This study shows that after ART procedures were included in social health insurance (SHI) coverage in Guangxi, more women were able to achieve pregnancy through ART. By reducing out-of-pocket expenses, insurance coverage helped lower financial barriers and allowed individuals with infertility to seek treatment more timely. The benefits were particularly evident among women covered by the Urban and Rural Resident Basic Medical Insurance and those living in areas with fewer ART facilities. Importantly, the increase in ART pregnancies was not accompanied by a rise in multiple pregnancy proportion, which are associated with higher health risks. Overall, these findings suggest that health insurance coverage of ARTs can improve access to fertility care while maintaining pregnancy safety, especially in resource-constrained settings.

China, the prevalence of infertility among individuals aged 24–46 was estimated at about 15.5%,[12] yet the costs of ARTs had been predominantly borne by patients themselves.[13] Our study took advantage of the recent extension of social health insurance (SHI) coverage to ARTs in Guangxi Zhuang Ethnic Autonomous Region, China, to evaluate the policy's short-term effects on pregnancies with ARTs and the proportion of multiple pregnancies among pregnancies with ARTs. Although a less developed area compared to other provinces in the country, Guangxi is one of the earliest pioneers in China that introduced such SHI expansion. This study may thus contribute much needed evidence on effectiveness of ART coverage from an LMIC setting.

Methods

Setting and Study Design

Located in southwestern China, Guangxi is a provincial-level administrative region with one of the lowest per-capita gross domestic product (57 071 Chinese *yuan*, or 8153 United States dollars, in 2024).[14] It had a total population of 57.43 million in 2022.[15] By the end of 2023, 51.62 million residents in Guangxi were covered by SHI, including 44.2 million[16] by the Urban and Rural Resident Basic Medical Insurance (URRBMI) scheme and 7.42 million by the Urban Employee Basic Medical Insurance (UEBMI) scheme. These corresponded to 90% of the total population, with URRBMI and UEBMI enrollees accounting for 77% and 13% of the total population, respectively. From November 2023, URRBMI and UEBMI introduced reimbursement for 50%[17] and 70%,[17] respectively, of the costs on the selected ART procedures. Table S1 (Supplementary file 1) provides a full list of reimburseable ART procedures and their fees. While the majority of municipalities of Guangxi have at least one SHI designated facility, where reimbursable ART procedures are provided (See Table S2, Supplementary file 1).

The pre-intervention and post-intervention period were defined as January 2022 to October 2023 and as November 2023 to July 2024, including 22 months before and 9 months after policy implementation. An interrupted time series (ITS) design was used as the primary analytical approach, as described in the statistical analysis section. Controlled interrupted time series (CITS) analysis using non-ART pregnancies as a comparison series was conducted as a supplementary robustness analysis.

Data and Study Population

The primary study population comprised women with pregnancies achieved through ARTs, identified from health insurance claims using ART-related codes (Z33.x01 or Z33.x02) together with pregnancy-related ICD-10 (International Classification of Diseases, 10th Revision) diagnosis codes. Each woman was counted once, according to the month of her first pregnancy-related diagnosis record during the study period. Among women with ART pregnancies, multiple pregnancies were identified using O30-related ICD-10 codes, including O30.000, O30.100, O30.200, O30.800, O30.800x002, O30.801, and O30.900. The monthly multiple pregnancy proportion among ART pregnancies was calculated as the number of ART pregnancies with multiple pregnancy codes divided by the total number of ART pregnancies in the same month.

For the supplementary CITS sensitivity analysis, we additionally constructed a broader cohort of all women with pregnancy-related diagnosis records using ICD-10 codes O26.900–O26.900x510, which mainly document pregnancy progression from early pregnancy to 42 weeks of gestation. Within this cohort, women with any ART-related pregnancy code (Z33.x01 or Z33.x02) were classified into the ART

pregnancy series, while those without were classified into the non-ART pregnancy series. The construction of the primary ART pregnancy cohort and the supplementary CITS analytical cohort is illustrated in Figure 1. The monthly aggregated data used in the analyses are provided in Supplementary file 2 (Table S9)

Besides the overall data, we obtained the number of pregnancies with or without ARTs and multiple pregnancy proportion separated by maternal age group (≤25, 26–30, 31–35, 36–40, or ≥41 years), SHI scheme (URRBMI or UEBMI), or the number of SHI-certified ART facilities in the woman's city of residence (0, 1, or ≥2).

