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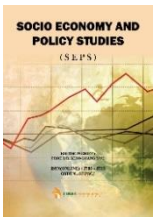

RESEARCH ARTICLE

MAPPING GENDER INEQUALITY IN NIGERIA: A META-ANALYTIC AND SPATIAL APPROACH TO POLITICAL, EDUCATIONAL, AND LABOUR DISPARITIES

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ABSTRACT

This study investigates the multidimensional nature of gender inequality across Nigeria's 36 states and the Federal Capital Territory, focusing on disparities in political representation, educational attainment, and labour force participation. By employing gender ratios and composite indicators such as the Gender Inequality Index (GII) and Gender Equality Index (GEI), the analysis reveals entrenched structural disparities. Political representation exhibits the greatest imbalance, with a national average gender ratio of only 9.78%, ranging from 16.8% in the South East to 4.41% in the North West. Educational attainment records a higher average gender ratio of 69.79%, but significant regional inequities persist, especially in the North West and North East. Labour force participation presents a nuanced picture, with higher female ratios in some northern states but without corresponding educational or political inclusion. The analysis further reveals significant heterogeneity across states, as evidenced by a high τ^2 of 128,239,554.78 and I^2 of 99.96%, indicating systemic, rather than random, variability. The GII highlights pronounced disparities, with values ranging from 18,177 in Sokoto to 213,992 in Enugu. Using random-effects meta-analysis, correlation matrices, choropleth maps, radar charts, and ratio-based plots, the study provides a comprehensive visual and statistical understanding of gender gaps. Key policy recommendations include enforceable gender quotas, education-to-employment pathways, regional strategies, robust gender data systems, civic awareness campaigns, legal reforms, and digital/financial inclusion initiatives. The findings call for integrated, data-driven, and context-sensitive policies to advance SDGs 5 and 10 and promote inclusive national development.

KEYWORDS

Meta-Analysis, Political Representation, Labour Force Participation, Education, Gender Ratios, SDG 5

1. INTRODUCTION

The issue of gender inequality in Nigeria has emerged as a critical area of research, shaped by historical, cultural, and socio-economic factors that have developed over centuries. Scholars have traced the roots of gender inequality back to the past 5,000 to 8,000 years, particularly highlighting the transition from nomadic to agricultural societies that established male dominance (Ogwu, 1996). This historical development has led to persistent power imbalances, with men predominantly occupying roles in hunting and warfare, which subsequently evolved into cultural practices that have entrenched gender disparities. The significance of understanding these origins has been emphasized as essential for addressing contemporary gender inequality.

In Nigeria, prevailing cultural and religious beliefs have contributed to the perception of women as inferior, particularly in spheres such as politics and education (Green, 2006). Despite a historical context where gender roles were more balanced evidenced by women's active participation in governance and land ownership before colonial interventions, the imposition of rigid gender roles during colonialism has had lasting effects. The marginalization of women, despite their contributions to decolonization efforts, has been noted in various studies, which highlight the continued underrepresentation of women in both political and economic domains in post-independence Nigeria (Aluko, 2008; Enyioko, 2021). Current statistics indicate that women constitute 50.5% of Nigeria's workforce; however, they remain underrepresented in formal sectors and frequently encounter wage disparities, reflecting colonial-era beliefs about gender productivity (Aro, 2022; Agbalajobi, 2010; Jaiyeola and Aladegbola, 2020). This ongoing inequality illustrates how historical legacies have shaped the socio-political status of women in Nigeria, maintaining structures that hinder progress toward gender parity.

Recent studies have explored various dimensions of gender inequality and its implications for economic and social development. For example, highlighted the role of Information and Communication Technology (ICT) in mitigating gender inequality and its subsequent impact on income inequality across diverse countries (Shah and Krishnan, 2024). Similarly, found a correlation between gender equality and increased entrepreneurial activity, emphasizing that gender-equal environments foster economic opportunities (Rietveld and Patel, 2022). The persistence of gender inequality, despite significant progress in various sectors, has prompted a need for meta-analyses that consolidate findings from multiple studies. Such analyses can provide a comprehensive understanding of the factors influencing gender inequality in Nigeria, paving the way for effective policy interventions and promoting inclusive growth. By examining the interplay of socio-cultural, economic, and historical elements, this study aims to contribute to the discourse on gender inequality in Nigeria, offering insights that can inform strategies for sustainable development and social equity.

Gender inequality in Nigeria is a persistent issue rooted in historical, cultural, and socio-economic factors that have marginalized women for centuries. As noted, the origins of gender inequality can be traced back thousands of years, particularly with the advent of agricultural societies that established male dominance (Ogwu, 1996). This historical context is essential for understanding contemporary dynamics, as traditional views continue to inform societal attitudes towards women, particularly in

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politics and education (Green, 2006). Despite a historical balance between genders before colonialism, the imposition of rigid gender roles during this period disrupted women's participation in governance and economic activities (Aluko, 2008; Enyioko, 2021).Today, while women represent a significant portion of Nigeria's workforce, they remain underrepresented in formal sectors, often facing wage disparities rooted in longstanding colonial-era beliefs (Aro, 2022; Agbalajobi, 2010). This ongoing marginalization reflects the legacy of colonialism, which entrenched gender disparities and undermined women's socio-political status (Anigwe, 2014). Recent studies, such as those, indicate that despite women's contributions, factors like geography and marital status further exacerbate income inequality (Adeosun and Owolabi, 2021).

The relationship between gender inequality and sustainable development has gained significant scholarly attention across multiple domains, including economics, ICT, health, education, law, and governance. They conceptualized Information and Communication Technology (ICT) as an institutional actor and found through cross-lagged panel analysis across 86 countries that ICT helps reduce gender inequality (SDG 5), which subsequently contributes to lowering income inequality (SDG 10) (Shah and Krishnan, 2024). This ICT-gender-income nexus was context-dependent, varying by development level. Similarly, demonstrated that gender equality is positively correlated with entrepreneurial activity using Global Entrepreneurship Monitor data from 97 countries (Rietveld and Patel, 2022). Their findings emphasized that opportunity-driven entrepreneurship, particularly among women, thrives in gender-equal environments, reinforcing the economic rationale for promoting gender inclusion.

They extended this discourse by using quantile regression to reveal that tourism significantly reduces gender inequality across most countries except in the lowest quantile of income where underdeveloped tourism limits impact (Mitra et al., 2023). They linked societal gender inequality to adolescent bullying across 46 countries, finding that national-level disparities influenced the prevalence and type of bullying, emphasizing the social dimension of gender inequity (Cosma et al., 2022). They highlighted how institutional framing in Sweden's forestry sector fails to challenge underlying masculine norms, thereby limiting women's meaningful inclusion despite surface-level gains in representation (Ville et al., 2023).

