Personality and Individual Differences 260 (2026) 113892

Contents lists available at ScienceDirect

Personality and Individual Differences

journal homepage: www.elsevier.com/locate/paid

Dark Triad traits across sex and sexual orientation: Evidence from Brazil

Samuel Gualberto dos Santos [a], Emerson Do Bú [b,*]

[a] Department of Psychology, Universidade Federal da Paraíba, João Pessoa, PB, Brazil
[b] Institute of Social Sciences, University of Lisbon, Lisbon, Portugal

ARTICLE INFO

Keywords:
Dark Triad
Sexual orientation
Sex differences
Measurement invariance

ABSTRACT

Most evidence on Dark Triad differences by sex and sexual orientation comes from WEIRD (Western, Educated, Industrialized, Rich, Democratic) samples, and many studies skip tests of measurement equivalence, limiting the interpretability of group mean differences. To address this gap in Brazil, we evaluated the structure and invariance of the Dark Triad Dirty Dozen (DTDD) and examined sex- and sexual-orientation differences in a large online sample ($N = 2073$; ages 18–80). Confirmatory factor analyses supported the expected three-factor model (Narcissism, Machiavellianism, Psychopathy). Multigroup CFAs supported configural, metric, scalar, and strict invariance across both sex and sexual-orientation groups, enabling mean comparisons. Factorial ANOVAs revealed trait-specific stratification. Narcissism and Psychopathy showed main effects of sex and sexual orientation and significant Sex × Orientation interactions, indicating that sex differences varied across orientation strata. Machiavellianism differed by sexual orientation but showed no sex main effect and no interaction. Effects were small but consistent. Bisexual women tended to score higher across traits, whereas heterosexual women anchored the lower end. These findings extend Dark Triad research beyond WEIRD settings, show that the DTDD performs comparably across groups in Brazil, and suggest that orientation-linked differences are subgroup- and trait-dependent, potentially reflecting gendered norms, mating-strategy calibration, and socioecological constraints.

1. Introduction

Psychological differences associated with sex and sexual orientation remain a core topic across disciplines, yet key parts of the evidence base still come disproportionately from WEIRD settings, with limited tests of whether widely used measures operate equivalently across sex and sexual-orientation groups in non-WEIRD societies (Aluja et al., 2022; Putnick & Bornstein, 2016; Semenyna et al., 2018; Skoog et al., 2025). This gap matters because group comparisons are only interpretable when measurement is comparable, and because cultural ecologies can shape both trait expression and the meaning of items (Kline, 2023; Putnick & Bornstein, 2016). Brazil is especially relevant in this regard. Despite its demographic size and cultural influence, systematic research on how sexual orientation intersects with socially consequential personality traits remains scarce, even as sexual and gender minorities face elevated stigma, victimization, and psychosocial strain (Malta et al., 2023; Vasconcelos et al., 2023; Veras et al., 2024). The present study addresses these limitations by testing measurement invariance of a widely used Dark Triad measure across sex and sexual orientation and estimating sex- and orientation-linked differences in Dark Triad traits in a large Brazilian sample.

1.1. Dark Triad traits across sex and sexual orientation

Sex, gendered socialization, and sexual orientation are intertwined with broader biobehavioral patterns relevant to personality, mating, and social behavior (Ellis et al., 2022; Lippa, 2020; Urganci et al., 2025). Contemporary evolutionary and psychobiological perspectives argue that developmental systems may follow partially sex-typical trajectories, and that variation in sexual orientation can coincide with sex-atypicality across certain psychological domains (Jonason & Luoto, 2021; Semenyna et al., 2025b). Sex-shift and gender-shift hypotheses extend this logic, proposing that sexual orientation diversity may reflect sex-atypical pathways that generalize beyond attraction to broader behavioral and personality profiles (Luoto & Jonason, 2022). Empirically, lesbian women tend to show more male-typical patterns in gender expression and certain traits, whereas gay men often show female-typical shifts in comparable domains (Allen & Robson, 2020; Lippa,

* Corresponding author at: Institute of Social Sciences, University of Lisbon, Av. Prof. Aníbal Bettencourt 9, 1600-189, Lisboa, Portugal.
E-mail address: emerson.bu@edu.ulisboa.pt (E. Do Bú).

https://doi.org/10.1016/j.paid.2026.113892
Received 31 January 2026; Received in revised form 1 May 2026; Accepted 12 May 2026

2020). At the same time, evidence on bisexual women suggests that sexual-orientation differences in personality cannot be reduced to a single masculinity–femininity continuum (Lippa, 2005, 2010, 2020; Skoog et al., 2025).

