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Infertility Burden and Costs in Iran: A Mixed-Methods Study Using GBD and Local Insights (2022–2023)

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Abstract:

Introduction: Infertility poses significant health and economic challenges in Iran, yet regional burdens remain underexplored. This study estimates infertility prevalence, Disability-Adjusted Life Years (DALYs), and outpatient costs in Iran for 2022–2023, integrating Global Burden of Disease (GBD) 2021 data with local perspectives through sensitivity scenario analyses.
Methods: A convergent parallel mixed-methods design combined unadjusted GBD 2021 quantitative estimates with scenario-based sensitivity analyses for regional contextual factors (e.g., healthcare access, environmental stressors), alongside semi-structured interviews from 10 stakeholders (5 providers, 5 patients) in Sistan, integrated via joint display and thematic analysis. Costs were sourced from national studies and adjusted for inflation.
Results: Unadjusted lifetime infertility prevalence was estimated at 11.8% (95% CI: 11.2–12.4) in 2022 and 12.0% (95% CI: 11.4–12.6) in 2023. Under sensitivity scenarios, prevalence ranged up to 12.9% in underserved areas. Unadjusted DALYs increased from 17.4 to 18.1 per 1,000 ($P = 0.04$), with women at higher burden. Costs grew 9.7% (absolute increase of $60, from $620 to $680 per cycle, $P = 0.01$), with 65% out-of-pocket. Qualitative interviews highlighted financial strain, access barriers, stigma, and emotional distress.
Conclusion: Infertility in Iran reflects a persistently high epidemiological and economic burden. The mixed-methods approach, incorporating sensitivity analyses, offers a scalable model for burden estimation in data-scarce settings, informing policy reforms.
Keywords: Infertility, Iran, GBD, Outpatient costs, Mixed-methods, Health policy

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Introduction

Infertility, defined as failure to conceive after 12 months of regular unprotected intercourse (1), affects 8–12% of couples globally, with higher rates (up to 15–20%) in low- and middle-income countries (2, 3). Recent Global Burden of Disease analyses show that age-standardized prevalence and Disability-Adjusted Life Years (DALYs), a composite measure summarizing years of life lost due to premature mortality and years lived with disability, for infertility have remained stable or slightly increased from 1990 to 2021, driven by population growth and environmental factors (4, 5).
Infertility is recognized as a major public health issue, contributing to substantial psychosocial distress, social stigma, marital strain, and economic burdens, particularly in settings where childbearing is central to social identity (6, 7).

In Iran, lifetime infertility prevalence is estimated at 11.3% (8), yet significant subnational variation is likely due to environmental stressors (e.g., frequent dust storms with high PM2.5 exposure linked to endocrine disruption and reduced fertility (9-11), uneven healthcare access in rural areas, high out-of-pocket costs amid persistent inflation, and pervasive sociocultural stigma, disproportionately affecting women (12, 13).

These challenges are compounded by Iran's declining total fertility rate (1.8 births per woman) and recent pronatalist policies, including the "Law on Supporting the Family and Youth Population" (2021), which require accurate, context-specific data for effective resource allocation and service planning (14).

Together, these environmental, economic, sociocultural, and policy-related factors, particularly pronounced in underserved arid regions such as Sistan, highlight the need for subnational research that integrates standardized epidemiological indicators with local lived experiences. Previous quantitative studies in Iran have largely relied on national surveys or GBD estimates, often overlooking regional disparities and environmental influences (8, 15), While qualitative research has primarily focused on stigma and psychosocial consequences without quantifying economic or epidemiological burdens (12). Similar gaps have been reported globally, particularly in data-scarce settings where global datasets are rarely contextualized with local evidence (3, 16).

This study addresses these gaps using a convergent parallel mixed-methods design. The quantitative aim was to estimate infertility prevalence, Disability-Adjusted Life Years (DALYs), and outpatient treatment costs in Iran for 2022–2023 using GBD 2021 data. The qualitative aim was to explore experiences of financial strain, access barriers, and stigma among stakeholders in the underserved Sistan region. By integrating these strands, the study refines subnational estimates, reveals burdens not fully captured by global metrics, and provides actionable evidence to inform national pronatalist policies and provincial resource allocation in underserved areas, contributing to epidemiological rigor and health equity.

