

Determinants of Fertility Behavior in Pakistan: A Meta-Analysis for Evidence-Based Policy



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Abstract

Fertility preferences play a central role in shaping reproductive choices and long-term population patterns. They influence when individuals decide to have children: how many they desire, and the extent to which they engage with family-planning services. In countries like Pakistan where fertility transition is still in progress, understanding these preferences is essential for formulating responsive population policies and strengthening reproductive health programmes.

This study presents the first-ever comprehensive meta-analysis of fertility determinants in Pakistan, synthesizing research from 1968-2025 to provide evidence-based guidance for population policy. Despite having one of Asia's oldest population control programmes, Pakistan maintains the highest fertility rate among neighbouring countries with 3.6 children per woman. Various studies find that traditional assumptions about fertility drivers require significant revision. Key findings show that female age (30 and above), household wealth, and child gender preferences are the strongest predictors of fertility behaviour. The evidence calls for fundamental shifts in policy priorities and resource allocation.

Keywords: Family planning, Fertility rate, Reproductive choices, Contraceptive use, Child gender preference, Population growth

1. INTRODUCTION

1.1 Population Explosion in Pakistan and Policy Gaps

High population growth is one of the world's most persistent demographic challenges today. Pakistan is also faced with the same challenge that has undermined the country's economic development, public service delivery and poverty reduction efforts. Despite having one of Asia's oldest population control programmes, launched in the 1960s, Pakistan continues to experience fertility rates well above replacement level while its neighbouring countries have achieved significant demographic transitions (Ahmed, 2001; Goujon et al. 2020). With a fertility rate of 3.39, Pakistan is now on the top in South Asia followed by India and Bangladesh. The statistics as given below exposes Pakistan's irresponsible behaviour in this regard.

Comparative Fertility Statistics (Average Live Births per Woman):

Pakistan: 3.39 | India: 2.18 | Sri Lanka: 2.17 | Bangladesh: 1.99 |
Bhutan: 1.93 | Nepal: 1.85 | Maldives: 1.82

Source: Statista (2020)

The country exhibits all major drivers of high population growth, including very low contraceptive prevalence rate, above replacement level total fertility rate, a large cohort of women in reproductive age (16-45), and a high children-per-woman ratio of 3.6. Most alarmingly, there has been no decline in fertility rate since 2006, which indicates that existing policies are insufficient to address the demographic challenge (Jabeen & Dar, 2023).

1.2 Demand vs Supply-side Debate

While there is a consensus among researchers and policymakers that population growth planning is essential for Pakistan's development, there is little agreement on the most important reasons for policy failure. This disagreement has created a fragmented policy landscape with competing explanations:

Demand-side Arguments emphasize low acceptance and demand for contraceptives and modern family planning methods, which suggest that cultural barriers, inadequate education, and lack of awareness are primary obstacles to fertility decline.

Supply-side Arguments point to unmet contraceptive needs and poor access to family planning services, which suggest that infrastructure gaps, service quality issues, and economic barriers prevent couples from implementing their fertility preferences.

This fundamental disagreement about causes has led to inconsistent programme priorities, inefficient resource allocation, and conflicting policy recommendations from different experts and agencies.

1.3 Challenge of Mixed Evidence

In Pakistan, population studies that explore determinants of high fertility are heterogeneous in nature and provide mixed evidence. These studies vary widely in their measures of fertility (children ever born, birth spacing, contraceptive use, ideal family size), use different statistical methods, focus on diverse population groups, and frequently produce inconsistent or non-comparable results. This lack of coherence makes it difficult for policymakers to identify which determinants matter most, how strongly they influence fertility outcomes, and whether effects differ across demographic or socioeconomic subgroups.

The evidence fragmentation is compounded by methodological heterogeneity. Studies employ different empirical approaches — cross-sectional regressions, multilevel models, experimental evaluations — each estimating different types of relationships. Variable definitions also vary significantly, e.g. education measured in years versus categories, wealth measured through asset indices versus income, contraceptive behaviour captured through different indicators.

1.4 Objectives and Approach

The study conducts the first-ever systematic review and meta-analysis of fertility determinants research in Pakistan. It aims to:

1. **Synthesize fragmented evidence** on fertility determinants through objective statistical methods;
2. **Identify key drivers** that most consistently influence fertility behaviour across studies and contexts;
3. **Quantify effect sizes** to enable evidence-based resource allocation and programme prioritization;
4. **Resolve contradictions** in existing research through systematic analysis of heterogeneity; and
5. **Provide actionable recommendations** based on robust empirical evidence rather than selective interpretation.