Outcomes

Primary Outcome

The primary outcome was the monthly number of newly recorded ART pregnancies. An ART pregnancy was defined as a record containing both pregnancy-related ICD-10 diagnosis codes and ART procedure codes Z33.x01 or Z33.x02. Each woman was counted once in the month when she was first determined to be pregnant during the study period.

Secondary Outcome

The secondary outcome was the monthly multiple pregnancy proportion among ART pregnancies. This was calculated as the number of multiple pregnancies identified using O30-related ICD-10 codes among ART pregnancies divided by the total number of ART pregnancies in the same month.

Statistical Analysis

We first summarized the monthly number of newly recorded ART pregnancies and the multiple pregnancy proportion among ART pregnancies before and after policy implementation, as well as across different grouping variables.

We then used segmented regression in an ITS framework as the primary analysis to evaluate changes after the inclusion of ART procedures in SHI coverage in November 2023. The ITS model was specified as follows[18]:

$$Y_t = \beta_0 + \beta_1 T_t + \beta_2 X_t + \beta_3 P_t + \epsilon_t$$

Y_t represents the outcome variables (ie, pregnancies or multiple pregnancy proportion); T_t represents the continuous time trend from the start of the study period; X_t is an intervention dummy variable (0 before the intervention, 1 after); P_t represents the time elapsed after the intervention, coded as 0 before policy implementation; β_0 represents the baseline level of the outcome at the start of the study period; β_1 represents the underlying pre-intervention monthly trendn; β_2 estimates the immediate change in outcome level following policy implementation; β_3 estimates the change in the monthly trend after policy implementation relative to the pre-intervention trend. Accordingly, β_2 and β_3 were considered the main parameters of interest.[18]

Considering the potential heterogeneity of policy effects, we performed subgroup analyses by SHI scheme, availability of designated ART facilities in the municipality, and age group (<40 vs. ≥40 years). To facilitate interpretation and comparison over time, the outcome series used in both primary and subgroup ITS analyses were indexed to their January 2022 baseline values. For the monthly number of ART pregnancies, this transformation converted absolute counts into relative changes from baseline, accounting that the baseline number differed substantially across subgroups. Therefore, estimates from the ITS models should be interpreted as changes relative to the January 2022 baseline accordingly.

To account for the potential delay between ART treatment and pregnancy recognition, we conducted a one-month lagged sensitivity analysis. November 2023 was modeled as

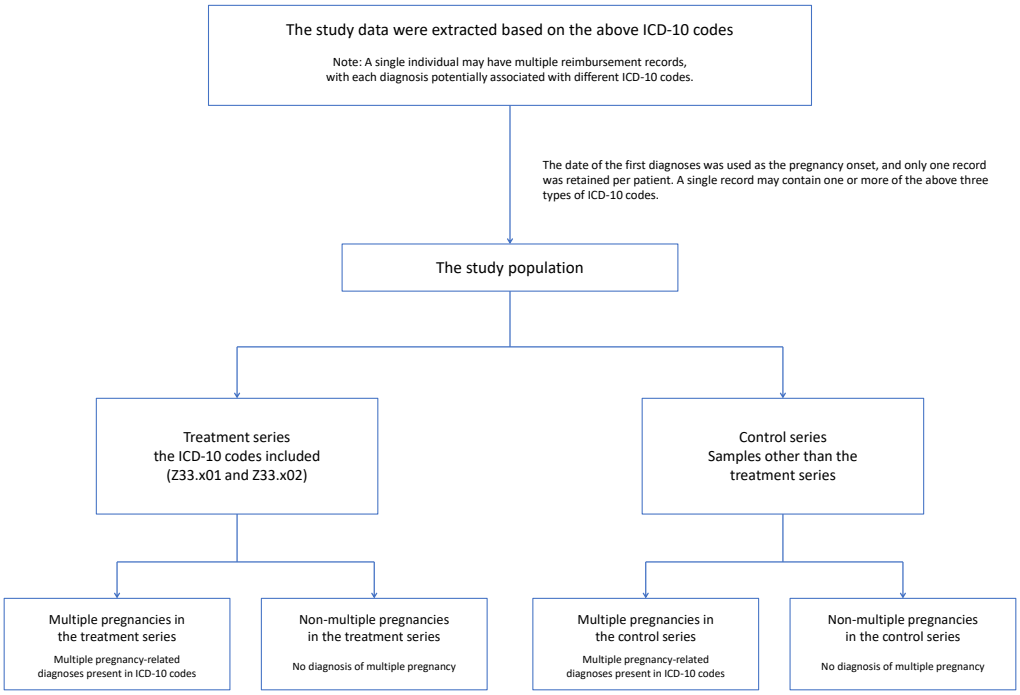


Figure 1. Flow Diagram of Data Processing for the Study. Abbreviation: ICD-10, International Classification of Diseases, 10th Revision.

a transition month using a separate indicator variable, and the lagged intervention period was defined as beginning in December 2023. The results are presented in Supplementary file 1.