Institutional quality, especially the rule of law, also plays a key role. They identified that weak enforcement, corruption, and gender-biased legal frameworks underpin higher gender inequality (Barajas-Sandoval et al., 2023). They showed that individual beliefs and social perceptions perpetuate inequality in professional and domestic spheres, indicating that structural and perceptual barriers are interlinked (Gurieva et al., 2022). In China, found that structural gender inequality at macro, meso, and micro levels negatively affects mental health, highlighting the psychological cost of persistent inequality (Yang and Sun, 2023). They further illustrated that energy poverty disproportionately impacts women's health, due to gendered household roles, thus advocating for inclusive energy and health policy reforms (Zhang et al., 2023).

Focusing on India, demonstrated that despite economic advancement, gender gaps persist across health, education, and economic participation especially in labour force participation (Jose and Sivaraman, 2023). In Africa, showed that inclusive finance reduces gender inequality only when gender disparity is below a critical threshold (Xu et al., 2023). They, examining Pakistan, reported that financial development reduces gender inequality but paradoxically worsens poverty unless structural reforms, especially in education, are introduced (Kanat et al., 2023).

In Nigeria, they used Theil's entropy index and OLS regression to reveal that geography, education, and marital status are strong predictors of income inequality, especially among women (Adeosun and Owolabi, 2021). They highlighted persistent gender gaps in leadership despite increasing female participation (Ajemba, 2023). They examined Nigeria's patriarchal and colonial legacies, concluding that entrenched gender roles and systemic discrimination continue to hinder female empowerment (Makama, 2013; Jaiyeola and Isaac, 2020). Studies emphasized the ideological and technological threats to educational and workplace gender equality, especially amid the Fourth Industrial Revolution (Hu, 2023; Olatokun, 2021).

They critiqued the ineffectiveness of policy frameworks due to prevailing cultural and religious norms (Okongwu, 2021). They found that gender inequality in education and employment limits inclusive growth (Lawanson and Umar, 2019). They revealed that economic growth alone does not guarantee gender equality without targeted interventions(Godslove and Sandra, 2018). They showed that gender inequality in formal employment expands the informal sector in Africa, calling for international frameworks to prioritize women's inclusion (Joseph et al., 2022).

They critiqued patriarchal values in African culture and called for a reinterpretation of traditions to support gender equity (Bassey and Bubu, 2019). They analyzed the poverty-gender inequality nexus in Nigeria, finding strong correlations but no causality, urging inclusive and unbiased poverty reduction strategies (Ezenekwe and Umeghalu, 2021). They traced the historical trajectory of educational gender gaps in Sub-Saharan Africa, noting that structural inequality was exacerbated during colonialism but began narrowing post-independence (Baten et al., 2021). Lastly, found that gender inequality and governance interact to amplify poverty, emphasizing institutional reform as a dual remedy (Workneh, 2020). Collectively, these studies underscore that gender inequality is deeply rooted in structural, institutional, and perceptual systems. Addressing it requires a multidimensional approach involving legal reform, economic inclusion, educational access, and cultural change. These insights are foundational for the present study, which seeks to further explore the dynamics of gender inequality in Nigeria through quantitative and spatial analysis, integrating political, educational, and economic indicators.

Research on gender inequality has proliferated globally, yet there remains a notable gap in comprehensive meta-analyses specifically addressing the multifaceted nature of gender inequality in Nigeria. While studies like those provide insights into gender dynamics in other contexts, the unique cultural, economic, and historical factors influencing gender inequality in Nigeria require targeted investigation (Shah and Krishnan, 2024; Rietveld and Patel, 2022). Existing literature has yet to synthesize these findings to provide a nuanced understanding of the intersectionality of gender inequality in Nigeria. Motivated by this research gap, the present study seeks to conduct a meta-analysis on gender inequality in Nigeria, integrating diverse perspectives to inform policy and advocacy efforts aimed at promoting gender equity. By systematically reviewing existing literature, this study will contribute to a deeper understanding of the underlying causes and potential solutions to gender inequality in Nigeria, ultimately supporting sustainable development goals related to gender equality and economic empowerment. Therefore, the study aims to assess gender inequality in Nigeria by: computing average effect sizes of gender disparities in political representation, education, and labour force participation; evaluating variability in these disparities using the Q statistic; calculating gender ratios across key domains; and developing and analyzing a Gender Inequality Index (GII) to quantify overall gender imbalance in the country.

1.1 Conceptual Framework

This study is structured around three interrelated dimensions of gender inequality in Nigeria:

- Political Representation (Seats in Parliament)
- Educational Attainment
- Labour Force Participation

These variables serve as observed indicators used to estimate disparities through effect sizes, gender ratios, and composite indices (GII and GEI).

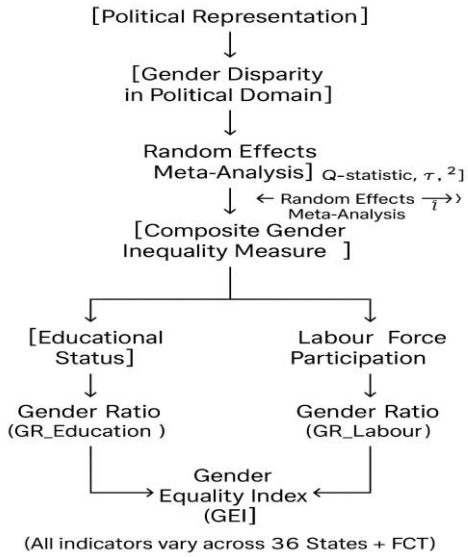

Figure 1: Graphical Representation of the Conceptual Framework

The conceptual framework presented in Figure 1 is designed to analyze gender inequality across Nigeria's 36 states and the FCT. It links three key domains political representation, educational attainment, and labour force participation through both individual and composite metrics. The design is grounded in two theoretical pillars:

The conceptual framework is rooted in:

- Social Equity Theory: This theory posits that equitable access to resources, opportunities, and institutional participation is fundamental to social justice (Rawls, 1971; Guy and McCandless, 2012). In this context, gender equity is achieved when men and women have proportionate representation and access to political, educational, and economic spaces.
- Capability Approach: Amartya Sen's framework argues that development should be assessed by the freedom individuals have to achieve outcomes they value (Sen, 1999). Here, gender inequality is not only a function of outcomes but also of unequal freedoms in attaining them such as unequal participation in governance, restricted access to quality education, or barriers to formal employment.

The framework integrates four analytical dimensions:

(i) Quantitative Synthesis through Meta-Analysis :Random-effects meta-analysis allows for the estimation of average effect sizes and heterogeneity across states, accounting for differences in contextual and methodological characteristics (Günhan et al., 2020; Jackson and Turner, 2017). This is critical for identifying non-random patterns of gender disparity in political representation.