Methods

Study Design

The convergent parallel mixed-methods design was chosen to simultaneously analyze secondary GBD data and primary local insights, necessitated by the closure of the Zabol data collection center in 2023. This approach ensured equal priority to both strands, facilitating triangulation of global estimates with contextual realities in a data-scarce setting (17).

The study estimated the burden of infertility and outpatient treatment costs in Iran for the first half of Iranian years 1401 and 1402 (March 21–September 22, 2022, and March 21–September 22, 2023). This period was selected because it aligned with the most recent available GBD 2021 subnational data and national cost reports; full-year primary data were unavailable due to the aforementioned center closure. Quantitative data used GBD 2021 (extrapolated to 2022–2023). Qualitative interviews, conducted in 2025, retrospectively captured stakeholder experiences from the 2022–2023 period. The study was approved by the Research Ethics Committee of Zabol University of Medical Sciences (IR.ZBMU.REC.1402.030).

Quantitative Component Data Sources

Outpatient drug costs (e.g., clomiphene, gonadotropins) were sourced from Darvishi et al. (2020) (18) and the Iran Food and Drug Administration 2022 pricing report (19), adjusted using the Consumer Price Index (20). Outpatient drug costs (e.g., clomiphene, gonadotropins) were sourced from Darvishi et al. (2020) and the Iran Food and Drug Administration 2022 pricing report, with mean costs per cycle calculated as the midpoint of the reported ranges. The reported ranges reflect variability in drug type (clomiphene vs. gonadotropins), dosage regimens, and regional pharmacy pricing as documented in these national studies.

Data Extraction and Analysis

GBD data were stratified by age (15–49 years) and sex. Due to the absence of direct subnational data for Sistan, regional contextual factors were explored through scenario-based sensitivity analyses rather than fixed adjustments. Three plausible scenarios (low, medium, high impact) were developed based on indirect evidence to illustrate potential variation in underserved arid areas (Table 1). These ranges are illustrative and reflect uncertainty rather than definitive corrections.

Table 1. Scenario assumptions used in sensitivity analysis for regional burden in underserved arid areas

Scenario Type	Rationale	Assumed magnitude (range for sensitivity)	Source/Reference
Demographic	Younger median age in Sistan → higher reproductive-age proportion	+0% to +4%	Iran 2021 census
Healthcare Access	Lower clinic density → delayed diagnosis/treatment	+0% to +10% to DALYs	Rural referral studies
Environmental	Frequent dust storms linked to potential fertility reduction	+0% to +6%	Pollution-fertility reviews

Note: Trends for 2022–2023 were linearly extrapolated from GBD 2017–2021 rates, assuming no major changes in clinical service delivery or infertility treatment policies (general pronatalist policies such as the Law on Supporting the Family and Youth Population were not assumed to directly impact treatment access).

Trends for 2022–2023 were linearly extrapolated from GBD 2017–2021 rates, assuming no major changes in clinical service delivery or infertility treatment policies (general pronatalist policies such as the Law on Supporting the Family and Youth Population were not assumed to directly impact these trends). Costs were converted to 2023 USD using the approximate World Bank Purchasing Power Parity conversion factor for Iran around mid-2022 to early 2023 (approximately 1 USD ≈ 12,500 IRR), acknowledging significant year-to-year fluctuations. SPSS version 20 (IBM Corp, Armonk, NY) was used for statistical analysis, employing paired t-tests to compare 2022 and 2023 values. Additional sensitivity analyses varied prevalence (±10%) and costs (±20%). Estimates were validated against a 2023 Iranian meta-analysis (8).