Within this broader landscape, socially exploitative and agentic traits have drawn particular attention, especially the Dark Triad (i.e., Narcissism, Psychopathy, and Machiavellianism) (Paulhus, 2014; Paulhus & Williams, 2002). Narcissism reflects grandiosity and entitlement; Psychopathy involves callousness and impulsive antisocial tendencies; and Machiavellianism captures strategic manipulation and cynical interpersonal pragmatism (Paulhus, 2014; Paulhus & Williams, 2002). These traits show consistent sex differences (i.e., typically higher scores among men, particularly for Psychopathy) often discussed in relation to short-term mating and opportunistic social strategies (Jonason et al., 2009; Semenyna et al., 2025a; Valentova et al., 2020). Dark Triad traits also vary by sexual orientation, with several studies reporting differences that are especially pronounced among women. For example, bisexual women often score higher on Psychopathy than heterosexual women, with lesbian women frequently showing intermediate or comparable levels, and cross-national evidence suggests bisexual individuals may score lower on conscientiousness and honesty–humility (traits aligned with the broader "dark" core) relative to heterosexual and homosexual individuals (Allen & Robson, 2020; Jonason & Luoto, 2021; Semenyna et al., 2018).

Interpreting such differences requires a framework that is theoretically informative yet explicitly non-essentialist. Life History Theory offers one such approach by conceptualizing socially exploitative tendencies as context-sensitive strategic orientations that may calibrate to ecological unpredictability, competition, and constrained relational opportunities, rather than as fixed deficits (Del Giudice et al., 2016; Diamond & Alley, 2019; Ellis et al., 2022). Consistent with this account, Dark Triad traits covary with faster life history indicators such as short-term mating orientation and reduced long-term investment, particularly under stress and instability (Jonason et al., 2009; Semenyna et al., 2025a). At the same time, it is essential to avoid moralizing or pathologizing conclusions. Group differences in Dark Triad traits typically reflect modest mean shifts with substantial overlap, and they do not justify treating sexual minorities as inherently "darker" or maladaptive (Jonason & Luoto, 2021; Paulhus, 2014; Semenyna et al., 2025b). Sexual minority status is embedded in social and developmental contexts that can shape trait expression and self-report, including stigma exposure and identity negotiation (Diamond, 2021; Ellis et al., 2022). Thus, observed differences should be treated as descriptive population patterns, not as evidence of intrinsic dysfunction.

These considerations are particularly salient in Brazil, where relatively high visibility of sexual diversity coexists with persistent traditional gender norms, marked inequality, and documented discrimination and violence against LGBTQ+ populations (Malta et al., 2023; Vasconcelos et al., 2023). Representative and epidemiological evidence indicates elevated victimization and psychosocial stressors among sexual minorities compared to heterosexual individuals, with downstream implications for wellbeing and social functioning (Szwarcwald et al., 2025; Vasconcelos et al., 2023). Brazilian studies also link sexual minority status to psychosocial correlates (including coping and risk-related behavioral patterns) that may reflect adaptive responses to marginalization rather than dispositional deficits (Chinazzo et al., 2025; Veras et al., 2024). Yet, despite these socioecological features and Brazil's global relevance, systematic tests of how sexual orientation relates to socially aversive personality traits, and whether the measurement models support valid comparisons across sex and orientation, remain limited.

1.2. The present research

We address this gap by examining Dark Triad traits across sex and sexual orientation in a large Brazilian sample using the DTDD (Jonason & Webster, 2010). The study addresses three questions. First, does the DTDD demonstrate measurement invariance across sex and sexual orientation groups in Brazil? Second, do the sex differences in Dark Triad traits documented in WEIRD samples replicate in a large Brazilian sample, and do they extend to comparisons across sexual orientation groups? Third, does sexual orientation moderate sex differences in Dark Triad traits? Drawing on gender-shift accounts, sociosexuality-based models, and life history perspectives, we expected that (a) men would score higher than women on Dark Triad traits overall, (b) non-heterosexual individuals would show elevated scores relative to their heterosexual counterparts, and (c) the magnitude and direction of sex differences would vary across sexual orientation groups. All procedures were approved by the Research Ethics Committee of Centro Universitário UNIFIP (No. 75624523.1.0000.5181).

