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Sociosexual orientation, life history strategy, and reproductive success: A large-scale cross-cultural analysis across 92 contemporary societies

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A B S T R A C T

This study presents a large-scale cross-cultural analysis to examine the relationships between sociosexual orientation, life history strategy, and reproductive success across 92 contemporary societies. We aim to contribute to the understanding of whether sociosexual orientation is part of a fast-slow continuum of life history strategies and how these factors are related to reproductive outcomes overall as well as among men and women separately. Specifically, we addressed four research questions: (1) is a relatively fast life history strategy at the population level associated with an unrestricted sociosexual orientation at the individual level; (2) is an unrestricted sociosexual orientation positively associated with the number of children at the individual level; (3) is a relatively fast life history strategy at the population level associated with a higher number of children per individual; and (4) is the association between sociosexual orientation and number of children moderated by the country-level indicator of life history strategy? Using multilevel models in an analytic sample of 80,047 participants from 92 countries, we found a differentiated pattern across levels of analysis. At the country level, a relatively faster life history strategy (rF-LHS) was initially associated with lower sociosexuality; however, this association did not persist after adjusting for country-level covariates. By contrast, rF-LHS was consistently positively associated with the number of children reported by participants. For attitudes and desire toward uncommitted sex, between-country differences were not associated with fertility, within-country deviations were negatively associated with number of children, and there was little evidence that this within-country association

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varied as a function of rF-LHS. For sociosexual behavior, between-country differences were positively associated with fertility, within-country deviations were negatively associated with number of children, and this negative within-country association became weaker in countries with higher rF-LHS. Sex-stratified analyses revealed a stable asymmetry: the negative within-country association between sociosexuality and fertility was stronger among women, whereas the positive country-level association between rF-LHS and fertility, as well as the moderation pattern for sociosexual behavior, were more pronounced in the pooled and male specifications. These findings do not support treating sociosexuality as a straightforward core marker of the fast–slow life history continuum in contemporary reproductive contexts. Rather, sociosexuality appears to be part of a multilevel and context-dependent process linking mating orientation to reproductive outcomes.

1. Introduction

The relationship between sociosexuality, life history strategies, and reproductive outcomes has sparked considerable debate. A key issue in this discussion is whether sociosexuality—one's openness to engage in uncommitted sexual relationships (Simpson & Gangestad, 1991)—fits within the fast-slow continuum of life history strategies and whether sociosexual orientation is associated with having more children. Recent work by Dinh and Gangestad (2024) critically re-examines these ideas, challenging the assumption that unrestricted sociosexuality naturally leads to higher reproductive output or is a clear indicator of a fast life history strategy.

Indeed, Dinh and Gangestad (2024) provide a comprehensive analysis that questions the traditional view that suggests that variations in sociosexual orientation straightforwardly reflect trade-offs central to the fast-slow life-history continuum. They argue that the relationship between sociosexuality, life history strategies, and reproductive outcomes is more nuanced and complex than previously thought. This is particularly true when accounting for sex differences and the unique aspects of human reproductive behavior. For instance, they point out that for women, having multiple sexual partners does not necessarily correlate with having more children, which complicates the idea that an unrestricted sociosexuality aligns with a fast life history strategy.

This ongoing debate has led to diverse perspectives on the function of sociosexuality as an expression of life history trade-offs. While some scholars argue that sociosexuality is not a meaningful component of life history pathways, others call for a fundamental reconsideration of the core assumptions within life history theory itself (Volk, 2023). Alternatively, some advocate for expanded models that account for multiple behavioral pathways toward mating and parenting efforts within the life history theory framework (Del Giudice, 2024). These differing approaches underscore the necessity of a more nuanced and integrative analysis of sociosexuality's relevance and underlying mechanisms within the broader paradigm of life history theory.

Stemming from this debate, our study seeks to contribute to the understanding of whether sociosexuality reliably aligns with the fast-slow life history continuum and whether it is directly associated with reproductive success. By examining a large cross-cultural dataset, we evaluated existing evidence and considered alternative perspectives on this part of the life history literature. In particular, we examined whether a relatively fast life history strategy at the population level is linked to an unrestricted sociosexual orientation at the individual level, taking into account the influence of cultural practices that may help reduce mortality risks and enhance reproductive outcomes. This approach allows us, for the first time, to study in detail how population-level life history strategies are related to individual behaviors and reproductive success.

1.1. *Life history theory and reproductive strategies*

Throughout human evolution, adaptation to complex and challenging environments has shaped many behavioral traits that maximize fitness. Like other species, humans must allocate physical and psychological resources between immediate needs and long-term goals, leading to trade-offs between different life priorities. These trade-offs significantly influence reproductive strategies, all of which are shaped by evolutionary pressures. Understanding how these strategies evolve and manifest, particularly in modern society, is crucial to comprehending the dynamics of human behavior. How individuals manage these competing priorities profoundly influences personal fitness and broader social dynamics.

Life history theory suggests that reproductive strategies are shaped by trade-offs between mating and parental efforts, as well as other trade-offs such as survival versus reproductive effort and offspring quality versus quantity (Cabeza de Baca & Ellis, 2017; Szepsenwol & Simpson, 2019). These trade-offs determine an individual's life history strategy, which can range from a fast strategy—focused on immediate reproduction and high-risk behaviors—to a slow strategy—focused on long-term planning and investment in fewer offspring.[3] This distinction is important because individual- and population-level life history strategies are not simply scaled versions of one another: the same ecological pressures, such as environmental harshness, may be associated with reproductive timing at the individual level and with demographic patterns at the population level, but the consequences of these associations may differ (Ellis et al., 2025).

Behavioral traits such as sociosexual orientation and parental investment do not necessarily scale up to broader fertility and mortality trends. This is particularly crucial in modern societies, where a multitude of social, cultural, and economic factors compromise the natural behavioral expression of life-history strategies trade-offs (Del Giudice, 2024). A clear understanding of these complexities is essential for accurately interpreting findings and avoiding conflations between levels of analysis.

Dinh and Gangestad (2024) highlight similar claims in developmental psychology, such as psychosocial acceleration theory (Belsky et al., 1991), which argues that human mating strategies are adaptively shaped by these life history trade-offs. Specifically, strategies that emphasize mating efforts, like short-term relationships and immediate reproduction, are associated with a fast life history strategy. In contrast, strategies emphasizing parental efforts, such as forming long-term bonds

[3] Evolutionary psychology applies this theory not only to compare reproductive strategies across populations within a species, but also to explain individual differences in life history strategies. Additionally, the theory has been extended beyond demographic trade-offs to include behavioral expressions of these strategies (Jackson & Kirkpatrick, 2007). That is, the two main branches of life history theory—evolutionary and psychological—differ in their emphasis: the evolutionary approach focuses on long-term evolutionary frameworks, while the psychological approach is concerned with cognitive processes and individual behavioral differences. Despite these distinctions, both approaches share a common historical foundation and could benefit from greater collaboration. By integrating methodologies and empirical findings, they could provide a more comprehensive understanding of human psychology within a broader biological context, thereby advancing scientific knowledge in both areas (Nettle & Frankenhuis, 2020). For instance, amid ongoing debates about demographic and behavioral trade-offs, Del Giudice (2024) proposed a clearer distinction by labeling demographic life history patterns as “FAST” and “SLOW” (in all caps), while using lowercase “fast” and “slow” to refer to allocation strategies and the constellations of life history-related traits (including psychological ones) that shape their implementation in practice.

and investing in fewer offspring, are associated with a slow life history strategy (Holtzman & Senne, 2014; Međedović, 2021a).

1.2. Life history strategy and sociosexual orientation

Dinh and Gangestad (2024) also refer to Chisholm (1993), who directly linked sociosexual orientation to life history strategies. Sociosexuality refers to individual differences in openness to casual, non-committed sexual relationships (Simpson & Gangestad, 1991). Individuals with restricted sociosexuality tend to engage in sexual activity only within emotionally intimate and committed relationships. In contrast, individuals with unrestricted sociosexuality are more likely to pursue sexual relationships with minimal commitment and investment, often after brief acquaintance and with multiple partners. This construct comprises three domains: attitudes toward casual sex, desire for casual sex, and engagement in casual sexual behavior (Hlay et al., 2022; Penke & Asendorpf, 2008). According to Chisholm (1993), a restricted sociosexual orientation that favors committed relationships and high parental investment is consistent with a slow life history strategy. Conversely, an unrestricted sociosexual orientation, characterized by uncommitted sexual behaviors, has often been theorized to align with a fast life history strategy and to increase reproductive output. This framework suggests that in environments with high mortality risks, a fast life history strategy that promotes diversified reproduction (diversified bet-hedging) can enhance survival across generations (Starrfelt & Kokko, 2012). Otherwise, if all offspring were born with identical traits, the performance of these offspring could be either consistently successful or unsuccessful (Brumbach et al., 2009).

Critically, sociosexual orientation is best understood as reflecting one of the central life history trade-offs, that is, between mating effort and parenting effort (Međedović, 2021b). Unrestricted sociosexuality indicates a prioritization of mating effort, often at the expense of sustained investment in offspring, while restricted sociosexuality allows for a greater allocation toward parenting effort and long-term pair bonds. The pursuit of multiple short-term sexual partners requires time, financial, and cognitive resources that could otherwise be invested in offspring care. Additionally, frequent changes in the parents' romantic partners contribute to environmental unpredictability (e.g., repeated entry and exit of stepparents or parental partners from the household)—one of the core forms of early adversity influencing life history development (Komyaginskaya et al., 2024). While sociosexuality is not equivalent to mating effort in a narrow behavioral sense, it is often treated as a useful proxy for mating effort across diverse populations and contexts in the life history literature (Gassen et al., 2018).

Empirical studies support this theoretical link. Individuals with more unrestricted sociosexuality tend to exhibit lower parenting predispositions (Valentova et al., 2020). Individuals with restricted sociosexuality have been shown to be more responsive to potential mates who interact positively with infants in distress, suggesting that parenting-related cues are more salient for those oriented toward long-term relationships (Bleske-Rechek et al., 2006). Similarly, women with more restricted sociosexual orientations place greater value on cooperative coparenting and report that high-quality coordination with their partner in raising children is central to relationship satisfaction (Lamela et al., 2020). These findings indicate that restricted sociosexuality is associated not only with preferences for long-term mating, but also with a stronger motivation to invest in and sustain parental roles.

1.3. Sex differences lead to complex interactions in reproductive outcomes

However, as Dinh and Gangestad (2024) continue to argue, the relationship between sociosexuality, life history strategy, and reproductive outcomes is complex and not well defined. While some studies suggest a link between a fast life history strategy and short-term mating behaviors (Brumbach et al., 2009; Ellis et al., 2009), other research indicates that these behaviors do not necessarily result in having more children or align with fast life history trajectories (Dinh et al., 2022; Holtzman & Senne, 2014; Međedović, 2021b). Moreover, short- and long-term mating preferences may not be opposite ends of a single spectrum but rather distinct strategies with only a small negative correlation between them (Holtzman & Senne, 2014; Jackson & Kirkpatrick, 2007). Still, it would be premature to dismiss sociosexuality as a component of life history strategies altogether. The exceptional intensity and duration of parental investment in humans—extending beyond basic care—underscore the significance of trade-offs between offspring quantity and quality in human resource allocation decisions. In turn, sustained parental investment is best promoted by stable, committed couple relationships, which are inherently in tension with the pursuit of other partners and/or sexual opportunities (Del Giudice, 2024). Thus, the role of sociosexuality must be examined within the context of when and how mating trade-offs become salient. Del Giudice (2014) argues that the decision between short-term and long-term relationships is contingent on the timing and relevance of such trade-offs. Although individuals may engage in both strategies, the balance between them shifts as real constraints—such as parenting responsibilities—emerge.[4]

Nevertheless, empirical evidence linking sociosexual orientation to life history trajectories remains inconsistent. For example, an unrestricted sociosexual orientation has in some instances been associated with later pregnancies and fewer children, suggesting that it does not universally indicate a fast life history strategy (Dinh et al., 2022). Regional demographic patterns further complicate these findings. Schmitt's (2005) study, for example, found that unrestricted sociosexuality correlates with higher life expectancy and lower fertility across countries—an association seemingly at odds with fast life history strategies. However, closer examination of the data suggests that these correlations are largely driven by a small subset of sub-Saharan African countries characterized by low life expectancy, high fertility, and restricted sociosexuality. When these countries are excluded, the associations weaken substantially (Del Giudice, 2024).

This highlights why associations between high sociosexuality and slow life history indicators may reflect specific contextual cases rather than a universal pattern. More broadly, the weak link between sociosexuality and biodemographic markers of life history strategies may be expected, given that sociosexual orientation is a behavioral trait that is more salient at the individual level of analysis rather than a strict demographic indicator that reflects patterns at the population level. At the individual level, sociosexuality reliably correlates with other life history-related traits. For instance, an earlier age of sexual debut is strongly linked to impulsivity, sensation seeking, a higher number of sexual partners, and various forms of risk-taking behavior (Del Giudice, 2024). These findings underscore the need for further investigation into the relationship between sociosexuality and broader demographic and ecological factors that shape its expression, particularly through a cross-cultural lens. Regardless of the precise role of sociosexuality in life history trade-offs, men and women navigate the balance between mating and parenting based on context-specific cost-benefit considerations. These calculations often lead to divergent strategies and sex-specific discrepancies, reflecting fundamental differences in reproductive constraints and investment patterns.

Dinh and Gangestad (2024) also examine in greater detail the relationship between reproductive outcomes and sociosexuality in women. They argue that, for women, having more sexual partners does not

[4] Furthermore, there is also a related statistical issue: standard factor rotation techniques, such as varimax and oblimin, are designed to break up general factors and produce semi-independent components. In other words, these methods do not necessarily reflect the true structure of underlying dimensions and can obscure a general continuum of variation, leading to an artificial perception that certain traits—such as short- and long-term mating strategies—are more independent than they actually are (Del Giudice, 2020).

necessarily result in higher reproductive success, whereas for men, the relationship is more straightforward. This asymmetry reflects fundamental sex differences in parental investment: in humans, female parental investment is obligate—women are biologically required to gestate and nurse offspring—while male parental investment is facultative and more variable. In other words, men can sire offspring without the obligatory gestational and lactational investment required of women (although offspring survival and eventual reproductive success may still depend on paternal, alloparental, and kin support).

To put it simply, a man who mates with 100 women in a year—especially during periods when the women are near ovulation and more inclined toward short-term mating (but see Thomas et al., 2021)—is likely to father significantly more offspring than a woman who mates with 100 men in the same period. A historical example is Genghis Khan, who is estimated to have fathered numerous children, with genetic studies suggesting that about 16 million men today carry his Y chromosome (Zerjal et al., 2003). While this is an exceptional case, it illustrates the potential for men to have a significantly higher reproductive ceiling, or maximum reproductive output, through multiple mating opportunities. Consequently, men with a greater number of sexual partners tend to produce more offspring than both men and women with fewer partners (Buss & Schmitt, 2019; Schmitt, 2005; Schmitt, 2015). However, it is important to note that such extreme cases are rare, and most men do not have such high numbers of direct descendants.

Reproductive outcomes in women may also be shaped by sociocultural factors beyond biological constraints. Specifically, engaging in multiple sexual partnerships may carry reputational costs for women, affecting their long-term mating prospects. In many societies, women who engage in frequent or noncommitted sexual behavior are often labeled negatively and perceived as less suitable for long-term relationships or parenting roles. Cross-cultural research highlights the persistence of sexual double standards, whereby frequent sexual activity is evaluated more positively for men than for women. Men's sexual behaviors are more likely to be socially accepted and even expected, whereas women who display similar behaviors face more negative evaluations (Endendijk et al., 2020).

The general trend supports the idea that men can significantly increase their reproductive success through multiple mating, while women, due to biological constraints, do not experience the same proportional gains. However, in some cases, multiple mating can enhance female reproductive success. Research shows that polyandry provides both direct and indirect benefits to females across species (Fromonteil et al., 2024), and strategic multiple partnerships can sometimes increase fitness in women (Wang et al., 2024). In human societies like the Pimbwe in Tanzania and the Himba of Namibia, multiple marriages and extramarital relationships have been linked to greater reproductive success for women than for men, also challenging the notion that investing in multiple partners does not enhance female fertility (Borgerhoff Mulder & Ross, 2019; Del Giudice, 2024; Scelza, 2013). Still, such cases are exceptions rather than the norm. Even where women benefit from multiple mating, the potential reproductive ceiling remains far higher for men due to fundamental differences in gamete production and parental investment, reinforcing the broader pattern seen across species.

1.4. Cultural and environmental influences on mating behavior

From a life history perspective, men, on average, can be expected to allocate more effort toward mating compared to women, reflecting sex-specific reproductive strategies shaped by differences in necessary parental investment. However, even though the general pattern predicts greater mating effort in men across a wide range of conditions, both men and women retain flexibility in adopting short-term or long-term mating strategies depending on ecological and social factors. For instance, environments characterized by high pathogen stress have been theorized to promote fast life history strategies, as unpredictable conditions favor earlier reproduction and higher fertility rates. Some research suggests that in such ecologies, polygynous marriage systems are more prevalent, and women tend to have their first child at an earlier age, with both sexes producing more offspring on average (Marlowe, 2003).

