

Predicting Fertility Intention Based on the Theory of Planned Behavior: A Three-Level Meta-Analysis

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Abstract

Fertility intention is a key factor in predicting fertility behavior. Numerous studies have explored the role of the Theory of Planned Behavior (TPB) in predicting fertility intention, but the conclusions remain inconsistent. To examine the applicability of TPB in explaining fertility intention, this study employed a random-effects model to conduct a three-level meta-analysis on 33 included studies (comprising 128 effect sizes and a total of 47,923 participants). The results indicate that all TPB variables are significantly correlated with fertility intention, with attitude showing the strongest relationship ($r=0.41$), followed by subjective norm ($r=0.30$) and perceived behavioral control ($r=0.23$). The strength of the correlation between TPB and fertility intention is moderated by participants' gender, childbearing experience, and socioeconomic background, but not by individualistic-collectivistic cultural context or time frame. This study clarifies the relationship between TPB variables and fertility intention, providing theoretical support for developing fertility intention enhancement programs and building a fertility-friendly society.

Full Text

Preamble

Predicting Fertility Intentions with the Theory of Planned Behavior: A Three-Level Meta-Analysis

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Abstract

Fertility intentions are a key predictor of fertility behavior. While numerous

studies have examined the role of the Theory of Planned Behavior (TPB) in predicting fertility intentions, findings remain inconsistent. To test the applicability of TPB in explaining fertility intentions, this study employed a random-effects model to conduct a three-level meta-analysis of 33 studies (including 128 effect sizes and 47,923 participants). Results showed that all TPB variables were significantly correlated with fertility intentions, with attitude showing the strongest relationship ($r+ = 0.41$), followed by subjective norms ($r+ = 0.30$) and perceived behavioral control ($r+ = 0.23$). The strength of associations between TPB and fertility intentions was moderated by participants' gender, childbearing history, and socioeconomic background, but not by individualist-collectivist cultural context or temporal framing. This study clarifies the relationship between TPB variables and fertility intentions, providing theoretical support for developing fertility intention enhancement programs and building a fertility-friendly society.

Keywords: meta-analysis, fertility intentions, theory of planned behavior, attitude, subjective norm, perceived behavioral control

Classification Codes: B849; C91

Introduction

China's fertility rate has declined sharply in recent years. In 2023, the country recorded 9.02 million births, with a natural growth rate of -1.48% —the lowest since the founding of the People's Republic of China (National Bureau of Statistics, 2024). Meanwhile, the total fertility rate (TFR) dropped from 5.55 in 1950 to 1.23 in 2021, far below the replacement level of 2.1 (Bhattacharjee et al., 2024). President Xi Jinping has emphasized that population development is fundamental to the great rejuvenation of the Chinese nation and remains a global, long-term, and strategic issue facing China. Fertility intentions (FI) refer to individuals' plans and desires to have one or more children within a certain future period (Ajzen & Klobas, 2013; Michalos, 2014). Previous research indicates that fertility intentions are a critical factor in predicting future fertility behavior (Schoen et al., 1999; Ajzen & Klobas, 2013; Mencarini et al., 2015). Therefore, accurately understanding the fertility intentions of childbearing-age populations is essential for maintaining moderate fertility levels and building a fertility-friendly society.

The Theory of Planned Behavior (TPB) is an important theoretical model for explaining behavioral intentions and has been widely applied in fertility intention research (Armitage & Conner, 2001; Xie & Hong, 2022). The theory emphasizes the role of psychosocial factors and behavioral intentions in fertility decision-making and clarifies the multidimensional nature of fertility intentions, providing a crucial explanatory framework for understanding fertility behavior. Additionally, TPB offers guidance for predicting and intervening in fertility intentions from a psychological perspective. However, despite its strong predictive power across various behavioral domains, the applicability of TPB in fertility intention research remains controversial. Specifically, findings on the

relationships between TPB variables (attitude, subjective norm, and perceived behavioral control) and fertility intentions are inconsistent and sometimes contradictory (Ghasemi et al., 2023; Matera et al., 2023; Chappell, 2024). Some studies demonstrate that TPB variables effectively predict fertility intentions and are closely related (Williamson & Lawson, 2015; Ghasemi et al., 2023; Chappell, 2024), while others find that some TPB variables are unrelated to fertility intentions (Mynarska, 2021; Guo et al., 2022), with considerable variation in the strength of associations (Matera et al., 2023; Yao, 2024).

Given this background, this study employed a three-level meta-analysis (TMA) to systematically integrate research on TPB's prediction of fertility intentions, aiming to test the validity of TPB in this domain. Previous meta-analyses have typically focused on single variables (e.g., attitude) in relation to fertility intentions, lacking comparisons of the synergistic effects and relative weights of TPB components. Moreover, existing empirical studies, due to fragmented samples (limited to single countries or small samples) and methodological heterogeneity (differences in measurement tools), fail to provide universal evidence for policy-making. The TMA approach effectively disentangles variance at the individual, within-study, and between-study levels, thereby providing more accurate estimates and identification of moderating effects. By quantifying the predictive effects of attitude, subjective norm, and perceived behavioral control in the TPB model on fertility intentions, this study provides evidence for theoretical refinement of TPB in fertility decision-making. Furthermore, by identifying sample structural heterogeneity and measurement methodological heterogeneity in effect sizes, this study explores potential moderating factors influencing these relationships, offering a theoretical basis for differentiated fertility support policies.

1. Theoretical Framework

1.1 Theory of Planned Behavior and Fertility Intentions

The Theory of Planned Behavior is a classic model for predicting human social behavior, designed to explain individuals' behavioral intentions in specific contexts (Ajzen, 1991; Matera et al., 2023). The theory posits that behavioral intentions are primarily influenced by three factors: attitude, subjective norm, and perceived behavioral control.

1.1.1 Attitude and Fertility Intentions In fertility intention research, attitude refers to individuals' subjective evaluation of childbearing, associated with perceived benefits and costs—that is, the positive or negative outcomes individuals anticipate from having children (Ajzen & Klobas, 2013). Generally, when individuals perceive greater benefits and lower costs from childbearing, their attitudes become more positive and fertility intentions strengthen (Azmoode et al., 2017). Conversely, if individuals perceive high costs of childbearing, their attitudes become more negative and intentions decline (Ajzen & Klobas, 2013). Some studies show that TPB can predict married women's fertility intentions,

with attitude being the strongest predictor (Ghasemi et al., 2023). However, a study of working women found a significant negative correlation between attitude and fertility intentions (Alizadeh et al., 2023). Additionally, Guo et al. (2022) examined fertility intentions among people living with HIV using the TPB model and found that positive or negative fertility attitudes were unrelated to intentions. Thus, previous research remains controversial regarding the attitude-intention relationship, warranting further clarification.