For the supplementary CITS sensitivity analysis,[19] we additionally constructed a broader cohort of all women with pregnancy-related diagnosis records using ICD-10 codes O26.900–O26.900x510, which mainly document pregnancy progression from early pregnancy to 42 weeks of gestation. Within this cohort, women with any ART-related pregnancy code (Z33.x01 or Z33.x02) were classified into the ART pregnancy series, while those without were classified into the non-ART pregnancy series. All the analyses were conducted using RStudio (version 4.3.2). A two-sided significance threshold of $P<.05$ was applied.

Results

Descriptive Statistics

Table 1 shows that 8543 ART pregnancies were identified during the study period, including 4557 before reimbursement coverage (53.34%) and 3986 after reimbursement coverage (46.66%). ART pregnancies were mainly concentrated among women aged 31–35 years (39.41%) and 36–40 years (30.21%). Women enrolled in UEBMI accounted for a larger proportion than those enrolled in URRBMI (61.06% vs. 38.94%), and most ART pregnancies occurred among women living in municipalities with two or more ART facilities (69.58%).

Among ART pregnancies, 1107 multiple pregnancies were observed, with an overall multiple pregnancy proportion of 12.96%. The multiple pregnancy proportion decreased slightly after reimbursement coverage compared with the pre-reimbursement period (12.44% vs. 13.41%). Across age groups, the proportion was highest among women aged 31–35 years (14.70%) and lowest among those aged 41 years or above (7.83%). By year, the proportion decreased from 13.50% in 2023 to 12.39% in the first seven months of 2024.

Effects of Social Health Insurance Coverage of Assisted Reproductive Technologies

Table 2 shows that the number of ART pregnancies was already increasing significantly before the intervention ($\beta_1=0.022$, $P=.001$), meaning that the monthly number of ART pregnancies increased by approximately 2.2 percentage points relative to the January 2022 baseline each month before policy implementation. After ARTs were included in insurance coverage, there was an immediate and statistically significant increase in ART pregnancies ($\beta_2=0.693$, $P<.001$), together with a further significant increase in the post-intervention monthly trend ($\beta_3=0.050$, $P=.001$). These findings are consistent with the visual pattern in Figure 2, which shows a clear upward shift and sustained increase after the policy change. For multiple pregnancy proportion among ART pregnancies, no significant pre-intervention trend was observed ($\beta_1=-0.002$, $P=.560$). Neither the immediate level

Table 1. General Characteristics of the Study Population

Variable	ART Pregnancies, n (column %)	Multiple Pregnancies, n	Multiple Pregnancy Proportion Among ART Pregnancies, (Row %)
Total	8543 (100.00)	1107	12.96
Insurance coverage of ARTs			
Before reimbursement coverage	4557 (53.34)	611	13.41
After reimbursement coverage	3986 (46.66)	496	12.44
Age group			
≤25	212 (2.48)	27	12.74
26–30	1476 (17.28)	211	14.30
31–35	3367 (39.41)	495	14.70
36–40	2581 (30.21)	303	11.74
≥41	907 (10.62)	71	7.83
Type of SHI			
URRBMI	3327 (38.94)	422	12.68
UEBMI	5216 (61.06)	685	13.13
Number of local ART facilities			
0	684 (8.01)	61	8.92
1	1915 (22.42)	232	12.11
≥2	5944 (69.58)	814	13.69
Year of pregnancy			
2022	2302 (26.95)	300	13.03
2023	3037 (35.55)	410	13.50
2024 (Jan–Jul)	3204 (37.50)	397	12.39

Abbreviations: ARTs, assisted reproductive technologies; URRBMI, Urban and Rural Resident Basic Medical Insurance; UEBMI, Urban Employee Basic Medical Insurance; SHI, social health insurance.

Percentages in the ART pregnancies column represent the distribution of ART pregnancies within each category. Multiple pregnancy proportion was calculated as the number of multiple pregnancies divided by the number of ART pregnancies in the corresponding category.