Other findings present a more complex picture. Cross-cultural studies indicate that in regions with historically high levels of infectious disease, individuals report lower sociosexuality, extraversion, and openness to experience, suggesting that heightened disease threat may foster more cautious behavioral strategies (Schaller & Murray, 2008). Regions with higher disease-related mortality also exhibit smaller sex differences in ingroup and outgroup trust (Zhu et al., 2021). Notably, disease-related mortality negatively predicts ingroup trust but shows no association with outgroup trust, which contradicts conventional predictions of parasite stress theory that suggest pathogen threat reduces openness toward outgroups. These findings illustrate that in some cultural contexts, high pathogen stress may promote fast life history strategies, while in others it may simultaneously suppress behaviors associated with sociosexuality and openness. The effects of pathogen stress on social and mating behaviors thus appear to be highly context-dependent and may diverge from standard theoretical expectations. This complex interplay underscores that although men and women differ in certain life history trade-offs, they also share a capacity for context-dependent flexibility in their mating strategies and social behaviors.

Research on other mammals supports this idea: differences in obligatory parental investment create distinct selection pressures for males and females and, consequently, distinct trade-offs between reproduction and somatic maintenance. Therefore, males, on average, are more likely to exhibit a faster strategy than females (Tarka et al., 2018). However, in humans—who are a pair-bonding species—these trade-offs may be moderated by shared parental investment, leading to more cooperation between sexes in reproductive and self-maintenance strategies. Nonetheless, these trade-offs remain relevant, particularly in shaping sociosexual behaviors. For instance, even in pair-bonded species like humans, men are more likely to display unrestricted sociosexuality, a pattern that persists despite egalitarian norms. Interestingly, this gender gap in sociosexuality is even wider in more egalitarian societies (Schmitt, 2015). However, recent meta-analytic findings by Herlitz et al. (2024) suggest that the gap in sexual behaviors (e.g., casual sex, oral sex) is smaller in countries with better living conditions, potentially reflecting the influence of environmental factors on these dynamics.

A key point in Dinh and Gangestad's (2024) argument is that having multiple partners increases genetic conflicts of interest, which they suggest can reduce offspring fitness and, consequently, maternal fitness. By 'genetic conflicts of interest', they are referring to situations where offspring from different fathers may compete for maternal resources, leading to reduced overall fitness. They also argue that offspring from multiple fathers are likely to receive less paternal investment and support, as the certainty of paternity decreases when a woman has children with multiple men (Dinh & Gangestad, 2024). Furthermore, they suggest that in human societies, especially foraging groups, long-term relationships can enhance reproductive success. Stable partnerships promote more frequent sexual activity and reduce the need for partner change, thereby minimizing the costs associated with finding new mates. In these societies, multiple sexual partners typically do not lead to an increase in the number of offspring, as longer birth intervals and lower certainty of paternity reduce overall parental investment (Meehan et al., 2013).

However, this perspective overlooks a crucial concept in life history theory trade-offs: Concerns about paternal investment are more relevant within the context of a slow life history strategy. For example, in forager societies where pathogen stress is lower and men contribute more to provisioning compared to environments that favor faster life history strategies, monogamous systems are more prevalent (Marlowe, 2003). In contrast, in environments that favor a fast life history strategy, women prioritize 'good genes,' often indexed by physical attractiveness, symmetry, and other markers of genetic quality, since they can only expect limited male parental involvement. Cross-cultural research consistently shows that when selecting short-term mates, women focus more on these traits as indicators of genetic fitness (Buss & Schmitt, 2019).

Yet, Dinh and Gangestad (2024) raise an important question: Why is restricted sociosexuality more prevalent in countries with unstable and harsh environments, even though, according to life history theory, unrestricted sociosexuality would be more adaptive in these contexts? It is important to mention that the relationship between environmental harshness and sociosexuality is more complex than a straightforward prediction from life history theory might suggest. A key distinction lies between extrinsic mortality risks (e.g., violence, disease) and resource scarcity (chronic energetic constraints). While high unpredictability favors early reproduction and reduced parental investment, resource scarcity often constrains reproductive effort, promoting cooperative breeding and stable pair bonds to enhance offspring survival (Del Giudice, 2024; Ellis et al., 2025; Sear, 2016). Taken together, the interplay between environmental stressors and sociosexuality is not a simple function of "harshness" per se, but depends on the nature of the stressor—whether it is extrinsic mortality risk or resource scarcity. At the same time, many societies experience high levels of unpredictability without suffering from chronic energetic constraints, yet restricted sociosexuality still prevails. We propose that the answer is that, unlike other animals, humans rely heavily on social norms to enhance social functionality and increase the likelihood of survival (Tybur et al., 2016). In environments where resources are scarce and competition is high, social norms may help reduce competition by reinforcing pair bonds and promoting long-term cooperation (Cantor & Farine, 2018; Gallyamova & Grigoryev, 2025). This not only increases group cohesion and functionality but also enhances offspring survival through shared parenting and caregiving arrangements, often involving extended family networks. By providing a more reliable environment for child-rearing, these cooperative structures help ensure the community's survival in harsh conditions.

This reliance on social norms as a means of regulating reproductive strategies is particularly evident in collectivist societies, where group cohesion and adherence to strict social conventions are prioritized. In such contexts, the preference for stable, committed relationships can be understood as a cultural adaptation that enhances group survival under challenging conditions (Gallyamova & Grigoryev, 2025). By promoting long-term pair bonds and cooperative parenting, these norms function to stabilize reproductive outcomes, reduce intra-group competition, and ensure greater offspring survival, particularly in resource-scarce or unpredictable environments. Therefore, culturally enforced restricted sociosexuality may, counterintuitively, serve as a socially stabilizing reproductive strategy under fast life history conditions. Even though fast strategies often emphasize early reproduction and low parental investment, norm-based sociosexual restraint can coexist with these tendencies, promoting collective survival by increasing social coordination and reducing reproductive risk.

Conversely, in societies where a slow life history strategy dominates, there tends to be greater variation in sociosexuality among women compared to societies characterized by a fast life history strategy. This aligns with the strategic differentiation–integration effort hypothesis, which suggests that individuals with a slower life history strategy tend to show more differentiation, evolving into specialized socioecological niches due to environmental stability and increased social competition throughout their evolutionary history (Fernandes et al., 2016).

In slow life history societies, particularly in WEIRD contexts, both sexes but especially women enjoy greater flexibility in adopting diverse mating strategies due to more egalitarian norms (Zhu & Chang, 2020). In these environments, women tend to be more educated, have broader access to contraception, and are better equipped to mitigate the risks traditionally associated with unrestricted sociosexuality, such as unplanned pregnancies and sexually transmitted infections. Consequently, a more open sociosexual orientation can represent a viable and adaptive strategy, especially in dense and competitive mating markets where the availability of desirable partners is high (Gallyamova & Grigoryev, 2025). Moreover, in societies where self-development and personal growth are prioritized, unrestricted sociosexuality may serve as a time-efficient means of fulfilling physiological and emotional needs without the resource investment required for early long-term relationships. This view is supported by recent evidence indicating that when women have economic autonomy and fewer parenting demands, unrestricted sociosexual behavior becomes more viable and less costly (Pirlott & Foley, 2023). Similarly, gender differences in sexual behavior, such as engagement in casual sex, are smaller in countries with higher standards of living (Herlitz et al., 2024), further suggesting that stable and prosperous ecological conditions enable greater behavioral flexibility.

Moreover, as previously discussed, gender-norm dynamics specific to certain cultural environments play a central role in shaping sociosexual expression. Across societies, women's sexual behavior is more tightly regulated and often subject to reputational sanctions not imposed on men (Endendijk et al., 2020). These double standards persist even in egalitarian contexts, but are particularly pronounced in fast life-history societies, which are associated with stronger male control over mating and reproduction and lower gender equality (Zhu & Chang, 2020). In such patriarchal societies, men and women occupy highly asymmetrical social positions, framing women as reproductive resources to be controlled. In such environments, sociosexual restrictions are institutionalized through cultural norms that safeguard paternity certainty and male dominance. For example, in 128 non-industrial societies, stricter restrictions on adolescent female premarital sex correlated with lower tolerance for extramarital sex and higher paternal investment, suggesting that cultural control over female sexuality helps mitigate paternity uncertainty (Šaffa et al., 2022). Contemporary data from 27 sub-Saharan African countries similarly indicate that greater female sexual autonomy is associated with higher rates of intimate partner violence, suggesting that efforts to assert reproductive autonomy often provoke backlash in fast life history societies (Tesema et al., 2024). In more extreme forms, such control manifests through honor-based violence such as honor killings across South Asia, the Middle East, and among diaspora communities, used to enforce compliance with sexual norms (Loza, 2022). Grant and Montrose (2018) conceptualize such practices, including female genital cutting and mobility restrictions, as part of an institutionalized mate-guarding system designed to limit women's sexual autonomy and ensure male reproductive control.

Evidently, mating behavior is highly complex, influenced by social, ecological, and cultural factors, which can shape sociosexuality and life history outcomes in various ways (Copping & Campbell, 2015; Međedović, 2021a, 2021b). Moreover, the relationship between the fast-slow life history continuum and sociosexuality has become more complicated in modern industrial societies. Factors like legally enforced monogamy, the welfare state (e.g., government support reducing resource competition among families), and widespread contraceptive use have likely weakened the association between life history outcomes, such as age at first birth and the number of offspring (Del Giudice, 2024; Figueredo et al., 2015). These macro-level shifts can also be understood through the lens of strategic differentiation–integration effort (Woodley of Menie & Fernandes, 2014). In fast life history contexts, mating, partnering, and reproduction are typically integrated into a single, early-life behavioral cluster. However, as populations undergo the second demographic transition—operationally reflected in higher mean age at first birth and widespread contraceptive use (Lesthaeghe, 2014), these domains become increasingly differentiated: sexual activity, marriage, and childbearing decouple and follow more independent trajectories. This differentiation reflects growing behavioral specialization in slow life history contexts with high resource stability, extended education, and intense status competition.

While we acknowledge that modern research on human life history strategies can sometimes oversimplify the link between trade-offs and sociosexual behaviors, we believe it is premature to dismiss the connection entirely. We argue that life history strategy and sociosexuality are interconnected, though the relationship is likely more nuanced than the straightforward assumption that faster life history strategies always lead to more unrestricted sociosexuality. Furthermore, much of the research on human life history strategies overlooks the fact that this theory was initially designed for population-level analysis, not for individual-level applications. This does not mean individual-level findings are invalid, but they can sometimes lead to ecological fallacies—errors that arise when inferences about individuals are drawn from population-level data. To address this, our study adopts a multilevel perspective to explore whether individual-level life history patterns primarily reflect broader population-level conditions or if they exhibit substantial variation within populations.

To further investigate these issues, our study explores four research questions (RQ) using a large cross-cultural sample (Kowal et al., 2022), analyzing the total sample as well as men and women separately.

The classical life-history prediction and the institutional-filter account therefore point to different expectations. Under the classical fast–slow interpretation, faster population-level life-history conditions should be associated with more unrestricted sociosexuality. Under the institutional-filter account, however, this association may be attenuated, absent, or even reversed when modernization, gender order, kinship organization, and norm-based regulation of mating are taken into account.

First, we investigate whether a relatively faster life history strategy at the population level is associated with more unrestricted sociosexual orientation at the individual level (**RQ1**), while recognizing that culturally transmitted norms and institutional arrangements may regulate sociosexual expression in ways that weaken or reverse the classical fast–slow expectation. In populations characterized by higher rF-LHS, norm-based regulation of mating behaviors—particularly by reinforcing pair bonds and promoting long-term relationships—can function as an adaptive strategy to stabilize reproductive outcomes (Cantor & Farine, 2018).

Second, we examine whether an unrestricted sociosexual orientation is positively associated with the number of children at the individual level (**RQ2**). If unrestricted sociosexual orientation does not lead to having more children, it may not be adaptive in fast life history strategy contexts, even if it was an adaptation in ancestral environments; this highlights the need to distinguish between historical adaptations and present-day adaptiveness (Symons, 1990). This question addresses a central point of debate raised by Dinh and Gangestad (2024), who challenge the traditional assumption that sociosexuality reliably reflects fast life history strategies by facilitating increased reproduction. But if we accept the classical view, it remains possible that modern socioeconomic conditions and widespread contraception decouple sociosexual behavior from reproductive outcomes. So in this view, traits associated with fast life history strategies such as lower behavioral regulation, heightened impulsivity, and sensation-seeking (Del Giudice, 2024; Sherman et al., 2013) may still promote an unrestricted sexual orientation, even if it no longer translates into greater reproductive output. Thus, RQ2 should be understood primarily as a test of present-day reproductive adaptiveness: whether unrestricted sociosexuality is associated with realized reproductive output in contemporary societies, rather than as a test of whether sociosexuality originated as an adaptation over evolutionary history.

Third, we assess whether a fast life history strategy at the population level, characterized by quick reproduction and reduced longevity, is associated with a higher number of children per individual (**RQ3**), which aligns with the core assumptions of life history theory (Del Giudice, 2020). In ecologies characterized by high extrinsic mortality and unpredictability, delaying reproduction carries risks. This population-level pattern can be clarified through Tooby and Cosmides's (1992) distinction between evoked culture and transmitted culture. Evoked culture refers to recurrent behavioral patterns generated when shared evolved psychological mechanisms respond in similar ways to similar ecological inputs, without requiring explicit norms or institutions. Thus, high-mortality or pathogen-risk environments may evoke earlier reproduction or stronger fertility preferences before these responses become culturally codified. Transmitted culture, by contrast, refers to socially learned customs, norms, values, and institutions that preserve and stabilize such recurrent responses over time. Once common within a population, evoked reproductive responses may be reinforced through pronatalist values, dense kinship networks, early marriage expectations, customary obligations, and institutional arrangements that reduce the costs of early reproduction and support higher fertility (Cabeza de Baca, Sotomayor-Peterson, Smith-Castro and Figueredo, 2014; Figueredo, Black, et al., 2021; Figueredo, Hertler, & Peñaherrera-Aguirre, 2021; Gallyamova et al., 2025). Individuals may then internalize these local reproductive patterns through exposure to prevalent and successful behaviors, thereby reinforcing locally adaptive strategies through social learning (Boyd & Richerson, 2009).

Some empirical evidence supports this framework. Fertility intentions—one of the most proximal psychological predictors of reproductive behavior—are shaped by the behavior of others. A one-unit increase in local community fertility raises individual fertility intentions by approximately 15.1% (Yu & Liang, 2022). Similarly, a rise in peer fertility decreases the likelihood of preferring only one child and increases the preference for three children (Nie et al., 2025). Other studies confirm that individuals adjust their reproductive decisions based on observed behavior in their social environment (Colleran, 2016; Fiori et al., 2014; Jin et al., 2023).

To adequately interpret the association between fertility at the population and individual levels, it is essential to recognize that a population-level life history strategy does not determine the behavior of each individual, who maintains their own reaction norm. At the population level, ecological conditions provide a general landscape within which biological reaction norms are expressed; individual expressions reflect the range of what is adaptive under prevailing conditions. At the cultural level, norms and institutions function as group-level adaptations tuned to that same context and as an additional selection filter that influences which individual strategies are favored and transmitted.

Thus, the population-level context establishes a background of adaptive pressure to which individuals may be more or less sensitive, while the cultural layer alters payoffs, risks, and coordination mechanisms that structure developmental opportunities. In this framework, ecological and cultural variables do not rigidly determine reproductive behavior; instead, they shift the range and probabilities of different individual predispositions being expressed through developmental microniches. For example, a population characterized by a relatively slower life history strategy may, on average, exhibit lower sociosexuality, yet individual sociosexual orientation (or reproductive motivation, parental investment tendencies, and related dispositions) can move a person toward the upper or lower bounds of that population-level norm—or even beyond it. This perspective aligns with life history models that emphasize environmental sensitivity and developmental calibration, explicitly distinguishing (1) population-level life history strategies—an adaptive landscape defined by mortality pressures, resource unpredictability, and selection histories—from (2) individual-level strategies that unfold within that landscape (Del Giudice, 2020). These individual strategies arise from interactions between evolved sensitivity thresholds and proximal ecological developmental cues, including social and institutional signals.

We treat culturally transmitted norms as extensions of evolved life history trade-offs rather than independent forces. These norms emerge as collective responses to ecological pressures and feed back into the developmental niche by modulating costs, risks, and cooperative structures. Pronatalist norms in high-mortality contexts, for instance, operate as social mechanisms that reinforce relatively faster life history strategies by lowering reproductive costs and enhancing kin support (Gallyamova et al., 2025). Following multilevel evolutionary and niche construction models (Figueredo, Black, et al., 2021), culture is an interdependent medium through which biological strategies are expressed and stabilized across generations. As kin-dense social networks give way to non-kin configurations during modernization, the family-based pronatalist "teaching bias" weakens and cultural transmission shifts toward more individualistic, fitness-decoupled goals (Newson & Richerson, 2009), indicating that kin-network structure conditions how these cultural processes play out in reproduction.

