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The trend in male-to-female ratio at birth from 2005 to 2022 in Georgia

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Abstract

This study examines the impact of family planning and abortion policy changes (2006, 2010, 2014) on Georgia's male-to-female birth ratio. Using data from 920,803 live births (2005–2022), we calculated annual male-to-female ratios per 100 females by region and birth order, assessing trends with linear regression. In 2005, the overall male-to-female ratio was 113.0, declining to 107.2 by 2022. The imbalance was most pronounced in third or higher-order births (from 145.7 in 2005 to 114.3 in 2022), and lowest among first births (109.1 to 107.3). Regionally, Kakheti had the highest ratio (123.1). Notably, after 2014, the ratio declined significantly across all regions and birth orders. These findings suggest that policy interventions were associated with a reduction in sex-selective practices and a gradual move toward a more natural sex ratio at birth in Georgia. *(Afr J Reprod Health 2026; 30 [14] 19-25).*

Keywords: Sex-selective abortions; birth ratio imbalance; sex ratio at birth; family planning; reproductive policy impact

Résumé

Cette étude examine l'impact des changements de politique en matière de planification familiale et d'avortement (2006, 2010, 2014) sur le ratio masculin/féminin des naissances en Géorgie. À partir des données de 920 803 naissances vivantes (2005–2022), nous avons calculé les ratios annuels masculins/féminins pour 100 femmes par région et par ordre de naissance, en évaluant les tendances à l'aide de la régression linéaire. En 2005, le ratio masculin/féminin global était de 113,0, déclinant à 107,2 en 2022. Le déséquilibre était le plus prononcé pour les naissances de troisième ou d'ordre supérieur (passant de 145,7 en 2005 à 114,3 en 2022), et le plus faible pour les premières naissances (109,1 à 107,3). Régionalement, la Kakhétie avait le ratio le plus élevé (123,1). Il est à noter qu'après 2014, le ratio a diminué de manière significative dans toutes les régions et pour tous les ordres de naissance. Ces résultats suggèrent que les interventions politiques ont été associées à une réduction des pratiques de sélection du sexe et à un mouvement progressif vers un ratio sexuel plus naturel à la naissance en Géorgie. *(Afr J Reprod Health 2026; 30 [14]:19-25).*

Mots-clés: avortements sélectifs selon le sexe ; déséquilibre du ratio à la naissance ; ratio de sexe à la naissance ; planification familiale ; impact des politiques de reproduction

Introduction

The natural male-to-female ratio at birth typically falls between 105 and 106 male births for every 100 female births, assuming no manipulation.[1] Any significant deviation from this natural ratio may indicate the presence of gender-biased sex selection (GBSS).[1-2]

Globally, elevated sex ratios at birth (SRB) have been most prominently observed in East and South Asia, where cultural, economic, and social pressures for male offspring have historically shaped reproductive behaviors. In China, the implementation of the one-child policy alongside the availability of ultrasonography in the 1980s contributed to SRB levels exceeding 120 male births per 100 female births during the early 2000s. In India, the combination of deeply rooted patriarchal norms and accessible sex-determination technologies led to regional SRB levels reaching 110–120, despite national legislation prohibiting prenatal sex selection. South Korea, once experiencing SRB levels over 113 in the 1990s, has since demonstrated a successful normalization

toward natural levels due to coordinated policy interventions, legal enforcement, and public awareness campaigns.[3-4]

Beyond East Asia, the South Caucasus region - including Armenia, Azerbaijan, and Georgia - emerged in the 1990s as one of the few non Asian regions exhibiting comparable SRB imbalances. In these countries, declining fertility, entrenched son preference, and improved access to prenatal diagnostic tools contributed to SRB levels rising above natural thresholds. Armenia recorded SRBs as high as 115–120, Azerbaijan surpassed 116, and Georgia reached 114.9 male births per 100 female births in 2004, positioning the region among global outliers.[5-6]

Up until the early 1990s, Georgia's male-to-female ratio at birth remained within natural bounds due to a lack of access to reproductive sex-detection tools such as prenatal sonography and relatively high fertility. However, beginning in 1992, the ratio began to deviate significantly, reaching a peak of 114.9 male births per 100 female births in 2004, positioning Georgia among the countries with the most pronounced gender imbalances at birth.[7]