Table 2. Interrupted Time Series Effects of Insurance Coverage of Assisted Reproductive Technologies on the Number of ART Pregnancies and Multiple Pregnancy Proportion Among ART Pregnancies

	Pregnancies		Multiple Pregnancy Proportion	
	Estimate	*P*	Estimate	*P*
Baseline level of the outcome (β_0)	0.832	<.001	0.848	<.001
Pre-intervention trend (β_1)	0.022	.001	-0.002	.560
Level change after intervention (β_2)	0.693	<.001	0.007	.914
Slope change after intervention (β_3)	0.050	.001	-0.009	.326

Abbreviation: ARTs, assisted reproductive technologies.
Note: The numbers of pregnancies have been normalized as ratios to baseline (ie, Jan 2022) levels.

change ($\beta_2 = 0.007$, $P = .914$) nor the post-intervention slope change ($\beta_3 = -0.009$, $P = .326$) was statistically significant. Although Figure 3 shows a slight downward trend after the intervention, the model did not detect a statistically significant policy effect on multiple pregnancy proportion. A similar overall pattern was observed in the ITS estimates on the original outcome scales (Table S3, Supplementary file 1).

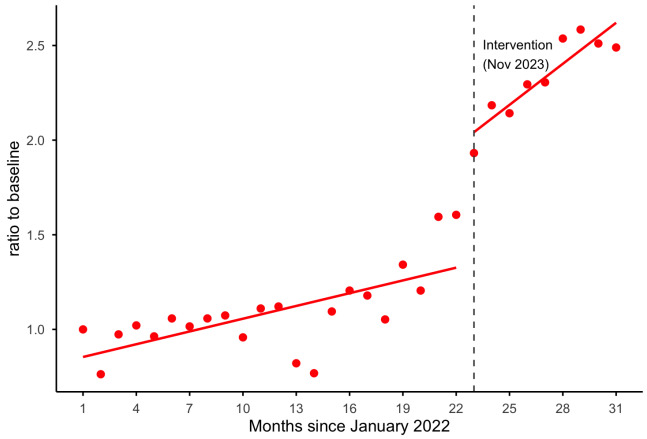


Figure 2. Interrupted Time Series of Monthly Assisted Reproductive Technology Pregnancies.

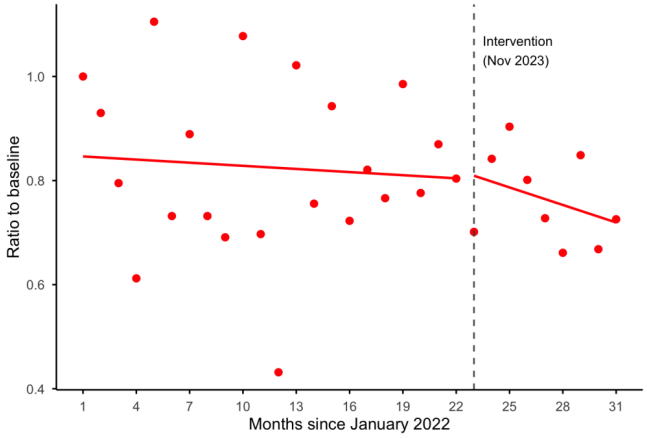


Figure 3. Interrupted Time Series of Monthly Multiple Pregnancy Proportion Among Assisted Reproductive Technology Pregnancies. Note: (1) The multiple pregnancies proportion have been normalized as ratios to baseline (ie, January 2022) levels. (2) We only included women who received a pregnancy-related diagnosis for the first time.

Subgroups

Tables S4 and S5 present the age-stratified results. ART pregnancies had already been increasing before the intervention in both age groups (<40 years: $\beta_1 = 0.022$, $P < .001$; ≥40 years: $\beta_1 = 0.024$, $P = .013$). After policy implementation, both groups showed a significant immediate increase in ART pregnancies ($\beta_2 = 0.702$, $P < .001$; $\beta_2 = 0.681$, $P < .001$). The post-intervention trend further increased among women aged <40 years ($\beta_3 = 0.050$, $P = .010$), while the trend change among women aged ≥40 years was close to but did not reach statistical significance ($\beta_3 = 0.049$, $P = .054$). No significant changes in multiple pregnancy proportion were observed in either age group.