1.5 Why This Meta-Analytical Approach Matters

Unlike narrative reviews that may be limited by selective interpretation or inconsistent framing, meta-analytic techniques allow researchers to quantitatively assess the magnitude and direction of effects across different datasets and methodologies (Fagard et al. 1996; Card & Casper, 2013). In Pakistan's context — where research findings on fertility determinants are abundant but often inconsistent — meta-analysis provides a structured way to resolve contradictions, estimate average effects, and uncover patterns that may not be visible in single studies.

The goal is to move from subjective and opinion-based policy debates to objective statistically grounded recommendations that can guide resource allocation and programme design with greater confidence and effectiveness.

2. AN OVERVIEW OF STUDIES

2.1 Comprehensive Literature Search Strategy

A comprehensive literature search was conducted using Boolean logic across multiple academic databases, including JSTOR, PubMed, Scopus, ScienceDirect, and Google Scholar. The search identified quantitative, empirical studies focused exclusively on fertility behaviours in Pakistan, published between 1968 and 2025. This extended timeframe captures the full evolution of Pakistan's demographic research and encompasses studies conducted under varying socioeconomic and policy conditions.

2.2 PRISMA Framework and Study Selection

Following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework, a four-step process (i.e. identification, screening, eligibility, and inclusion) was used to filter studies. From an initial pool of 64 studies, at least 30 studies were selected based on the rigorous eligibility criteria.

Eligibility Criteria:

Geographic Focus: Studies conducted exclusively in Pakistan

Methodological Requirements: Quantitative empirical analysis using regression models (OLS, Logistic, Probit) with reported coefficients and inferential statistics

Population Scope: Women of reproductive age (15-49), men, couples, or households

Outcome Variables: Fertility behaviour measures, including contraceptive use, fertility rates, or fertility preferences

2.3 Challenge of Heterogeneous Evidence

The selected studies identifies substantial challenges for evidence synthesis. **Variable definition heterogeneity** was pervasive where the same determinant is measured in multiple ways across studies (e.g. education in years versus categorical attainment, or wealth through asset indices versus income). **Methodological heterogeneity** was also substantial with studies employing different empirical approaches that estimate different types of relationships.

Contextual variation further complicated synthesis. Many studies highlight that determinant impacts varied sharply by region, urban-rural location, parity, or education level. A factor reducing fertility in one subgroup might show no effect or even opposite effects in another subgroup.

2.4 Outcome Variable Harmonization

To address measurement heterogeneity, Exploratory Factor Analysis (EFA) was employed to group diverse but closely related fertility behaviour outcomes. This statistical technique identified underlying patterns among different outcome measures, supporting the hypothesis that various indicators measure closely related constructs.

Three Major Fertility Outcomes:

- 1. Contraceptive Use:** Current use, ever-use, modern vs traditional methods (most frequently studied—over two-thirds of studies)
- 2. Fertility Levels:** Children ever born (CEB), total fertility rate (TFR), birth spacing measures
- 3. Stated Fertility Preferences:** Ideal number of children, desire for more children, timing of next birth

This categorization provided a coherent framework for synthesis, allowing for pooling of estimates and identification of patterns across diverse contexts while maintaining the conceptual integrity of different fertility behaviour dimensions.

3. METHODOLOGY

3.1 Systematic Evidence Synthesis Framework

This study employs systematic review and meta-analysis techniques to transform scattered, sometimes conflicting research findings into consolidated, actionable evidence. The approach addresses a fundamental policy challenge: how to make evidence-based decisions when multiple studies examine the same relationships but reach different conclusions.

Rather than narrative synthesis that might be subject to selection bias, the meta-analytical approach follows rigorous protocols to identify, evaluate, and statistically combine results from all qualifying studies. This provides a more objective foundation for policy recommendations than traditional literature reviews.

3.2 Multilevel Multivariate Meta-Regression

The study employs an advanced statistical framework called multilevel multivariate meta-regression, designed to handle the complexity of fertility research data. This approach recognizes that studies operate at multiple levels simultaneously and addresses three key sources of variation:

Level 1: Within-Effect Variability - Statistical noise and measurement error inherent in any empirical estimate, captured through reported standard errors from primary studies;

Level 2: Within-Study Variation - Real differences among multiple outcomes reported within the same study (e.g. when one study reports effects on both contraceptive use and fertility preferences);

Level 3: Between-Study Variation - Differences across studies due to different contexts, time periods, populations, and methodological approaches.