Policies regarding family planning and abortion in Georgia have changed over the last two decades. The main changes began in 2006, which limited legal abortion to up to 12 weeks of pregnancy.[8-13] In 2010, the regulation was updated to permit voluntary termination of pregnancy only in certified medical institutions, conducted by a certified doctor. Additionally, a preliminary consultation became mandatory, and a waiting period of 3 days was introduced.[9] Later in 2014, the legislation prohibited the disclosure of the fetus's sex during the early stages of pregnancy (up to 12 weeks). Abortion could be extended to 22 weeks only by special medical or social indication, which required approval from the Ministry of Health and Social Affairs of Georgia. Terminating pregnancy based on the fetus's sex is strictly prohibited. The waiting period after the voluntary termination approval increased from 3 days to 5 days in 2014,[10] and in November 2023, a new law set to take effect in 2024 introduced mandatory psychosocial and social consultations before an abortion.[11]

Despite these regulatory efforts, no comprehensive evaluation has been conducted to determine the effectiveness of these policy changes in reducing gender-biased sex selection and normalizing the male-to-female ratio. This study represents the first nationwide analysis of live birth registrations in Georgia over an extended period, combining quantitative and ongoing qualitative research to explore the policy impact and contributing factors. This approach provides a novel contribution to the existing literature by integrating demographic trends, legislative changes, and healthcare system responses.

This study aims to assess whether the legal and policy shifts introduced since 2005 have led to a normalization of the male-to-female ratio at birth, using national birth registration data from 2005 to 2022.

The analysis of 920,803 live births recorded in Georgia from 2005 to 2022 revealed a general downward trend in the male-to-female ratio at birth across Georgia. Nationally, the ratio decreased from 113.0 in 2005 to 104.4 in 2016, with a slight increase to 108.3 in 2020–2022, but it remained significantly lower than the peak observed in the early 2000s.

The highest male-to-female ratio was recorded in Kakheti in 2005 (123.1), with the lowest recorded in Guria (103.8). By 2022, six regions had a male-to-female ratio at or near the natural ratio, while three regions (Kakheti, Samtskhe-Javakheti, and Guria) continued to report elevated ratios. The highest ratios were observed among third and subsequent births, with a peak of 145.7 in 2005, which declined to 114.3 in 2022.

These findings suggest that the changes in family planning policies in Georgia since 2006 have had a positive effect in reducing the male-to-female ratio at birth, bringing it closer to the natural ratio. These measures, such as restricting early disclosure of fetal sex and mandating pre-abortion consultations, have contributed to reducing gender imbalances at birth. However, the persistence of elevated ratios in some regions suggests that further efforts are needed to address cultural and regional factors contributing to gender-biased sex selection.

Methods

All live births in Georgia are recorded by the national vital statistics system, with approximately

98 percent of births occurring in health facilities. These data are centralized in the National Birth Registry.[12] By 2005, the system's coverage was nearly complete, making it a reliable data source for longitudinal analysis. For this study, we analyzed 920,803 live births recorded between 2005 and 2022. Data prior to 2005 were excluded due to incomplete reporting, and births from the occupied territories were not included because data from those regions were unavailable. For each recorded birth, information was extracted on the child's gender, year of birth, region of birth (classified into 11 regions: Tbilisi, Adjara, Guria, Imereti, Mtskheta-Mtianeti, Kakheti, Racha-Lechkhumi and Kvemo Svaneti, Samegrelo-Zemo Svaneti, Samtskhe-Javakheti, Kvemo Kartli, and Shida Kartli), and birth order (first, second, or third and above). We calculated the annual male-to-female ratio at birth per 100 female births overall, and separately by region and birth order. These ratios were compared to the natural baseline ratio of 105. Annual trends and subgroup patterns were analyzed using linear regression models.

To analyze temporal trends and subgroup differences in the sex ratio at birth, linear regression models were employed. The dependent variable in the model was the sex ratio (number of male births per 100 female births), while independent variables included year (as a continuous variable), region, and birth order (both treated as categorical variables with appropriate reference categories). Model fit was evaluated using the coefficient of determination (R^2), which quantifies the proportion of variance in the sex ratio explained by the model. Statistical significance of the predictors was assessed at the 0.05 alpha level (p-value < 0.05). Additionally, 95% confidence intervals were calculated for each regression coefficient to provide a measure of estimate precision.

The natural sex ratio at birth, commonly established at approximately 105 males per 100 females, is a well-documented biological phenomenon observed consistently across human populations.[1-14-15] There is no evidence to suggest that this biological norm differs significantly for the Georgian population. Therefore, this ratio serves as an appropriate reference point for analyzing birth sex ratios in Georgia. Deviations from this baseline were interpreted as potential indicators of artificial factors influencing sex-selective practices.[4-7-16] The use of the natural baseline ratio of 105 males per 100 females at birth in this study provides a standard benchmark for identifying and evaluating potential deviations in Georgia's male-to-female birth ratio.