Table 3 and Table S6 present subgroup results by SHI scheme. ART pregnancies had been increasing before the intervention among both UEBMI and URRBMI enrollees ($\beta_1 = 0.019$, $P = .001$; $\beta_1 = 0.030$, $P = .005$). After policy implementation, ART pregnancies increased immediately among UEBMI enrollees ($\beta_2 = 0.361$, $P = .005$), but the post-intervention trend change was not significant ($\beta_3 = 0.033$, $P = .126$). Among URRBMI enrollees, the increase was larger immediately ($\beta_2 = 1.503$, $P < .001$), with a significant further increase in the post-intervention trend ($\beta_3 = 0.089$, $P = .028$). No significant immediate or trend changes in multiple pregnancy proportion were detected in either insurance group.

Table 3 presents subgroup results by the number of ART facilities in the patient's municipality. After policy implementation, ART pregnancies increased immediately in all three groups, with the largest increase observed in municipalities with one ART facility ($\beta_2 = 1.644$, $P < .001$), followed by those without ART facilities ($\beta_2 = 1.403$, $P < .001$) and those with two or more facilities ($\beta_2 = 0.451$, $P < .001$). A significant post-intervention trend increase was observed only in municipalities with two or more ART facilities ($\beta_3 = 0.048$, $P = .026$), suggesting that sustained growth was mainly concentrated in areas with greater ART service capacity.

Robustness Analysis

As shown in Table S7, the CITS analysis using non-ART pregnancies as a comparison series was conducted as a robustness analysis. The results were generally consistent with the primary ITS findings. Before policy implementation, ART pregnancies had already shown a faster increasing trend than non-ART pregnancies ($\beta_5 = 0.024$, $P < .001$). After ART procedures were included in SHI coverage, ART pregnancies

Table 3. Effects of Intervention on Number of Pregnancies with Assisted Reproductive Technologies by Sub-groups

	SHI Scheme				Number of ART Facilities					
	URRBMI		UEBMI		None		One		Two or more	
	Estimate	*P*	Estimate	*P*	Estimate	*P*	Estimate	*P*	Estimate	*P*
Baseline level of the outcome (β_0)	0.973	<.001	0.754	<.001	0.847	<.001	0.997	<.001	0.798	<.001
Pre-intervention trend (β_1)	0.030	.005	0.019	.001	0.034	.010	0.036	.003	0.019	.001
Level change after intervention (β_2)	1.503	<.001	0.361	.005	1.403	<.001	1.644	<.001	0.451	<.001
Slope change after intervention (β_3)	0.089	.028	0.033	.126	0.030	.552	0.066	.144	0.048	.026

Abbreviations: ART, assisted reproductive technology; URRBMI, Urban and Rural Resident Basic Medical Insurance; UEBMI, Urban Employee Basic Medical Insurance; SHI, social health insurance.

showed a significant additional immediate increase relative to non-ART pregnancies ($\beta_6 = 0.513$, $P < .001$), followed by a further increase in the monthly trend ($\beta_7 = 0.054$, $P = .023$). For multiple pregnancy proportion, no statistically significant immediate level change or trend change was observed ($\beta_6 = 0.024$, $P = .862$; $\beta_7 = -0.016$, $P = .516$). Results of the one-month lagged sensitivity analysis are presented in Table S8 (Supplementary file 1).

Discussion

This study is the first empirical evaluation from an LMIC setting of the inclusion of ARTs in health insurance coverage on pregnancies. We found that SHI coverage of ARTs in Guangxi, China, was associated with a significant immediate increase in the number of pregnancies achieved through ARTs, followed by a sustained upward monthly trend during the post-policy observation period. Meanwhile, multiple pregnancy proportion among women with ART pregnancies showed no statistically significant change after policy implementation. The significant immediate effects were observed consistently across SHI schemes, and were larger among URRBMI beneficiaries than among UEBMI beneficiaries. Similarly, across municipalities with varied availability in ART facilities, and between younger and older groups. The immediate effect of SHI coverage was more pronounced in regions with limited ART infrastructure (ie, no or only one facility), while regions with two or more ART facilities saw a stronger and more sustained upward trend in pregnancies with ARTs during the observed period.

Perhaps surprisingly, the coverage policy had a greater impact on ART pregnancies among URRBMI enrollees (140.2%) who enjoyed lower reimbursement rates than UEBMI enrollees (25.7%) who enjoyed higher reimbursement rates. This result may stem from that, primarily, UEBMI enrollees (stable employees) tended to have lower fertility intentions but also lower affordability barriers to using ARTs than URRBMI enrollees,[20-21] and were therefore less sensitive to the policy change. The significant immediate increase in ART pregnancies may reflect a rapid release of previously delayed or unmet demand after reimbursement became available. Before the policy, high out-of-pocket costs may have led some patients to postpone ART treatment. Once ART procedures were covered by SHI, these patients may have proceeded with treatment more quickly. In addition, some patients may have prepared in advance after the policy announcement or already had cryopreserved embryos, allowing pregnancy recognition shortly after implementation. Therefore, the immediate level change should be interpreted as an early increase in newly recorded ART pregnancies, rather than the immediate effect on ART treatment initiation.