(ii) Ratio-Based Diagnostics: Gender Ratios (GR) are computed for political seats, education levels, and labour force participation. These ratios serve as direct indicators of gender gaps in each domain.

(iii) Composite Evaluation Metrics

Two indices are used:

- Gender Inequality Index (GII): A multiplicative composite of gender ratios in political representation, education, and labour (Charmes et al., 2023).
- Gender Equality Index (GEI): The arithmetic mean of the three gender ratios.

(iv) Comparative Geopolitical Insights

The framework enables zone-based comparisons, revealing regional inequalities. For instance, while South East Nigeria shows high educational ratios, the North West demonstrates higher female labour participation but lower political and educational ratios.

This multidimensional framework:

- Reveals hidden disparities that single-variable analyses might miss.
- Facilitates evidence-based policy targeting by showing which states or zones need focused interventions.
- Supports gender advocacy by offering clear benchmarks for parity and inequality.
- Serves as a decision-making guide for institutions and government agencies involved in educational reform, labour market integration, and political inclusion of women.

2. Research Method

This section outlines the methodological framework employed in assessing gender inequality in Nigeria using secondary data from the National Bureau of Statistics in 2023. The analysis integrates advanced quantitative techniques, including random-effects meta-analysis, to synthesize effect sizes across states. Key gender-sensitive indicators political representation, educational attainment, and labour force participation were examined using effect size metrics, gender ratios, and composite indices, offering a multidimensional view of gender disparities nationwide.

2.1 Source of Data

In this research, secondary data was used for the study. Secondary data was collected from the National Bureau of Statistics Bulletin 2023. The variables considered include the Seats in the Parliament (SITP), Educational Status (ES), and Labour Force Participation Rate (LFPR).

2.2 Method of Data Analysis

2.2.1 Random-Effects Meta-Analysis

A meta-analysis is a statistical synthesis of findings from two or more independent studies (Günhan et al., 2020). Improved precision, the capacity to address issues not addressed by individual research, and the chance to resolve disputes resulting from contradictory assertions are some potential benefits of meta-analyses. Considering the variety of studies and possible variations within Nigerian states, this study would use a random-effects meta-analysis methodology. This approach is appropriate in cases when variations in populations, circumstances, or methodology lead to discrepancies in the genuine effect magnitude among studies. The random-effects model incorporates both within-study and between-study variance to account for heterogeneity, in contrast to a fixed-effects model that assumes that the impact size is constant across all studies.

To estimate the average effect size across studies while accounting for variability between studies (heterogeneity). We define the Effect Size and Variance as:

Let y_i be the observed effect size (e.g., mean difference, odds ratio) from the ith study, and let v_i be the variance of the effect size for the ith study.

2.2.2 Model Specification

The random-effects meta-analysis model according to the researchers can be specified as:

$$y_i = \theta + \epsilon_i \tag{1}$$

where:

θ is the true effect size (fixed effect).

ϵ_i is the random effect specific to the ith study, assumed to be normally distributed with mean zero and variance τ^2 (between-study variance) (Jackson and Turner, 2017).

The total variance of the effect size y_i is given by:

$$var(y_i) = \sigma_i^2 + \tau^2 \tag{2}$$

where:

σ_i^2 is the within-study variance (known as v_i).

$\tau^2$is the between-study variance (random effect variance).

2.2.3 Estimation of τ^2 (Between-Study Variance)

The estimation of τ^2can be done using various methods. The Restricted Maximum Likelihood (REML) method is commonly used. REML estimates τ^2 by maximizing the likelihood function of the model while accounting for the degrees of freedom associated with estimating the fixed effect (Günhan et al., 2020).

The REML estimator of $\tau^2$is given by:

$$\hat{\tau}^2_{REML} = \frac{\sum_{i=1}^{k} w_i (y_i - \hat{\theta})^2 - (k-1)\hat{\sigma}^2}{\sum_{i=1}^{k} w_i - \frac{\sum_{i=1}^{k} w_i^2}{\sum_{i=1}^{k} w_i}} \tag{3}$$

Where:

$w_i = \frac{1}{\sigma_i^2 + \tau^2}$is the weight for each study,

$\hat{\theta}$is the weighted average of the effect sizes

$\hat{\sigma}^2$is the estimated within-study variance

2.2.3.1 Estimation of the Overall Effect Size

The overall effect size$\hat{\theta}$ is estimated using the weighted average of the observed effect sizes:

$$\hat{\theta} = \frac{\sum_{i=1}^{k} w_i y_i}{\sum_{i=1}^{k} w_i} \tag{4}$$

2.2.3.2 Testing for Heterogeneity

The Q statistic is used to test for heterogeneity:

$$Q = \sum_{i=1}^{k} \; w_i \left(y_i - \hat{\theta}\right)^2 \tag{5}$$

The Q-statistic follows a chi-squared distribution with k−1 degrees of freedom, where k is the number of studies (Günhan et al., 2020). A significant Q-value suggests significant heterogeneity among the studies.

2.2.4 Gender Ratio

The Gender Ratio (GR) is a measure that indicates the relative proportion of females to males in a particular domain (Szadvári et al., 2023). It is often expressed as a percentage to illustrate how closely women's participation aligns with men's (Lindberg et al., 2010). A ratio of 100% indicates gender parity, where the number of females equals the number of males. Ratios below 100% indicate male dominance, while ratios above 100% show female dominance in that variable.

$$GR = \left(\frac{Number\ Female}{Number\ of\ Male}\right) \times 100 \quad (6)$$

This formula is used to compute the ratio for variables like political representation (Seats in Parliament), educational status, and labor force participation. Based on the purpose of the present study, this ratio would represent the proportion of female seats in the state parliament relative to male seats. A ratio significantly below 100% would highlight a strong gender disparity in political representation, with males holding the majority of positions. Also, the ratio will be used to compare the number of females to males who have attained a particular level of education (e.g., secondary or tertiary). It helps identify educational gaps and whether females are equally represented in the educational system. In addition, the ratio measures the number of females participating in the labour force relative to males. A lower ratio would indicate that fewer females are engaging in formal employment or job-seeking activities compared to males.

The decision rule is given as follows:

- Gender Ratio of 100%: This suggests that females are equally represented as males in the variable being measured. For example, if the educational status ratio is 100%, it means there is gender parity in educational attainment.
- Gender Ratio < 100%: This indicates gender inequality, with males dominating the variable in question. A ratio of 50% in labour force participation would mean that for every 100 males, only 50 females are participating.
- Gender Ratio > 100%: While less common, this scenario would indicate a dominance of females over males. For example, in some educational sectors, females may outnumber males.