In parallel, modernization elevates gender equality, reallocating women's time and bargaining power, delaying marriage and childbearing, and attenuating pronatalist pressures (Inglehart & Welzel, 2005). Empirically, gender equality tracks this cultural shift and tends to be higher where intensive kinship institutions are weaker (Schulz et al., 2019). Because humans reconstruct their environments (niche construction), cultural dynamics feed back on ecological conditions over historical time, including through changes in kinship-network structure; consequently, individual strategies are shaped not only by broad ecological conditions but also by dynamic interactions with local social environments (social micro-niches) during development.

Fourth, we examine whether the relationship between an individual's sociosexual orientation and number of children is moderated by the life history strategy at the population level (**RQ4**). This is a useful question for assessing the extent to which sociosexuality can be treated as a component of life history strategy. Indeed, such an interpretation is theoretically plausible, given that sociosexuality is partly heritable (Bailey et al., 2000), but still there are arguments both in favor of and against this notion, and many inconsistencies in the literature remain. These inconsistencies are likely due to the fact that human societies differ significantly from ancestral environments, leading to numerous evolutionary mismatches. As a result, the relationship between sociosexuality and reproductive outcomes is unlikely to be straightforward and may vary for men and women (Schmitt, 2005; Strouts et al., 2017). With caution, we hypothesize that the association between sociosexual orientation and number of children would differ for men and women, as well as across relatively slower and faster country-level life history strategies. In slow societies, we expect unrestricted sociosexual orientation at the individual level to be unrelated to the number of children for women, as greater access to contraception and higher gender equality reduce the likelihood that short-term mating behaviors result in increased fertility (Figueredo et al., 2015; Pirlott & Foley, 2023). In contrast, restricted sociosexuality may confer reproductive advantages for women in such contexts, where reproductive success depends less on the number of offspring and more on the long-term investment required to ensure their social and developmental success. Stable pair bonds facilitate cooperative parenting, access to shared resources, and emotional support, enabling women to sustain larger families through higher per-child investment. Thus, restricted sociosexuality may enhance women's ability to capitalize on the ecological and social affordances of slow life history environments.

For men in slow life history strategy countries, we predict a positive association between unrestricted sociosexuality and number of children, although this relationship may be relatively modest. Conversely, in countries characterized by a relatively fast life history strategy, this positive association is expected to be stronger, as ecological and social conditions in these environments may make mating effort more closely linked to reproductive outcomes. This pattern is further enabled by gendered social norms, which tend to impose fewer constraints and less social sanction on male sexual behavior (Endendijk et al., 2020), as well as by male reproductive strategies that are more oriented toward diversification and maximizing reproductive opportunities across multiple partners (Buss & Schmitt, 2019). So in both life history contexts, sociosexually unrestricted men may have children both within formal long-term partnerships and through casual or extramarital relationships, allowing one man to have multiple female partners. However, although sociosexually unrestricted men may reproduce with multiple women, each of those women is typically limited to that one male partner in a reproductive context. This asymmetry arises because women's reproductive outcomes are more strongly constrained by societal expectations surrounding marriage, monogamy, and maternal roles—even in cases where women maintain stable extramarital relationships, such as being in the role of a mistress.

These constraints may be especially salient in relatively fast life history societies, where gender hierarchies are more pronounced and female behavior is subject to tighter social control (Tesema et al., 2024; Zhu & Chang, 2020). In such settings, early marriage, limited autonomy, and rigid pronatalist norms often enforce high fertility regardless of individual mating orientation. Even women with unrestricted sociosexuality may find their reproductive behavior shaped by institutional pressures toward monogamous, high-fertility paths. Simultaneously, biological factors—such as obligatory interbirth intervals, prolonged breastfeeding, and the high energetic demands of pregnancy and caregiving—further limit the reproductive potential of sociosexual freedom. In this dual context of social constraint and biological cost, restricted sociosexuality may offer more consistent reproductive advantages by promoting stable partnerships that support long-term cooperative parenting and deliberate fertility planning.

In sum, a moderation pattern in line with RQ4, where sociosexuality predicts fertility more strongly in relatively faster life history contexts, would be consistent with the idea that sociosexuality is embedded in a broader behavioral complex shaped by ecological and cultural conditions. However, such a pattern would not, by itself, demonstrate that sociosexuality is a fast life history trait in the strict sense of the quantity–quality trade-off. Rather, it would indicate that sociosexuality may participate in a multilevel and context-dependent process linking demographic regimes, mating orientation, and reproductive outcomes. Conversely, if sociosexuality is unrelated to fertility across contexts, or is more predictive in relatively slower life history societies, this would challenge its conceptualization as a core life history trait aligned with the fast–slow continuum and would instead favor accounts emphasizing evolutionary mismatch, behavioral decoupling, or cultural constraint. We also acknowledge that individual-level fertility outcomes exhibit high stochasticity, which can substantially attenuate observed effect sizes compared to aggregate analyses (Del Giudice, 2020). However, large-scale, cross-cultural samples, such as ours, help mitigate this issue by enabling the detection of modest but meaningful population-level patterns despite substantial individual-level variability.

Taken together, these research questions should be interpreted within contemporary reproductive contexts. The present analyses do not reconstruct ancestral selection pressures and do not provide a definitive test of whether sociosexual orientation was a stable component of life history strategy over evolutionary history. Rather, they test whether sociosexual orientation functions as a simple marker of relatively fast life history strategy in contemporary societies. From this perspective, RQ2 evaluates whether unrestricted sociosexuality is associated with realized reproductive output within countries, whereas RQ4 tests whether this within-country association varies across broader country-level demographic regimes. Thus, the findings are primarily informative about the contemporary association between mating dispositions and number of children, rather than about the evolutionary status of sociosexuality as an adaptation. At the same time, this design allows us to address a broader theoretical issue: whether mating-versus-parenting and quantity-versus-quality trade-offs are organized along a single fast–slow dimension or become partially dissociated across levels of analysis and socioecological contexts. Ultimately, by formally preregistering our analytic approach and testing these associations across a large and heterogeneous cross-cultural dataset, we aim to reduce inferential flexibility and contribute to a more precise empirical delineation of the conditions under which sociosexuality aligns with, diverges from, or interacts with population-level life history dynamics.

2. Method

2.1. Sample

The study utilizes data from 93 countries, encompassing a diverse range of socio-economic and cultural contexts (Kowal et al., 2022). This data included 118,320 participants who gave their consent to participate in this survey. However, only participants who indicated their sex as either 'male' or 'female' and reported a heterosexual orientation were included in the analysis. This restriction was applied because life history strategies are closely related to reproductive strategies, and the relationships may differ for other gender identities and sexual orientations. We also excluded participants who were born in a different country than the one they were currently living in. Finally, only individuals who passed the attention check were included in the final sample.

We also excluded Taiwan from the dataset because some country-level statistics were unavailable, and mainland China statistics may not be appropriate due to significant economic, social, and political differences between the two regions. Excluding Taiwan led to the loss of 593 participants, or approximately 1% of our total sample.

Additionally, because our measure of historical kin density was not available for Montenegro, we conducted separate analyses without these participants; and since data on contraceptive use was available for only 90 countries in the sample (with Cyprus and Brunei lacking such data), in sensitivity analyses we further excluded these two countries, which removed an additional 519 participants. Moreover, HIV prevalence data were unavailable for 20 countries in our dataset (Austria, Bahrain, Bosnia and Herzegovina, Brunei, China, Dominican Republic, Finland, Hungary, Israel, Japan, Kazakhstan, Nigeria, Norway, Russia, South Korea, Sweden, Turkey, the United Kingdom, Ukraine, and Uzbekistan). As a result, all analyses involving HIV prevalence as a covariate were conducted on a reduced subsample that excludes these countries.

Regarding missing data, we first conducted a test to determine whether missing data follows a Missing Completely at Random (MCAR) pattern. Our plan was as follows. If the data was found to be MCAR, the complete-case approach would ensure that our findings are based on fully observed data, enhancing the reliability of the results without introducing potential biases associated with data imputation. If the data was not MCAR, we would apply multiple imputation using packages such as *mice*, taking into account the multilevel structure of the data. In case of potential MNAR patterns, we would conduct sensitivity analyses to assess the robustness of our results under different missing data assumptions.

Missing data were first summarized descriptively and evaluated with Little's test of MCAR. Item-level missingness was concentrated in the individual self-report variables and was highest for the SOI items (19.1%–19.3%), followed by level of education and perceived socio-economic status (17.6%–17.7%), perceived financial prospects, perceived religiousness, perceived physical attractiveness, and perceived physical health (14.8%–14.9%), the individualistic attitudes items (7.0%–7.6%), and the attitudes toward gender equality items (6.6%–6.7%). Missingness for age, number of children, relationship status, and religion type was negligible ($\leq$ 0.6%). Because Little's MCAR test rejected the MCAR assumption ($p < .001$), the primary analyses were estimated under a MAR multiple-imputation strategy ($M = 20$) using a multilevel-compatible imputation procedure. Sensitivity analyses under alternative MNAR scenarios were also conducted to evaluate the robustness of the main conclusions. The resulting post-imputation analytic sample comprised 80,047 participants from 92 countries, including 26,407 men (32.99%) and 53,640 women (67.01%); mean age was 30.96 years ($SD = 12.90$).

2.2. Measures

2.2.1. Individual-level variables

All the individual-level variables, including predictor, outcome, and control variables, are reported in Table 1. **Sociosexual orientation** was measured using the revised Sociosexual Orientation Inventory (SOI-R) by Penke and Asendorpf (2008), which uses a 9-point scale to assess individuals' openness to casual sex. The scale included three key items focusing on *behavior, attitude,* and *desire*. Behavior was measured by asking how many different partners someone has had sex with without seeking a long-term relationship, with responses ranging from *0* (1) to *20 or more* (9). Attitude was assessed by rating comfort with casual sex on a scale from *strongly disagree* (1) to *strongly agree* (9). Desire was measured by how often participants fantasized about sex with someone they had just met, with responses ranging from *never* (1) to *at least once a day* (9). To distinguish between orientation, behavior, and effort, we used the SOI-R indexes to evaluate attitudes and desires, as well as short-term behavior. However, we did not consider the energetic inputs that constitute "effort." To obtain the most comparable model estimates across SOI operationalizations, we: (1) fitted models using the SOI-R total score; (2) re-fitted models using only the behavioral subscale; and (3) re-fitted models using only the attitudes + desire subscale. **Number of children** was measured using a single item, asking participants how many children they had. Responses were recorded on a 6-point scale, ranging from *0* (0) to *5 or more* (5).

Scale reliability in the analytic sample was moderate for SOI total (Cronbach's $\alpha = 0.66$) and for the combined SOI attitudes + desire index (Spearman-Brown = 0.63). The covariate scales showed acceptable to good reliability (individualistic attitudes: $\alpha = 0.75$; attitudes toward gender equality: $\alpha = 0.84$). By sex, SOI total α was 0.63 among men and 0.64 among women, and the SOI attitudes + desire index showed Spearman-Brown coefficients of 0.61 among men and 0.60 among women. Because country-specific SOI reliability varied substantially, country-level SOI associations are interpreted more cautiously than the within-country coefficients. Mean SOI scores were 3.01 ($SD = 1.83$) for SOI total, 3.11 ($SD = 2.02$) for SOI attitudes + desire, and 2.82 ($SD = 2.36$) for SOI behavior, and the mean number of children was 0.53 ($SD = 0.99$). Men scored higher than women on all SOI operationalizations (SOI total: 3.72 vs. 2.65; SOI attitudes + desire: 3.92 vs. 2.69; SOI behavior: 3.32 vs. 2.56).

2.2.2. Country-level variables

In the analysis, the relatively Faster Life History Strategy Index (rF-LHS) was calculated using Principal Axis Factoring (PAF). This index was derived from three country-level indicators by the United Nations (2024a). Indeed, it is crucial not to limit the assessment of life history strategies solely to fertility-related indicators. Across mammalian species, the full syndrome of fast life history strategies is characterized not only by early reproduction and high fertility but also by elevated mortality (short lifespan) and reduced offspring quality (Del Giudice, 2020). Focusing exclusively on fertility and reproductive timing risks oversimplifying life history strategies, as fast and slow life histories represent specific constellations of interrelated traits rather than isolated demographic patterns. That is why we employed Principal Axis Factoring (PAF), which mitigates unique measurement errors and balances out the distinct contributions of the component indicators by capturing their shared variance. This approach allows us to distill three highly correlated indicators into a single composite index, which represents the country-level tendency toward a relatively faster life history strategy based on the life history trade-off between reproduction and maintenance/growth in the population: (1) **Total Fertility Rate (live births per woman)**: This represents the average number of children a woman would have over her lifetime, providing insight into the reproductive strategy of the population; (2) **Births by women aged 15 to 19 per 1000**: This measure reflects the rate of adolescent fertility, which is indicative of a relatively faster life history strategy where reproduction

Table 1
Description of the individual-level measures.

Variable	Item	Response scale	Reference
Sociosexual orientation	With how many different partners have you had sexual intercourse without having an interest in a long-term committed relationship with this person?	0 (1) 1 (2) 2 (3) 3 (4) 4 (5) 5–6 (6) 7–9 (7) 10–19 (8) 20 or more (9)	Penke & Asendorpf, 2008
	I can imagine myself being comfortable and enjoying 'casual' sex with different partners.	(1) strongly disagree - (9) strongly agree	Penke & Asendorpf, 2008
	In everyday life, how often do you have spontaneous fantasies about having sex with someone you have just met?	Never (1) Very seldom (2) About once every two or three months (3) About once a month (4) About once every two weeks (5) About once a week (6) Several times per week (7) Nearly every day (8) At least once a day (9)	Penke & Asendorpf, 2008
Number of children	How many children do you have?	0 (0); 1 (1); 2 (2); 3 (3); 4 (4); 5 or more (5)	
Age	How old are you (in years)?	18 to 90 (one-year intervals)	
Gender (Computed score)	A dichotomized Sex variable	Men (0), Women (1), other sexes denoted as missing	
Sexual orientation	Please select the sexual orientation label(s) that best fits you currently.	Heterosexual or straight (1); Gay (2); Lesbian (3); Bisexual (4); Pansexual (5); Asexual (6); Prefer not to say (7); Other identity not listed (please specify): (8)	
Relationship status	What is your relationship status?	Single (0), Dating (1), In a committed relationship (2), Married (3)	
Religious affiliation (Computed score)	A dichotomized Religion_type variable, with recoded labels	'Religious', 'Not-Religious'	
Perceived religiousness	How strong is your religious belief?	Extremely weak religious belief (Bottom 1 out of 100 people) (1) (Bottom 3 out of 100 people) (2) (Bottom 8 out of 100 people) (3) (Bottom 18 out of 100 people) (4) (Bottom 32 out of 100 people) (5) Average (Top 50 out of 100 people) (6) (Top 32 out of 100 people) (7) (Top 18 out of 100 people) (8) (Top 8 out of 100 people) (9) (Top 3 out of 100 people) (10) Extremely strong religious belief(Top 1 out of 100 people) (11)	Conroy-Beam et al., 2022
Level of education	Which of the following answers best describes your level of education?	No formal education (1); Primary school only (2); Primary school through Secondary school (3); Primary school through High school or Technical college (4); Primary school through Bachelor's degree (5); Primary School through Master's Degree (6); Primary School through PhD, MD, JD, or other advanced degree (7)	
Perceived socio-economic status (SES)	Which of the following answers best describes your social class level?	upper class (5), upper middle class (4), middle class (3), lower middle class (2), lower class (1)	
Perceived financial prospects	How good are your financial prospects?	Extremely poor financial prospects (Bottom 1 out of 100 people) (1) (Bottom 3 out of 100 people) (2) (Bottom 8 out of 100 people) (3) (Bottom 18 out of 100 people) (4) (Bottom 32 out of 100 people) (5) Average (Top 50 out of 100 people) (6) (Top 32 out of 100 people) (7) (Top 18 out of 100 people) (8) (Top 8 out of 100 people) (9) (Top 3 out of 100 people) (10) Extremely good financial prospects (Top 1 out of 100 people) (11)	Conroy-Beam et al., 2022
Perceived physical attractiveness	How physically attractive are you?	Extremely physically unattractive(Bottom 1 out of 100 people) (1) (Bottom 3 out of 100 people) (2) (Bottom 8 out of 100 people) (3) (Bottom 18 out of 100 people) (4) (Bottom 32 out of 100 people) (5) Average (Top 50 out of 100 people) (6) (Top 32 out of 100 people) (7) (Top 18 out of 100 people) (8) (Top 8 out of 100 people) (9) (Top 3 out of 100 people) (10)	Conroy-Beam et al., 2022

(continued on next page)

Table 1 (*continued*)

Variable	Item	Response scale	Reference
		Extremely physically attractive(Top 1 out of 100 people) (11)	
Perceived physical health	How healthy are you?	Extremely unhealthy (Bottom 1 out of 100 people) (1) (Bottom 3 out of 100 people) (2) (Bottom 8 out of 100 people) (3) (Bottom 18 out of 100 people) (4) (Bottom 32 out of 100 people) (5) Average (Top 50 out of 100 people) (6) (Top 32 out of 100 people) (7) (Top 18 out of 100 people) (8) (Top 8 out of 100 people) (9) (Top 3 out of 100 people) (10) Extremely healthy (Top 1 out of 100 people) (11)	Conroy-Beam et al., 2022
Individualistic attitudes	Group welfare is more important than individual rewards.	Definitely disagree (7) - Definitely agree (1)	Wu, 2006
	Group success is more important than individual success.	Definitely disagree (7) - Definitely agree (1)	Wu, 2006
	Being accepted by the members of the workgroup is very important.	Definitely disagree (7) - Definitely agree (1)	Wu, 2006
	Employees should pursue their goals only after considering the welfare of the group.	Definitely disagree (7) - Definitely agree (1)	Wu, 2006
Attitudes toward gender equality	A woman's most important role is to take care of her home and cook.	Definitely disagree (7) - Definitely agree (1)	Levtov et al., 2014
	Changing diapers, giving kids a bath, and feeding kids are the mother's responsibility.	Definitely disagree (7) - Definitely agree (1)	Levtov et al., 2014
	A man should have the final word about decisions in his home.	Definitely disagree (7) - Definitely agree (1)	Levtov et al., 2014

begins at an earlier age. It also serves as a proxy for age at first reproduction and highlights early births, which is important because the age at first reproduction can obscure the frequency of teenage pregnancies, blending early and later reproductive patterns; (3) **Mortality before Age 40 – both sexes (deaths under age 40 per 1000 live births)**: This variable captures the risk of early mortality, which is often higher in environments where a relatively faster life history strategy is more prevalent. We chose this measure over child mortality under five because it captures a broader range of mortality risks affecting life history strategy into adulthood, providing a more comprehensive indicator of environmental pressures on reproductive behavior.