3.3 Handling Multiple Outcomes and Study Dependencies

Many studies in the sample highlighted effects of the same determinants on multiple fertility outcomes, creating statistical dependence between effect sizes. The multilevel framework addresses this by modeling correlated outcomes jointly while accounting for clustering within studies. This approach provides more accurate standard errors and enables reliable assessment of how determinants consistently influence different dimensions of fertility behaviour.

3.4 Moderator Analysis and Heterogeneity Assessment

The meta-regression framework incorporates moderator variables to explain why studies reach different conclusions. Key moderators examined include: outcome type (contraceptive use vs. fertility levels vs. preferences), estimation method (OLS vs logistic vs probit models), and study characteristics. This study helps identify conditions under which different determinants are most or least influential.

3.5 Pooled Effect Estimation

For each determinant, the study produces both outcome-specific estimates (how the factor affects contraceptive use, fertility levels, and preferences separately) and pooled estimates (the overall average effect across all fertility measures). Pooled estimates provide policymakers with summary measures of each determinant's overall importance while outcome-specific estimates reveal mechanisms through which factors influence fertility behaviour (Tesfa et al. 2023; Blettner et al. 1999).

All models were estimated using restricted maximum likelihood (REML) methods, with heterogeneity statistics calculated to assess consistency of effects across studies. High heterogeneity indicates that intervention effects may be highly context-dependent, while low heterogeneity suggests more generalizable relationships.

4. RESULTS AND DISCUSSION

4.1 Female Work and Employment

The evidence on female employment as a fertility determinant reveals a complex relationship that challenges simple policy assumptions about women's economic empowerment and demographic transition.

Key Finding: Female labour force participation shows a weak and marginally significant overall effect (pooled $\beta = 0.88$, $p = 0.08$). Individual outcome effects are not statistically significant, with wide confidence intervals indicating considerable heterogeneity across studies.

Policy Implications: The weak relationship suggests that programmes promoting female employment should not be designed primarily as fertility interventions. While women's economic participation may contribute to demographic transitions, the effects are modest and inconsistent. The marginal significance indicates that female employment may be a necessary but not sufficient condition for fertility change in Pakistan's context.

Challenging Assumptions: These findings contradict common assumptions that female employment automatically leads to fertility decline. In Pakistan's patriarchal context, cultural norms and structural barriers may limit the fertility effects of women's work, particularly when employment is informal, low-paying, or when women lack autonomy over their earnings. The evidence suggests that the pathway from female employment to fertility change requires supportive conditions that may not be universally present.

4.2 Income and Wealth

Economic factors emerge as among the most consistent and significant fertility determinants in the Pakistani context, with particularly strong effects on contraceptive adoption behaviours.

Key Finding - PRIORITY DETERMINANT: Income and wealth show strong and significant effects. Contraceptive use is significantly associated with higher income ($\beta = 0.74$, $p = 0.018$), and the pooled effect across all fertility measures is positive and significant ($\beta = 0.47$, $p = 0.014$).

Policy Implications: These results provide strong evidence for economic-based fertility interventions. Policies that increase household income — through poverty reduction programmes, employment generation, or targeted subsidies — are likely to have measurable demographic effects. The particularly strong relationship with contraceptive use suggests that income affects fertility primarily through improved access to and affordability of family planning services.

Mechanism Analysis: The significant effect on contraceptive use but weaker relationship with ideal family size ($\beta = 0.22$, $p = 0.62$) suggests that income affects fertility behaviour more through enabling couples to implement existing preferences rather than changing desired

family size. This points to supply-side constraints and economic barriers as major obstacles to fertility control among Pakistan's lower-income populations.

Resource Allocation Guidance: The consistent and significant effects make income-based interventions a high priority for demographic policy. Contraceptive subsidies, free family planning services, and integration of fertility counseling with economic development programmes should be prioritized in resource allocation decisions.

4.3 Family Planning Programme Exposure

The relationship between family planning programme exposure and fertility outcomes reveals concerning patterns about the programme's effectiveness and implementation quality.