2.2.5 Gender Inequality Index

The Gender Inequality Index (GII) is a composite metric designed to quantify the extent of gender disparities across three key dimensions: political participation, educational attainment, and labour force participation (Charmes et al., 2023). The index provides a single numerical value that reflects the degree of inequality between males and females, where a lower GII score indicates higher gender inequality. Below is an elaboration on how this index is constructed and interpreted.

$$GII = \left(\frac{NFS}{NMS}\right) \times \left(\frac{NFE}{NME}\right) \times \left(\frac{NFL}{NML}\right) \quad (7)$$

Where:

NFS represents the number of female seats in political institutions (such as state parliaments or national assemblies),

NMS represents the number of Male Seats in political institutions (such as state parliaments or national assemblies),

NFE represents the number of female's educational attainment (such as enrollment in secondary or tertiary education),

NME represents the number of Male's educational attainment (such as enrollment in secondary or tertiary education),

NFL represents the number of female participation in the labour force,

NML represents the number of Male participation in the labour force

The decision rule for the interpretation of GII Scores is given as:

GII = 1: This indicates perfect gender equality across the three dimensions. Women and men are equally represented in political seats, have equivalent educational attainment, and participate equally in the labour force.

GII < 1: A score below 1 indicates gender inequality, where males outperform females in the measured dimensions. The further below 1, the greater the degree of inequality.

For example, if GII = 0.5, this means that, on average, women are half as represented as men across the political, educational, and labour force dimensions.

GII > 1: This is less common but would indicate that females outperform males in these areas, suggesting possible gender inequality in favour of women.

2.2.6 Gender Equality Index (GEI)

The Gender Equality Index (GEI) is a composite measure designed to assess the level of gender parity across various dimensions within a state (United Nations Development Programme (UNDP), 2015). The GEI provides a single numerical value that combines indicators of gender representation in parliament, education, and labour force participation (World Bank., 2020). The methodology used to calculate the GEI in this study is as follows:

The GEI is computed as the average of three key gender ratios:

Gender Ratio in Parliament (GR_Parliament): The proportion of women holding parliamentary seats relative to men.

Gender Ratio in Education (GR_Education): The proportion of women enrolled in educational institutions relative to men.

Gender Ratio in Labour (GR_Labour): The proportion of women in the labour force relative to men.

The formula is expressed as:

$$GEI = \frac{GR\_Parliament + GR\_Education + GR\_Labour}{3} \quad (8)$$

The GEI values range from 0 to 100, where higher values indicate greater gender parity across the three dimensions. States with higher GEI values demonstrate more balanced gender representation in parliament, education, and the labor force.

In summary, the analytical approach combines robust statistical methods and gender-focused indicators to provide a nuanced assessment of inequality across Nigeria's states. The random-effects meta-analysis captures state-level heterogeneity, while the Gender Ratio (GR), Gender Inequality Index (GII), and Gender Equality Index (GEI) offer both disaggregated and composite insights into disparities in political, educational, and labour domains. This methodology not only ensures empirical precision but also supports evidence-based gender policy recommendations, making it a vital framework for understanding and addressing structural inequalities across Nigeria's diverse geopolitical landscape.

3. Results and Discussions

This section provides an exploration of descriptive statistics and normality assessments for key financial and macroeconomic variables in Nigeria from 1981 to 2021. By evaluating central tendencies, dispersion, and distributional characteristics of the data, we ensure methodological rigour and proper model specification. These preliminary insights form the foundation for robust econometric modelling, facilitating meaningful interpretation of the relationships among commercial banking dynamics, monetary aggregates, and economic growth trends.

3.1 Results

3.1.1 Meta-Analysis using the Random-Effects Model

Table 1: Result of the Heterogeneity Analysis using the Random-Effects Model (k = 37; tau2 estimator: REML)

Test Statistics	Test Value
tau^2 (estimated amount of total heterogeneity)	128239554.7807
Standard Error (SE)	30239193.3005
tau (square root of estimated tau^2 value)	11324.2905
I^2 (total heterogeneity / total variability)	99.96%
H^2 (total variability / sampling variability)	2356.3400
Q(df = 36)	84280.1773
p-value	< .0001

The heterogeneity analysis presented in Table 1 reveals significant variability among effect sizes across different states. The estimated tau-squared (τ^2) value, representing the total heterogeneity, is exceptionally high at 128,239,554.7807, indicating substantial differences in effect sizes beyond what can be attributed to sampling error. Correspondingly, tau (τ), the square root of τ^2, is 11,324.2905, further highlighting the large variation. The I-squared (I^2) statistic is 99.96%, suggesting that nearly all observed variability in effect sizes arises from heterogeneity between states rather than random chance. Additionally, the H-squared (H^2) value of 2,356.34 demonstrates that the total variability, including heterogeneity, far exceeds the variability expected from sampling alone. The Q-test for heterogeneity yields a Q statistic of 84,280.1773 with 36 degrees of freedom and a *p*-value of less than 0.0001, confirming that the observed variability is significantly greater than what would occur by chance. Collectively, these result underscore the pronounced heterogeneity in effect sizes, necessitating further exploration to understand the underlying factors driving these differences across states.\

Table 2: Result of the Random-Effects Model

Estimate	SE	Z-value	*p*-value	Confidence Interval of Lower Bound	Confidence Interval of Upper Bound
-90170.3080	1862.0973	-48.4241	<.0001	-93819.9516	-86520.6644

The model's results in Table 2 reveal a statistically significant effect size estimate of -90,170.31, representing the average difference in seats across all states. This negative estimate suggests a notable disparity in the variable of interest as can be seen in Figure 2. The precision of this estimate is reflected in the standard error (SE) of 1,862.10, indicating a high level of accuracy in the measurement as can be observed in Figure 4.2. The z-value of -48.42, a tremendous absolute value, confirms the statistical significance of the effect size, strongly supporting the hypothesis that the effect is different from zero. Furthermore, the *p*-value of < .0001 underscores the robustness of this finding, as it indicates a probability of less than 0.01% that the observed effect occurred by chance. The 95% confidence interval (CI), ranging from -93,819.95 to -86,520.66, provides additional insight into the reliability of the estimate, suggesting with high confidence that the true effect size lies within this interval. These results collectively highlight a meaningful and statistically significant effect, warranting further investigation into its implications.