The PAF loadings for these indicators were 0.852, 0.887, and 0.878, respectively. The cumulative variance explained by rF-LHS was 76.1%. rF-LHS was then included as the focal country-level predictor in models of SOI and models of number of children, allowing us to investigate its relationship with sociosexual orientation and number of children while accounting for other relevant factors at both the individual and country levels.

Our analysis considered eight country-level control variables: National Education, National Wealth, Gender Gap Index, Kinship Intensity Index, Sex Ratio, Age Childbearing, Contraceptive Prevalence, and HIV Prevalence (measures detailed below). Colleran et al. (2014) found that a country's aggregate education level is a better predictor of fertility decline than individual education levels, highlighting the importance of National Education in demographic changes. Herlitz et al. (2024) indicated that in countries with better living conditions—often associated with greater National Wealth—the gap in sexual behaviors between men and women is smaller. While men are generally more likely to exhibit unrestricted sociosexuality regardless of egalitarian norms, Schmitt (2015) observed that this gender gap is wider in more egalitarian societies, emphasizing the complex role of the Gender Gap Index in sociosexual behaviors. Additionally, Schacht and Smith (2017) reported that when there are more men in the population—that is, a male-biased Sex Ratio—long-term relationships tend to flourish, as evidenced by increased marriage and decreased divorce rates. This suggests that the Sex Ratio significantly impacts relationship dynamics.

The National Education Index was derived from four country-level indicators by the United Nations (2024a) via PAF: (1) **Expected Years of Schooling**: This represents the average number of years a child can expect to spend in school, providing insight into the access to and duration of education within a population; (2) **Mean Years of Schooling**: This measure reflects the average number of years of education completed by adults aged 25 and older, indicating the level of educational attainment in a population; (3) **Population with at least some secondary education, female**: This variable measures the percentage of females aged 25 and older who have completed some form of secondary education, highlighting gender disparities in educational access and achievement; (4) **Population with at least some secondary education, male**: Similarly, this indicator reflects the percentage of males aged 25 and older who have completed some secondary education, providing a parallel measure for comparison across sexes. The PAF loadings for these indicators were 0.596, 0.961, 0.965, and 0.959, respectively. The cumulative variance explained by the National Education Index was 78.3%.

The National Wealth Index was derived from two country-level indicators via PAF: (1) **Gross National Income per capita**: This represents the average income of a country's citizens, adjusted for purchasing power parity (PPP) as of 2017 (United Nations, 2024a), which provides a comprehensive measure of national wealth and economic productivity; (2) **Gross Domestic Product per capita:** This indicator reflects the gross domestic product per person in current US dollars, as reported by the World Bank (2024a), and serves as a measure of the economic output and living standards within a country. The PAF loadings for both indicators were 0.965. The cumulative variance explained by the National Wealth Index was 93.1%.

The Gender Gap Index was obtained from the World Economic Forum (2024). It is designed to measure gender equality at the country level. This index, first published by the World Economic Forum in 2006, assesses countries on how well they are dividing their resources and opportunities between their male and female populations. It takes into account four key areas: (1) **Economic participation and opportunity**: This includes measures such as labor force participation, wage equality for similar work, estimated earned income, representation among legislators, senior officials, and managers, and participation as professional and technical workers; (2) **Educational attainment**: This area measures access to education across four stages: literacy rate, enrollment in primary education, enrollment in secondary education, and enrollment in tertiary education; (3) **Health and survival:** This component includes the sex ratio at birth and healthy life expectancy, recognizing inherent biological differences between men and women, such as the expected longer lifespan of women; (4) **Political empowerment:** This measures the gap between men and women in political decision-making positions, including the proportion of women in parliament, ministerial positions, and the number of years with a female head of state. The upper limiting value of the Gender Gap Index, or the maximum score that reflects perfect equality between men and women, is 1.0. We assume that patriarchal social norms may influence the relationship between sociosexuality and life history strategy, and this variable helped to capture potential societal effects.

To account for historical variation in kinship-based cultural norms, we included the Kinship Intensity Index (KII) developed by Schulz et al. (2019). This index captures the historical strength of kin-based institutions and is derived from ethnographic and anthropological data on pre-industrial populations, primarily around 1900. The KII aggregates five core dimensions of kinship organization: (1) **Preference for cousin marriage, reflecting the normative tightness of familial networks**; (2) **Polygyny**, as an indicator of extended household structure and reproductive inequality; (3) **Coresidence of extended families**, which increases intergenerational dependence and kin cohesion; (4) **Lineage organization**, distinguishing between unilineal and bilateral descent systems; and (5) **Localized community organization**, such as clan-based residential clustering and endogamy. These components were standardized and averaged to create a composite index, which was then extrapolated globally via linguistic phylogenies and weighted by contemporary population shares to generate country-level KII scores. The Kinship Intensity Index reflects the depth and rigidity of familial norms that historically shaped individual obligations, autonomy, and marriage patterns. Higher KII values denote denser, more encompassing kinship networks and tighter constraints on individual decision-making. In our analyses, KII controlled for deep-rooted cultural variation that shapes reproductive behavior via social learning, independent of life-history trade-offs. By indexing historical kin density, KII captures the pronatalist kin transmission that historically buffered populations against the antinatalist drift accompanying the shift from kin-dense to non-kin social networks (Newson & Richerson, 2009). It also complements the Gender Gap Index by accounting for premodern kin institutions, helping to isolate country-level rF-LHS associations with SOI and number of children from enduring kinship structures.

The Sex Ratio in reproductive age (15–49 years) (United Nations, 2024a) typically reflects the biological tendency for approximately 105 men to be born for every 100 women (1.05:1). This slight male bias is observed in most societies and is driven by natural biological factors. In social contexts, a balanced sex ratio, close to 1:1, is generally considered optimal, as it minimizes gender imbalances in mate selection, fostering more stable reproductive and marital systems. However, deviations from this ratio can result in distinct social and behavioral dynamics. Hypothetically, a male-biased sex ratio, for instance, could lead to increased competition among men for potential partners, which may contribute to higher rates of long-term mating and a more restricted sociosexual orientation. Conversely, a female-biased sex ratio may increase competition for mates among women, leading to more short-term relationships and a tendency for men to be more engaged in short-term mating strategies. These imbalances also influence fertility patterns: male-biased sex ratios are associated with higher fertility rates, as men increase parental investment and women secure more committed partners, whereas female-biased ratios lead to lower fertility, increased non-marital births, and earlier reproduction among women due to lower paternal investment and less stable pair-bonds (Maner & Ackerman, 2020; Stone, 2019). From an evolutionary standpoint, a sex ratio that is more balanced tends to promote a better distribution of reproductive opportunities and resources, which supports more stable mating and parental investment strategies. As such, a more balanced sex ratio is generally associated with greater stability in reproductive systems and societal structures.

The Mean Age at Childbearing was obtained from United Nations (2024a) data and reflects the average age at which women in a given country give birth. This indicator captures a key demographic aspect of reproductive timing. This variable provides a direct, population-level measure of reproductive timing, complementing life history indicators, and offers critical context for interpreting age–fertility associations across countries. Including mean age at childbearing as a country-level control allows us to disentangle structural demographic effects from individual-level behavioral patterns and ensures that differences in fertility outcomes are not simply artifacts of varying reproductive timing across populations.

We also incorporate Contraceptive Prevalence (United Nations, 2024b) to capture the extent to which access to and usage of contraception shape reproductive outcomes, particularly in societies where greater contraceptive availability allows individuals to engage in unrestricted sociosexual behavior without necessarily increasing fertility. This measure is crucial for understanding why unrestricted sociosexuality may not always translate into higher reproductive success, as access to contraception fundamentally alters the relationship between mating strategies and reproductive output. In some wealthy countries, contraception may be restricted for legal or moral reasons (e.g., Saudi Arabia). Importantly, contraceptive prevalence in many countries is not simply a reflection of individual behavioral choices or the organic outcome of cultural evolution. Rather, it often reflects exogenous policy interventions introduced by governments or international organizations, aimed at addressing public health priorities such as reducing HIV transmission, limiting unintended pregnancies, or regulating population growth. For example, in many sub-Saharan African countries, large-scale contraceptive distribution programs have been implemented as part of global efforts to combat the AIDS epidemic. In such contexts, the availability and use of contraception are shaped more by structural and political factors than by individual-level reproductive strategies. Therefore, we treated contraception prevalence as an exogenous, country-level covariate, which alters the ecological conditions under which life history-related traits, such as sociosexual orientation, may translate into reproductive outcomes. This approach allowed us to investigate potential evolutionary mismatch effects: whether behavioral predispositions that historically enhanced reproductive output (e.g., increased mating effort) still do so in environments where modern technologies or policies have decoupled sexual behavior from reproduction. Thus, including this control variable provides a more comprehensive basis for analyzing variations in mating and reproductive strategies across different socio-ecological contexts.

We also estimated models that include HIV prevalence, measured as the percentage of individuals aged 15–49 living with HIV based on UNAIDS estimates (World Bank, 2024b). This indicator captures the extent to which populations are affected by one of the most significant global health challenges directly linked to sexual behavior. High HIV prevalence is expected to alter life history trade-offs by increasing mortality risks, reshaping reproductive incentives, and prompting large-scale public health interventions that influence sociosexual behaviors and reproductive patterns.

For annual demographic and socioeconomic indicators, values from 2020, 2021, and 2022 were averaged; historical and time-invariant variables were taken from their respective sources. The values were then averaged to enhance reliability by minimizing the impact of random fluctuations and errors. Additionally, the use of multiple indicators for some variables and PAF further helped to mitigate the bias of any single indicator as a data source, ensuring a more robust analysis. The bivariate correlations between the focal country-level variables are reported in Table 2. These results indicated that higher national education and wealth were associated with lower rF-LHS scores and reduced gender gaps. Higher historical kinship intensity was positively related to rF-LHS, total fertility, and mortality before age 40, and negatively related to national education, wealth, gender equality, and contraceptive use; no association was found with mean age at childbearing. Countries with greater wealth tended to have a higher proportion of men compared to women; as gender equality increased, this difference became smaller, and higher kinship intensity was also associated with a higher male-to-female ratio, with no other significant relationships

Table 2
Correlation matrix between focal country-level variables ($N = 92$).

	1	2	3	4	5	6	7	8	9	10	11
1. rF-LHS	–										
2. Adolescent Fertility	0.93***	–									
3. Total Fertility Rate	0.89***	0.76***	–								
4. Mortality before Age 40	0.92***	0.78***	0.75***	–							
5. National Education	−0.67***	−0.70***	−0.55***	−0.57***	–						
6. National Wealth	−0.55***	−0.54***	−0.42***	−0.54***	0.59***	–					
7. Gender Gap Index	−0.32**	−0.24*	−0.39***	−0.29**	0.53***	0.44***	–				
8. Kinship Intensity Index[a]	0.30**	0.16	0.46***	0.25*	−0.29**	−0.29**	−0.58***	–			
9. Sex Ratio	−0.17	−0.18	−0.10	−0.16	0.05	0.39***	−0.26*	0.28**	–		
10. Age Childbearing	−0.52***	−0.60***	−0.31**	−0.47***	0.46***	0.71***	0.24*	−0.11	0.19	–	
11. Contraceptive Prevalence[b]	−0.56***	−0.41***	−0.62***	−0.53***	0.37***	0.32**	0.40***	−0.52***	−0.15	0.12	–
12. HIV Prevalence[c]	0.35**	0.26*	0.24*	0.49***	−0.08	−0.15	0.13	0.12	−0.07	−0.13	−0.14

rF-LHS = the relatively Faster Life History Strategy index. * $p < .05$, ** $p < .01$, *** $p < .001$

** $p < .01$.

*** $p < .001$.

[a] Data on KII is not available for Montenegro.

[b] Data on contraceptive prevalence is not available for Brunei and Cyprus.

[c] Data on HIV prevalence is not available for Austria, Bahrain, Bosnia and Herzegovina, Brunei, China, Dominican Republic, Finland, Hungary, Israel, Japan, Kazakhstan, Nigeria, Norway, Russia, South Korea, Sweden, Turkey, UK, Ukraine, Uzbekistan.

observed. Higher mean age at childbearing was associated with lower rF-LHS scores and with higher national education, wealth, and gender equality. In addition, higher contraceptive prevalence was associated with lower rF-LHS scores and higher national education, wealth, and gender equality, as well as with lower kinship intensity. HIV prevalence showed a positive association with rF-LHS, while no significant links with national education, wealth, or gender equality were observed.

2.2.3. Spatial and cultural controls

To partially address Galton's problem and account for spatial and cultural autocorrelation, we included several additional variables in the robustness specifications: (1) **Biogeographic Zones**: Countries were grouped into nine biogeographic zones (Holt et al., 2013), which was included as a random effect in the multilevel model. This accounts for shared environmental and ecological factors influencing life history strategies. Each country was categorized into one of nine biogeographic zones (e.g., Afro-Tropical, Nearctic) to account for broad ecological differences; (2) **Language Families**: Similarly, countries were categorized into 12 language families (e.g., Austronesian, Afroasiatic) (Hammarström et al., 2024), included as another random effect, to control for cultural and linguistic similarities to account for cultural differences; (3) **Geospatial Variables**: Latitude, longitude, and altitude of each country (TessaDEM, 2023) were included as covariates to control for spatial trends and possible proximate ecological influences on sociosexual orientation.

3. Results

The materials to reproduce the results are available at https://osf.io/fxjym/overview?view_only=6ab38c7d00e24b918c8247a12b079729. The results are organized around the study's substantive research questions, following the statistical analysis strategy described in the Supplementary Material. We first report the baseline multilevel structure of the data, and then report the main models addressing RQ1–RQ4. We then synthesize the resulting multilevel pattern by distinguishing within- and between-components in the models considering number of children, clarify how the findings differ across SOI components, summarize sex-stratified patterns, examine whether the results depend on the specific indicators used to construct rF-LHS, and finally report additional robustness and diagnostic checks.

Throughout the Results, models are described by their substantive role rather than by internal analysis labels. Because the study combines individual-level and country-level predictors, all substantive interpretations distinguish within-country, between-country, and cross-level estimands. To avoid ambiguity, rF-LHS is constructed from demographic indicators and used to capture cross-national variation in faster versus slower life-history conditions; therefore, we also refer to it as a demographic regime. Models that replace the rF-LHS composite with its separate indicators are referred to as component-decomposition specifications. Models that only include reproductive indicators are specifically referred to as the models of the number of children.

All main confirmatory models were estimated in the full analytic sample (80,047 observations from 92 countries), whereas models including KII were estimated in the subsample with available KII data (80,015 observations from 91 countries). Thus, the country-adjusted specifications with KII reflect not only stricter covariate adjustment but also a minimal narrowing of country coverage.