1.1.2 Subjective Norm and Fertility Intentions Subjective norm refers to individuals' perception of social pressure and normative expectations from important referent individuals or groups (Mencarini et al., 2015). Partners (Matera et al., 2023), parents (Barber, 2000), and friends (Chen Sijing et al., 2024) are important sources of social pressure influencing fertility intentions. Other referent groups also affect intentions, such as colleagues (Ciliberto et al., 2010) and religious peers (Manski & Mayshar, 2003). Some research indicates that subjective norm is the most important predictor of fertility intentions (Cirtel et al., 2019). Survey data from China show that subjective norm is the strongest variable predicting university teachers' second-child intentions (Yao, 2024). However, other studies find weak or non-significant relationships between subjective norm and fertility intentions. For instance, Matera et al. (2023) found that fertility intentions are primarily influenced by individual attitudes rather than referent group expectations, while Alizadeh et al. (2023) reported low correlations between subjective norm and working women's fertility intentions. Krisprimada et al. (2019) also found no significant relationship between primiparous women's subsequent childbearing intentions and subjective norm. Overall, research conclusions on the subjective norm-intention relationship are inconsistent and require systematic synthesis.

1.1.3 Perceived Behavioral Control and Fertility Intentions Perceived behavioral control refers to individuals' subjective perception of their ability to successfully perform a behavior (Ajzen & Klobas, 2013). In fertility intention research, perceived behavioral control is closely related to external environmental factors such as economic conditions and family support. When individuals perceive more resources or support for childbearing, their intentions strengthen; conversely, when they perceive more constraints or obstacles, intentions weaken (Dommermuth et al., 2011). Williamson and Lawson (2015) examined childbearing intentions among nulliparous women over 30 and found perceived behavioral control to be the most significant predictor among TPB variables (Li et al., 2019). However, studies on adolescent fertility intentions found that perceived behavioral control could not effectively predict intentions, with no significant relationship (Ibrahim & Arulogun, 2020), a finding supported by European researchers (Mynarska, 2021). Meanwhile, research in low-fertility countries like Iran shows that perceived behavioral control is unrelated to first-birth intentions but significantly related to second-birth intentions (Erfani, 2017). Thus, the relationship between perceived behavioral control and fertility intentions

requires further exploration and verification.

1.2 Moderating Effects

In TPB research predicting fertility intentions, results are closely tied to researchers' specific designs and sample characteristics, potentially diverging from overall patterns. Through literature review and analysis, heterogeneity in conclusions regarding TPB variables' relationships with fertility intentions may stem from two sources: (1) sample structural heterogeneity, including demographic characteristics (gender, childbearing history) and socioeconomic-cultural backgrounds (individualist/collectivist cultural orientation, economic development level); and (2) measurement methodological heterogeneity, reflected in differences in temporal framing when measuring fertility intentions (short-term vs. long-term intentions). Therefore, this study systematically examined the effects of these five moderating variables through meta-analysis.

1.2.1 Gender Based on Social Role Theory, society's differential expectations for gender roles shape individuals' psychological cognitions and behavioral patterns in decision-making through gender socialization processes (Eagly & Wood, 2012). Specifically, women bear greater child-rearing responsibilities in domestic and parenting domains (McDonald, 2000), and the resulting work-family conflict may intensify negative fertility attitudes, leading to lower fertility intentions (Esping-Andersen & Billari, 2015; Raybould & Sear, 2021). Previous research indicates gender differences in the attitude-intention relationship, with men showing more positive fertility attitudes and stronger intentions than women (Matera et al., 2023; Chappell, 2024). Additionally, gender differences exist in the subjective norm-intention relationship (Kim & Kim, 2022). Therefore, it is necessary to systematically examine gender's influence on TPB variables' relationships with fertility intentions. This study hypothesizes that gender moderates these relationships.

1.2.2 Childbearing History Life-Course Theory posits that early experiences and choices produce cumulative effects that influence future decisions (Elder, 1998). First childbirth brings a unique identity transition, marking the shift from non-parent to parent status (Philipov et al., 2006; Billari et al., 2009). Lacking childbearing experience, most young women cannot clearly anticipate how childbirth will affect their future family, education, and career, basing decisions more on abstract attitudes (e.g., imagined ideal family size). Women with childbearing history, however, adjust their perceived behavioral control based on actual parenting experiences (e.g., assessments of time/economic costs) (Bernardi et al., 2007). Research shows that for first-time mothers, personal family experiences are an important foundation for understanding family functions, so their intentions are more influenced by siblings, whereas this influence is weaker for subsequent births (Lyngstad & Prskawetz, 2010). Thus, this study hypothesizes that childbearing history moderates TPB variables' relationships with fertility intentions.

1.2.3 Individualist-Collectivist Culture Cultural Cognition Theory suggests that individuals from different cultural backgrounds develop different cognitive frameworks that influence their values, judgments, and decisions (Kahan & Braman, 2006). Individualist cultures tend to view women as autonomous individuals morally equal to men, encouraging personal goal pursuit and self-development, with fertility attitudes considered highly personal and selective (Erfani et al., 2020). Collectivist cultures, conversely, emphasize filial piety, authority compliance, and convention adherence (Chao, 2000), assigning women more subordinate and supportive social roles and emphasizing family- and group-oriented responsibilities like child-rearing (Davis & Williamson, 2019). Spéder and Bálint (2024) argue that compared to collectivist cultures, individuals in individualist cultures view childbearing as a self-determined private matter, generally holding more positive autonomous attitudes and thus higher fertility intentions. In collectivist countries, even when individuals hold negative attitudes toward childbearing, strong social pressure—such as cultural values promoting “more children, more blessings”—may still produce strong intentions (Erfani et al., 2020). Therefore, this study hypothesizes that individualist-collectivist culture moderates TPB variables’ relationships with fertility intentions.