The sex ratio at birth (SRB) was computed annually by dividing the total number of male live births by the total number of female live births, then multiplying the quotient by 100. This calculation method adheres to established demographic conventions as documented in previous studies.[14-16] The SRB was further stratified by region and birth order to enable subgroup analyses. Temporal trends in SRB were evaluated using linear regression models, adjusting for these subgroup factors. Statistical significance of temporal changes was determined by the regression coefficient associated with the year variable, with the 95% confidence interval providing an estimate of the precision of this effect.

All analyses were performed using R and Microsoft Excel.As the data used were anonymized and publicly available through the National Statistics Office of Georgia,[12-18] the study did not require institutional review board approval. No personal identifiers were included in the dataset, and there were no conflicts of interest.

Results

The analysis of 920,803 live births revealed a general downward trend in the male-to-female ratio at birth across Georgia. Nationally, the ratio decreased from 113.0 in 2005 to 104.4 in 2016 (Figure 1). Although a slight increase was observed thereafter, with the ratio rising to 108.3 during the 2020–2022 period, the overall trend remained significantly lower than the early 2000s peak. In 2005, the highest male-to-female ratio was recorded in Kakheti at 123.1, while the lowest was in Guria at 103.8 (Figure 1). In the same year, 9 out of 11 regions had ratios above the natural range, varying between 110.0 and 123.1. By 2022, six regions had ratios at or near the natural level, two additional regions had nearly normalized values, while three - Kakheti (113.0), Samtskhe-Javakheti (119.7), and Guria (115.8) - continued to exhibit elevated ratios. When disaggregated by birth order