2. Method

2.1. Procedures and participants

Data were collected in an online environment through social media platforms (e.g., Facebook and Instagram). Participation was voluntary and anonymous. Individuals could access the survey via the Qualtrics platform only after providing informed consent and confirming that they were 18 years of age or older. A total of 2073 participants completed the questionnaire. Participants ranged in age from 18 to 80 years (M = 26.59, SD = 11.64). The sample was predominantly female (60%), single (81.5%), and self-identified as bisexual (34.4%). Regarding educational attainment, 33.2% reported having completed secondary education. Most participants were students (39.2%) and self-identified as belonging to the lower-middle socioeconomic class (42%) (full sociodemographic results are in STable 1).

2.2. Measure

We assessed Dark Triad traits using the Dark Triad Dirty Dozen (DTDD; Jonason & Webster, 2010), a brief self-report measure originally developed in the North American context and subsequently adapted and validated for use in Brazil by Medeiros et al. (2017). The instrument comprises 12 items distributed across three latent dimensions. Psychopathy (e.g., "I tend to lack remorse"), Machiavellianism (e.g., "I have used deceit or lied to get my way"), and Narcissism (e.g., "I tend to want others to admire me"). Responses were provided on a five-point Likert-type scale ranging from 1 (strongly disagree) to 5 (strongly agree), with higher scores indicating greater levels of the respective traits. Internal consistency indices for the three DTDD subscales were as follows. For Narcissism, Cronbach's $\alpha = 0.79$ and McDonald's $\omega = 0.80$; for Machiavellianism, $\alpha = 0.82$ and $\omega = 0.83$: and, finally, for Psychopathy, $\alpha = 0.75$ and $\omega = 0.76$. We additionally examined internal consistency within each Sex × Sexual Orientation subgroup. All three dimensions retained acceptable reliability across subgroups, with α values ranging from 0.72 to 0.90 and ω values ranging from 0.73 to 0.91 (see STable 2).

2.3. Data analysis

Data analyses were conducted using R-4.5.2 software. Preliminary analyses included descriptive statistics. To examine the internal structure of the Dark Triad measures, confirmatory factor analyses (CFA) were performed using Weighted Least Squares Mean and Variance adjusted. Model fit was evaluated based on multiple indices, including the comparative fit index (CFI), Tucker–Lewis index (TLI), root mean square error of approximation (RMSEA) with 90% confidence intervals, and standardized root mean square residual (SRMR). Conventional cutoffs were used to guide model evaluation (i.e., CFI and TLI $\geq$ 0.90–0.95, RMSEA $\leq$0.06–0.08, SRMR $\leq$0.08; Kline, 2023), with emphasis placed on overall model adequacy rather than strict adherence to any single criterion.

Measurement invariance across sex and sexual orientation groups was assessed through multigroup CFA following a hierarchical sequence of increasingly restrictive models. Configural invariance was first tested to evaluate whether the same factor structure held across groups. Metric invariance was then examined by constraining factor loadings to equality, followed by scalar invariance with additional equality constraints on item intercepts, and strict invariance with further constraints on residual variances. Invariance decisions were based on changes in approximate fit indices rather than chi-square difference tests, with decreases in CFI (ΔCFI $\leq$0.010) and increases in RMSEA (ΔRMSEA $\leq$0.015) considered indicative of acceptable invariance across models (Putnick & Bornstein, 2016).

After establishing measurement invariance, group differences in Dark Triad traits were examined using factorial multigroup analyses. Two-way analyses of variance were conducted with sex and sexual orientation as between-subjects factors for each Dark Triad trait. Partial eta squared (η_p^2) was reported as an effect size index (Lakens, 2013). Significant interactions were probed using estimated marginal means and Tukey-adjusted post hoc comparisons to control the family-wise error rate (Tukey, 1949). Subscale scores were computed as the mean of the four items comprising each factor (Narcissism, Machiavellianism, and Psychopathy), yielding scores on the original 1 to 5 response metric.