Our study from the resource-constrained setting of Guangxi corroborated the findings from previous research in high-income countries that insurance coverage significantly increased service utilisation of ARTs[22,23] and eventually enhanced fertility.[4] Previous studies have shown that covering ARTs in health insurance can increase the utilization of ARTs across different age groups and geographic regions.[24,25] Our results indicate age heterogeneity. Although both age groups exhibited immediate increases, only individuals aged <40 years showed a sustained post-policy upward trend during the observation period. This pattern suggests that insurance coverage not only released previously cost-constrained demand but also generated continued uptake among those with a larger effective reproductive window, whereas the ≥40 group primarily reflected a short-term release of pent-up demand. Geographically, in regions with no or only one ART facility, the immediate increase in ART pregnancies was more pronounced, while areas with two or more ART facilities exhibited a more substantial upward trend during the post-policy observation period. It suggests that in LMICs the restricted supply of fertility care[8] may lead to uneven effects geographically.

We found no significant changes in multiple pregnancy proportion, with no increases observed across age-stratified and insurance-type subgroup analyses. Studies from the United States[26] and Canada[6] reported reduced multiple pregnancy proportion among those conceived with ARTs. While patients with infertility were incentivized to opt for multiple-embryo transfer with higher success rates to minimize out-of-pocket costs prior to insurance coverage of ARTs, more patients would likely choose the safer, single-embryo transfer, to mitigate health risks once the financial burden was relieved.[6,27] The fact that our finding was not statistically significant shows that the effect of coverage of ARTs on improving patient safety may be less certain in our setting. Another study from Korea[4] mentioned earlier reported elevated population-level multiple pregnancy rates following coverage expansion for ARTs. In our study, following the policy intervention, there was an increase of 0.2% in the rate of multiple pregnancies among the total study population. It is consistent with our

finding regarding the increase of pregnancies with ARTs and the stability of multiple pregnancy proportion among them.

Policy Implications

The inclusion of ART in health insurance has yielded notable success in Guangxi, marking a significant policy achievement. However, despite these gains, pregnancies with ARTs still account for only 1.85% of all pregnancies after the reform, far lower than the proportions in Japan and South Korea, where births with ARTs represent approximately 9.7%[28,29] and 12.3%,[4] respectively. To further amplify the policy's impact, it is worth considering the inclusion of ART-related medications and diagnostic tests in the reimbursement coverage. However, such expansion should be conditional on the fiscal capacity of the SHI fund. In addition, the policy demonstrated a more pronounced effect among URRBMI group, with both immediate and short-term impacts being more substantial. Therefore, increasing the reimbursement rate for this group or providing fertility subsidies specifically for infertile individuals covered under the urban and rural resident scheme could help enhance the policy's effectiveness and promote greater equity.

Limitations

This study has several limitations that warrant consideration. First, because the primary analysis used a single-group ITS design, residual confounding from other time-varying factors cannot be fully excluded. Although CITS using non-ART pregnancies was retained as a robustness analysis, non-ART pregnancies were not directly targeted by the ART reimbursement policy and may not serve as an ideal comparison series. Second, ART pregnancies were identified using diagnosis codes in claims data, which may underestimate the actual number of ART pregnancies, particularly among individuals treated outside SHI-designated facilities or with incomplete ART-related coding. Third, the date of the first pregnancy-related diagnosis was used as a proxy for pregnancy recognition rather than the actual timing of ART treatment initiation. Therefore, some pregnancies recorded shortly after policy implementation may have reflected ART procedures initiated before the policy took effect, particularly during the transition period immediately following policy implementation. To address this concern, we conducted a one-month lagged sensitivity analysis, which yielded results generally consistent with the primary analysis. Nevertheless, because the claims database did not contain the exact timing of ART treatment initiation, some uncertainty regarding the timing of the immediate level change remains. Finally, the post-policy observation period was relatively short given data availability, covering only nine months after implementation. Longer follow-up is warranted to assess the persistence of the observed policy effects. Lastly, the generalizability of findings may be influenced by Guangxi's unique population and socioeconomic characteristics.