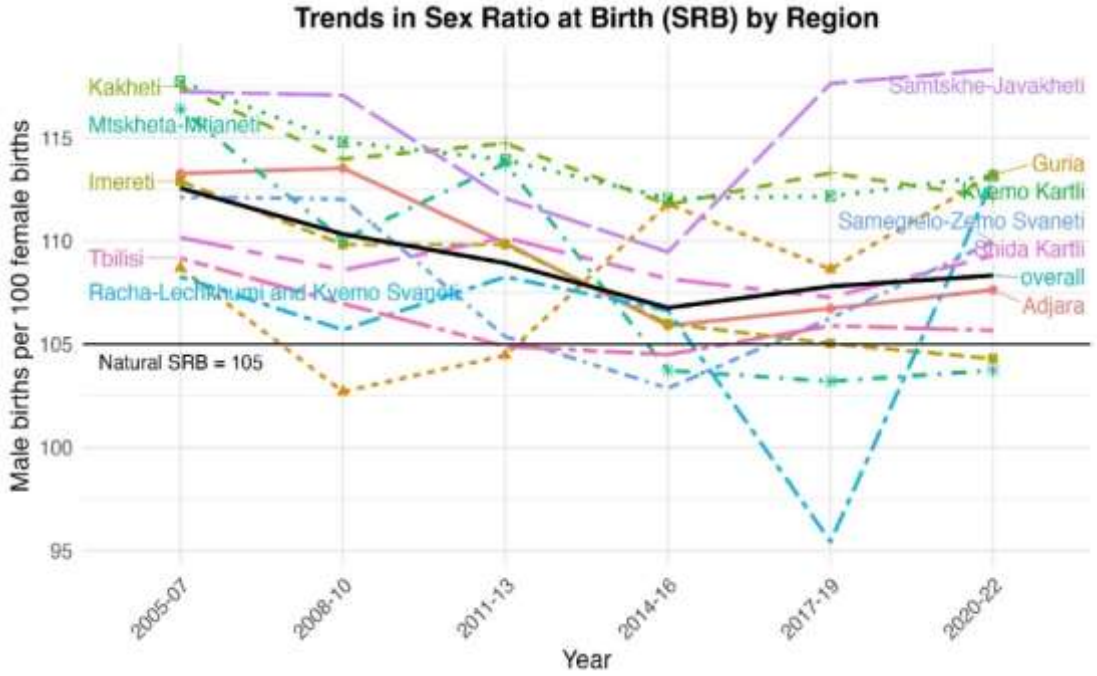

Figure 1: Male-to-female birth ratio overall and by region, 2005-2022

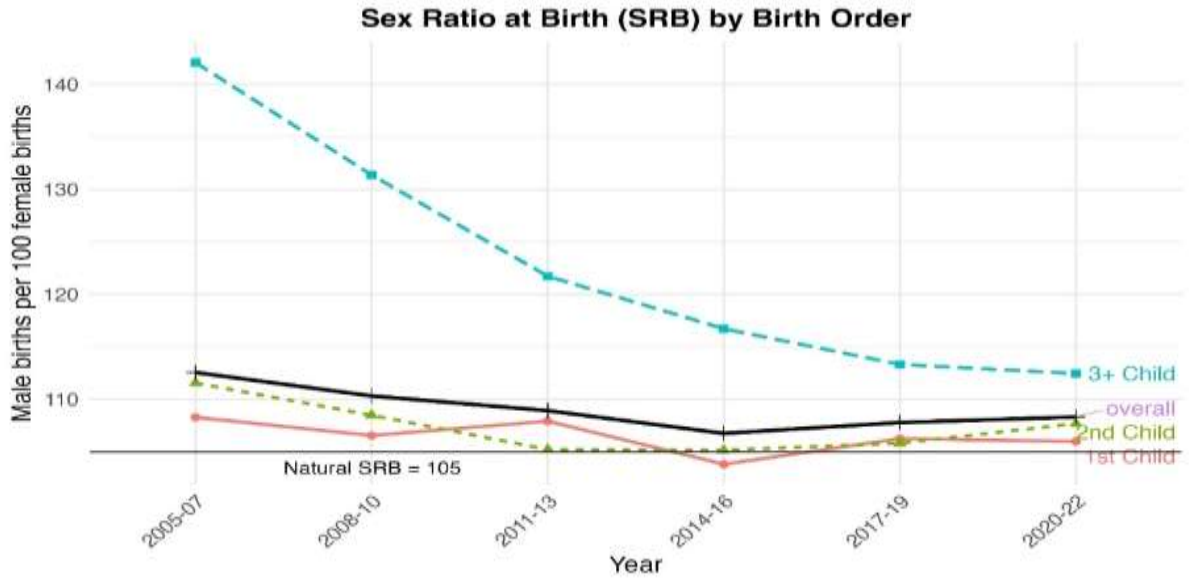

Figure 2: Male-to-female birth ratio by birth order, 2005-2022

(Figure 2), the highest male-to-female ratios were consistently found among third and higher-order births. In 2005 , this group exhibited a peak ratio of 145.7, which declined to 114.3 by 2022. First-order births remained closest to the natural norm, with the ratio ranging from 109.1 to 107.3 during the study period. Notably, even in 2022, first-order births in Kakheti continued to display elevated ratios (113) (Figure 3).