3. Results

3.1. Multigroup confirmatory factor analyses

Confirmatory factor analyses supported the expected three-factor structure of the DTDD (Narcissism, Machiavellianism, Psychopathy). The standardized solution (Fig. 1) showed coherent loadings and no anomalous parameters, and overall fit indices indicated adequate-to-good model fit (Table 1), supporting the use of the three subscale scores for substantive inference. Multigroup CFAs then demonstrated measurement invariance across gender (Table 1): configural and metric models showed essentially unchanged fit, and scalar invariance was also supported (ΔCFI ≈ -0.003; ΔRMSEA $\approx +0.002$), legitimizing latent/observed mean comparisons; the strict model remained acceptable as well. The same conclusion held for sexual orientation (Table 2): fit was stable from configural to metric, and scalar invariance was retained (ΔCFI ≈ -0.004; ΔRMSEA $\approx +0.002$), indicating comparable loadings and intercepts across orientation groups; the strict step was more demanding but remained broadly consistent with invariance. Overall, the DTDD functioned equivalently across gender and sexual-orientation strata, providing a psychometrically defensible basis for the subsequent group comparisons.

3.2. Sex and sexual orientation differences in the Dark Triad

Narcissism showed reliable differences by both sex ($F(1, 2065) = 4.397$, $p = .036$, $\eta_p^2 = 0.002$) and sexual orientation ($F(3, 2065) = 10.352$, $p = .001$, $\eta_p^2 = 0.015$), and these effects were further qualified by a significant Sex $\times$ Orientation interaction ($F(3, 2065) = 2.696$, $p = .045$, $\eta_p^2 = 0.004$). In practical terms, the interaction reflects that the pattern of orientation differences is not the same for women and men (and, likewise, any sex difference depends on orientation subgroup), which is apparent in the non-parallel profiles in Fig. 2. Tukey-adjusted post hoc tests across the eight Sex $\times$ Orientation cells (STables 3–4) indicated that bisexual women were higher than bisexual men and higher than heterosexual women and heterosexual men, and they also exceeded homosexual men. In addition, heterosexual women were lower than homosexual women and lower than women in the "other" category. Finally, heterosexual men were lower than homosexual women and lower than women in the "other" category.

Psychopathy displayed the same inferential architecture, with significant main effects of sex ($F(1, 2065) = 6.365$, $p = .012$, $\eta_p^2 = 0.003$) and sexual orientation ($F(3, 2065) = 4.281$, $p = .005$, $\eta_p^2 = 0.006$) alongside a significant Sex $\times$ Orientation interaction ($F(3, 2065) = 3.602$, $p = .013$, $\eta_p^2 = 0.005$), again indicating that sex-related differences are not constant across orientation strata (Fig. 3). The Tukey-corrected pairwise results (STables 3–4) were especially diagnostic here because they revealed that the interaction is largely organized around the heterosexual-female cell. Specifically, heterosexual women were lower than bisexual women, bisexual men, heterosexual men, homosexual women, homosexual men, women in the "other" category,