Key Finding - HIGH HETEROGENEITY: Family planning exposure shows weak and non-significant effects (pooled $\beta = 0.45$, $p = 0.26$) with extremely high heterogeneity across studies ($Q = 2073$, $p < 0.0001$), indicating that programme effects vary dramatically across different contexts.

Policy Implications: The high heterogeneity suggests that family planning programme success depends heavily on implementation quality, cultural context, and programme design rather than mere exposure to information. Generic awareness campaigns may be less effective than targeted high-quality service delivery programmes.

Quality Over Coverage: The inconsistent effects indicate that expanding programme coverage without paying attention to quality may not produce expected demographic returns. Investment should prioritize programme intensity, service quality, and context-specific design over broad but shallow information dissemination.

Adaptive Management Needs: The extreme variation in programme effectiveness calls for sophisticated monitoring systems that can identify successful programme elements and adapt interventions to local contexts. One-size-fits-all approaches appear inadequate given the context-dependency of programme effects.

4.4 Female Age (30 & above)

Female age emerges as one of the strongest and most consistent fertility determinants, with particularly pronounced effects for women aged 30 and above.

Key Finding - PRIORITY DETERMINANT: Women aged 30 and above show highly significant effects across fertility measures. Contraceptive use shows strong association ($\beta = 0.45$, $p < 0.001$), and the pooled effect is highly significant ($\beta = 0.61$, $p < 0.001$).

Policy Implications: These results provide strong evidence for age-targeted family planning services. Women over 30 consistently show the highest receptivity to fertility control measures, representing the most promising target group for intensive family planning interventions.

Life-Course Programming: The strong age effects suggest that fertility interventions should be sequenced according to women's life stages. Rather than generic programmes, services should be tailored to different phases such as pre-marital counseling for younger women, birth spacing services for women in their twenties, and family limitation services for those over 30.

Service Integration Opportunities: The pattern suggests that maternal and child health services, which naturally reach older women, provide excellent platforms for integrating intensive family planning counseling and services. Women over 30, who are accessing healthcare for existing children, represent a highly receptive audience for fertility control messages.

4.5 Child Gender Composition

The influence of child gender composition, particularly son preference, represents one of the most culturally specific and policy-relevant findings with clear implications for Pakistan's demographic future.

Key Finding - CULTURAL FACTOR: Child gender composition shows significant effects on fertility behaviour. Contraceptive use is significantly associated with achieving preferred gender composition ($\beta = 0.33$, $p = 0.021$), with a significant pooled effect ($\beta = 0.34$, $p = 0.023$).

Policy Implications: Son preference continues to drive fertility decisions in Pakistan, confirming that couples are more likely to adopt contraception after achieving desired numbers of male children. This cultural factor must be directly addressed through integrated gender equality and family planning programmes.

Long-term Cultural Change Strategy: The persistent influence of son preference indicates that sustainable fertility decline requires broader cultural change beyond contraceptive service provision. Programmes must address the economic and social structures that make sons more valuable than daughters, including old-age security systems, inheritance practices, and employment opportunities.

Integrated Intervention Design: Family planning programmes should be combined with gender equality initiatives that promote the value of daughters, support women's economic empowerment, and address discriminatory practices. Legal reforms ensuring daughters' inheritance rights and property ownership may have significant long-term demographic effects.

5. POLICY RECOMMENDATIONS

Priority Interventions Based on Evidence Strength

1. Age-Targeted Family Planning Services (HIGH PRIORITY)

Evidence Base: Strongest statistical relationship ($\beta = 0.61$, $p < 0.001$) for women aged 30 and above

Immediate Actions:

- Develop intensive family planning programmes specifically targeting women aged 30 and above;
- Establish age-specific counseling protocols emphasizing transition from family-building to family-limiting;
- Train healthcare providers in life-course fertility counseling techniques;
- Integrate services into maternal and child health programmes where older women access care;
- Develop targeted communication campaigns for women over 30 with messages about family completion.

Implementation Strategy:

- Partner with existing maternal health services to reach women (30 and above) during routine healthcare visits;
- Provide specialized contraceptive counseling and immediate service provision to capitalize on this population's high receptivity to fertility control.