Qualitative Component Participants

Unadjusted (direct GBD 2021 extrapolated) lifetime infertility prevalence was 11.8% (95% CI: 11.2–12.4) in 2022 and 12.0% (95% CI: 11.4–12.6) in 2023. Under sensitivity scenarios for regional factors, prevalence could range up to 12.9% in underserved areas. Unadjusted DALYs per 1,000 population were 17.4 (95% CI: 16.1–18.7) in 2022 and 18.1 (95% CI: 16.7–19.5) in 2023 ($P = 0.04$). In sensitivity scenarios, DALYs ranged up to 20.2 per 1,000. In 2023, women experienced a higher burden (unadjusted: approximately 19.6 vs. men 15.6 per 1,000; $P = 0.03$). Outpatient costs increased from a mean of $620 per cycle (range: $500–$740) in 2022 to $680 (range: $550–$810) in 2023; an absolute increase of $60 and a 9.7% rise ($P = 0.01$).

Data Collection

Semi-structured interviews, conducted in Persian from May 1–June 15, 2025 (20–30 minutes), were audio-recorded with informed consent. The guide (adapted from Hasanpoor-Azghdy et al. (12)) included open-ended questions such as:

- "What are the main financial costs patients face per treatment cycle?"
- "How far do patients typically travel for infertility care, and what barriers do they encounter?"
- "How does infertility affect social standing or family relationships?"

Although collected in 2025, questions explicitly focused on experiences during 2022–2023 to reflect the study period. Recall bias was minimized by cross-referencing patient reports with provider records.

Data Analysis

Transcripts were translated (20% back-translated, <2% discrepancy) and analyzed using Braun and Clarke's framework (21), Combining inductive (data-driven) and deductive (guide-informed) coding. Two researchers independently coded 30% of transcripts (Cohen's kappa = 0.85); discrepancies were resolved by consensus. NVivo 12 facilitated coding and theme organization.

Data Integration

Quantitative and qualitative findings were merged using a joint display matrix (presented in Results, Table 1). This side-by-side format mapped GBD metrics (e.g., DALYs, costs) to qualitative themes (e.g., emotional toll, financial strain), identifying convergence (e.g., cost increases aligning with asset sales) and divergence (e.g., psychosocial impacts exceeding DALY estimates) (22).

Results

Quantitative Findings

Infertility Burden: Unadjusted (direct GBD 2021 extrapolated) lifetime infertility prevalence was estimated at 11.8% (95% CI: 11.2–12.4) in 2022 and 12.0% (95% CI: 11.4–12.6) in 2023. Under the sensitivity scenarios described in the Methods, the estimated lifetime prevalence ranged from 11.8–12.7% in 2022 to 12.0–12.9% in 2023. Unadjusted DALYs per 1,000 population were 17.4 (95% CI: 16.1–18.7) in 2022 and 18.1 (95% CI: 16.7–19.5) in 2023 (P = 0.04). Under sensitivity scenarios, DALYs ranged from 17.4–19.4 in 2022 to 18.1–20.2 in 2023. In 2023, women experienced a higher burden (unadjusted: 19.6 vs. 15.6 per 1,000 for men; P = 0.03).

Outpatient Treatment Costs: Outpatient costs were limited to hormonal therapies (e.g., clomiphene, gonadotropins); travel, diagnostic, and procedural costs were not included. Unadjusted costs increased from a mean of $620 per cycle (range: $500–$740) in 2022 to $680 (range: $550–$810) in 2023; an absolute increase of $60 and a 9.7% rise (P = 0.01). The wide ranges reflect variability in drug type, dosage, and regional pricing reported in national studies. Insurance covered 35% of costs, leaving 65% out-of-pocket ($403 in 2022; $442 in 2023). Approximately 19% of patients (95% CI: 15–23%) had no insurance coverage. Additional sensitivity analyses (±20% on costs) produced ranges of $496–$744 in 2022 and $544–$816 in 2023.

Qualitative Findings

Interviews with 10 purposively sampled stakeholders (five providers: three gynecologists, two general practitioners; five patients) from Zabol University of Medical Sciences facilities in Sistan identified four key themes. This focused composition (providers and patients only) allowed in-depth exploration of clinical and lived experiences; inclusion of additional groups (e.g., midwives, policymakers, psychologists) is recommended for future research. Thematic saturation was achieved after the eighth interview, with the final two confirming no new themes.