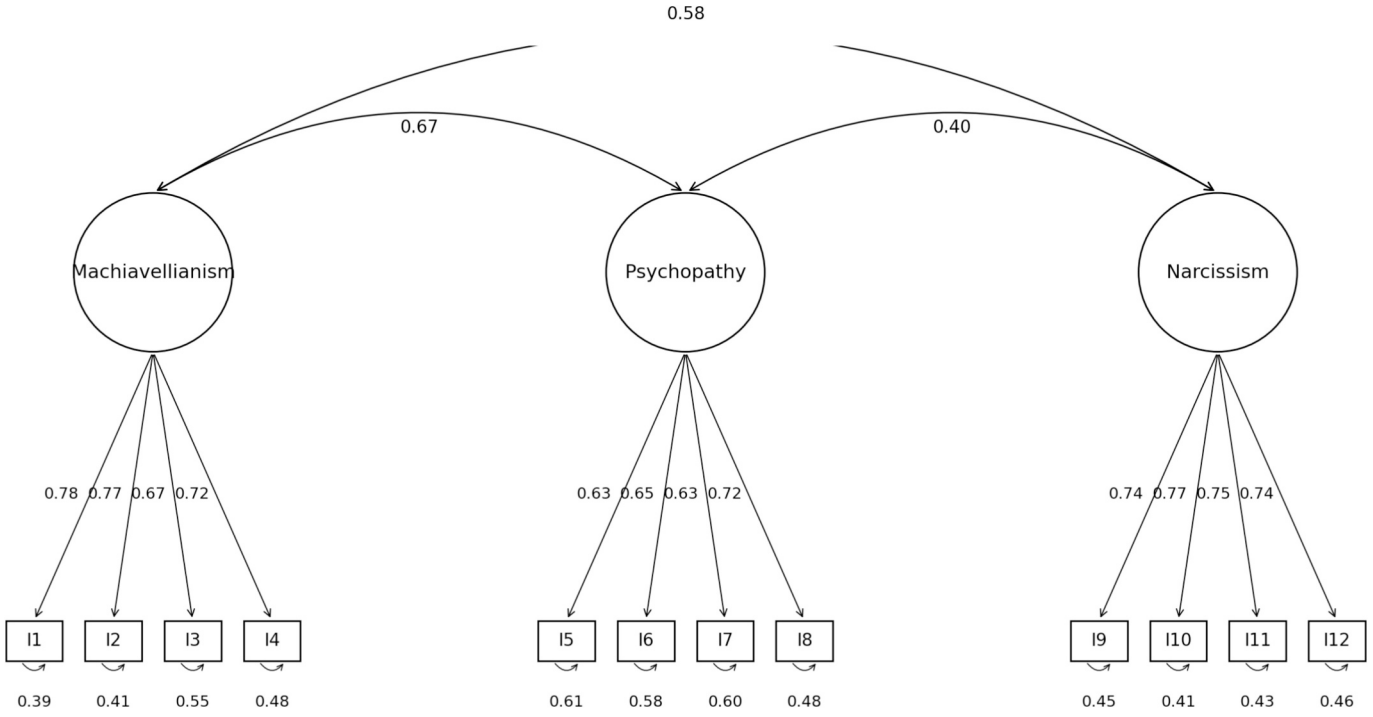

Fig. 1. DTDD, with standardized coefficients.

Table 1
Fit indices of the DTDD overall model, and configural, metric, scalar and strict invariance based on gender.

Model	χ^2 (df)	CFI	TLI	RMSEA [90% CI]	SRMR	ΔCFI	ΔRMSEA	ΔSRMR	$\Delta\chi^2$ *p*
Overall	377.077 (51)	0.978	0.971	0.056	0.055	–	–	–	–
Configural	387.194 (102)	0.981	0.975	0.052	0.055	–	–	–	–
Metric	400.076 (111)	0.980	0.977	0.050	0.056	−0.001	−0.002	0.001	0.168
Scalar	456.596 (120)	0.977	0.975	0.052	0.055	−0.003	0.002	−0.001	0.001
Strict	595.129 (141)	0.977	0.977	0.050	0.056	0.000	−0.002	0.001	0.001

Table 2
Fit indices of the DTDD configural, metric, scalar and strict invariance based on sexual orientation.

Model	χ^2 (df)	CFI	TLI	RMSEA [90% CI]	SRMR	ΔCFI	ΔRMSEA	ΔSRMR	$\Delta\chi^2$ *p*
Configural	447.539 (204)	0.984	0.979	0.048	0.059	–	–	–	–
Metric	486.666 (231)	0.983	0.980	0.046	0.061	−0.001	−0.002	0.002	0.062
Scalar	587.884 (258)	0.979	0.979	0.048	0.060	−0.004	0.002	−0.001	0.001
Strict	649.032 (294)	0.976	0.978	0.048	0.065	−0.003	0.000	0.005	0.006