1.2.4 GDP per Capita GDP per capita, as a macro-level indicator of national economic level, influences TPB-fertility intention relationships through micro-level personal factors (Ajzen & Klobas, 2013). Economic Theory of Fertility (Becker, 1988) proposes that parents weigh child-rearing costs against their own consumption and choose between child quantity and quality. Objective economic conditions affect parents’ assessments of fertility costs and benefits, thereby influencing intentions (Becker & Barro, 1988). Research shows that high-GDP countries and regions typically have well-developed public education systems and fertility support policies that help reduce direct economic costs of childbearing, thereby enhancing individuals’ perceived control over fertility (Ajzen & Klobas, 2013). Conversely, in low-GDP countries, economic pressure often forces individuals to abandon desired fertility levels, weakening the attitude-intention association. Especially during economic crises, unstable conditions compel individuals to postpone family formation and childbearing plans (Fahlén & Oláh, 2018). Based on this, this study hypothesizes that GDP per capita moderates TPB variables’ relationships with fertility intentions.

1.2.5 Temporal Framing Temporal Construal Theory conceptualizes temporal distance as a form of psychological distance, where different time frames lead to different construal levels that affect judgments and decisions (Liberman & Trope, 1998). When events are framed by short-term or long-term time horizons, individuals’ temporal reference points and psychological reference points change, ultimately leading to different benefit-loss assessments (Trope & Liberman, 2003). According to this theory, short-term fertility intentions are primarily based on feasibility assessments, while long-term intentions more strongly reflect desires (Liberman & Trope, 1998). As women’s education and career

development levels increase, their likelihood of completing childbearing in the short term decreases, with many choosing to postpone childbearing, showing weaker short-term but stronger long-term intentions (Mills et al., 2011). Based on this, this study hypothesizes that temporal framing moderates TPB variables' relationships with fertility intentions.

1.3 Research Purpose and Questions

In summary, although TPB is widely applied in fertility intention research, conclusions remain highly variable. No study has yet systematically evaluated the TPB-fertility intention relationship. Therefore, a meta-analysis examining the strength of these relationships and potential moderating factors is essential. This not only helps assess TPB's predictive validity in the fertility domain and clarify its applicability but also provides theoretical support for fertility policy development. Meta-analysis (MA) is a statistical method for synthesizing previous empirical findings, typically assuming all included effect sizes come from a single population distribution. Three-level meta-analysis builds upon traditional MA by constructing multilevel models to address limitations in modeling dependent effect sizes and multilevel heterogeneity, thereby improving parameter estimation accuracy and ensuring robust conclusions. Based on this, this study employed three-level meta-analysis to examine relationships between TPB variables (attitude, subjective norm, perceived behavioral control) and fertility intentions, and to explore potential differences across gender, childbearing history, cultural background, economic level, and temporal framing.

2. Methods

This study followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) 2020 statement (Liberati et al., 2009) for literature search, screening, coding, quality assessment, and publication bias testing to ensure systematicity and reproducibility.

2.1 Literature Search and Screening

To ensure comprehensive coverage, we searched four Chinese databases (CNKI, Wanfang, VIP, and CSSCI) and five English databases (PubMed, Web of Science, EBSCO, ProQuest, Elsevier SD). We also conducted citation searches on Google Scholar for three key TPB papers (Ajzen, 1991, 2002; Armitage & Conner, 2001) to collect cross-sectional studies applying TPB to predict fertility intentions. Search strategies combined subject terms and free-text terms, with synonyms expanded. Chinese search terms included: fertility, childbirth, intention, first child, second child, third child, theory of planned behavior, theory of planned action, theory of reasoned action. English terms included: childbearing, fertility, intention, willingness, desire, *attitud** and *norm** and control and intention, *theory of planned behavi*, *planned behavi** and Ajzen, *attitud*, *norm* and *perceived behav** control, theory of rational action. The search covered

literature up to July 2024, yielding 1,227 articles.

Inclusion criteria were: (1) empirical studies; (2) direct measurement of both fertility intentions and TPB constructs, with bivariate statistics for at least one TPB component (attitude, subjective norm, perceived behavioral control) and fertility intentions obtainable from the paper or by contacting authors; (3) for duplicate publications, the most complete published version was included; (4) besides journal articles, dissertations, conference papers, and book chapters were included. Exclusion criteria: (1) studies without full text or extractable data; (2) studies on contraceptive intentions or fertility intention interventions.

Following PRISMA guidelines, two researchers independently reviewed titles and abstracts of 1,227 papers for relevance. To control language bias and ensure comprehensive coverage, no language restrictions were applied during screening. Non-English/non-Chinese literature (e.g., Korean) was screened using translation tools (Google Translate, Baidu Translate) with bilingual researchers verifying semantic accuracy. Disagreements were resolved through structured discussion, with a third researcher arbitrating unresolved issues. The final sample included 32 studies: 7 Chinese, 23 English, and 2 Korean. The PRISMA flowchart documenting all decisions is shown in Figure 1 [Figure 1: see original paper].

2.2 Quality Assessment and Coding

Literature quality was assessed using the tool developed by Zhang Yali et al. (2019). All included studies scored above 4 points, and all 32 were coded. Extracted data included: title, author information, publication year, participant nationality, sampling method, age, female ratio, sample size, sample characteristics, and correlation coefficients. Pearson's correlation coefficient r was used as the effect size, following these principles: (1) effect sizes were extracted and coded by independent sample—if a single paper reported multiple independent samples, each was coded separately; (2) if effect sizes were reported by participant characteristics, they were extracted separately; (3) if only test statistics were reported (e.g., t -values from independent samples t -tests, F -values from ANOVA, β -values from linear regression), they were converted to correlation coefficients using formulas: $r = \sqrt{t^2/(t^2 + df)}$; $r = \sqrt{F/(F + df)}$; $r = \sqrt{s^2/n}$; $r = 0.98\beta + 0.05\lambda$ (if $0.5 \geq \beta \geq 0$, $\lambda = 1$; if $-0.5 < \beta < 0$, $\lambda = 0$) (Wu Jianguan & Fu Hailun, 2024; Peterson & Brown, 2005). All coding was completed independently by two researchers. Discrepancies were resolved by reviewing original texts and recalculating until agreement was reached. Final inter-coder consistency was 98.22%, indicating good agreement. The included studies are listed in Appendix A.