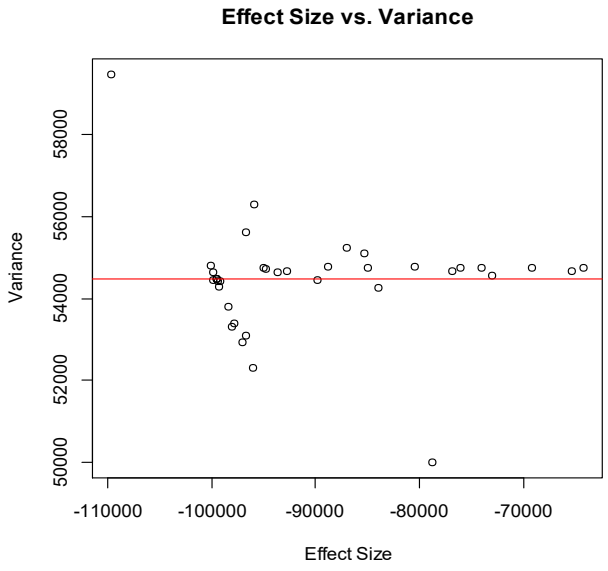

Figure 2: Distribution of Effect Sizes by Variance Across Nigerian States

Figure 2 displays a graph of effect size against variance from the random-effects meta-analysis. The scatterplot reveals that studies with larger variances tend to exhibit more extreme effect sizes, either positive or negative, indicating high heterogeneity across state-level observations. This pattern suggests that smaller studies (i.e., with higher variances) contribute disproportionately to the spread of effect estimates, which may reflect diverse socio-political and economic contexts across Nigerian states. The inverse funnel-like pattern underscores the need for weighting procedures in the analysis and validates the choice of a random-effects model that accounts for between-study variance. The strong variability in effect sizes implies that gender disparities in political representation, education, or labour force participation are not uniformly experienced across regions, necessitating context-specific policy responses.

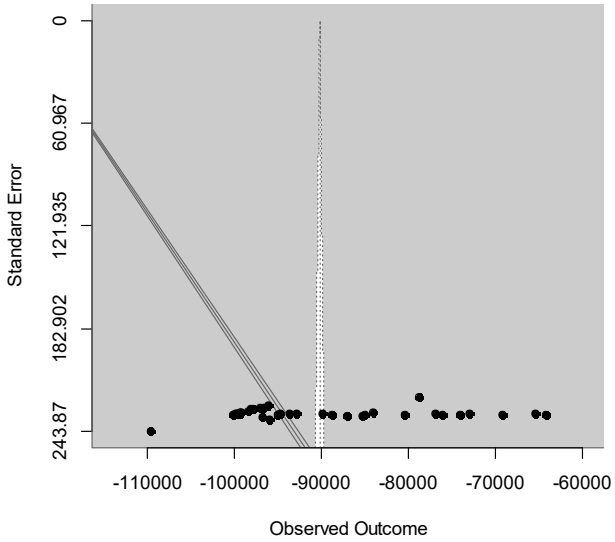

Figure 3: Precision of Gender Disparity Estimates across States

Figure 3 presents a funnel plot of observed effect sizes against their corresponding standard errors, commonly used to assess precision and potential publication or selection bias in meta-analysis. The plot reveals that most data points are concentrated near the bottom and symmetrically clustered around the average effect size (centre line), suggesting relatively high variability and heterogeneity among studies, yet no strong visual evidence of systematic bias. The widespread along the x-axis reflects considerable differences in effect estimates across states, while the narrowing funnel shape toward the top confirms that studies with smaller standard errors (i.e., larger samples) show less dispersion.

This plot supports the use of a random-effects model, given the spread of estimates and varying precision. The observed pattern implies that while the studies are generally centred around a mean effect, the context-specific differences across states influence both the size and reliability of estimates. Policy decisions must therefore consider both the average trend and individual state-level deviations.

3.1.2 Gender Parity Analysis

Table 3: Descriptive Analysis of Gender Parity in Parliament, Education, Labour, and GII Metrics

	GR_Parliament	GR_Education	GR_Labour	GII
Minimum	4.0770	38.3600	56.7500	18177
1st Quartile	4.5320	61.7600	90.0200	32776
Median	7.1900	71.4800	95.6800	49806
Mean	9.7820	69.7900	109.9600	73749
3rd Quartile	12.7300	84.1300	131.2800	108038
Maximum	26.0780	99.2300	180.5100	213992

The gender ratio in parliament (GR_Parliament) presented in Table 3 reveals significant disparities, with a minimum of 4.08%, indicating that in some states, female representation is only 4.08% of male representation. The first quartile (4.53%) shows that 25% of states have a gender ratio

below this level, while the median ratio of 7.19% indicates that half of the states have female representation below 7.19%, reflecting generally low participation of women. The mean ratio of 9.78% suggests that, on average, female representation in parliament is about 9.78% of male representation. The third quartile (12.73%) reveals that 75% of states have a gender ratio below this threshold, with a maximum ratio of 26.08%, showing that the highest female representation reaches just 26.08% of male representation in some states.

The gender ratio in education (GR_Education) ranges from a minimum of 38.36%, indicating that in some states, female educational attainment is just 38.36% of male attainment, to a maximum of 99.23%, reflecting near parity. The first quartile (61.76%) shows that 25% of states have a gender ratio below this level, while the median (71.48%) indicates that half of the states have a ratio below 71.48%. The mean ratio of 69.79% suggests that, on average, female educational attainment is approximately 69.79% of male attainment. The third quartile (84.13%) reveals that 75% of states fall below this threshold, highlighting persistent disparities in education between genders across many regions.

The Gender Ratio in Education (GR_Education) ranges from a minimum of 38.36%, where female educational attainment is just 38.36% of male attainment in some states, to a maximum of 99.23%, indicating near parity in educational attainment. The first quartile (Q1) is 61.76%, meaning 25% of states fall below this level, while the median is 71.48%, showing that half of the states have a gender ratio below this value. On average, female educational attainment is 69.79% of male attainment, with the third quartile (Q3) at 84.13%, indicating that 75% of states have a ratio below this level. For the Gender Ratio in Labour Force Participation (GR_Labour), the minimum is 56.75%, showing significant disparities in some states, while the maximum of 180.51% suggests that, in certain states, female participation exceeds male participation by a substantial margin. The first quartile is 90.92%, with 25% of states below this level, and the median is 95.68%, indicating that half of the states have a ratio below this threshold. On average, female labour force participation is 109.96% of male participation, with the third quartile at 131.28%, showing that 75% of states have a ratio below this value.

The Gender Inequality Index (GII) ranges from a minimum of 18,177, indicating relatively high gender equality in some states, to a maximum of 213,992, reflecting significant gender inequality in others. The first quartile (Q1) is 32,776, meaning 25% of states have a GII score below this value, while the median is 49,806, indicating that half of the states score below this level. On average, the GII score is 73,749, suggesting moderate gender inequality across states. The third quartile (Q3) is 108,038, showing that 75% of states have a GII score below this threshold. Women remain significantly underrepresented in political institutions, with an average Gender Ratio (GR) of only 9.78%, highlighting the need for greater political representation. In education, the gender gap is narrower but still present, with an average GR of 69.79%, suggesting ongoing disparities. In the labour force, an interesting trend emerges where the mean GR exceeds 100%, indicating that in some states, women are more active in the workforce than men. The Gender Inequality Index (GII) shows considerable variation across states, ranging from 18,177 to 213,992, with lower scores reflecting better gender equality. These findings underscore the importance of policies aimed at improving female political representation, addressing educational disparities, and tackling gender inequality in various sectors.