Conclusion

During the first nine months after implementation, the inclusion of ARTs in Guangxi's SHI program effectively increased pregnancies achieved through ARTs while maintaining stable multiple pregnancy proportion. Subgroup analyses demonstrated the policy's preferential benefits for those covered by URRBMI compared to those covered by UEBMI, and those in regions without ARTs facilities at least in the short term. This study supports the broader implementation of ARTs insurance policies in LMICs, considering its potential to improve access to and equity in reproductive healthcare. Further research may investigate the policy's long-term impacts on overall fertility rates.

Disclosure of artificial intelligence (AI) use

Type of AI tool(s) used: ChatGPT.
Purpose of use: Language editing.

Ethical issues

The study was part of a project in collaboration with the Guangxi Healthcare Security Administration to evaluate the policy effect for the public benefits. As aggregated level data was used, ethics approval was deemed unnecessary.

Conflicts of interest

Authors declare that they have no conflicts of interest.

Authors' contributions

Conceptualization: Chengkun Lyu and Jin Xu.
Data curation: Chengkun Lyu, Qihang Zhao, and Jin Xu.
Formal analysis: Chengkun Lyu, Qihang Zhao, and Jin Xu.
Methodology: Chengkun Lyu, Yang Wang, and Jin Xu.
Writing–original draft: Chengkun Lyu, Qihang Zhao, and Jin Xu.
Writing–review & editing: Chengkun Lyu, Yang Wang, Yu He, and Jin Xu.

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Supplementary files

Supplementary file 1 contains Tables S1-S8.
Supplementary file 2 contains Table S9.

References

1. World Health Organization. Infertility Prevalence Estimates, 1990-2021. https://www.who.int/publications/i/item/978920068315. Published 2022. Accessed February 18, 2025.
2. Njagi P, Groot W, Arsenijevic J, Dyer S, Mburu G, Kiarie J. Financial costs of assisted reproductive technology for patients in low- and middle-income countries: a systematic review. *Hum Reprod Open*. 2023; 2023(2):hoad007. doi:10.1093/hropen/hoad007
3. Peipert BJ, Montoya MN, Bedrick BS, Seifer DB, Jain T. Impact of in vitro fertilization state mandates for third party insurance coverage in the United States: a review and critical assessment. *Reprod Biol Endocrinol*. 2022;20(1):111. doi:10.1186/s12958-022-00984-5
4. Cha W, Yun I, Nam CM, Nam JY, Park EC. Evaluation of Assisted Reproductive Technology Health Insurance Coverage for Multiple Pregnancies and Births in Korea. *JAMA Netw Open*. 2023;6(6):e2316696. doi:10.1001/jamanetworkopen.2023.16696
5. Lv H, Diao F, Du J, et al. Assisted reproductive technology and birth defects in a Chinese birth cohort study. *Lancet Reg Health West Pac*. 2021;7:100090. doi:10.1016/j.lanwpc.2020.100090
6. Vélez MP, Connolly MP, Kadoch IJ, Phillips S, Bissonnette F. Universal coverage of IVF pays off. *Hum Reprod*. 2014;29(6):1313-1319. doi:10.1093/humrep/deu067
7. Zagadailov P, Seifer DB, Shan H, Zarek SM, Hsu AL. Do state insurance mandates alter ICSI utilization? *Reprod Biol Endocrinol*. 2020;18(1):33.