2.3 Moderator Variable Measurement

Following Meng Xianxin et al.'s (2024) coding methods and considering the demographic characteristics of included samples, we coded moderators as follows.

First, female ratio was used to code gender. Second, participants were coded as parous or nulliparous based on childbearing history. Temporal framing was categorized using Miller's (2011) classification: intentions to have a child within three years were defined as short-term, while future intentions without time limits were long-term. Additionally, based on Hofstede's cultural dimensions and individualism index data (Hofstede et al., 2010) and previous coding methods, 50 was used as the cutoff to classify high vs. low individualism groups (Yuan Yue et al., 2024). GDP per capita data were obtained from the World Bank Open Data (<https://data.worldbank.org/>). Considering the publication years of included studies, we used the median year (2001) GDP per capita values to code national economic levels.

2.4 Statistical Analysis

We conducted three-level meta-analysis using the metafor package in R 4.3.2 (Viechtbauer, 2010), with model parameters estimated via Restricted Maximum Likelihood (REML). Sample-size weighted averaging yielded pooled correlation coefficients (r^+), with all correlations converted to Fisher's Z scores for main effect and moderator calculations (Peterson & Brown, 2005). For interpretation, Fisher's Z scores were converted back to correlation coefficients, with magnitude evaluated using Cohen's (1992) criteria: 0.10, 0.30, and 0.50 as thresholds for small, medium, and large effects. The significance level was set at $\alpha = 0.05$ ($p < 0.05$ considered statistically significant).

2.4.1 Model Selection To address non-independent effect sizes reported within the same study, we constructed a three-level random-effects model (Assink & Wibbelink, 2016; Harrer et al., 2021). Effect size variance was partitioned into three levels: sampling variance (Level 1), within-study variance (Level 2), and between-study variance (Level 3) (Cheung, 2014). REML was used to fit the model, with intraclass correlation coefficients calculated to verify the necessity of the hierarchical structure (Harrer et al., 2021). Compared to traditional models, the three-level model significantly reduces Type I error risk, preserves data integrity, accounts for correlations among effect sizes within the same study, and improves statistical efficiency (Cheung, 2019).

2.4.2 Heterogeneity and Moderator Testing Heterogeneity among included studies was assessed using Q tests and quantified with I^2 statistics. One-tailed log likelihood ratio tests examined variance at Levels 2 and 3 (Assink & Wibbelink, 2016). If no statistical heterogeneity existed, fixed-effects models would be used; moderate to high heterogeneity warranted random-effects models. Following Higgins et al. (2003), I^2 values of 25%, 50%, and 75% represented low, moderate, and high heterogeneity thresholds, with moderator analyses conducted to identify heterogeneity sources (Gao et al., 2024). Moderators included: (1) continuous variables (female ratio, GDP per capita) tested via meta-analytic regression for slope significance; (2) categorical variables (childbearing history,

individualist-collectivist culture, temporal framing) tested via mixed-effects subgroup analysis, following Card's (2012) robustness criterion (\$5 effect sizes per subgroup).

2.4.3 Publication Bias and Sensitivity Analysis Publication bias was visually assessed using funnel plots and quantitatively evaluated using Classic Fail-safe N, Egger's regression, and the trim-and-fill method. Funnel plots are scatterplots of effect sizes; in the absence of publication bias, data should be symmetrically distributed, concentrated in the upper middle region, forming an inverted funnel shape (Light & Pillemer, 1984). Fail-safe N indicates how many additional null-effect studies would be needed to render results non-significant; values exceeding $5k + 10$ (where k = number of effect sizes) suggest no significant bias (Rosenthal, 1995). Egger's regression uses linear regression of natural log odds ratios to measure funnel plot asymmetry, with intercept deviation from zero indicating asymmetry magnitude (Egger et al., 1997). Trim-and-fill assumes publication bias causes funnel plot asymmetry, "trimming" and "filling" to achieve symmetry and re-estimating the pooled effect; minimal change before and after trimming suggests low bias (Duval & Tweedie, 2000).

If included correlations vary substantially, meta-analytic conclusions may be affected by outliers, leading to spurious results (Kepes & Thomas, 2018). We employed three sensitivity analysis methods: Leave-One-Out Analysis, outlier detection, and influence analysis. Leave-One-Out assesses individual studies' impact by sequentially removing each study and recalculating the pooled effect; minimal fluctuation suggests stability (Dodell-Feder & Tamir, 2018; Meng Xianxin et al., 2024). Studentized deleted residuals (SDR) detected outliers, reflecting deviation between observed and predicted average effects. $|SDR| > 1.96$ with outlier count $> 10\%$ of total effect sizes indicated influential outliers (Viechtbauer & Cheung, 2010). Influence was assessed using Cook's distance (CD) and DFBETAS. CD measures Mahalanobis distance differences when including/excluding an effect size; DFBETAS indicates standard deviation changes in model parameters after exclusion. $CD < 0.45$ (Cook & Weisberg, 1982) or $|DFBETAS| < 1$ indicated non-significant influence (Viechtbauer & Cheung, 2010).

3. Results

3.1 Main Effects

The three-level meta-analysis evaluated TPB components' predictive effects on fertility intentions. Results showed attitude ($r+ = 0.41$) and subjective norm ($r+ = 0.30$) had medium positive correlations with fertility intentions, while perceived behavioral control showed a weak correlation ($r+ = 0.23$). All 95% confidence intervals excluded zero, indicating statistically significant associations. Q tests revealed significant heterogeneity for all three models ($p < 0.001$). One-tailed log likelihood ratio tests further showed significant variance at both

Level 2 (within-study) and Level 3 (between-study) ($p < 0.001$). Based on Higgins et al.'s (2003) criteria, within-study heterogeneity was low ($I^2 < 50\%$), while between-study heterogeneity was high. Therefore, moderator analyses were warranted to further explain the effects of attitude, subjective norm, and perceived behavioral control on fertility intentions (see Table 1).