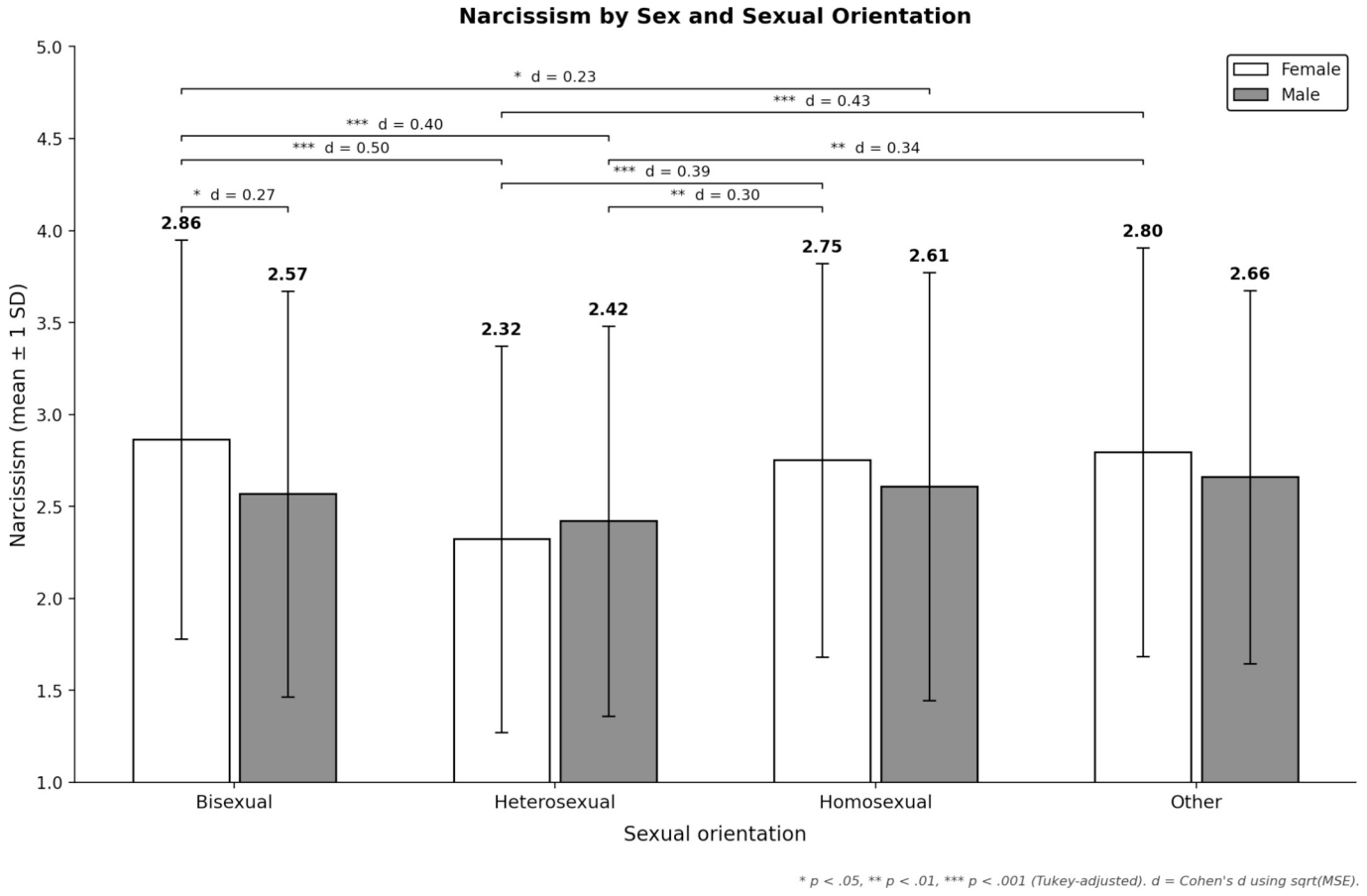

Fig. 2. Means (±1 SD) of Narcissism by sex and sexual orientation.
Note. Brackets above bars indicate Tukey-adjusted pairwise contrasts, with asterisks denoting significance levels (*$p < .05$, **$p < .01$, ***$p < .001$) and Cohen's *d* reported on each bracket.

and men in the "other" category. The only clear within-orientation sex difference that survived Tukey adjustment was within heterosexual participants, where men exceeded women, replicating the canonical sex difference for Psychopathy reported in the broader literature (Cohen's $d = 0.40$).

Machiavellianism diverged from the other traits. The omnibus tests supported an effect of sexual orientation ($F(3, 2065) = 5.389$, $p = .001$, $\eta_p^2 = 0.008$), but there was no evidence for a main effect of sex ($F(1, 2065) = 0.309$, $p = .578$, $\eta_p^2 = 0.001$) and no Sex × Orientation interaction ($F(3, 2065) = 1.418$, $p = .236$, $\eta_p^2 = 0.002$), indicating that orientation-linked differences are broadly similar for women and men rather than sex-contingent (Fig. 4). Consistent with this, the Tukey-adjusted post hoc comparisons were comparatively sparse (STables 3–4). The reliable differences were confined to higher Machiavellianism among bisexual women relative to heterosexual women and relative to heterosexual men, and higher Machiavellianism among women in the "other" category relative to heterosexual women.