Figure 4 illustrates the gender ratio (female-to-male percentage) across Nigeria's 36 states and FCT in three domains: parliamentary representation, educational attainment, and labour force participation. The plot reveals stark disparities, especially in parliamentary representation (blue line), where gender ratios remain consistently below 30% across all states, indicating a deep underrepresentation of women. In education (red line), while several states show moderate progress with ratios approaching or exceeding 80%, full parity (100%) is not achieved. The labour force (green line) shows the most variability, with some states (e.g., Bauchi, Katsina) surpassing 150%, suggesting female labour participation exceeds that of males possibly due to informal economic engagement or local gender roles. The horizontal reference line at 100% helps highlight states where parity has been reached or exceeded.

This multidimensional plot underscores the urgent need for targeted, domain-specific gender interventions. The persistent underrepresentation of women in governance demands structural reforms, while the relative progress in education and fluctuating labour force participation point to context-specific successes and gaps. Policymakers must avoid one-size-fits-all approaches and instead design strategies that align with domain-specific gender realities across regions.

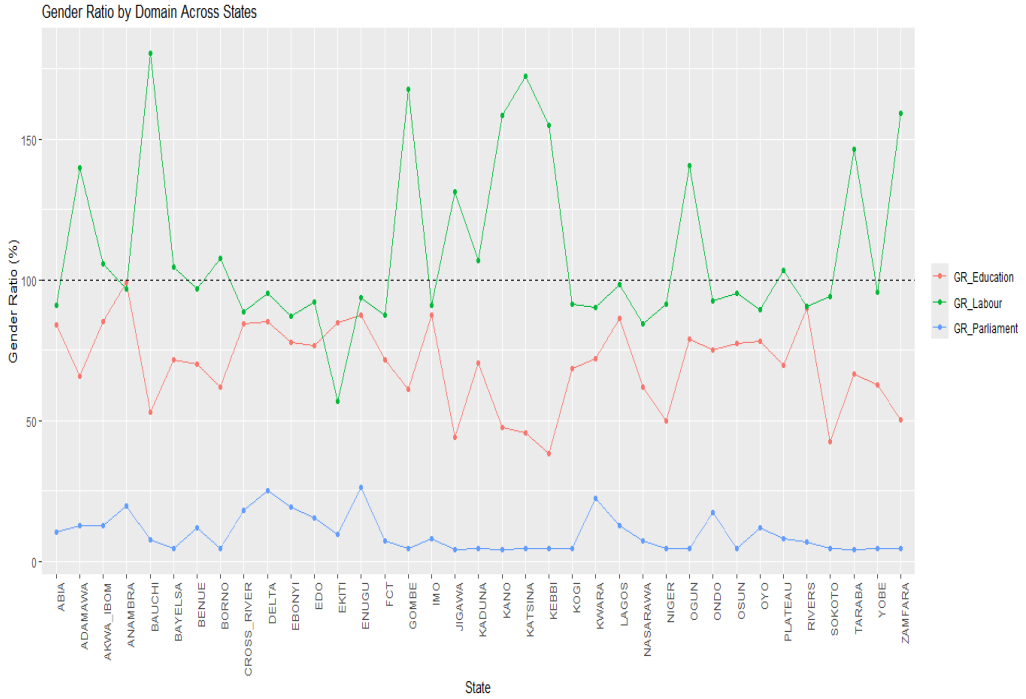

Figure 4: State-Level Gender Parity Trends Across Governance, Education, and Labour Domains in Nigeria

The result of the correlation Heat map in Figure 5 reveals several important relationships between gender, education, and labour force participation. A strong negative correlation of -0.90 between Female_Seats and Male_Seats suggests a gender-based trade-off in seat allocation. Female_Education is moderately positively correlated with Female_Seats (0.46) and Male_Education (0.34), indicating that increased female representation in seats may be associated with higher educational outcomes for both genders. Male_Education and Female_Education have a very strong positive correlation of 0.96, suggesting that improvements in female education are closely linked to improvements in male education. There are moderate positive correlations between Female_Labour and Male_Labour (0.54), and between Female_Education and Male_Labour (0.53), implying that increased education for females may lead to greater labour force participation for both genders. Conversely, Male_Seats shows weak negative correlations with most variables, including Male_Education (-0.21) and Male_Labour (-0.31), suggesting that higher male representation in seats does not strongly correlate with educational or labour outcomes.

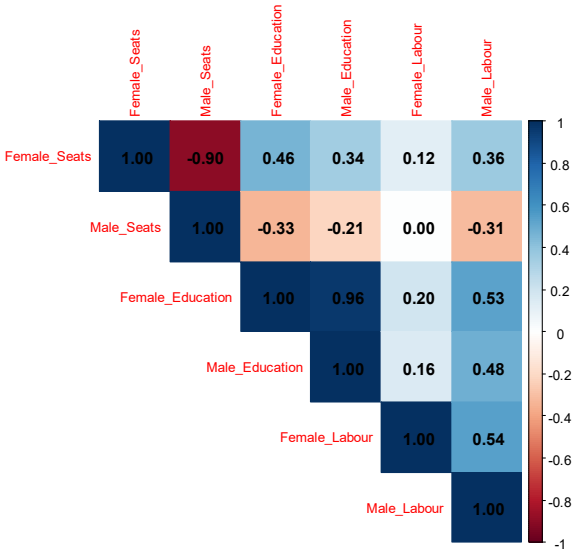

Figure 5: Correlation Heat Map of Gender Disparities in Parliamentary Seats, Education, and Labour Force Participation across Nigerian States

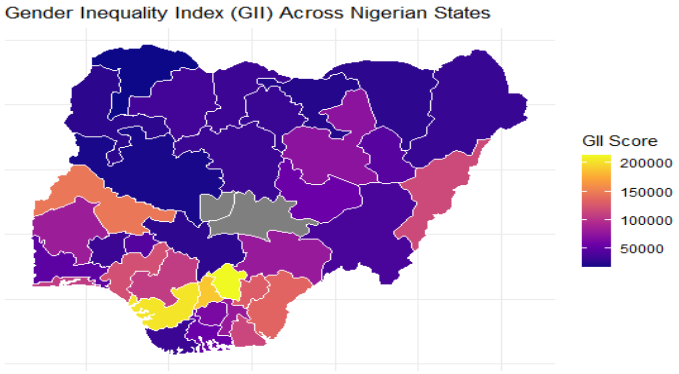

Figure 6: Geospatial Distribution of Gender Inequality Across Nigerian States (GII Heat Map)

The choropleth map in Figure 6 displays the Gender Inequality Index (GII) across Nigerian states, where colour gradients represent the severity of gender disparities. States shaded in yellow and orange (e.g., Delta, Anambra, and Enugu) exhibit the highest GII scores, indicating greater gender inequality across political, educational, and labour domains. In contrast, states shaded deep blue or purple, particularly in the northwest and northeast, show lower GII scores, suggesting comparatively better gender balance or fewer disparities. This spatial visualization reveals clear regional disparities, where southern and southeastern states face higher measured gender inequality despite potentially higher socio-economic indicators a paradox that could stem from unequal political participation or reporting biases. These findings emphasize the need for region-specific gender equity policies, particularly in the governance and education sectors.