Table 1 Correlations among Attitude, Subjective Norm, Perceived Behavioral Control, and Fertility Intentions

Relationship	Weighted Mean r	95% CI	Level 2 Variance	Level 3 Variance
ATT→FI	0.41***	[0.36, 0.46]	0.005*** (3.70%)	0.13*** (96.29%)
SN→FI	0.30***	[0.25, 0.35]	0.004*** (7.92%)	0.05*** (92.07%)
PBC→FI	0.23***	[0.18, 0.28]	0.01*** (8.54%)	0.11*** (91.45%)

Note: ATT = Attitude; SN = Subjective Norm; PBC = Perceived Behavioral Control; FI = Fertility Intentions; k = number of effect sizes; 95% CI = 95% confidence interval; $p < 0.05$, $p < 0.01$, $p < 0.001$.

3.2 Publication Bias and Sensitivity Analysis

Funnel plot symmetry was assessed using Fisher's Z-transformed effect sizes on the x-axis and standard errors on the y-axis, with 95% confidence intervals constructed around the pooled effect. Visual inspection showed effect sizes concentrated in the upper middle region of the funnel, roughly symmetrically distributed around the pooled effect, suggesting no significant publication bias (see Supplementary Figure A). Classic Fail-safe N tests yielded values far exceeding the $5k + 10$ threshold for attitude ($31,559 > 5 \times 30 + 10$), *subjectivenorm* ($41,505 > 5 \times 41 + 10$), and *perceivedbehavioralcontrol* ($4,281 > 5 \times 35 + 10$), indicating no publication bias. Egger's regression tests showed non-significant results for attitude, $t(28) = 0.01$, $p = 0.986$, intercept = 0.434 (SE = 0.141), and subjective norm, $t(39) = 0.627$, $p = 0.433$, intercept = 0.25 (SE = 0.089). Perceived behavioral control showed significant Egger's test, $t(33) = 12.616$, $p = 0.001$, intercept = -0.155 (SE = 0.121). Trim-and-fill analysis for perceived behavioral control added 0 studies to the left (effect = 0.19, 95% CI [0.10, 0.28]) and 6 studies to the right (effect = 0.28, 95% CI [0.17, 0.39]), with minimal change. Combined funnel plot and quantitative tests revealed no significant publication bias.

Leave-One-Out sensitivity analysis showed that after sequentially removing each study, effect sizes for attitude-intention ranged 0.39–0.43 (close to overall $r = 0.41$), subjective norm-intention ranged 0.29–0.31 (close to $r = 0.30$), and

perceived behavioral control-intention ranged 0.19–0.24 (close to $r+ = 0.23$), indicating stability. Studentized residual tests identified 2, 1, and 2 outliers respectively (see Supplementary Figure B), all below 10% of total effect sizes. Influence analysis showed all Cook's distances < 0.45 (see Supplementary Figure C), indicating no multivariate outliers. DFBETAS plots showed parameter changes < 1 standard deviation when excluding each effect size (see Supplementary Figure D). In conclusion, although a few outliers existed, their impact was limited, and meta-analytic results demonstrated high robustness and reliability.

3.3 Moderator Effects

For the attitude-intention relationship, continuous moderators showed: (1) significant gender effect ($\beta = 0.07$, 95% CI [0.02, 0.13], $p = 0.015$); (2) significant GDP per capita effect ($\beta = 0.11$, 95% CI [0.01, 0.21], $p = 0.03$). Categorical moderators showed: (1) significant childbearing history effect ($F(1, 14) = 9.61$, $p = 0.008$, $\beta = -0.16$, 95% CI [-0.27, -0.05]), with subgroup analysis showing stronger effects in nulliparous than parous individuals; (2) non-significant individualist culture effect ($F(1, 28) = 1.62$, $p = 0.21$); (3) non-significant temporal framing effect ($F(1, 22) = 0.65$, $p = 0.43$). See Table 2.

For the subjective norm-intention relationship, continuous moderators showed: (1) non-significant gender effect ($\beta = 0.02$, 95% CI [-0.04, 0.09], $p = 0.47$); (2) marginally significant GDP per capita effect ($\beta = 0.07$, 95% CI [-0.002, 0.13], $p = 0.058$). Categorical moderators showed: (1) non-significant childbearing history effect ($F(1, 19) = 0.54$, $p = 0.47$); (2) non-significant individualist culture effect ($F(1, 39) = 0.26$, $p = 0.61$); (3) non-significant temporal framing effect ($F(1, 34) = 1.16$, $p = 0.29$). See Table 2.

For the perceived behavioral control-intention relationship, continuous moderators showed: (1) non-significant gender effect ($\beta = 0.07$, 95% CI [-0.11, 0.24], $p = 0.44$); (2) significant GDP per capita effect ($\beta = 0.12$, 95% CI [0.01, 0.23], $p = 0.032$). Categorical moderators showed: (1) significant childbearing history effect ($F(1, 16) = 5.02$, $p = 0.04$, $\beta = 0.15$, 95% CI [0.01, 0.30]), with stronger effects in nulliparous individuals; (2) non-significant individualist culture effect ($F(1, 33) = 0.56$, $p = 0.46$); (3) non-significant temporal framing effect ($F(1, 27) = 2.08$, $p = 0.16$). See Table 2.

Table 2 Moderator Analysis Results

Relationship	Moderator	Category	Intercept/Mean z (95% CI)	β (95% CI)	p-value
ATT→FI	Gender	Continuous	0.39 [0.20, 0.59]	0.07 [0.02, 0.13]	0.015*
	GDP per capita	Continuous	0.62 [-1.59, 0.34]	0.11 [0.01, 0.21]	0.031*

Relationship	Moderator	Category	Intercept/Mean z (95% CI)	β (95% CI)	p- value	
SN→FI	Childbearing history	Nulliparous	0.58 [0.42, 0.75]	-0.16 [-0.27, -0.05]	0.008**	
		Parous	0.42 [0.25, 0.60]			
		Individualism	0.41 [0.25, 0.57]	0.11 [-0.07, 0.29]	0.21	
	Gender	Low IDV				
		High IDV	0.52 [0.32, 0.72]			
		Continuous	0.29 [0.19, 0.40]	0.02 [-0.04, 0.09]	0.47	
	GDP per capita	Continuous	0.30 [-0.94, 0.34]	0.07 [-0.002, 0.13]	0.058	
		Childbearing history	Nulliparous	0.32 [0.21, 0.43]	-0.04 [-0.17, 0.08]	0.47
			Parous	0.28 [0.15, 0.40]		
	Individualism		0.30 [0.21, 0.40]	0.03 [-0.10, 0.17]	0.61	
PBC→FI	Gender	High IDV	0.34 [0.20, 0.47]			
		Continuous	0.22 [0.03, 0.40]	0.07 [-0.11, 0.24]	0.44	
		GDP per capita	0.89 [-1.93, 0.14]	0.12 [0.01, 0.23]	0.032*	
	Childbearing history	Nulliparous	0.23 [0.04, 0.42]	-0.15 [-0.30, -0.01]	0.04*	
		Parous	0.08 [-0.13, 0.28]			
		Individualism	0.21 [0.06, 0.36]	0.08 [-0.13, 0.28]	0.46	
		High IDV	0.29 [0.08, 0.49]			