Expected Impact:

- Significant increase in contraceptive uptake among the most receptive population segment, leading to measurable and rapid fertility decline;

2. Income-Based Fertility Interventions (HIGH PRIORITY)

Evidence Base: Strong and significant effects, especially on contraceptive use ($\beta = 0.74$, $p = 0.018$)

Economic Barrier Removal:

- Provide free contraceptives for households below poverty line;

- Subsidize Long-Acting Reversible Contraceptives (LARCs) for low-income families;
- Eliminate user fees for family planning services in public health facilities;
- Link family planning services to existing poverty reduction and social protection programmes;

Integration with Development Programmes:

- Include fertility counseling in microfinance and livelihood programmes;
- Develop conditional cash transfer programmes that incentivize fertility limitations;
- Partner with employment generation programmes to provide comprehensive reproductive health services.

Targeting Strategy:

- Divert resources on economically disadvantaged populations who show strong response to income-related interventions while ensuring that services remain accessible across all income levels.

3. Comprehensive Son Preference Reduction Programmes (HIGH PRIORITY)

Evidence Base: Significant cultural factors affecting fertility decisions ($\beta = 0.34$, $p = 0.023$)

Structural Interventions:

- Strengthen legal frameworks ensuring daughters' inheritance and property rights;
- Develop old-age security systems that reduce dependence on sons for the elderly's care;
- Promote women's economic empowerment through education and employment opportunities;
- Address workplace discrimination that limits daughters' economic contributions.

Cultural Change Initiatives:

- Launch sustained public awareness campaigns that may promote the value of daughters in society;
- Integrate gender equality messages into family planning counseling;
- Engage religious and community leaders in promoting gender-balanced family values;
- Develop school curricula that challenge gender stereotypes and promote equality.

Long-term Vision: Gradual cultural shift reducing son preference, leading to smaller desired family sizes and increased contraceptive uptake regardless of existing children's gender composition.

4. Family Planning Programme Quality Enhancement (MEDIUM PRIORITY)

Challenge Addressed:

- High heterogeneity in programme effects (Q = 2073) indicates quality matters more than coverage.

Quality-Focused Reforms:

- Shift resources from generic awareness campaigns to high-quality service delivery;
- Develop context-specific programme designs rather than standardized approaches;
- Invest in comprehensive provider training and ongoing supportive supervision;
- Establish robust quality monitoring systems tracking service effectiveness, not just coverage;
- Implement adaptive management systems allowing programme modification based on local feedback.

Service Delivery Innovation:

Develop innovative approaches, including mobile services, community-based distribution, and technology-enabled counseling, to improve accessibility and quality simultaneously.

Resource Allocation Framework

Evidence-Based Priority Ranking

HIGH PRIORITY (60% of resources):

- Age-targeted services (women 30 and above), economic interventions, son preference reduction programmes.

MEDIUM PRIORITY (30% of resources):

- Programme quality improvements, geographic targeting reform, comprehensive gender approaches.

RECONSIDER ALLOCATION (10% of resources):

- Generic rural programmes, male education as standalone intervention, broader awareness campaigns.

Implementation and Monitoring Framework

Phased Implementation:

- Begin with high-evidence interventions (age-targeting, income-based programmes) in pilot areas while developing long-term cultural change initiatives (son preference reduction, gender equality programmes);
- Scale successful models systematically based on rigorous evaluation results.

Monitoring and Evaluation:

- Establish outcome-based monitoring systems that track fertility behaviour changes and contraceptive adoption, not just service delivery outputs;
- Use randomized controlled trials for innovative programme models before scaling up to ensure cost-effectiveness.

Adaptive Management:

- Build programme flexibility to adapt interventions based on local results and changing contexts;
- Given the context-dependency of many interventions, establish mechanisms for continuous programme improvement and local customization.

Inter-Agency Coordination:

- Create coordination mechanisms ensuring that population policies are integrated with broader development strategies in health, education, economic development, and gender equality;
- Establish joint planning and resource mobilization across ministries and agencies concerned.