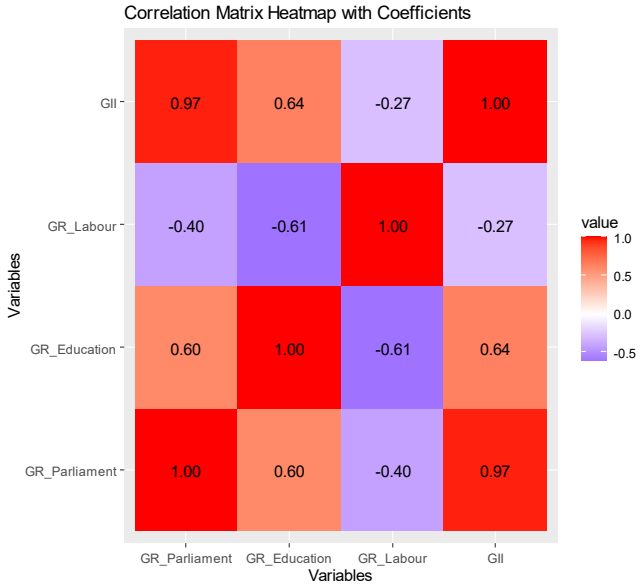

Figure 7: Correlation Heat Map of Gender Inequality Indices and gender ratios (GR) in Parliamentary Seats, Education, and Labour Force Participation across Nigerian States

The correlation heat map in Figure 7 reveals significant relationships among the variables. The Gender Ratio in Parliament (GR_Parliament) shows a very strong positive correlation with the Gender Inequality Index (GII) (0.96834), indicating that higher disparities in parliamentary representation are closely associated with greater overall gender inequality. GR_Parliament also exhibits a moderate positive correlation

with the Gender Ratio in Education (GR_Education) (0.5979), suggesting systemic factors may influence both education and political representation. Conversely, GR_Parliament has a moderate negative correlation with the Gender Ratio in Labour (GR_Labour) (-0.40271), implying that higher disparities in parliament are associated with less disparity in labour force participation. GR_Education has a moderate positive correlation with GII (0.6368), indicating that educational equity alone does not significantly reduce overall inequality, while its moderate negative correlation with GR_Labour (-0.6059) highlights a gap between educational and labour equity. Lastly, GR_Labour has a weak negative correlation with GII (-0.272), suggesting that labour disparities contribute less to overall gender inequality compared to other factors.

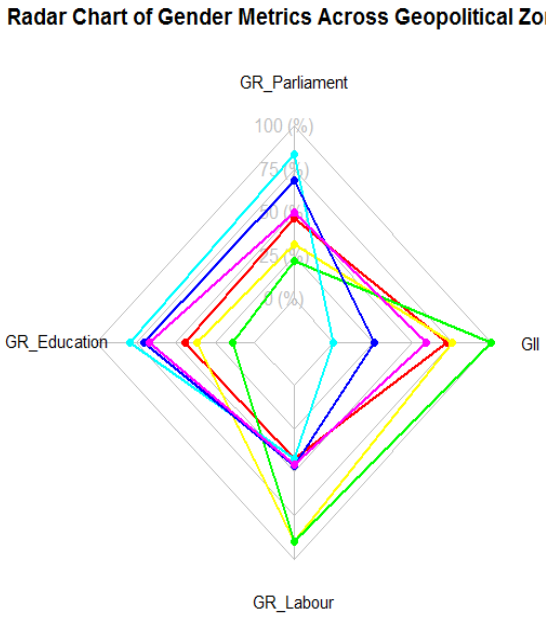

Figure 8: Radar Visualization of Gender Equity Metrics Across Nigeria's Geopolitical Zones

The radar chart in Figure 8 illustrates the performance of Nigeria's six geopolitical zones across four key gender-related metrics: the Gender Ratio in Parliament, Education, Labour Force Participation, and the normalised Gender Inequality Index (GII). The South East and South South zones show relatively high values in GR_Parliament and GR_Education, indicating stronger female representation in politics and better access to education. The North East and North West zones display higher GR_Labour scores but lower GR_Education and GR_Parliament values, suggesting that while women in these regions may be more economically active, they lag in education and political inclusion. The GII axis, inversely scaled, shows better scores for northern zones, such as Sokoto and Jigawa; however, this may reflect low participation across both genders rather than true parity. The South East, despite good educational access, has a high GII, highlighting persistent structural disparities in representation and labour access. The chart reveals the uneven distribution of gender equity indicators across zones, underscoring the need for region-specific policy interventions to improve women's political inclusion, educational attainment, and economic participation holistically.

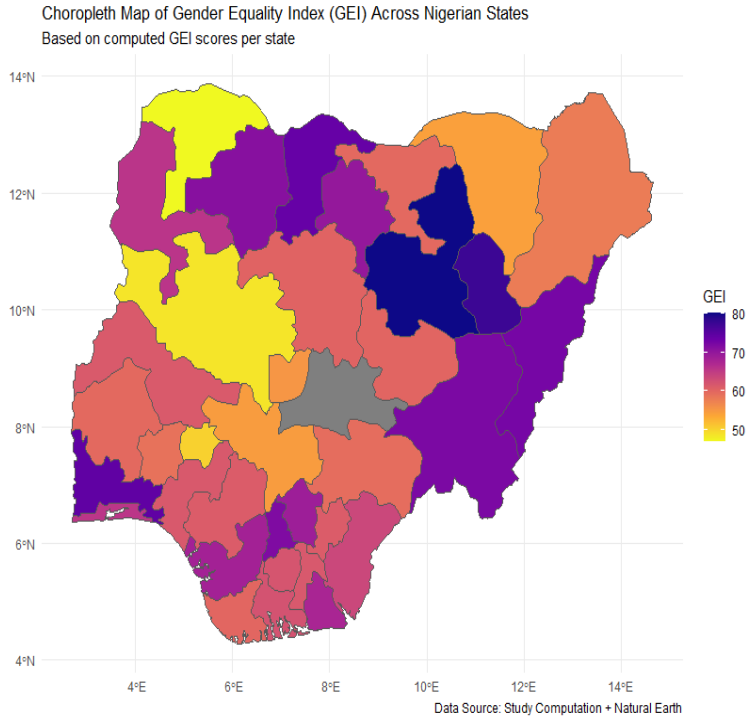

Figure 9: Choropleth Map of Gender Equality Index (GEI) Across Nigerian States

The choropleth map in Figure 9 illustrates the distribution of the Gender Equality Index (GEI) across Nigerian states, using color gradients from yellow (lower equality) to deep blue (higher equality). States in the North such as Bauchi, Gombe, and Katsina show higher GEI scores, reflecting more balanced gender representation in education, labour force, and political participation. In contrast, several Southern states such as Niger,

Ekiti, and Sokoto display lower GEI scores, suggesting notable gender imbalances. The variation across geopolitical zones highlights persistent regional disparities in gender equality. These insights are crucial for policymakers and stakeholders aiming to implement targeted gender equity interventions tailored to specific regional dynamics.