Supplementary Table S1 summarizes the baseline multilevel structure; Table 3 provides the main answer to RQ1, that is, the association between country-level rF-LHS and sociosexual orientation; Table 4 presents the three central fertility estimands: the within-country SOI slope (RQ2), the country-level main effect of rF-LHS (RQ3), and the cross-level interaction between within-country SOI and rF-LHS (RQ4). Stepwise country-adjustment ladders are reported in Supplementary Table S3a–b, individual conditioning in Supplementary Table S6, interaction probing in Supplementary Tables S8–S10, and overall

Table 3
Associations of country-level rF-LHS with SOI behavior and SOI attitudes + desire in the baseline and the country-adjusted models of SOI (RQ1).

	Baseline			Country-adjusted		
	Pooled	Men	Women	Pooled	Men	Women
Panel A. SOI behavior						
rF-LHS	−0.192* [−0.372, −0.011]	−0.103 [−0.278, 0.072]	−0.268** [−0.458, −0.078]	0.090 [−0.102, 0.282]	0.126 [−0.085, 0.338]	−0.004 [−0.201, 0.194]
R^2 marginal	0.06	0.04	0.04	0.11	0.07	0.11
R^2 conditional	0.19	0.14	0.19	0.18	0.14	0.18
ICC	0.13	0.10	0.16	0.08	0.07	0.08
N	80,047	26,407	53,640	80,015	26,395	53,620
n	92	92	92	91	91	91
Panel B. SOI attitudes + desire						
rF-LHS	−0.189*** [−0.285, −0.093]	−0.201*** [−0.318, −0.083]	−0.177*** [−0.280, −0.073]	−0.072 [−0.185, 0.040]	−0.033 [−0.169, 0.103]	−0.104 [−0.236, 0.029]
R^2 marginal	0.10	0.01	0.01	0.12	0.04	0.03
R^2 conditional	0.15	0.07	0.08	0.15	0.07	0.08
ICC	0.06	0.06	0.07	0.04	0.04	0.05
N	80,047	26,407	53,640	80,015	26,395	53,620
n	92	92	92	91	91	91

Note. Entries are unstandardized coefficients; 95% *CIs* are reported in square brackets. Age, age^2, and a random intercept for country were included in all models; sex was additionally included as a covariate in the pooled versions. The country-adjusted model for SOI additionally included National Education, National Wealth, GGI, and KII. None of the models shown in this table produced singular fits. * $p < .05$. ** $p < .01$. *** $p < .001$.

Table 4
Associations of SOI and rF-LHS with number of children in the baseline and country-adjusted decomposed models (RQ2-RQ4).

	Baseline decomposed model			Country-adjusted decomposed model		
	Pooled	Men	Women	Pooled	Men	Women
Panel A. SOI behavior						
SOI within	−0.017*** [−0.020, −0.014]	−0.010*** [−0.015, −0.006]	−0.023*** [−0.028, −0.019]	−0.017*** [−0.020, −0.014]	−0.010*** [−0.015, −0.006]	−0.023*** [−0.028, −0.019]
SOI country mean	0.208*** [0.131, 0.285]	0.144*** [0.060, 0.227]	0.202*** [0.127, 0.278]	0.212*** [0.114, 0.310]	0.150** [0.053, 0.246]	0.203*** [0.102, 0.303]
rF-LHS	0.110** [0.038, 0.182]	0.147*** [0.066, 0.227]	0.073 [−0.003, 0.148]	0.115* [0.024, 0.206]	0.125* [0.025, 0.226]	0.101* [0.008, 0.195]
SOI within × rF-LHS	0.007** [0.003, 0.010]	0.007** [0.002, 0.013]	0.003 [−0.004, 0.010]	0.007** [0.003, 0.010]	0.007** [0.002, 0.013]	0.003 [−0.004, 0.010]
R^2 marginal	0.46	0.43	0.45	0.46	0.43	0.45
R^2 conditional	0.53	0.52	0.53	0.54	0.52	0.53
ICC	0.14	0.16	0.15	0.14	0.16	0.15
N	80,047	26,407	53,640	80,015	26,395	53,620
n	92	92	92	91	91	91
Panel B. SOI attitudes + desire						
SOI within	−0.018*** [−0.021, −0.014]	−0.010*** [−0.015, −0.005]	−0.024*** [−0.029, −0.019]	−0.018*** [−0.021, −0.015]	−0.010*** [−0.015, −0.005]	−0.024*** [−0.029, −0.019]
SOI country mean	0.029 [−0.113, 0.171]	−0.007 [−0.133, 0.118]	0.061 [−0.086, 0.208]	−0.081 [−0.235, 0.074]	−0.093 [−0.245, 0.059]	−0.035 [−0.195, 0.124]
rF-LHS	0.117** [0.034, 0.200]	0.144** [0.054, 0.234]	0.064 [−0.023, 0.152]	0.145** [0.048, 0.242]	0.143** [0.040, 0.246]	0.110* [0.008, 0.211]
SOI within × rF-LHS	0.002 [−0.003, 0.006]	0.002 [−0.004, 0.009]	−0.004 [−0.011, 0.003]	0.002 [−0.003, 0.006]	0.002 [−0.004, 0.009]	−0.004 [−0.011, 0.003]
R^2 marginal	0.44	0.42	0.43	0.45	0.43	0.44
R^2 conditional	0.54	0.53	0.54	0.54	0.53	0.53
ICC	0.18	0.18	0.19	0.16	0.17	0.17
N	80,047	26,407	53,640	80,015	26,395	53,620
n	92	92	92	91	91	91

Note. Entries are unstandardized coefficients; 95% *CIs* are reported in square brackets. SOI $_{within}$ denotes the individual deviation from the country mean of SOI. SOI $_{country\ mean}$ denotes the country-level mean of SOI. The country-adjusted decomposed model of number of children adjusted for National Education, National Wealth, GGI, and KII. Age, age^2, Age Childbearing, and a random intercept for country were included in all models; sex was additionally included as a covariate in the pooled versions. None of the models shown in this table produced singular fits. * $p < .05$. ** $p < .01$. *** $p < .001$.

robustness in Supplementary Tables S17a–S18.

3.1. Baseline variance structure

The null multilevel models confirmed the appropriateness of the multilevel specification (Supplementary Table S1). The between-country share of variance in the number of children was 0.12. For sociosexuality, between-country variance differed by operationalization: it was lowest for SOI attitudes + desire (ICC = 0.06), higher for SOI behavior (ICC = 0.12), and intermediate for SOI total (ICC = 0.09). Thus, SOI behavior showed greater between-country heterogeneity than SOI attitudes + desire already at baseline, making it the most likely SOI operationalization to show between-country SOI associations and interactions between within-country SOI and country-level rF-LHS in models of number of children.

The between-country SOI results nevertheless require additional caution because country sample sizes were highly unequal and the reliability of the SOI scales, while acceptable overall, was only moderate and varied across countries. This is especially important for country-level SOI gradients, which depend not only on total sample size but also on the quality of country means. Thus, the main inferential vulnerability from the outset lies less in within-country SOI coefficients in models of number of children than in the between-country SOI means.

3.2. RQ1: Is country-level rF-LHS associated with individual sociosexuality?

Table 3 provides the main answer to RQ1: the association between country-level rF-LHS and individual SOI is negative, but it does not survive country adjustment. Supplementary Table S17a shows how this pattern behaves across specifications, and Supplementary Table S3a shows where attenuation occurs in the adjustment ladder.

In the baseline model, we observed a negative contextual association between rF-LHS and individual SOI. For SOI attitudes + desire, the effect was stable and significant in the pooled sample ($b = -0.189$) and separately among men ($b = -0.201$) and women ($b = -0.177$). For SOI behavior, the pooled coefficient was also negative and significant ($b = -0.192$); it remained negative and significant among women ($b = -0.268$), but was not significant among men ($b = -0.103$). For SOI total, the overall pattern largely reproduced that of SOI attitudes + desire: pooled $b = -0.189$, men $b = -0.167$, women $b = -0.205$. Thus, the initial coefficient for rF-LHS in models of SOI was most consistent for SOI attitudes + desire and SOI total, though SOI behavior also showed a significant negative pooled gradient.

However, the association between rF-LHS and SOI disappeared after simultaneous adjustment for the modernization and cultural-institutional blocks—National Education, National Wealth, Gender Gap Index, Kinship Intensity Index—in the country-adjusted SOI model estimated in the subsample with available KII data (in all model versions). For SOI attitudes + desire, the pooled estimate declined to $b = -0.072$; for SOI behavior, it moved toward zero and became non-significant ($b = 0.090$); for SOI total, the pooled estimate dropped to $b = -0.019$. This attenuation was not driven equally by all country-level covariates. For SOI attitudes + desire and SOI total, the most stable predictor in the full model was GGI ($b = 4.499$ and $b = 5.767$, respectively). In the SOI behavior model, wealth also retained an independent contribution ($b = 0.247$), whereas KII weakened substantially after joint inclusion of the country-level variables. The disappearance of the rF-LHS coefficient may therefore reflect an overlap with broader modernization and gender-institutional gradients.

The same pattern appeared in the between-country variance. Moving from the baseline SOI model to the country-adjusted version, the conditional ICC declined from 0.056 to 0.037 for SOI attitudes + desire, from 0.134 to 0.077 for SOI behavior, and from 0.105 to 0.062 for SOI total. Thus, the core country-level controls absorbed a substantial share of between-country variation in sociosexuality, although SOI behavior still retained a more pronounced residual between-country structure than SOI attitudes + desire.

The stepwise SOI models show that the largest attenuation already occurs with the addition of the modernization block. For SOI attitudes + desire, the rF-LHS coefficient declines from -0.189 to -0.049; for SOI behavior, from -0.192 to $+0.136$; for SOI total, from -0.189 to $+0.012$. GGI then absorbs the remaining signal further, especially for SOI attitudes + desire and SOI total, whereas KII contributes less and less consistently. The original association between rF-LHS and SOI therefore appears to function largely as a proxy for a broader modernization/gender-order pattern rather than as an independent and stable country-level life-history effect.

As noted above, there could be reasons to expect this negative pattern is driven more strongly by specific countries and notably by the cluster of Sub-Saharan African countries. However, when Sub-Saharan African countries were excluded, the initial contextual association became stronger rather than weaker: $b = -0.282$ for SOI attitudes + desire, $b = -0.520$ for SOI behavior, and $b = -0.358$ for SOI total. Thus, the primary RQ1 pattern cannot be explained solely by the inclusion of Sub-Saharan African countries.

In the strict confirmatory sense, then, RQ1 does not support the interpretation of rF-LHS as showing an independent and stable country-level association with SOI. The baseline coefficient for rF-LHS in models of SOI is negative, but it does not survive core country adjustment. The country-level signal for SOI is therefore substantially more fragile than the coefficient for rF-LHS in models of number of children.

3.3. RQ2: Is individual SOI associated with number of children?

For RQ2, the main focus was the within-country association between individual SOI and number of children, estimated first in the baseline decomposed model of number of children and then in the country-adjusted decomposed model of number of children (Table 4). In all three SOI versions, the within-country association with the number of children was negative and highly robust. For SOI attitudes + desire, the pooled coefficient was $b = -0.018$ in the baseline model and remained $b = -0.018$ after country adjustment. For SOI behavior, the pooled effect was $b = -0.017$ and again remained virtually unchanged after adjustment. For SOI total, the effect was stronger: $b = -0.026$ in both models. Thus, in the subsample with available KII data, the magnitude of the within-country SOI effect barely changed after country adjustment, making it one of the results most robust to adjustment for between-country differences in wealth, education, gender institutions, and historical kinship structure.

RQ2 was clearly answered, but in the opposite direction to our expectation: within countries, greater sociosexual unrestrictedness (relative to the country mean) is associated with having fewer children. This pattern reproduces across all SOI operationalizations and is systematically stronger among women than among men. For SOI attitudes + desire, the corresponding estimates were about -0.010 in men and -0.024 in women; for SOI behavior, about -0.010 in men and -0.023 in women; for SOI total, about -0.015 in men and -0.035 in women.

Supplementary Table S6 addresses the question of whether and how much the within-country SOI coefficient in models of number of children is attenuated by individual-level blocks. The strongest attenuation occurred after adjustment for partner/family status. For SOI attitudes + desire, the within-country coefficient was reduced by approximately 88.9% and became statistically nonsignificant after adjustment for relationship status. For SOI behavior, the same block attenuated the effect by approximately 18.5% while preserving a clearly negative sign. For SOI total, the reduction was approximately 60.6%, but the sign remained negative. Religiosity, SES, health, and ideational variables produced much smaller changes. The coincidence of the largest attenuation of the focal coefficient with the largest increase in explained variance indicates that relationship status is the dominant attenuation pathway in these models, especially for SOI attitudes + desire.

RQ2 is therefore one of the most robust results of the article: the negative within-country SOI coefficient in models of number of children reproduces across operationalizations, sexes, and after core country adjustment.

3.4. RQ3: Is country-level rF-LHS associated with the number of children?

RQ3 is best interpreted as a sequence of increasingly stringent estimands for the country-level association between rF-LHS and number of children: the descriptive contextual association from the simplest model of number of children, the rF-LHS coefficient from the baseline decomposed model, and the rF-LHS coefficient from the country-adjusted decomposed model. All steps are summarized in Table 4, and Supplementary Table S3b shows how the coefficient for country-level rF-LHS in models of number of children behaves under sequential addition of country-level controls.

In the descriptive model of number of children with rF-LHS (Supplementary Table S7), the association was positive and significant: pooled $b = 0.107$, men $b = 0.129$, women $b = 0.063$. In the baseline decomposed model of number of children, the rF-LHS coefficient remained positive in the pooled sample for all three SOI versions: $b = 0.117$ for SOI attitudes + desire, $b = 0.110$ for SOI behavior, and $b = 0.123$ for SOI total. The adjusted coefficient for rF-LHS in the country-adjusted decomposed model of number of children also remained positive (Supplementary Table S3b). After simultaneous adjustment for wealth, education, GGI, and KII, the pooled coefficients were $b = 0.145$ for SOI attitudes + desire, $b = 0.115$ for SOI behavior, and $b = 0.145$ for SOI total. These effects remained positive and significant in both men and women. RQ3 is therefore supported: individuals living in countries with faster rF-LHS have, on average, more children, and this country-level pattern survives core country adjustment.

Comparison with the SOI models is especially important. In the sociosexuality models, the same core country-level block absorbed a large share of between-country variation and eliminated the rF-LHS coefficient. In the models of number of children, by contrast, adjustment only modestly reduced the ICC and did not eliminate the positive country-level association (Table 4). For SOI attitudes + desire, the conditional ICC declined from 0.181 to 0.164; for SOI behavior, from 0.144 to 0.142; for SOI total, from 0.171 to 0.164. Thus, modernization and institutional gradients nearly explained away the original country-level signal in SOI, but clearly did not exhaust the between-country structure of fertility.

The rF-LHS coefficient also sharpened slightly under adjustment rather than weakening; SOI attitudes + desire: 0.117 to 0.145, SOI behavior: 0.110 to 0.115, SOI total: 0.123 to 0.145. This implies that the modernization and institutional variables partially mask rather than explain away the gradient for rF-LHS in models of number of children (Supplementary Table S3b). In that sense, the unadjusted estimate for RQ3 is conservative.

Accordingly, the association between rF-LHS and the number of children is the most robust country-level result in the main models.

3.5. RQ4: Does country-level rF-LHS moderate the association between SOI and the number of children?

For RQ4, three pieces of evidence are relevant: whether an interaction between within-country SOI and rF-LHS in models of number of children is present in the main model, whether it survives the SOI-slope diagnostics, and what form it takes in the conditional slopes. The main interaction estimates are reported in Table 4 and Supplementary Table S9, whereas Supplementary Table S8 addresses the shape of the effect.

For SOI attitudes + desire, there was no evidence for moderation: the interaction coefficient in the pooled sample was small and nonsignificant both before and after country adjustment ($b = 0.002$ in both cases), and the same conclusion was reproduced in the protective SOI-slope robustness diagnostic (Table 4; Supplementary Table S9). For SOI behavior, by contrast, a stable positive moderation was detected. In the pooled sample, the interaction was $b = 0.007$ both in the baseline decomposed model of number of children and in the country-adjusted decomposed model of number of children. In men, the effect was also preserved ($b = 0.007$), whereas in women it was smaller and nonsignificant ($b = 0.003$). The protective SOI-slope diagnostic did not weaken this conclusion: in the pooled sample, the interaction remained positive and significant, $b = 0.008$. For SOI total, the pooled cross-level interaction between within-country SOI and rF-LHS was positive ($b = 0.005$ in both the baseline and country-adjusted decomposed models of number of children) and remained positive in the protective random-slope diagnostic ($b = 0.006$), indicating a weaker and more specification-sensitive pattern than for SOI behavior.