1. ***Financial Strain**:* Severe economic pressure dominated narratives ("$600 per cycle is half our monthly income—we sold livestock" [P4]; "Families borrow heavily, often delaying care" [HCP2]).
2. ***Access Barriers**:* Long distances and specialist shortages were recurrent ("100 km to the nearest clinic, $50 per trip, monthly" [P5]; "Patients wait months for referrals" [HCP3]).
3. ***Social Stigma**:* Women faced disproportionate blame ("I'm nothing without a child—my husband's family blames me" [P3]; "Women bear the shame even when it's male-factor" [HCP1]).
4. ***Emotional Toll**:* Repeated failures caused profound distress ("Each failed cycle is

devastating; I've lost hope" [P1]; "The stress is unbearable; it's ruined our marriage" [P5]).

Integrated Findings: Quantitative and qualitative data were triangulated using a joint display matrix (Table 1), highlighting convergence and divergence.

Table 2. Joint Display of Quantitative and Qualitative Findings

Domain	Quantitative (2022–2023)	Qualitative Theme	Illustrative Quote	Insight
Overall Burden	Unadjusted DALYs: 17.4 → 18.1 per 1,000 (P = 0.04); up to 20.2 in high-impact sensitivity scenarios	Emotional Toll, Access	"Each failed cycle is devastating" [P1]	Psychosocial burden appears substantial and not fully captured by DALY metrics
Economic Burden	Costs: \$620 → \$680 per cycle (+9.7%, \$60 absolute increase, P = 0.01)	Financial Strain	"\$600 is half our income—we sold livestock" [P4]	Rising costs drive asset sales and debt
Insurance Gap	35% coverage; 65% out-of-pocket	Financial Strain	"Families borrow heavily, often delaying care" [HCP2]	Inadequate insurance coverage exacerbates economic hardship
Gender Disparity	Women higher burden (unadjusted: approx. 19.6 vs. men 15.6 DALYs per 1,000; P = 0.03)	Social Stigma	"I'm nothing without a child—my husband's family blames me" [P3]	Women experience greater burden and disproportionate blame
Access Barriers	Explored via sensitivity scenarios for lower clinic density and distance	Access Barriers	"100 km to the nearest clinic, \$50 per trip, monthly" [P5]	Geographic distance and specialist shortages amplify cost and delay

Note: Quantitative values are primarily based on unadjusted GBD 2021 estimates. Where ranges or upper bounds are mentioned, they reflect plausible high-impact sensitivity scenarios for regional contextual factors (demographic, healthcare access, and environmental) in underserved arid areas, rather than definitive adjustments.

Discussion

This study presents unadjusted GBD 2021-based estimates, along with scenario-based sensitivity analyses, of the infertility burden in Iran for 2022–2023. Unadjusted lifetime infertility prevalence was 11.8% (95% CI: 11.2–12.4) in 2022 and 12.0% (95% CI: 11.4–12.6) in 2023. Unadjusted DALYs per 1,000 population increased from 17.4 (95% CI: 16.1–18.7) in 2022 to 18.1 (95% CI: 16.7–19.5) in 2023 (P = 0.04). Outpatient treatment costs rose from a mean of \$620 per cycle (range: \$500–\$740) in 2022 to \$680 (range: \$550–\$810) in 2023 (9.7% increase, P = 0.01), with 65% out-of-pocket expenditure. Qualitative findings from stakeholder interviews identified four main themes: financial strain, access barriers, social stigma, and emotional toll.

Comparative Analysis with Prior Studies

Unlike earlier national-level studies that reported lifetime prevalence of 11.3% without subnational detail (23, 24), our adjusted estimates suggest higher burdens in arid, underserved areas, potentially associated with environmental stressors (e.g., dust storms) and limited healthcare access. This is consistent with older national estimates of 10.9–20.2% but underscores rural–urban disparities not previously quantified; a pattern observed across multiple conditions in Iran, including dental caries and oral disorders (25), breast cancer (26), transport injuries (27), and type 2 diabetes (28), as well as in rural Indian settings (29, 30). The significant DALY increase and gender gap (women 20.5 vs. men 16.3 per 1,000; P = 0.03) align with global and national trends showing women bearing higher burdens for numerous conditions (3, 31-34). Our cost estimates exceed regional benchmarks of \$500–\$600 (35), reflecting Iran-specific inflation and low insurance coverage, in contrast to urban-focused analyses (18). Qualitatively, Hasanpoor-Azghdy et al. identified stigma(12), yet our findings reveal its interplay with financial distress and access barriers, illustrating a broader socioeconomic impact also seen in high-burden chronic diseases in Iran (34) and rural Punjab (36).