4. Discussion of Results

The findings from this study substantiate and extend the growing literature on gender inequality by offering state-level and geopolitical insights into Nigeria's persistent disparities across political, educational, and labour domains. The meta-analysis results revealed pronounced heterogeneity (I^2 = 99.96%) among states in terms of gender inequality, confirming the relevance of a random-effects model due to the substantial between-state variability. This heterogeneity aligns assertion that the impact of institutional factors, like ICT or governance structures, varies contextually (Shah and Krishnan's, 2024). Similarly, the observed disparity in effect sizes mirrors the findings, who noted that gender equality outcomes differ significantly based on country-level development and social norms (Rietveld and Patel, 2022).

The significantly negative average effect size of -90,170 (Table 2) underscores the widespread underrepresentation of women in core domains, especially political participation. This corroborates, who found that even in countries like Sweden, female inclusion in decision-making remains limited despite high-level gender equity goals (Ville et al., 2023). In Nigeria, this limitation appears even more severe, with GR_Parliament scores averaging only 9.78%, affirming the claims that institutional and cultural barriers continue to obstruct women's political inclusion (Agbalajobi, 2010; Ajemba, 2023).

The variation in gender ratios by state and domain especially the finding that female labour participation sometimes exceeds male participation (mean GR_Labour = 109.96%) challenges simplistic assumptions about gender roles. This paradox is reflective, who showed that the developmental benefits of female participation are nuanced and highly context-dependent (Mitra et al., 2023). For instance, higher female labour force participation in the North may be linked to subsistence or informal activities rather than formal employment, echoing the critique by Lawanson and Umar (2019) that growth without structured inclusion perpetuates inequality.

Figure 4's state-level gender ratio trends further demonstrate that political representation remains deeply unequal across all regions. Despite improvements in education (GR_Education median = 71.48%), a gap remains between educational access and labour market outcomes similar to findings in India, where educational gains have not yet translated into labour force inclusion (Jose and Sivaraman, 2023).

The GII-based heat maps (Figures 6 and 7) present a paradox: states like Lagos and Delta, with better socioeconomic indicators, still show higher GII values, signalling persistent gender gaps. This mirrors findings in China, where structural barriers, rather than resource availability, sustain inequality (Zhang et al., 2023). Additionally, the high correlation (0.97) between GR_Parliament and GII implies that political inclusion is a critical driver of broader gender parity, reinforcing the perspective on the importance of legal and governance frameworks (Barajas-Sandoval et al., 2023).

The radar chart (Figure 8) highlights the uneven performance of Nigeria's geopolitical zones. While the South East leads in education and political representation, it also records high GII values, revealing a disconnect between domain-specific achievements and overall gender equity. Conversely, the North West and North East exhibit high labour force parity but underperform in education and political inclusion, consistent with the findings, who noted that governance quality mediates the relationship between gender equity and poverty reduction (Workneh, 2020).

Finally, the GEI choropleth map (Figure 9) illustrates that states in the North such as Bauchi, Gombe, and Katsina surprisingly rank higher in overall gender equality. However, this may be due to lower male participation in some metrics rather than true parity. This aligns with observations that lower absolute gender gaps do not always indicate equity if both genders are marginally represented (Cosma et al., 2022).

These results confirm that gender inequality in Nigeria is multidimensional and regionally varied, necessitating tailored policy interventions. Educational reforms must be paired with employment and political empowerment strategies to ensure that progress in one domain supports others. Consistent with the Capability Approach, enhancing women's substantive freedoms requires dismantling institutional, cultural, and perceptual barriers concurrently (Sen, 1999). Moreover, reinforcing inclusive governance and targeted financial inclusion as advocated is essential to break the cycle of inequality and underdevelopment (Xu et al., 2023; Kanat et al., 2023).

5. Conclusion

This study presents a comprehensive, multidimensional analysis of gender inequality in Nigeria, employing a random-effects meta-analysis, ratio-based diagnostics, and composite indices to assess disparities in political representation, education, and labour force participation across all 36 states and the Federal Capital Territory. The findings reveal several critical insights that have implications for policy, institutional reforms, and gender equity advocacy.

The meta-analytic results demonstrated significant heterogeneity across states, with an estimated I^2 of 99.96% and a statistically significant average effect size of -90,170.31. This suggests that gender inequality is neither random nor uniform but deeply embedded in Nigeria's sociopolitical and economic structures. The Gender Ratio (GR) analysis revealed persistent underrepresentation of women in parliament (mean GR = 9.78%) and education (mean GR = 69.79%), while the labour domain showed surprising variability, with some states exhibiting female labour participation surpassing male levels (mean GR = 109.96%). The Gender Inequality Index (GII) and Gender Equality Index (GEI) further revealed strong regional disparities, with southern states displaying higher educational ratios but lower overall gender equity due to limited political participation.

The correlation analyses underscored the interdependence of gender metrics, particularly the high correlation between GR_Parliament and GII, highlighting political inclusion as a key driver of broader gender equality. Spatial visualizations confirmed the existence of regional clusters of inequality, with certain northern states appearing more balanced due to low male and female participation rather than true gender parity.

To address the deeply rooted and regionally varied gender disparities identified in this study, a comprehensive policy response is required. Key recommendations include the implementation of institutional gender quotas to improve political representation, especially given the stark underrepresentation of women in parliament. Bridging the gap between female educational attainment and labour market participation necessitates education-to-employment initiatives such as job placement schemes, entrepreneurship support, and anti-discrimination policies. Recognizing the uneven progress across geopolitical zones, region-specific gender equality strategies should be developed, particularly in southern states where educational gains have not translated into economic or political power. Strengthening inclusive data systems will enable more targeted and effective interventions, while civic awareness campaigns are crucial to challenging entrenched patriarchal norms. Furthermore, legal reforms must ensure the protection and enforcement of women's rights, and investments in digital and financial inclusion especially for rural and underserved populations are essential to empower women economically. These policy measures, aligned with the findings of this study, are critical for advancing gender equity and achieving inclusive development in Nigeria.

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