Supplementary analyses were also conducted using a composite Dark Triad total score and trait-level models in which each dimension was re-estimated while statistically controlling for the remaining two traits. The

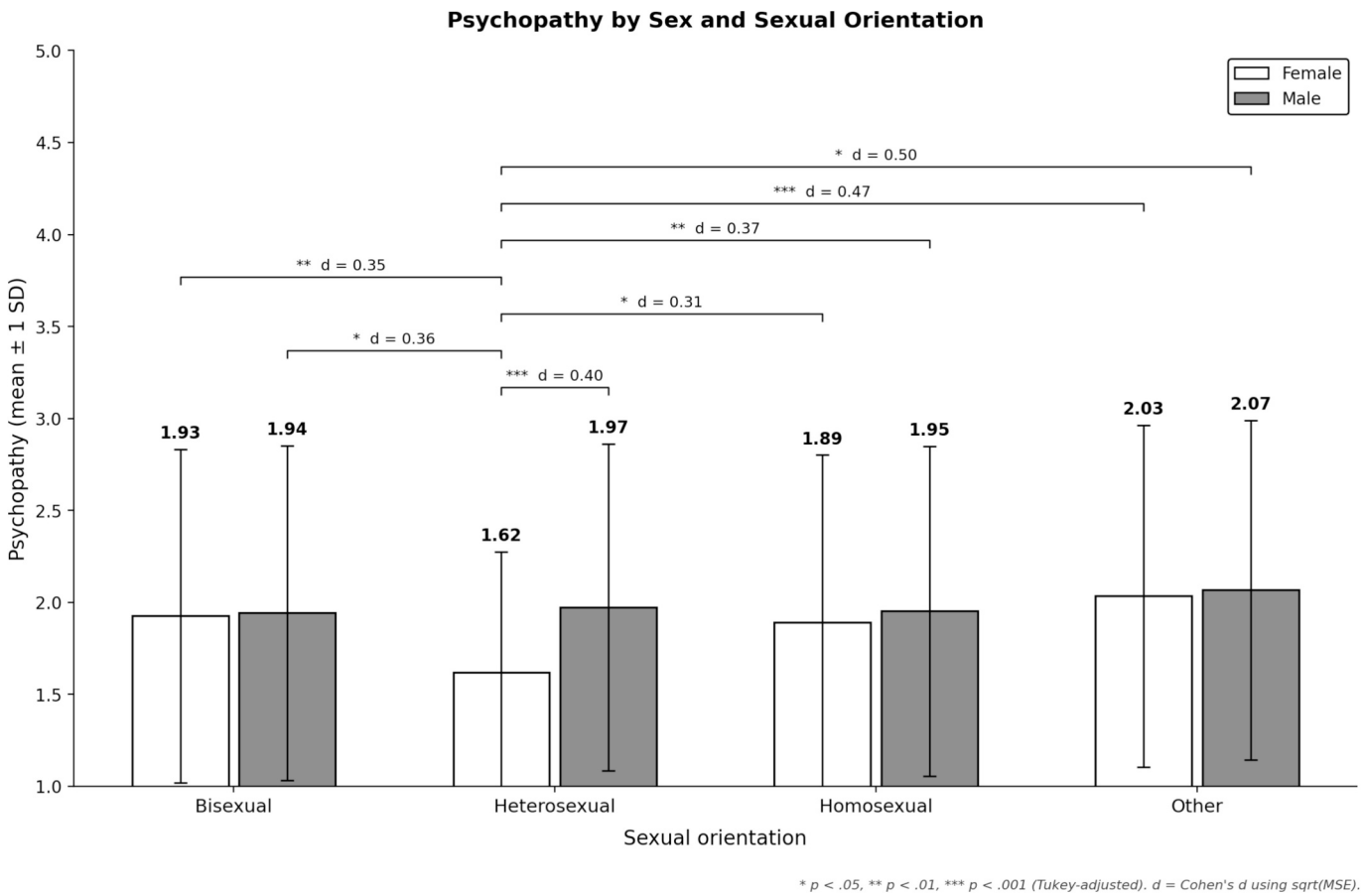

Fig. 3. Means (±1 SD) of Psychopathy by sex and sexual orientation.
Note. Brackets above bars indicate Tukey-adjusted pairwise contrasts, with asterisks denoting significance levels (*$p < .05$, **$p < .01$, ***$p < .001$) and Cohen's *d* reported on each bracket.