Note: ATT = Attitude; SN = Subjective Norm; PBC = Perceived Behavioral Control; FI = Fertility Intentions; k = number of effect sizes; 95% CI = 95%

confidence interval; β = estimated regression coefficient; Level 2 variance = within-study variance; Level 3 variance = between-study variance; $p < 0.05$, $p < 0.01$, $p < 0.001$.

4. Discussion

4.1 Relationship Between TPB and Fertility Intentions

First, this study confirms TPB's validity in explaining fertility intentions. Meta-analytic results demonstrate that TPB components (attitude, subjective norm, perceived behavioral control) significantly predict fertility intentions, consistent with TPB meta-analyses in other behavioral domains (e.g., alcohol consumption, organic food purchasing, green product consumption) (Cooke et al., 2016; Scalco et al., 2017; Panda et al., 2024). This indicates that TPB effectively explains the psychological mechanisms underlying fertility intentions and provides a sound theoretical basis for interventions targeting these components.

Second, the study reveals differential predictive strength among TPB components. Attitude emerged as the strongest predictor, confirming previous meta-analytic findings (Armitage & Conner, 2001; Hagger et al., 2002; Cooke et al., 2016). TPB's attitude dimension typically includes both positive (benefits) and negative (costs) attitudes toward childbearing (Philipov et al., 2006). According to TPB, fertility attitudes essentially represent a cost-benefit function evaluation of childbearing (Billari et al., 2009). When individuals perceive higher expected benefits, their attitudes become more positive and childbearing likelihood increases; conversely, when perceived costs dominate, attitudes become negative and likelihood decreases (Ajzen & Klobas, 2013). Notably, Barber (2001) extended TPB's attitude concept by introducing attitudes toward competing behaviors, suggesting that positive attitudes toward resource-competing activities (e.g., education investment, career development) indirectly weaken fertility intentions through resource competition mechanisms. Therefore, simply increasing fertility benefits may be insufficient; future policies must address both direct and opportunity costs of childbearing to ensure net benefits exceed potential losses.

Furthermore, subjective norm showed stronger associations with fertility intentions than perceived behavioral control, differing from TPB findings in other behavioral domains (McEachan et al., 2011; Starfelt Sutton & White, 2016). Fertility decisions are highly complex, involving not only individual rational choice but also couple-level joint decision-making (Rossier & Bernardi, 2009) and social influences from traditional customs and normative pressures (Cislaghi & Shakya, 2018). Bühler and Philipov (2005) argue that individuals are not isolated but embedded in social environments that shape fertility preferences. Even in highly individualist societies, support or opposition from significant others affects fertility decisions. Thus, subjective norm demonstrates stronger predictive power. Additionally, included studies focused more on external control factors (income, grandparental support, housing, social support) (Chesnais, 1996; Li et

al., 2019) than internal factors (fertility capacity, parenting experience, health status) (Williamson & Lawson, 2015; Guo et al., 2022), possibly explaining the weaker perceived behavioral control-intention association.

Overall, strengthening emotional, familial, and economic values of childbearing, increasing women's expected benefits, and promoting positive fertility norms in society are effective pathways to enhance fertility intentions.

4.2 Moderating Effects

4.2.1 Gender Gender significantly moderated the attitude-intention relationship, consistent with previous research (Matera et al., 2023; Chappell, 2024). As women bear the primary biological and social responsibility for reproduction, consuming more physical and psychological resources, they naturally focus more on childbearing costs and benefits. A Hong Kong family tracking study found men hold more positive fertility attitudes than women, rooted in gender inequality in domestic division of labor (Chen et al., 2024). Among Chinese university students, gender differences also exist, with male students viewing childbearing as more important and more likely to have future fertility plans than female students (Xu et al., 2023). However, gender did not significantly moderate subjective norm or perceived behavioral control relationships, suggesting no gender differences in perceived social pressure or confidence in childbearing capacity.

4.2.2 Childbearing History Childbearing history moderated TPB-fertility intention relationships. First, it significantly affected the attitude-intention association, with stronger predictive power among nulliparous individuals, supporting previous research (Billari et al., 2009). The life-course perspective emphasizes that childbearing experiences shape fertility intentions by altering cognitive and emotional attitudes (Kuhnt et al., 2021). Nulliparous individuals, lacking direct parenting experience, base intentions primarily on abstract attitudes (Philipov et al., 2006), while parous individuals' attitudes are shaped by actual parenting experiences, with parenting stress being a key factor (Chen et al., 2024). Research shows first-time parents focus more on children's emotional value, while subsequent parents emphasize economic and instrumental value (Bulatao, 1981). Second, childbearing history moderated the perceived behavioral control-intention relationship, with control perceptions being more predictive among nulliparous individuals, while real-world constraints may weaken this association for parous individuals. Policy design should therefore consider childbearing history to enhance intervention specificity and effectiveness.

4.2.3 Cultural Background Results showed TPB variables demonstrated stable predictive power across individualist and collectivist cultural contexts, with no significant moderating effect of individualist-collectivist culture. This supports TPB's cross-cultural applicability (Ajzen & Klobas, 2013), indicating stable TPB-fertility intention relationships regardless of cultural orientation. However, the lack of significant macro-level cultural moderation does not imply

cultural irrelevance. Rather, it suggests shifting focus to micro-level cultural elements. From Maslow's Hierarchy of Needs perspective (Maslow, 1943), socioeconomic modernization drives value shifts—when material needs are met, individuals prioritize non-material needs like self-actualization, gender equality, and lifestyle diversity. This individualistic value transformation makes fertility decisions increasingly independent from macro-institutional constraints, becoming personal and family choices, while traditional family norms' regulatory pressure diminishes. Research shows women's individualistic tendencies lead to more self-focused considerations, typically resulting in lower fertility intentions compared to those influenced by traditional gender roles (Erfani et al., 2020). Due to meta-analytic methodological limitations, this study could not examine micro-level cultural variables; future research should explore these cultural elements in fertility studies.