Thus, RQ4 is supported not in general, but in a component-specific way: SOI behavior yields the clearest and most protected moderation pattern; SOI total reproduces the same pattern more weakly and with greater specification sensitivity; SOI attitudes + desire provides no convincing support for moderation.

The simple-slope analyses indicated not a sign reversal, but a gradual weakening of the effect as rF-LHS increases. For SOI behavior in the pooled sample, the slope was −0.023 at M-1SD, −0.018 around the sample mean, and − 0.014 at $M + 1SD$; at all three points it remained significantly negative. In men, the same pattern was more pronounced, with the slope weakening to −0.006 and becoming nonsignificant at $M + 1SD$. For SOI total in the pooled sample, the same direction was observed more weakly: −0.031, −0.027, and − 0.024. The interaction, therefore, describes progressive attenuation of a negative slope across levels of rF-LHS rather than a reversal of the effect. Supplementary Table S8 shows the functional form of the interaction already estimated in Table 4.

The same pattern was obtained when SOI behavior was coded as a within-country mid-rank percentile rather than as a raw within-country deviation: the within-country association in models of number of children remained negative and the SOI behavior × rF-LHS interaction remained positive (Supplementary Table S19). Thus, these findings do not depend on treating the SOI-behavior response categories as equally spaced.

3.6. Within- and between-components in the models of number of children

In the within-between models, the individual and country components of SOI were interpreted separately. The within-country SOI terms capture an individual's deviation from the mean SOI level in that person's own country and estimate whether individuals who are more unrestricted than others in the same country report more or fewer children. The country-mean SOI terms estimate the country's average SOI level as a country characteristic, capturing whether countries with higher average sociosexuality differ in fertility from countries with lower average sociosexuality. These coefficients, therefore, answer different questions. Within countries, higher individual SOI may be associated with fewer children, whereas across countries, higher average SOI may be associated with more children. This divergence is precisely why the within-between decomposition is substantively necessary rather than merely technical.

That necessity also had empirical consequences in the present data. In the corresponding nondecomposed robustness analysis, the aggregate rF-LHS coefficient was negative in all three SOI versions ($b = -0.193$ for SOI attitudes + desire, $b = -0.195$ for SOI behavior, and $b = -0.200$ for SOI total), whereas in the baseline decomposed models of number of children, the corresponding rF-LHS coefficient remained positive. Thus, omitting the decomposition did not simply reduce interpretive precision; it yielded a substantively different ecological picture. This should not be treated as a universal feature of every sensitivity specification, but it does show that, in the main confirmatory and robustness results, explicit separation of levels was necessary for an interpretable estimate of rF-LHS in models of number of children. That contrast is the central point of Supplementary Table S2.

This matters especially for SOI behavior, because in the raw descriptive relations it was positively associated with the number of children, whereas after age structuring and level separation its within-country slope became negative. Without separating age-related and level-specific contributions, the life cycle produces a misleading pattern.

3.7. Component-specific SOI patterns across levels of analysis

Although not framed as a separate preregistered question, the country-mean SOI coefficient remains structurally important because it completes the country-mean side of the within-between decomposition in models of number of children and should not be conflated with the within-country SOI effect. SOI attitudes + desire and SOI behavior were treated as the two main confirmatory branches of the analysis because they are theoretically distinct and showed different multilevel structures in the present data. Accordingly, the main interpretive weight falls on the SOI attitudes + desire and SOI behavior results, whereas SOI total serves primarily as a comparative anchor.

For SOI attitudes + desire, the country-mean coefficient remained nonsignificant in both the main and adjusted models ($b = 0.029$ and $b = -0.081$). For SOI behavior, by contrast, the country-mean SOI coefficient was clearly positive and stable: pooled $b = 0.208$ in the baseline decomposed model of number of children and $b = 0.212$ in the country-adjusted decomposed model of number of children, with the same direction among men and women. For SOI total, the country-mean SOI effect was noticeable in the baseline model ($b = 0.159$), but weakened after country adjustment and lost significance ($b = 0.086$).

SOI behavior therefore occupies a special position because it is the only component at which three independent lines of evidence converge: the largest baseline between-country variance, a stable positive country-mean effect, and a stable positive cross-level interaction between within-country SOI and rF-LHS. It appears not as a noisy aggregate version of the overall scale, but as the most clearly country-structured and context-sensitive component in the overall architecture of results. Both of its key estimates also change very little from the baseline decomposed model of number of children to the country-adjusted version: the country-mean coefficient remains close to 0.21, and the interaction remains close to 0.007.

The subsample analyses localize moderation more precisely. In the 40+ and parent-only samples, the negative within-country SOI effect did not disappear but became stronger, whereas country-mean SOI coefficients and SOI × rF-LHS interaction terms weakened or disappeared (Supplementary Tables S13–S14). This suggests that the main SOI–number-of-children trade-off is most clearly expressed in completed or near-completed reproductive trajectories, whereas the contextual SOI effects and moderation are concentrated earlier in the reproductive process, especially around the transition to parenthood.

Thus, already at the level of the main estimands, a hierarchy of results is visible: RQ2 and RQ3 yield the most robust answers, RQ4 is supported primarily through the SOI behavior branch, and RQ1 is sensitive to country adjustment.

3.8. Sex asymmetry in within-country SOI coefficients, rF-LHS coefficients, and SOI × rF-LHS interactions

The sex-stratified models of number of children revealed a stable asymmetry across levels of analysis (Table 4; Supplementary Tables S3b and S8). The within-country association between sociosexuality and number of children was systematically stronger in absolute value among women than among men across all three SOI operationalizations. By contrast, the positive association between country-level rF-LHS and number of children was generally more pronounced among men than among women, although the country-adjusted estimates remained positive in both sex-stratified models, whereas the moderation of the individual-level association between SOI behavior and number of children by country-level rF-LHS was concentrated primarily in the pooled and male models. Thus, stronger female within-country SOI–fertility trade-offs coexist with stronger male rF-LHS gradients and stronger male-centered moderation in the SOI behavior branch.

3.9. Which components of rF-LHS drive the effect of the composite index

Supplementary Table S16 should be read as a decomposition probe of the composite index, not as a replacement for the main composite analysis. For the SOI models, the negative coefficient for rF-LHS was driven primarily by reproductive-structure indicators. For SOI total, adolescent fertility yielded $b = -0.053$, total fertility rate $b = -0.279$, and mortality before age 40 $b = -0.004$. For SOI behavior, adolescent fertility alone did not yield a clear signal ($b = -0.050$), total fertility rate yielded a negative coefficient ($b = -0.276$), and mortality only a weak association ($b = -0.004$). Overall, total fertility rate appeared to be the strongest carrier of the country-level rF-LHS–SOI association, with adolescent fertility contributing additionally but more modestly.

The models of number of children showed a similar pattern for the rF-LHS effect: the positive association between country-level rF-LHS and number of children was reproduced most clearly through total fertility rate and adolescent fertility, whereas mortality before age 40 was weaker as a main-effect indicator. The moderation pattern, however, was carried by a different component structure. For SOI behavior, the cross-level interaction between within-country SOI and rF-LHS was reproduced most clearly by adolescent fertility and was also supported by mortality before age 40, whereas total fertility rate alone did not support the interaction term; the same pattern appeared more weakly for SOI total.

Thus, the rF-LHS composite was not driven uniformly by a single indicator. Reproductive indicators, especially total fertility rate and adolescent fertility, carried the main country-level associations, whereas adolescent fertility and mortality before age 40 were more relevant to the interaction results. This supports the use of the composite as a higher-order demographic regime, while cautioning against treating its component indicators as interchangeable in substantive interpretation.

3.10. Spatial diagnostic checks

Supplementary Table S11 reports Moran's *I* diagnostics for the SOI models and the main decomposed models of number of children. Overall, the coefficients were small: all absolute Moran's *I* values were approximately 0.11 or smaller, and those for the models of number of children were below 0.04. Residual spatial dependence was more apparent in the country-level SOI models than in the models of number of children, although the effect sizes remained modest even there. After country adjustment, Moran's *I* declined further and was no longer significant for SOI attitudes + desire. This general pattern was consistent with robustness analyses that explicitly incorporated spatial and cultural clustering.

3.11. Additional robustness checks

Supplementary Tables S12–S14 address a narrower question than the main models: not whether the focal coefficient exists at all, but at what stage of the reproductive trajectory it is most clearly expressed and where the country-mean SOI coefficients and SOI × rF-LHS interactions weaken.

In the sample excluding Sub-Saharan African countries, the within-country association between SOI and number of children was preserved: pooled coefficients were − 0.019 for SOI attitudes + desire, −0.017 for SOI behavior, and − 0.026 for SOI total. The RQ1 contextual association between rF-LHS and SOI became stronger, but rF-LHS coefficient and SOI × rF-LHS interactions in models of number of children became less stable. For SOI attitudes + desire, the country-level rF-LHS effect declined to 0.084 and lost significance; for SOI total, it declined to 0.120 and likewise weakened; for SOI behavior, pooled rF-LHS remained 0.120 but with less stable support. The interaction involving SOI behavior still retained support after exclusion of Sub-Saharan African countries ($b = 0.006$), whereas the interaction involving SOI total weakened and ceased to be significant.

In the parent-only sample, the negative within-country SOI effect was preserved, but the country-mean SOI coefficients and SOI × rF-LHS interaction terms weakened substantially. At the same time, the main effect of rF-LHS remained positive and significant in all three model versions, approximately at $b = 0.102$ for SOI attitudes + desire, $b = 0.107$ for SOI behavior, and $b = 0.103$ for SOI total. The parent-only restriction, therefore, primarily problematizes the contextual SOI effects and cross-level moderation, but not the country-level association between rF-LHS and number of children itself.

In the 40+ sample, within-country SOI effect and the rF-LHS effect in models of number of children became even stronger, whereas the interaction weakened. Pooled within-country SOI coefficients were − 0.042 for SOI attitudes + desire, −0.032 for SOI behavior, and − 0.057 for SOI total. The effect of rF-LHS increased to 0.362 for SOI attitudes + desire and SOI total and to 0.372 for SOI behavior. Yet the SOI behavior interaction was 0.006 and the SOI total interaction was 0.007, and neither remained robustly significant. Taken together, these subsample patterns indicate that the main SOI–number-of-children association is especially clear in completed fertility trajectories, whereas country-mean SOI coefficients and moderation are more closely tied to earlier phases of the reproductive process.

Supplementary Table S15 addresses sensitivity to missingness. Under mild, moderate, and strong MNAR scenarios, the negative association between rF-LHS and individual SOI in the baseline contextual SOI model retained both sign and overall interpretive meaning across all three SOI versions.

In the models of number of children, the negative within-country SOI effect and the positive effect of rF-LHS were also preserved. The most sensitive result remained the interaction term for SOI total, which weakened and lost significance in some MNAR specifications. By contrast, the interaction involving SOI behavior was preserved and even increased to 0.011 under MNAR scenarios. Fragility is therefore concentrated not in the main answers to RQ2 and RQ3, but chiefly in the broader interpretation of moderation for SOI total.

Supplementary Table S10 asks whether the main conclusions depend on the Gaussian engine rather than on the substantive structure of the data. The additional ordinal check showed that the main answers to RQ2 and RQ3 do not depend on whether the outcome is modeled with a Gaussian or ordinal specification. Across all SOI versions, the sign of the within-country SOI effect remained negative, and the rF-LHS effect in models of number of children remained positive. However, the interaction term displayed greater engine sensitivity. For SOI behavior, the positive moderation was preserved in the ordinal models as well (interaction = 0.020). For SOI total, by contrast, the ordinal branch did not reproduce the same level of support. Thus, the alternative engine specification reinforces the conclusion that support for RQ4 is most reliable, specifically for SOI behavior.

The strictest maximal random-effects stress test likewise did not alter the overall configuration of rF-LHS coefficients in models of number of children, but it clarified the degree of protection of the separate SOI branches. The association between rF-LHS and number of children remained, and the moderation involving SOI behavior continued to reproduce, although in somewhat compressed form. At the same time, the within-country coefficient for SOI attitudes + desire weakened and no longer reached the conventional significance threshold, whereas the within-country effect for SOI behavior remained clearly negative. SOI total again occupied an intermediate position.

Supplementary Table S18 addresses a specific inferential vulnerability of country-level SOI means: unequal country sample sizes and variable scale reliability. The additional reliability-aware empirical Bayes shrinkage checks did not alter the overall hierarchy of the results. For the SOI attitudes + desire and SOI behavior branches, the main answers to RQ2 and RQ3 were preserved; the moderation involving SOI behavior was also reproduced; the broader interaction signal for SOI total remained less protected. The shrinkage approach, therefore, does not eliminate the main results, but further confirms that the greatest interpretive caution is required specifically for the country-mean SOI coefficients and especially for SOI-total interaction interpretations.

It is also important that the key confirmatory models converged in a stable manner and showed no signs of singularity. The differences between the answers to RQ1–RQ4, therefore, reflect not computational instability, but differences in the structure of the data itself and in the level at which the corresponding effects and interactions were localized.

Several features of the sample warrant caution. First, the analytic sample was relatively young on average (M = 30.96 years), and mean completed fertility was low (M = 0.53), indicating substantial right-censoring of reproductive outcomes. This concern is reinforced by the fact that the parent-only and age-40+ robustness analyses were conducted on substantially reduced subsamples (22,011 participants from 91 countries and 17,804 participants from 88 countries, respectively), implying uneven cross-national representation of parents and older respondents. Second, the sample was sex-imbalanced (67.01% women). Third, country sample sizes were highly unequal, and the reliability of SOI measures varied across countries, making between-country SOI gradients more vulnerable than within-country estimates.

3.12. Relative strength of covariate blocks in the fully conditioned model

The fully individually conditioned model should be read as an over-conditioned diagnostic of relative attenuation structure. In this specification, the relationship block remained by far the strongest in its capacity to absorb the focal within-country SOI effect. In the fully adjusted model, the negative within-country SOI coefficient almost disappeared for SOI attitudes + desire (to 0.003), weakened markedly for SOI total (to −0.004), and remained present, though substantially reduced, for SOI behavior (to −0.010). At the same time, the largest individual predictors of number of children remained partner status, the age trajectory, and education; the health block added comparatively little. Thus, the fully conditioned model shows that the focal associations were not absorbed by a diffuse set of equally strong covariates; rather, the largest attenuation was concentrated in a structure dominated by partner status, age, and education.

3.13. Final formulation

Taken together, the most reliable conclusions of the analysis come from the models considering number of children, especially for RQ2 and RQ3. For RQ2, within countries, higher SOI was consistently associated with having fewer children. For RQ3, country-level rF-LHS was consistently associated with having more children. These two findings were reproduced across the main SOI specifications and were robust to core country-level adjustment.

The SOI components nevertheless differed in their broader multilevel pattern. For RQ2, SOI attitudes + desire and SOI behavior both showed the negative within-country SOI–number of children association. For RQ4, however, only SOI behavior showed stable context dependence: its country-mean SOI effect was positive, and the negative within-country SOI–number of children slope weakened as country-level rF-LHS increased. SOI total generally moved in the same direction, but less cleanly.

The main inferential caution concerns not the central RQ2 and RQ3 findings, but RQ1 and the SOI-total version of RQ4. For RQ1, the negative between-country association between country-level rF-LHS and SOI was present in the baseline models but disappeared after core country-level adjustment; the remaining SOI country-level estimates were also more vulnerable to spatial structure and to uncertainty in country means. For RQ4, the SOI-total interaction remained positive, but it was weaker and less stable than the SOI-behavior interaction. Thus, the strongest inferential weight should be placed on the robust RQ2 and RQ3 findings and, for RQ4, on the SOI behavior specification rather than the SOI total specification.

4. Discussion

This paper aims to better understand whether sociosexual orientation is part of a fast-slow continuum of life history strategies and how these factors are related to reproductive outcomes. In brief, the main conclusions of the present investigation are as follows. We found a negative baseline association between relatively faster life history strategy (rF-LHS) and sociosexual orientation (SOI; RQ1) that disappeared after core country adjustment. There was a robust negative within-country association between SOI and number of children (RQ2), as well as a robust positive country-level association between rF-LHS and number of children (RQ3). RQ4 received selective support, with evidence concentrated in the SOI behavior branch. Table 5 provides a compact summary of the preregistered research questions, focal estimands, preregistered expectations, and main findings.

Considered jointly, these findings are difficult to reconcile with a simple one-axis interpretation in which individual sociosexuality and demographic regime (i.e., country-level rF-LHS, indexed by fertility, adolescent fertility, and mortality before age 40) operate as parallel expressions of the same latent fast–slow dimension. The crucial asymmetry is that sociosexuality does not retain an independent country-level association after core country adjustment, whereas rF-LHS continues to predict fertility at the country level after the same modernization and institutional gradients have been included; at the same time, sociosexuality remains robustly and negatively associated with number of children within countries. Thus, sociosexuality loses explanatory power as a country-level gradient while remaining consequential within countries, whereas the demographic regime remains associated with fertility at the country level even when sociosexuality does not.