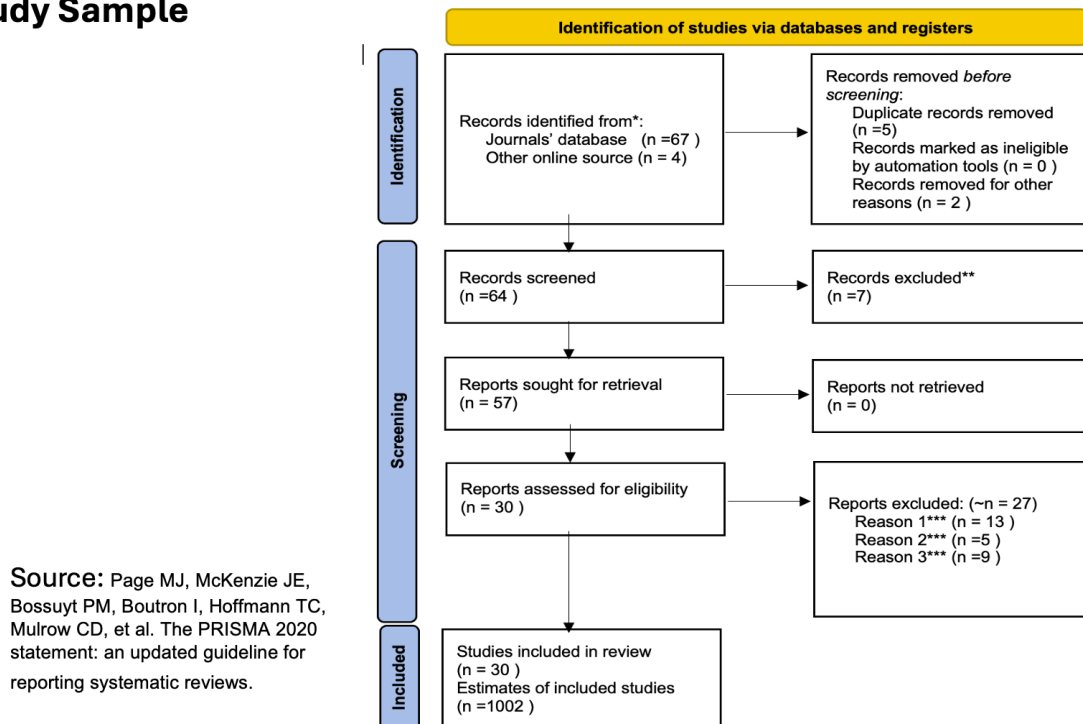
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6. APPENDIX

1. PRISMA Template

PRISMA Template For Reporting Systematic Review And Study Sample



2. Multivariate Multilevel Meta Regression Model

The hierarchical model estimation follows two levels:

Each observed effect size $y_{(ij)}$ (the estimated effect of determinant $x_{(ij)}$ on outcome $y_{(ij)}$ in study i for outcome category j) is:

$$y_{(ij)} = \theta_{(ij)} + e_{(ij)} \quad \text{Eq. 1}$$

where

- $y_{(ij)}$ = observed effect size for outcome j in study i
- $\theta_{(ij)}$ = true (unknown) effect size
- $e_{(ij)} \sim N(0, v_{(ij)})$ is the sampling error with known variance $v_{(ij)}$

The true effect size $\theta_{(ij)}$ in turn depends on study characteristics (moderators) and random effects:

$$\theta_{(ij)} = x_{(ij)}\beta + u_i + v_{(ij)} \quad \text{Eq.2}$$

where

- $x_{(ij)}$ = vector of moderator variables (e.g., outcome type, estimation method)
- β = vector of fixed-effect coefficients
- $u_i \sim N(0, \tau^2_{\text{study}})$ = random effect for study i
- $v_{(ij)} \sim N(0, \tau^2_{\text{effect}})$ = random effect for the specific outcome j within study i .

Combining the above two specifications, the final multi-level meta-regression model is given as:

$$Y_{(ij)} = X_{(ij)}\beta + U_i + V_{(ij)} \quad \text{Eq.3}$$

Total variance for each $y_{(ij)}$ is given as:

$$\text{Var}(v_{(ij)}) = \tau^2_{\text{study}} + \tau^2_{\text{effect}} + V_{(ij)}$$

The model was estimated using Restricted Maximum Likelihood (REML) via the `rma.mv()` function in the *metafor* package (Viechtbauer, 2010).

Term	Level	Description	Type of Variation
$e_{(ij)}$	Level 1	Sampling error in the <i>reported effect size</i> ($Y_{(ij)}$) (comes from the primary study's estimate)	Within-effect variability (measurement-level)
$v_{(ij)}$	Level 2	Deviation of effect (j) within study (i) from that study's mean effect	Within-study variation (true heterogeneity among multiple outcomes in same study)
u_i	Level 3	Deviation of the study's mean effect from the overall mean effect	Between-study variation (cross-study heterogeneity)

3. Pooled Model Results