4.2.4 Economic Level GDP per capita significantly moderated all TPB-fertility intention relationships. In high-GDP countries, individuals may hold more positive attitudes, perceive more inclusive social norms, and have stronger perceived control over childbearing. Parent-child relationships represent long-term commitments, with reliable income and stable employment being important prerequisites (Van Wijk et al., 2021). Material conditions may strengthen the effects of psychosocial factors on fertility intentions by altering attitudes, normative pressure, and perceived control (Matera et al., 2023). High GDP typically indicates better economic development, living standards, and social welfare (Cheng et al., 2022). Comprehensive social welfare and childcare support systems enhance parents' sense of control, help women better balance career and parenting, and thus strengthen fertility intentions (Shen & Jiang, 2020). Conversely, in low-GDP countries, weaker TPB-intention relationships may result from economic constraints hindering intention realization (Dommermuth et al., 2015). Policy-making should therefore prioritize economic security to enhance fertility intentions.

4.2.5 Temporal Framing Temporal framing did not significantly moderate TPB-fertility intention relationships, indicating stable predictive power of TPB core variables across time dimensions. This contrasts with Dommermuth et al. (2011), who found temporal framing moderated TPB effects, particularly for short-term intentions being more driven by attitude and subjective norm. This discrepancy may reflect that fertility, as a major life-course decision, involves core attitudes that, once formed, show strong temporal inertia and resist fundamental change despite time span extension. Notably, although temporal framing did not moderate TPB-intention relationships, research consistently shows it significantly moderates the intention-behavior translation (Ajzen & Klobas, 2013). Short-term intentions are more likely to be realized, while longer time frames increase environmental influences and decrease behavior likelihood (Dommermuth et al., 2015). Future research should therefore focus on translating long-term intentions into short-term ones and explore underlying mechanisms amid

increasing social uncertainty.

In summary, this meta-analysis systematically evaluated TPB' s explanatory power for fertility intentions, confirming the predictive roles of attitude, subjective norm, and perceived behavioral control, and examining potential moderators. Despite TPB' s strong predictive power, fertility as a key life-course decision involves irreversibility and time sensitivity that a single model cannot fully explain. At the micro-level, factors like religious beliefs (Bein et al., 2021), marriage type (Ahinkorah et al., 2021), partner attitudes (Matera et al., 2023), and biological clock effects (Wagner et al., 2019) significantly influence intentions. At the macro-level, policy effectiveness (Cheung et al., 2024), intergenerational transmission (Merz, 2012), and social uncertainty (Comolli, 2023) also shape fertility intentions. Recent research highlights economic and environmental uncertainty impacts, particularly COVID-19' s universal fertility intention decline (Meng et al., 2023; Mooi-Reci et al., 2023). Therefore, comprehensive analysis combining multidisciplinary perspectives with contemporary contexts is needed to fully reveal fertility intention mechanisms and provide scientific evidence for population policy optimization.

4.3 Reflections on China' s Fertility Situation

Currently, persistently low fertility intentions among Chinese childbearing-age populations pose an urgent social challenge. Exploratory analysis of Chinese data revealed that subjective norm showed the strongest correlation with fertility intentions, followed by attitude and perceived behavioral control. From a cultural sociology perspective, two factors may explain this: First, China' s millennia-old Confucian filial piety culture emphasizes offspring obedience and views childbearing as a familial duty, encapsulated in the concept “of all unfilial acts, childlessness is the worst” (Cheng, 2020). Second, fertility cultural paradigms formed in agrarian societies value large families and progeny, with beliefs like “more children, more blessings” widely circulated (Yu & Liang, 2022). These traditional cultural norms exert particularly strong pressure on Chinese reproductive-age populations (Yu & Liang, 2022), highlighting the special weight of social norms in Chinese fertility decisions. Thus, tapping into positive functions of traditional culture and shaping fertility-friendly social consensus and contemporary values may be particularly important for enhancing Chinese women' s fertility intentions.

Fertility decisions reflect not only individual personality traits and motivational needs but also specific social cultural products (Takac et al., 2011). Therefore, fertility policies should address differentiated psychological needs across populations while strengthening external fertility-friendly social construction. First, policy design should implement differentiated strategies, tailoring interventions to actual needs of women with different childbearing histories and implementing precise measures based on regional and group economic conditions. In low-income areas, economic incentives like enhanced subsidies and tax benefits can promote childbearing, while high-income areas should focus on fertility

cultural identity cultivation and fertility-friendly norm shaping. Second, given Chinese social norms' unique influence on fertility intentions, policy-making should leverage positive cultural guidance functions, such as modernizing traditional concepts like "family-state isomorphism" and "family harmony" (Wang Junlin & Wang Faqiang, 2023), transforming traditional family rituals' educational functions into new family customs adapted to modern society, thereby creating positive fertility cultural atmospheres. Simultaneously, utilizing new media platforms to disseminate contemporary fertility values and vigorously promoting family and social support for child-rearing are also important measures for building a fertility-friendly social environment.

4.4 Limitations and Future Directions

This study is the first to systematically examine TPB-fertility intention relationships using meta-analysis, preliminarily validating TPB's robustness in fertility research, but several limitations remain. First, constrained by original studies, the meta-analysis could not examine moderating effects of women's education background or intergenerational factors. As primary childbearing agents, women's education is closely related to child quantity and quality. While conventional wisdom suggests educational investment reduces fertility opportunity costs, prompting delayed or reduced childbearing, modern gender role transformations have made child quality important, with women's education promoting child quality. Cultural intergenerational transmission theory also indicates parental fertility values profoundly affect offspring's fertility behaviors, with grandparental child-rearing support influencing attitudes and perceived control. Second, when examining cultural background, childbearing history, and temporal framing moderators, some subgroups had limited effect sizes, potentially affecting conclusion stability. Finally, TPB scale standardization remains problematic, with some large-scale surveys measuring only partial TPB variables. For example, the Generations and Gender Survey's subjective norm scale excludes peers like classmates and colleagues, potentially underestimating the subjective norm-intention relationship. Future research should improve TPB scales by adding implicit attitude measures, expanding subjective norm measurement to include social media peer groups with gender-differentiated referents, and incorporating internal control factors to more comprehensively assess fertility intentions. Additionally, future studies could explore fertility intentions from perspectives of women's human capital and intergenerational transmission based on TPB theory.