doi:10.1186/s12958-020-00589-w
8. World Health Organization. Infertility. https://www.who.int/news-room/fact-sheets/detail/infertility. Published May 22, 2024. Accessed June 17, 2025.
9. Zhang Y, Mills A, Xu J. Benefit equity of social health insurance in China and its provinces (2014-2020): implications for universal health coverage. *BMJ Glob Health*. 2024;9(11):e014806. doi:10.1136/bmjgh-2023-014806
10. China Daily. Guangxi medical insurance to cover test-tube baby services from November. China Daily website. https://govt.chinadaily.com.cn/s/202310/30/WS6543463d498ed2d7b7e9efb5/guangxi-medical-insurance-to-cover-test-tube-baby-services-from-november.html. Published October 30, 2023. Accessed July 31, 2025.
11. National Healthcare Security Administration. Assisted reproductive technologies included in medical insurance to ease financial burden. National Healthcare Security Administration website. http://www.nhsa.gov.cn/art/2025/5/5/art_52_16450.html. Published May 5, 2025. Accessed July 31, 2025.
12. Zhou Z, Zheng D, Wu H, et al. Epidemiology of infertility in China: a population-based study. *BJOG*. 2018;125(4):432-441. doi:10.1111/1471-0528.14966
13. Huang R, Yu JY, He WC, Liu RH. Feasibility analysis of China's medical insurance coverage of assisted reproductive technology. *Sci Rep*. 2024;14(1):7998. doi:10.1038/s41598-024-58640-4
14. National Bureau of Statistics of China. Per Capita GDP. https://data.stats.gov.cn/english/easyquery.htm?cn=E0103. Published 2025. Accessed October 17, 2025.
15. National Bureau of Statistics of China. Population. https://data.stats.gov.cn/english/easyquery.htm?cn=E0103. Published 2025. Accessed October 17, 2025.
16. Guangxi Zhuang Autonomous Region Medical Security Bureau. Statistical Bulletin of Guangxi Medical Security Development in 2023. http://ybj.gxzf.gov.cn/zfxxgkzl/fdzdgknr/tjxx/t18936048.shtml. Published September 4, 2024. Accessed October 22, 2024.
17. Guangxi Zhuang Autonomous Region Medical Security Bureau, Guangxi Zhuang Autonomous Region Department of Human Resources and Social Security, Guangxi Zhuang Autonomous Region Health Commission. Notice on including selected therapeutic assisted reproductive medical services in the payment scope of basic medical insurance and work-related injury insurance funds. http://ybj.gxzf.gov.cn/xxgk/zcfg/zcfg_9912/xzgfxwj/t17370950.shtml. Published 2023. Accessed October 17, 2024.
18. Lopez Bernal J, Cummins S, Gasparrini A. Interrupted time series regression for the evaluation of public health interventions: a tutorial. *Int J Epidemiol*. 2017;46(1):348-355. doi:10.1093/ije/dyw098
19. Linden A. Conducting interrupted time-series analysis for single- and multiple-group comparisons. *Stata J*. 2015;15(2):480-500. doi:10.1177/1536867x1501500208
20. Huang W, Wang Y, Wu H, et al. The motherhood penalty and low fertility in China: a pseudo-event study. *J Popul Econ*. 2025;38(28). doi:10.1007/s00148-025-01078-3
21. Tang Y, Fu R, Noguchi H. Impact of medical insurance integration on reducing urban-rural health disparity: Evidence from China. *Soc Sci Med*. 2024;357:117163. doi:10.1016/j.socscimed.2024.117163
22. Dieke AC, Mehta A, Kissin DM, Nangia AK, Warner L, Boulet SL. Intracytoplasmic sperm injection use in states with and without insurance coverage mandates for infertility treatment, United States, 2000-2015. *Fertil Steril*. 2018;109(4):691-697. doi:10.1016/j.fertnstert.2017.12.027
23. Yun I, Cha W, Nam CM, Nam JY, Park EC. The impact of assisted reproductive technology treatment coverage on marriage, pregnancy, and childbirth in women of childbearing age: an interrupted time-series analysis. *BMC Public Health*. 2023;23(1):1379. doi:10.1186/s12889-023-16286-3
24. Morshed-Behbahani B, Lamyian M, Joulaei H, et al. Infertility policy analysis: a comparative study of selected lower middle-middle- and high-income countries. *Global Health*. 2020;16(1):104.
25. Mackay A, Taylor S, Glass B. Inequity of access: scoping the barriers to assisted reproductive technologies. *Pharmacy (Basel)*. 2023;11(1):17. doi:10.1186/s12992-020-00617-9
26. Boulet SL, Crawford S, Zhang Y, et al. Embryo transfer practices and perinatal outcomes by insurance mandate status. *Fertil Steril*. 2015;104(2):403-9.e1. doi:10.1016/j.fertnstert.2015.05.015
27. Kappy M, Plagianos M, Gingold J, Jindal S, Klugman S, Lieman H. Impact of in vitro fertilization insurance coverage in mandated vs nonmandated states in the United States before 2017. *Fertil Steril*. 2023;120(4):911-913. doi:10.1016/j.fertnstert.2023.07.005
28. Katagiri Y, Jwa SC, Kuwahara A, et al. Assisted reproductive technology in Japan: A summary report for 2022 by the Ethics Committee of the Japan Society of Obstetrics and Gynecology. *Reprod Med Biol*. 2024;23(1):e12620. doi:10.1002/rmb2.12620
29. Nippon.com. Annual births in Japan fall below 800,000 for the first time. Nippon.com website. https://www.nippon.com/en/japan-data/. Published February 28, 2023. Accessed June 30, 2025.