Table 5
Summary of preregistered research questions, focal estimands, predictions, and findings.

Research question	Focal estimand	Preregistered expectation	Main finding
RQ1. Is a relatively fast life history strategy at the population level associated with an unrestricted sociosexual orientation at the individual level?	Coefficient for country-level rF-LHS in models of SOI (Table 3)	Individuals in countries with higher rF-LHS were expected to report more unrestricted sociosexuality.	The baseline association was negative, but it did not remain after adjustment for country-level covariates.
RQ2. Is an unrestricted sociosexual orientation positively associated with the number of children at the individual level?	Within-country SOI coefficient in models of number of children (Table 4)	If SOI reflects a fast-LHS mating component, more unrestricted sociosexuality should be associated with more children, especially among men; among women, the association was expected to be weaker or potentially negative.	Within countries, higher SOI was consistently associated with fewer children across SOI operationalizations, with the strongest negative association among women.
RQ3. Is a relatively fast life history strategy at the population level associated with a higher number of children per individual?	Coefficient for country-level rF-LHS in models of number of children (Table 4)	Individuals in countries with higher rF-LHS were expected to have more children.	Higher country-level rF-LHS was consistently associated with more children and remained positive after country-level adjustment.
RQ4. Is the association between sociosexual orientation and number of children moderated by the country-level indicator of life history strategy?	Interaction between within-country SOI and country-level rF-LHS in models of number of children (Table 4)	The relationship between individual SOI and number of children was expected to differ across the range of country-level rF-LHS, with possible sex differences.	Evidence for moderation was limited mainly to SOI behavior: the negative within-country relationship between SOI behavior and number of children became weaker as country-level rF-LHS increased, especially in pooled and male models.

The comparison between decomposed and non-decomposed models shows why separating levels of analysis was essential. The key issue is that individual sociosexuality, average country-level sociosexuality, and country-level demographic regime answer different questions. The within-country SOI coefficient asks whether people who are more unrestricted than others in the same country have more or fewer children. The country-mean SOI coefficient asks whether countries with higher average sociosexuality differ in fertility from countries with lower average sociosexuality. The country-level rF-LHS coefficient asks whether people living in faster demographic regimes have, on average, more or fewer children. In the present data, these levels do not align in a simple way: higher SOI within countries is associated with fewer children, whereas faster demographic regimes are associated with more children. If these levels are collapsed into a single model, the estimate can become misleading and even change sign.

This level separation is especially important for interpreting the country-mean SOI term in the models of number of children. Because this coefficient was not part of the preregistered research questions, we treat it as a contextual, secondary association rather than as a direct test of individual-level life-history predictions. Although the models adjusted for several observed country-level covariates, including national education, wealth, gender equality, and kinship intensity, the country mean of SOI should not be equated with any specific cultural mechanism. Instead, it should be interpreted more cautiously as capturing residual between-country variation in mating and reproductive ecology that is not fully represented by the observed covariates.

A constructive account of these patterns can be formulated as a three-part multilevel conversion framework. At the country level, the demographic regime defines the average reproductive context. At the individual level, sociosexuality captures the profile of effort allocation between mating and parental investment—but only partially and unevenly across its components. At the institutional level, historical and institutional structures determine how tightly sexual behavior, union formation, and realized fertility are coupled within a given society. On this reading, the three principal findings need not share a single latent structure precisely because they describe different stages through which mating-related dispositions and demographic conditions are converted into reproductive outcomes.

This framework is continuous with a long demographic tradition that treats fertility as the endpoint of intermediate reproductive events. Davis and Blake (1956) identified exposure to intercourse, conception, gestation, and parturition as the channels through which distal factors affect births; Bongaarts (1978) condensed this scheme into proximate determinants such as union formation, sexual exposure, and deliberate fertility control. Behavioral-ecological work similarly treats these determinants as an adaptive system of nested reproductive decisions calibrated by local conditions (Colleran, 2016; Kaplan & Lancaster, 2003; Sear et al., 2016). The present framework maps onto this tradition: ecological regime (i.e., country-level life-history conditions), individual effort allocation, and institutional coupling summarize different segments of the same reproductive chain. This also explains why covariates that absorb one segment of the chain need not absorb another: different coefficients summarize different links in the reproductive process.

Recent theoretical work points in the same direction. One line of critique questions the extrapolation of a one-dimensional fast–slow continuum from interspecific and population-level patterns to individual psychological differences. Dinh and Gangestad (2024), whose critical analysis framed the present debate, argue from interspecies evidence that variation in mating effort and sociosexuality is not central to the fast–slow continuum, and that pair-bonding and biparental care do not map onto the fast–slow or quantity–quality axes in the manner commonly assumed. Del Giudice (2024) argues that extending the continuum to individual psychological differences requires substantial revision, and Stott et al. (2024) conclude that life histories do not reduce to "fast" or "slow" types. The debate points constructively toward concrete, level-specific trade-offs: Sear (2020) argues that, in the human sciences, it is safer to discuss concrete trade-offs than holistic strategies, and Van de Walle et al. (2023) report that individual life trajectories within populations often fail to organize along a single continuum.

The present findings fit more closely with this differentiated view than with a one-axis fast–slow interpretation. They are difficult to reconcile with the strongest version of the claim that sociosexuality functions, in a residual and autonomous sense, as a stable country-level psychological proxy of demographic fastness. At the same time, they remain broadly consistent with accounts emphasizing evolutionary mismatch and behavioral decoupling under modern institutional conditions (Del Giudice, 2024; Figueredo et al., 2015), as well as cultural or institutional filtering of how mating-oriented dispositions are converted into realized fertility (Copping & Campbell, 2015; Sear, 2020). More importantly, the multilevel framework helps reconcile mixed findings that have linked sociosexuality, fertility, and life history strategy in different ways. Evidence that sociosexuality tracks mating effort and other life-history-relevant traits supports one part of this picture (Hlay et al., 2022; Međedović, 2021a, 2021b), whereas findings showing that unrestricted sociosexuality does not necessarily translate into higher fertility point to another (Dinh et al., 2022; Dinh & Gangestad, 2024). The present data do not adjudicate decisively among these alternatives; however, they do narrow the field by showing that any viable account must explain why sociosexuality loses autonomy as a country-level gradient while remaining consequential within countries, and why rF-LHS continues to predict number of children even when sociosexuality does not. This is the value of a multilevel conversion framework: it accommodates the most robust findings simultaneously without forcing them into a single metric.

4.1. Main findings

Country-level differences in sociosexuality may reflect two broad sets of influences. The first concerns mortality-related ecology: in environments where extrinsic risk is higher, people may form unions earlier, unions may be less stable, and the balance between short-term and long-term mating may shift. The second concerns social norms and institutions. These include at least three closely related dimensions. One is modernization, which involves not only access to contraception but also longer education, later childbearing, and changing ideas about responsible parenthood (Colleran, 2016; Sear et al., 2016). Another is gender order, especially the extent to which societies regulate women's sexuality and attach different reproductive consequences to men's and women's mating behavior. Historically, such regulation has often been stronger in societies with heritable wealth and patrilineal organization (Buss & Schmitt, 1993, 2011; Gangestad & Simpson, 2000). A third dimension is kin-based social organization. Societies differ greatly in how central extended kin networks are to residence, marriage, inheritance, and reproductive decision-making, ranging from low-kinship-intensity societies with smaller, less kin-centered households to high-kinship societies with dense kin networks and marriage institutions shaped by wealth and family lineage (Henrich et al., 2012; Hill et al., 2011; Šaffa et al., 2026).

4.1.1. Country-level rF-LHS and sociosexuality

The first place in which this broader architecture becomes visible is RQ1. Although rF-LHS showed a baseline contextual association with SOI, this association disappeared after adjustment for modernization, gender order, and kinship-related institutional structure. Thus, cross-national variation in sociosexuality appears to be organized less by rF-LHS itself independently than by the broader modernization- and institution-linked package with which rF-LHS is entangled. South Korea offers a clear illustration: where the institutional link between marriage and childbearing has remained tight and nonmarital childbearing is normatively foreclosed, modernization-driven declines in union formation translate almost directly into declines in fertility, such that changing marriage behavior—rather than changing sociosexual dispositions—becomes the dominant proximate channel of the country-level fertility drop (Raymo et al., 2015). Once that broader package is modeled, little evidence remains for an independent residual effect of rF-LHS on sociosexuality itself. This does not show that demography is irrelevant to sociosexual norms. More narrowly, it suggests that in the present data, the association between demography and sociosexuality is not autonomous from the modernization and institutional gradients. That the association is not autonomous does not mean that it is absent; it means only that the signal does not persist as a residual country-level rF-LHS association with SOI once those broader structures are taken into account. In that sense, institutional context appears to condition how demographic structure is translated into observable mating behavior. As the next section shows, sociosexuality can still matter for fertility within countries even when it does not survive as an autonomous country-level gradient.

4.1.2. Within-country sociosexuality and number of children

RQ2 concerns the negative within-country association between sociosexuality and the number of children. This finding converges with the only prior individual-level study to have tested the prediction directly: in a sample of over 1800 women, Dinh et al. (2022) reported that higher short-term mating orientation and a higher lifetime number of sexual partners predicted later age at first pregnancy and first birth and fewer offspring, with the opposite associations observed for long-term mating orientation. The present multilevel decomposition extends that line of evidence by showing that the same directional association is recoverable as a within-country SOI effect in models of number of children across 92 contemporary societies, after country-level adjustment and across three distinct operationalizations of sociosexuality. The pattern survives the main country adjustment, becomes stronger in older and parent-only subsamples, and is attenuated primarily by partner and family status, whereas religiosity, socioeconomic position, health, and ideational variables have much smaller effects on the focal coefficient. In those same subsamples, country-mean SOI coefficients and SOI × rF-LHS interactions weaken—a pattern consistent with a life-course interpretation in which the underlying trade-off becomes more visible over more complete reproductive trajectories.

Substantively, the pattern admits two closely related, non-exclusive readings. *The first* interprets the within-country SOI coefficient as a trade-off between mating and parental effort, realized not as an abstract redistribution of resources but through the concrete trajectory of union formation and stability. Greater sociosexual unrestrictedness relative to the country mean plausibly shifts the individual profile toward mating-oriented allocation, and under contemporary institutional conditions, this shift does not necessarily translate into higher fertility. Instead, it may weaken the stable partnership pathway through which fertility is usually realized — entry into a durable union, transition to a first child, and progression to subsequent births. On this reading, partner and family status is neither a purely confounding nor a purely mediating factor: it is both a channel through which the trade-off is expressed and a downstream consequence of how effort is distributed between mating and parenting. More unrestricted sociosexuality may increase exposure to mating opportunities, but it may also reduce the likelihood that these opportunities develop into stable partnerships, parenthood, and subsequent births. The strong attenuation of the SOI coefficient after adjustment for partner and family status therefore suggests that the negative SOI–number of children association is largely expressed through relationship and family trajectories, not through sociosexuality as an isolated disposition. Beyond the sheer number of children, that trace plausibly concerns a broader profile of parental coordination — the stability of the union, the time horizon of joint investment, and the extent to which parenthood is sustained as a long-term cooperative project (Kaplan et al., 2000; Schacht & Kramer, 2019; Sear & Coall, 2011).

The second reading is more explicitly sequential. Part of the negative association may reflect reverse recalibration of the sociosexual profile under the influence of already completed life-course transitions—entering a stable union, having children, becoming anchored in a family role. This possibility is especially relevant for interpreting the stronger within-country SOI–number of children association among women. For women, childbearing and childcare may more directly reduce time, opportunity, and motivation for sociosexual behavior, whereas for men this pathway may be weaker because continued parental investment can more often take the form of provisioning and may be less directly incompatible with sociosexual motivation. Longitudinal evidence from Cebu supports the broader idea: men who transitioned from single non-father status to married residential fatherhood showed within-individual declines in sociosexuality relative to men who remained single, with parallel downregulation of testosterone (Gettler et al., 2011). More generally, Eastwick et al. (2019) argue that sociosexual orientation is better understood dynamically, as coevolving with the unfolding of a romantic and reproductive life course rather than as a time-invariant input into it. On this view, the coefficient captures not a one-time causal effect of disposition but the cumulative trace of a bidirectional dynamic between sociosexual disposition and life trajectory. Either way, what survives the within-country decomposition is a negative within-country SOI coefficient, consistent with a growing body of evidence that in contemporary populations, sociosexual unrestrictedness is not a direct route to higher completed fertility (Dinh et al., 2022; Hlay et al., 2022). Thus, mating-oriented allocation must be distinguished from realized fertility rather than equated with it.

The trade-off reading is especially plausible in humans. Our species combines unusually prolonged offspring dependence, substantial paternal provisioning, and support from post-reproductive kin, making durable coordination around childrearing central to reproductive success (Kaplan et al., 2000). Selection likely did not favor strict monogamy as an invariant human mating system, but it plausibly favored pair-bond stability and frequent effective monogamy insofar as these traits increased the conversion of reproductive effort into surviving offspring. This point runs counter to the common fast–slow assumption that biparental care and pair-bonding primarily increase offspring quality at the expense of quantity (Dinh & Gangestad, 2024). Long-term relationships may also increase reproductive output by stabilizing sexual access, reducing partner-search costs, and supporting offspring survival, including in relatively faster life-history contexts (Dinh & Gangestad, 2024; Meehan et al., 2013). These effects should be especially consequential for women, whose fertility is more tightly constrained by gestation, lactation, and access to reliable support (Sear & Coall, 2011). The balance between stable pair-bonding and alternative mating arrangements may nevertheless vary across ecologies; for example, elevated pathogen prevalence has been associated with polygyny, earlier first births, and higher fertility (Marlowe, 2003). Consistent with energetics interpretation, men's provisioning across human foraging societies correlates positively with women's total fertility rate—approximately 0.50 across 26 groups, rising to 0.74 after controlling for total environmental biomass (Marlowe, 2001). Durable male investment may therefore relax the energetic ceiling on female reproduction rather than redirect reproductive effort toward fewer, more-invested offspring.

Humans vary substantially in formal marriage and mating practices, yet pair bonds remain ubiquitous, and monogamy appears to be the modal realized reproductive pattern even where polygyny is institutionally permitted (Schacht & Kramer, 2019)[5]. This makes the negative within-country association between sociosexuality and the number of children less anomalous: more unrestricted sociosexual profiles may be less reliably converted into stable pair bonds, cooperative parenting, and ultimately realized fertility.

4.1.3. Demographic regime as a predictor of fertility

The third robust finding concerns RQ3, which examined the positive association between rF-LHS and the number of children. Its theoretical significance becomes clearest in contrast to RQ1. Unlike the country-level association between rF-LHS and sociosexuality, the demographic regime remained predictive of number of children after simultaneous adjustment for modernization, education, gender equality, and kinship intensity. The two country-level associations respond differently to the same covariate set, consistent with the argument that cross-national variation in sociosexuality and cross-national variation in reproductive tempo are grounded in distinct causal foundations and therefore need not co-vary in the manner predicted by a strong one-axis model (Dinh & Gangestad, 2024). The slight strengthening of the rF-LHS coefficient after adjustment further suggests that the unadjusted estimate is not a modernization artifact and may even understate the demographic signal carried by rF-LHS.

This point is reinforced by the structural heterogeneity of low-fertility societies. Similar aggregate fertility levels can emerge through markedly different configurations of proximate determinants: delayed union formation and rising childlessness in some cases, early family formation followed by stopping after one or two children in others; and historically high rates of induced abortion when modern contraception was limited in still other contexts (Coale & Watkins, 1986; Knodel & van de Walle, 1979; Rindfuss et al., 2016). Country-level fertility is therefore best understood as a downstream demographic outcome rather than a latent psychological trait. Similar fertility totals need not encode similar motivational or sociosexual profiles, because they may be generated through very different demographic pathways.

This also suggests that sociosexual orientation is a poor aggregate proxy for life history strategy, consistent with prior evidence that sociosexuality and biodemographic indicators show weak or even counterintuitive associations at the country level (Del Giudice, 2024; Schmitt, 2005). At the individual level, sociosexuality may still shape mating behavior, union formation, and the probability that sexual relationships are converted into childbearing (Eastwick et al., 2019; Penke & Asendorpf, 2008). At the country level, however, it does not behave as a stable psychological analogue of demographic fastness. This matters because sociosexuality is often treated, at least implicitly, as an indicator of a faster life history strategy in theoretical accounts of the construct (Brumbach et al., 2009; Chisholm, 1993; Gassen et al., 2018; Međedović, 2021b).

The theoretical interpretation of the RQ3 coefficient should therefore be built through the demographic meaning of rF-LHS rather than by treating it as a direct psychological manifestation of a fast life-history strategy. In the present data, rF-LHS captures primarily the tempo and intensity of reproduction as a demographic regime, rather than serving as a general psychological analogue of “fastness” in any strong one-axis sense (Del Giudice, 2024; Sear, 2020; Volk, 2023).[6] The institutional vehicle of this decoupling has been well characterized in the demographic literature. The Second Demographic Transition framework

[5] Dyble (2025) reports that human realized monogamy exceeds that of most other primates even in societies that formally permit polygyny.