5. Conclusions

1. Overall, TPB variables (attitude, subjective norm, perceived behavioral control) significantly predict fertility intentions. Individuals with more positive expectations of childbearing benefits, greater perceived social pressure, and more childbearing resources show stronger fertility intentions.

2. Among TPB variables, attitude is the strongest predictor of fertility intentions, followed by subjective norm and perceived behavioral control.
3. Gender moderates the attitude-intention relationship, with women's fertility attitudes showing stronger positive predictive effects on intentions compared to men.
4. Attitude and perceived behavioral control better predict fertility intentions in nulliparous than parous populations.
5. GDP per capita significantly moderates TPB variables' predictive utility for fertility intentions.
6. Individualist-collectivist culture and temporal framing did not significantly moderate TPB variables' predictive utility for fertility intentions.

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*Note: References marked with * indicate studies included in the meta-analysis.**

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Appendix A: Basic Data of Studies Included in the Meta-Analysis

Study	Country/Region	Sampling Method	Sample Size	Female Age Range	Demographic Ratio	Characteristics	Temporal Framing	Individual Index	GDP per capita (2020)
Wang Xi-ao-qian (2023)	China	Convenience	2,267	15-35	100%	Nulliparous	Long-term	24	10,409
Luo Siqu (2023)	China	Convenience	7,146	Adult	51.3%	Nulliparous	Long-term	24	10,409
Du Sumin (2023)	China	Stratified	1,034	Adult	43.9%	Mixed	Long-term	24	10,409
Yu Ting (2020)	China	Convenience	612	Adult	62.9%	Parous	Long-term	24	10,409
Zhang Miao (2020)	China	Convenience	523	<36	51.8%	Nulliparous	Long-term	24	10,409
Williamson (2015)	Canada	Random	205	Adult	100%	Nulliparous	Long-term	80	46,749
Banana (2023)	Iran	Convenience	384	Adult	54.4%	Parous	Short-term	41	3,896
Yao (2019)	China	Convenience	2,676	Adult	61.86%	Mixed	Long-term	24	10,409
Yao (2024)	China	Random	1,847	Adult	79.8%	Parous	Short-term	24	10,409
Ibrahim (2020)	Nigeria	Random	1,847	15-19	50.3%	Nulliparous	Long-term	30	2,075
Matera (2023)	Italy	Random	1,200	Adult	100%	Parous	Long-term	76	31,923
Domenech (2023)	Norway	National	3,000	Adult	51.68%	Mixed	Both	69	67,294

Study	Country/Region	Sampling Method	Sample Size	Female Ratio	Demographic Characteristics	Temporal Framing	Individual Index	GDP per Capita (2020)
Agar (2018)	Canada	Convenience	305	Adult 100%	Nulliparous	Long-term	80	46,749
Erfan (2017)	Iran	Random	1,200	Adult 46%	Parous	Long-term	41	3,896
Chae (2016)	Korea	Convenience	384	Adult 100%	Nulliparous	Long-term	18	31,923
Ghassemi (2023)	Iran	Convenience	305	Adult 100%	Parous	Short-term	41	3,896
Ajzen (2013)	Multi-country	Mixed	10,108	Adult 51.8%	Mixed	Both	50	31,721
Chapman (2024)	USA	Convenience	1,034	Adult 100%	Mixed	Long-term	91	63,593
Alizadeh (2023)	Iran	Convenience	523	Adult 100%	Parous	Long-term	41	3,896
Guo (2022)	China	Convenience	612	Adult 35.77%	Parous	Long-term	24	10,409
Cirit (2019)	Romania	Random	1,847	Adult 51.8%	Mixed	Short-term	35	12,896
Billar (2009)	Bulgaria	Random	1,200	Adult 54.4%	Mixed	Long-term	30	9,871
Buber (2011)	Austria	National	3,000	Adult 51.68%	Mixed	Both	55	48,634
Mynarski (2021)	Poland	National	2,746	Adult 51.8%	Mixed	Long-term	60	15,817
Zhou (2021)	China	Two-stage stratified	743	Adult 50.3%	Mixed	Long-term	24	10,409
Ma Rui (2023)	China	Convenience	1,034	Adult 51.68%	Parous	Long-term	24	10,409
Jorge (1988)	USA	Random	1,847	Adult 100%	Nulliparous	Long-term	91	63,593
Chen (2024)	Hong Kong	Two-stage stratified	1,034	Adult 51.8%	Mixed	Both	25	46,109
Krispin (2019)	Indonesia	Census	384	Adult 100%	Parous	Short-term	14	4,196

Study	Country/Region	Sampling Method	Sample Size	Female Ratio	Demographic Characteristics	Temporal Framing	Individualism Index	GDP per Capita (2020)
Han (2010)	Korea	Convenience	305	Adults	100% Parous	Long-term	18	31,923
Kim (2022)	Korea	Convenience	200	Adults	51.68% Nulliparous	Long-term	18	31,923
Khorrami (2015)	Iran	Convenience	523	Adults	100% Parous	Long-term	41	3,896

Note: PBC-I = Perceived Behavioral Control Index; IDV = Individualism Index; GDP data from World Bank (2020).

Supplementary Figures

Supplementary Figure A. Funnel plots for attitude, subjective norm, and perceived behavioral control relationships with fertility intentions.

- Figure 1 [Figure 2: see original paper]: Funnel plot for attitude-fertility intention relationship
- Figure 2 [Figure 3: see original paper]: Funnel plot for subjective norm-fertility intention relationship
- Figure 3: Trim-and-fill funnel plot for perceived behavioral control-fertility intention relationship

Supplementary Figure B. Studentized deleted residuals for effect sizes (top: attitude, middle: subjective norm, bottom: perceived behavioral control)

Supplementary Figure C. Mahalanobis distance plots for effect sizes (top: attitude, middle: subjective norm, bottom: perceived behavioral control)

Supplementary Figure D. DFBETAS plots for effect sizes (top: attitude, middle: subjective norm, bottom: perceived behavioral control)

Note: Figure translations are in progress. See original paper for figures.

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