Globally, similar patterns emerge in deprived arid regions. For example, environmental pollutants in Egypt's Nile Delta contribute to higher infertility prevalence among marginalized women (37), while in northwestern Nigeria, psychosocial morbidity from infertility mirrors the family pressures observed in Iran (38). These international comparisons, alongside GBD evidence of higher infertility burdens in low- and middle-SDI regions (6, 33, 39-41), reinforce our findings that infertility burdens in resource-limited arid settings like Sistan are amplified by environmental, social, and economic factors also observed in other low-SDI and rural environments worldwide.

Practical Implications for Policymakers

Findings indicate a persistently high infertility burden in Iran, with implications for national pronatalist policies and provincial resource allocation in underserved regions. The 65% out-of-pocket expenditure and inadequate insurance coverage (35%) highlight the need for expanded reimbursement mechanisms; however, any increase would require formal cost-effectiveness and budgetary impact analyses before implementation. Similarly, clinic scarcity and long travel distances suggest potential value in piloting targeted infrastructure improvements or tele-fertility services in high-burden provinces, again subject to feasibility and economic evaluation. Community-level stigma-reduction programs, adapted from successful models in South Asia and the Middle East (30) could complement clinical efforts and support reproductive health equity.

Scientific and Methodological Contribution

By integrating GBD-derived metrics with qualitative narratives, this study demonstrates that qualitative data reveal substantial psychosocial impacts not fully captured by DALY estimates. Regional adjustments and joint-display triangulation provide a replicable framework for refining global datasets in data-scarce settings, advancing mixed-methods applications in burden-of-disease research (42).

Limitations

Several limitations should be noted. Regional adjustments carry uncertainty due to reliance on indirect proxies and literature-based percentages rather than primary exposure data. The exact magnitude of the sensitivity scenario percentages remains inherently uncertain due to the absence of direct, primary exposure data for Sistan and reliance on indirect literature-based evidence. These values were selected as plausible illustrative ranges informed by the general direction and approximate scale of associations reported in the cited studies, rather than being derived from region-specific quantitative modeling or primary data collection. The qualitative sample was small (n = 10) and purposively selected from one province, limiting generalizability; recall and social-desirability biases are possible given retrospective reporting. The cross-sectional design limits causal inference. Indirect costs (travel, lost wages, diagnostics) and long-term outcomes were not quantified. Finally, reliance on GBD 2021 (the most recent version with subnational Iranian data at the time of analysis) may not reflect post-2021 changes; newer iterations, when available, should be incorporated in future work.

Future Research Directions

Future studies should quantify indirect costs through household surveys, establish causal links between dust-storm exposure and fertility outcomes via prospective cohorts with air-quality monitoring, and use validated instruments (e.g., Depression Anxiety Stress Scales (43)) in larger, multi-provincial samples. Pilot interventions (e.g., subsidized tele-consultations) with embedded economic evaluation would provide evidence for scalable solutions.

Conclusion

Infertility in Iran represents a persistently high public health concern with epidemiological, economic, and psychosocial dimensions. The convergent parallel mixed-methods approach presented here offers a robust, transferable model for burden estimation in similar data-limited contexts. It underscores the need for context-sensitive, evidence-informed reproductive health policies.

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Authors' Contribution

F.M, and SP.H conceptualized the study, conducted the research, wrote the manuscript, and approved the final version of the manuscript.

Ethics Approval and Consent to Participate

The study was approved by the Research Ethics Committee of Zabol University of Medical Sciences (IR.ZBMU.REC.1402.030). All participants provided written informed consent.

Conflict of Interest

There are no conflicts of interest.

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