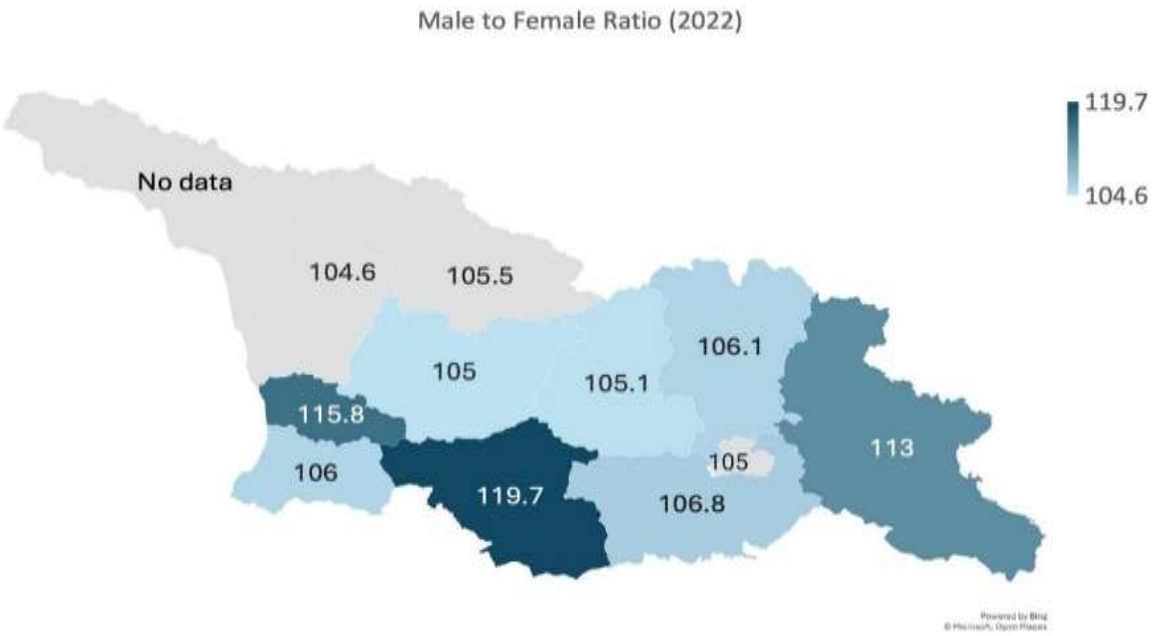

Figure 3: Spatial distribution of male-to-female birth ratio in 2022

Discussion

The findings of this study indicate that the male-to-female ratio at birth in Georgia has declined significantly since 2005, with marked improvements following the 2014 policy changes. These results suggest that interventions aimed at limiting access to sex-selective abortions - such as restricting early disclosure of fetal sex, mandating pre-abortion consultations, and reinforcing legal boundaries for abortion - were associated with reduced gender imbalances at birth. Georgia's legislative framework has also evolved more broadly to promote gender equality. The country's Constitution explicitly guarantees gender equality and prohibits discrimination, while the 2010 Law on Gender Equality obligates the state to ensure equal participation of men and women in all spheres of public life. These structural reforms may have contributed to shifting societal attitudes and decreasing the preference for male children, thereby curbing the practice of sex-selectiveabortion.

Despite this progress, regional disparities persist. In 2022, three regions - Kakheti, Samtskhe-Javakheti, and Guria - continued to report male-to-female ratios above the natural threshold. These patterns may reflect underlying cultural or economic dynamics, particularly in rural or socioeconomically disadvantaged areas where traditional gender roles are more deeply embedded. Prior research has shown that such communities are more likely to exhibit son preference and may be slower to adopt normative changes in reproductive behavior.

The consistently elevated ratios among third and higher-order births also merit attention. This pattern is suggestive of a phenomenon observed in other countries with strong son preference, wherein families continue childbearing until a male child is born. This behavior highlights the importance of family composition preferences in shaping reproductive decisions and suggests that policy efforts must be sensitive to intra-family dynamics.

This study has three limitations. First, it did not include individual or household-level data, such as parental education, economic status, or cultural attitudes, which could provide deeper insight into the observed patterns. Second, data from occupied territories were not included, which may slightly bias the national estimates. Third, our analysis was limited to live births, excluding other pregnancy outcomes such as stillbirths and miscarriages, which might also influence the sex ratio at birth. Nevertheless, this study provides a comprehensive and long-term view of birth ratio trends in Georgia,

demonstrating the potential effectiveness of policy interventions in addressing gender-biased sex selection. The reduction in the national male-to-female birth ratio is a promising sign, but continued efforts are required to address the persistent disparities in specific regions and among higher-order births. Future interventions should include educational campaigns, community engagement, and qualitative research to further understand and address the root causes of son preference in Georgian society.

Strengths and limitations

This study represents the initial phase of a broader research project. The current quantitative analysis identifies an association subsequent to the introduction of regulatory measures, primarily focusing on changes in the sex ratio at birth (SRB), employed here as a population-level proxy indicator for underlying sex-selective abortion practices.[1-14]

This approach is grounded in well-established biological and demographic evidence demonstrating that, under natural conditions, the SRB remains remarkably stable at approximately 105 male births per 100 female births.[15-16] Nevertheless, the SRB constitutes an indirect measure; it does not capture individual-level sex-selective abortion decisions or behaviors, and observed variations may be influenced by additional biological, environmental, or demographic factors beyond regulatory interventions.[1-14]

Future research

Building on these initial quantitative findings, the continuation of this study will focus on qualitative investigations to deepen understanding. This includes engaging healthcare professionals: gynecologists and radiologists with experience begore and after the 2014 regulatory reforms. Such qualitative methods, including focus group discussions and in-depth interviews, will help elucidate the pathways through which regulatory measures, clinical practices, social norms, and awareness levels interact, thereby providing clearer insights into causal mechanisms that quantitative data alone cannot fully capture.

Author's contributions

Khatia Otarashvili conceptualized and designed the study, conducted the literature review, performed data collection and analysis, and drafted the manuscript. Ali Mirzazadeh supported interpretation of results and manuscript revision. Eka Paatashvili assisted in policy analysis. All authors reviewed, commented on, and approved the final version of the manuscript and are equally accountable for all aspects of the work.

Data availability and ethical considerations

The quantitative data used in this study - specifically, the sex ratio at birth (SRB) statistics in Georgia- are publicly available from the National Statistics Office of Georgia (Geostat).[12] In accordance with Geostat's official data usage policy, users are permitted to download, use, disseminate, copy, and share statistical data, metadata, and official publications for both commercial and non-commercial purposes without prior permission, provided that Geostat is cited as the source.[18] These datasets are anonymized and publicly accessible through the Geostat website, ensuring that their use does not compromise confidentiality or violate ethical standards. Therefore, no ethical approval was required for the analysis of the quantitative data.

Conflict of interests

The authors declare no conflicts of interest.

Acknowledgments

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