[6] This is consistent with an energetic-threshold view of reproduction: below a first threshold, energetic shortfalls do not simply shift women toward fewer, more-invested offspring, but suppress reproduction itself — delaying maturation, down-regulating ovarian function and fecundability, and slowing the return to postpartum fertility. Only after that baseline threshold has been cleared does a second-order allocation problem emerge, such that additional energy can be distributed across offspring number versus per-offspring investment rather than merely determining whether reproduction is physiologically feasible at all (Ellis et al., 2025).

describes the contemporary reproductive regime as the joint outcome of coevolving contraceptive, sexual, and gender revolutions, sustained by a durable shift toward post-materialist value orientations emphasizing individual autonomy, self-realization, and the disconnection of marriage from procreation (Lesthaeghe, 2010, 2014; Zaidi & Morgan, 2017). However, contraceptive technology should be understood here less as an ultimate cause than as an instrument operating within an already transformed motivational and institutional structure: substantial fertility decline in nineteenth-century Europe preceded the diffusion of reliable modern contraception by decades, and cross-cultural evidence suggests that contraceptive access explains only a limited share of between-society variation once ecological and cooperative-support variables are taken into account (Coale & Watkins, 1986; Colleran, 2016; Colleran & Snopkowski, 2018; Knodel & van de Walle, 1979).

The central question, then, is not whether sociosexual unrestrictedness increases reproduction in any direct or universal sense. Rather, the question is when and through which institutions a given sociosexual profile is converted into realized fertility. In societies where sexual norms, stable union formation, kin support, and childbearing remain tightly linked, mating behavior may be more directly connected to reproduction. In societies where contraception, delayed marriage, individual autonomy, and nonmarital sexuality have loosened these links, the same behavioral profile may no longer translate into additional births. In evolutionary terms, this can be read partly as a mismatch problem: motivational systems that evolved under tighter coupling between mating and reproduction now operate in environments where sexual behavior, partnership, and fertility are more strongly decoupled. However, evolutionary mismatch should be treated as one plausible interpretation, not as the only explanation established by the present findings.

Because the moderation observed in RQ4 was component-specific and sex-asymmetric rather than general, it is discussed below in the Further Implications section. Specifically, the interaction was most clearly concentrated in SOI behavior and was more evident in pooled and male models. Thus, RQ4 is treated not as a separate global finding, but as a qualification of how sociosexuality is converted into fertility across components of SOI and sex-specific contexts.

4.2. Further implications

4.2.1. Component-specific SOI patterns

The results also suggest that the components of sociosexuality should not be treated as interchangeable. SOI behavior is the only component for which three kinds of evidence point in the same direction: greater between-country variation, a positive country-mean SOI coefficient in models of number of children, and interaction between within-country SOI and rF-LHS that remains visible across the main robustness checks. The SOI attitudes + desire component does not show this convergence, and the overall SOI score reproduces it only less strongly and less consistently. For SOI attitudes + desire, adjustment for partner and family status reduced the within-country SOI coefficient in models of number of children by almost 90%, whereas the behavioral component was attenuated much less and retained a negative association. The SOI attitudes + desire component may matter less as an independent fertility predictor and more as part of the pathway through which individuals enter, maintain, or avoid the stable partnerships in which childbearing usually occurs.

By contrast, the behavioral component is more tightly connected than attitudes or desires to the actual opportunity structure of the mating market and to the sequence of transitions through which reproduction unfolds over the life course. Behavior should be more directly shaped by local partner availability, the density of alternatives, the probability of entering or dissolving a union, and the practical feasibility of particular sexual and partnership trajectories. SOI behavior may also reflect not only current orientation but also accumulated biographical exposure—the cumulative residue of already completed sexual and partnership transitions. This fits a broader view of sociosexuality as a multidimensional construct in which behavior is not interchangeable with attitudes and desire (Penke & Asendorpf, 2008), as well as demographic work showing that fertility is produced through sequential transitions in union formation and childbearing rather than through a single undifferentiated disposition (Thomson et al., 2012). Importantly, the interaction does not indicate a reversal of mechanism. Faster demographic regimes reduce the negative association between SOI behavior and number of children but do not turn unrestricted sociosexuality into a fertility advantage. The pattern is therefore more consistent with recalibration of a common trade-off across institutional environments than with the emergence of qualitatively different processes. Thus, SOI behavior is informative not because it is the cleanest one-dimensional marker of fastness, but because it sits closest to the institutional interface at which mating trajectories are converted into births.

4.2.2. Component structure of rF-LHS

The component-decomposition analyses further qualify the interpretation of rF-LHS. The composite appears useful as a higher-order indicator of demographic regime, but its components should not be treated as substantively interchangeable. The main RQ3 association between rF-LHS and number of children is driven primarily by reproductive-regime indicators, especially total fertility rate and adolescent fertility, which directly capture the tempo and intensity of reproduction. For SOI behavior, the RQ4 moderation effect is reproduced most clearly by adolescent fertility and mortality before age 40, whereas total fertility rate alone does not carry the interaction. This suggests that moderation is not simply a by-product of living in high-fertility countries. Rather, it appears to be tied to contexts in which reproduction begins earlier and mortality-related pressures are stronger—conditions under which sociosexual behavior may remain more closely embedded in the reproductive pathway, so that the negative association between unrestricted sociosexuality and number of children is attenuated rather than reversed. In other words, total fertility rate captures the overall reproductive output of a population, but adolescent fertility and early mortality may better capture the ecological conditions under which individual sociosexual behavior becomes more or less consequential for fertility. This distinction fits broader arguments that life history indicators should be interpreted as distinct components of a demographic regime, not as interchangeable markers of a single fast–slow dimension (Del Giudice, 2024; Dinh & Gangestad, 2024; Sear, 2020).

4.2.3. Sex-asymmetric conversion of sociosexuality into fertility

The sex asymmetry of the results provides further support for the multilevel interpretation. For RQ2, the negative within-country association between sociosexuality and the number of children is stronger among women. For RQ3, the positive association between rF-LHS and number of children was more pronounced among men. For RQ4, the moderation of the individual SOI behavior–fertility association by country-level rF-LHS was also concentrated in pooled and male specifications. This pattern is difficult to reconcile with the idea that sociosexuality is a single psychological indicator of fastness that should translate into reproductive outcomes in the same way for both sexes.

The pattern does not, however, support a crude Bateman-like reading for men. If sociosexual unrestrictedness in modern societies were a direct and universal route to higher male fertility, the within-country SOI coefficient among men should be at most weakly negative or even positive. That is not what the models show. The male signal appears primarily in the rF-LHS coefficient and the SOI $\times$ rF-LHS interaction, whereas the individual within-country association between SOI and number of children remains negative in the pooled model and is weaker rather than positive among men. Given the pair-bond constraints in humans discussed above, the reproductive returns to male mating effort remain conditional on union stability and provisioning rather than tracking mate number linearly (Kokko & Jennions, 2008).

Read in the narrower sense, the stronger rF-LHS coefficient and SOI × rF-LHS interaction among men are theoretically plausible: macro-contextual conditions should more directly alter the marginal returns to mating effort in men. Where the operational sex ratio, local density of competitors, and degree of status-based reproductive skew vary, the same male disposition can be converted into markedly different reproductive prospects (Kokko & Jennions, 2008; Ross et al., 2023; Schacht & Borgerhoff Mulder, 2015). Under some conditions, greater mating orientation may increase access to opportunities; under others, it may mainly raise competition costs without yielding additional births. Evidence that sex-ratio variation shifts sociosexual orientation and that human populations differ substantially in male reproductive inequality is consistent with this interpretation (Moss & Maner, 2016; Ross et al., 2023). Men, therefore, appear more sensitive to macro-contextual conversion conditions, without enjoying a uniform fertility premium from sociosexual unrestrictedness at the individual level (Alexander & Fisher, 2003; Wiederman, 1997).

For women, the same profile is filtered through a more restrictive set of conversion constraints: obligate gestation, lactation, postpartum subfecundity, and the higher energetic and temporal costs of early childrearing. These physiological constraints are overlaid by social ones. Sexual double standards and broader reputational regulation can systematically alter the cost structure of female mating behavior by affecting partner commitment, support, and the social feasibility of particular sexual trajectories (Gómez-Berrocal et al., 2022; Weber & Friese, 2025). This should not be read as implying that female sociosexual flexibility is absent or necessarily maladaptive: work in small-scale populations shows that extra-pair sexuality can, under some ecologies, form part of a viable female reproductive tactic (Scelza, 2011). A final caveat is that some portion of the observed asymmetry may reflect differences in willingness to report as well as differences in behavioral consequences (Alexander & Fisher, 2003; Wiederman, 1997). Taken together, these results suggest that the same sociosexual profile is filtered through sex-specific market conditions, parental investment requirements, and institutional rules governing mating, partnership, and childrearing (Dinh & Gangestad, 2024).

4.2.4. Limitations

The limitations of this interpretation are organized not as a general list of weaknesses but around the specific inferential nodes they constrain.

4.2.4.1. The cross-national association between demographic regime and sociosexuality. The disappearance of the association between rF-LHS and SOI after adjustment is compatible with both a confounding interpretation and a stronger mediation interpretation, in which joint adjustment statistically removes not a spurious association but rather part of the very institutional-modernization mechanism through which the demographic regime may shape sexual norms and behavior. In that sense, the methodological ambiguity is between confounding and mediation. The present cross-sectional design therefore allows one to reject only the claim of an autonomous residual country-level association between rF-LHS and SOI; it does not decisively separate confounding from mediation in the pathway linking the demographic regime to sociosexuality. More generally, this ambiguity is likely to be intrinsic to the contemporary study of mating and fertility because macro-level conditions do not merely confound reproductive behavior; they also constitute part of the mechanism through which behavior is canalized over the life course.

4.2.4.2. The causal status of the partnership channel. Partner and family status can simultaneously function as a mediator, a confounder, and a post-treatment variable, so the precise causal status of the partnership pathway cannot be established here. Even so, this narrows only the causal interpretation of that pathway. It does not eliminate the negative within-country association between SOI and number of children, which is reproduced in specifications that do not condition on that variable. A related limitation concerns the interpretation of the within-country SOI coefficient itself. This coefficient may partly conflate allocation trade-offs with life-course position. Given the relatively young analytic sample and the fact that completed fertility is not observed for many participants, individuals who are more unrestricted than their country mean may be not only allocating less effort toward parenting, but also located earlier in the union-formation and childbearing sequence. Adjustment for age, age^2, and country-level mean age at childbearing, together with the persistence of the association in the parent-only and age-40+ subsamples, makes a pure life-course-staging explanation unlikely. However, these checks cannot fully separate delayed childbearing from a genuine mating–parenting allocation trade-off. Thus, the within-country SOI association is best interpreted as evidence consistent with an allocation trade-off, rather than as a clean estimate of that trade-off; distinguishing these mechanisms would require parity-specific or time-to-event models based on more complete reproductive trajectories.

4.2.4.3. Cross-national means of sociosexuality, especially the overall index. Unequal country sample sizes, moderate and variable scale reliability, and sensitivity to shrinkage procedures converge on a single uncertainty: how much of the observed cross-national variation reflects real differences in dispositions, and how much reflects culturally variable norms of self-disclosure. Country-level mean sociosexuality should therefore be understood not only as an aggregate of individual dispositions but also as an indicator of a permissive versus restrictive moral ecology—that is, a collective normative climate regulating the acceptability of sexual behavior, union formation, and nonmarital childbearing, as well as the social reportability of such trajectories. The uncertainty is localized, not general: it bears on cross-national sociosexuality means and on interaction inferences based on the aggregated SOI score. The basic within-country SOI association with number of children and the association between rF-LHS and number of children are markedly more robust to diagnostic variation.

4.2.4.4. Scope rather than identification. The Introduction discussed a broad range of possible ecological and institutional mechanisms—kinship structure, gender order, contraceptive regimes, and sex-ratio dynamics—none of which are tested by the present design as separate causal pathways. They are included in the article as elements of a broader background architecture and as covariate blocks used to localize where the focal rF-LHS and SOI associations survive, weaken, or disappear. The study should not be read as adjudicating among mechanisms one by one; its narrower and stronger claim is structural. Whatever the detailed pathway, the observed conversion of sociosexuality into number of children is level-dependent, institutionally filtered, and only partially captured by a single fast–slow dimension.

4.3. Future directions

These limitations point to several concrete directions for future research. First, decomposing the within-country association between sociosexuality and fertility across parity transitions would clarify where in the reproductive sequence the trade-off is most strongly expressed: entry into parenthood, progression to a second child, or transitions to higher-order parities. Second, shifting the unit of analysis from the individual to the couple would allow more direct testing of whether sociosexuality affects fertility through partner selection, assortative mating, and union stability rather than through individual disposition alone. Third, distinguishing mating success from fertility success as increasingly divergent outcomes would allow more direct examination of the institutional stage of conversion at the center of the present framework.

It would also be important to test whether sociosexual unrestrictedness shifts the mean number of children per se or instead primarily increases reproductive dispersion—producing a wider and more asymmetric spectrum of life trajectories, from childlessness and delayed parenthood to serial unions and nonmarital births. Modeling the temporal mismatch between a country's current macroregime and the accumulated reproductive biographies of older cohorts would help address one structural limitation of cross-sectional data in rapidly modernizing societies. A particularly productive direction is to test the conditional structure of the present associations in more ancestrally representative settings—smaller-scale, lower-income, or natural-fertility populations—where the institutional decoupling of sexuality from reproduction is less pronounced and where sex-specific market and ecological parameters vary more strongly across communities. Such designs would allow the multilevel conversion framework advanced here to be tested in contexts in which the historical link among sex, union, kinship, and fertility has not been radically loosened.

5. Conclusion

In sum, the present study does not support the interpretation of sociosexuality as a stable country-level psychological proxy for demographic regime. The cross-national SOI gradient is fragile, sensitive to standard country-level adjustment, and entangled with broader institutional and historical variation. By contrast, sociosexuality at the individual level—especially its behavioral component—appears to be part of a multilevel process in which mating-oriented dispositions are converted into fertility only through specific partnership, demographic, and institutional pathways. Within this framework, the three principal findings become jointly intelligible: a robust negative within-country association between SOI and the number of children, a robust positive association between rF-LHS and fertility, and selective interaction between within-country SOI and rF-LHS localized chiefly in SOI behavior. The main contribution of the article is therefore not to ask again whether sociosexuality is a life-history trait in a strong one-axis sense, but to replace that question with a more precise one: how, where, and under what institutional conditions sociosexuality is converted into realized fertility. Once posed in that form, the apparent tension between cross-national and individual-level findings ceases to be a paradox and becomes an expected feature of a reproductive process that unfolds across multiple levels but becomes observable as fertility only through some of them. At the broadest theoretical level, this framework accommodates elements of evolutionary mismatch, demographic decoupling, and cultural constraint without reducing the entire architecture to any one of them; its theoretical value lies in showing which readings remain viable once rF-LHS, within-country SOI, and interaction signals are prevented from collapsing into one another.

Open practices statement

The materials to reproduce the results are available at https://osf.io/fxjym/.

CRediT author statement

DG proposed the idea of the study. DG, AG, and EK wrote the first draft of the paper. OZ, FL, and MK substantially revised the draft to the final version. LAS, LHL, ETD, AAS, AM, PP, BG, RC, and JA edited the final version. The LSCCC contributed to data collection and minor manuscript editing. MK administered the project. All authors approved the final version of the paper.

CRediT authorship contribution statement

Dmitry Grigoryev: Writing – review & editing, Writing – original draft, Supervision, Methodology, Investigation, Formal analysis, Conceptualization. **Albina Gallyamova:** Writing – review & editing, Writing – original draft, Investigation. **Elizaveta Komyaginskaya:** Writing – review & editing, Writing – original draft, Conceptualization. **Oulmann Zerhouni:** Writing – review & editing, Writing – original draft. **Fanny Lalot:** Writing – review & editing, Writing – original draft. **Laith Al-Shawaf:** Writing – review & editing. **Linda H. Lidborg:** Writing – review & editing. **Ezgi Toplu-Demirtaş:** Writing – review & editing. **Anastasiya A. Steshova:** Writing – review & editing. **Anna Mironova:** Writing – review & editing. **Pavol Prokop:** Writing – review & editing. **Biljana Gjoneska:** Writing – review & editing. **Razieh Chegeni:** Writing – review & editing. **Jan Antfolk:** Writing – review & editing. **Marta Kowal:** Writing – review & editing, Software, Project administration, Data curation.

Ethics statement

This study was conducted in compliance with the ethical standards of COPE and APA. The procedure was in line with Russian regulations; as per university and national Russian regulations, no ethics clearance was required for this type of research (if it did not include medical data).

Declaration of competing interest

The authors declare they have no conflicts of interest.

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Appendix A. Supplementary data

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