composite score reproduced the general descriptive pattern across groups, indicating that the broader Dark Triad profile varied as a function of sexual orientation and its interaction with sex. In the covariate-adjusted comparisons, this pattern was distributed unevenly across the three dimensions. Contrasts remained more evident for Narcissism and Psychopathy but were comparatively sparse for Machiavellianism, with no Tukey-adjusted contrasts surviving covariate adjustment for that trait. This distribution is consistent with the substantial shared variance among the DTDD dimensions. The composite score appears to capture the broader socially aversive configuration indexed by the instrument, whereas the adjusted models provide a narrower view of variance that is more specific to each trait.

Cohen's *d* effect sizes for the significant Tukey-adjusted post-hoc comparisons are reported in STable 4. Across traits, the pairwise effect sizes ranged from $d = 0.234$ to $d = 0.504$, falling in the small-to-medium range.

4. Discussion

The present study pursued two interrelated objectives. The first was to evaluate whether the Dark Triad Dirty Dozen demonstrates measurement invariance across sex and sexual orientation groups in a large Brazilian sample. The second was to estimate sex and sexual-orientation differences in Narcissism, Machiavellianism, and Psychopathy. The multigroup CFAs indicated that the DTDD operated equivalently across both groups, with evidence for configural, metric, and scalar invariance. This pattern legitimizes between-group comparisons of observed and latent means as reflecting substantive differences rather than measurement artefacts.

Against this psychometric backdrop, the mean comparisons reveal a coherent but trait-specific pattern of stratification by sex and sexual orientation. Narcissism and Psychopathy both showed significant main effects of sex and sexual orientation, and in both traits these differences were further qualified by Sex × Orientation interactions, indicating that sex differences were not uniform across orientation strata (and vice versa). Machiavellianism, in contrast, showed an omnibus effect of sexual orientation but no evidence for either a sex main effect or a Sex × Orientation interaction, suggesting that orientation-linked differences are broadly similar for women and men. Across traits, partial η_p^2 values indicate small effects yet potentially meaningful for theory because they are systematic and based on measurement-invariant scores.

The trait-specific nature of the findings warrants direct engagement. Narcissism and Psychopathy shared a similar inferential architecture (main effects of both sex and orientation, qualified by interactions), whereas Machiavellianism diverged (orientation effect only, no sex main effect or interaction). This pattern may reflect the different functional properties of these traits. Narcissism is closely tied to status-seeking and self-display, domains in which gender norms shape both expression and self-report, and Psychopathy is anchored in affective and behavioral substrates that show robust sex differentiation across the Dark Triad literature (Jonason et al., 2009; Paulhus, 2014). Machiavellianism, by contrast, centers on cold and instrumental cognition (manipulation, deceit, and strategic flattery) that may be more uniformly distributed across sexes when context affords its use, and prior work has often reported smaller and less consistent sex differences for Machiavellianism than for Psychopathy. From this perspective, the orientation-linked variation persists for all three traits, but the sex-modulation that operates through gender-norm and affective

Fig. 4. Means (±1 SD) of Machiavellianism by sex and sexual orientation.
Note. Brackets above bars indicate Tukey-adjusted pairwise contrasts, with asterisks denoting significance levels (*$p < .05$, **$p < .01$, ***$p < .001$) and Cohen's *d* reported on each bracket.

pathways is selectively expressed in Narcissism and Psychopathy rather than in Machiavellianism.

A critical question raised by the present findings is why bisexual women not only exceeded heterosexual women but in several comparisons also exceeded men, including bisexual men. Gender-shift hypotheses rest on population-level tendencies and do not preclude subgroup-level variation that surpasses male averages when additional processes operate concurrently. Three mechanisms may jointly account for this pattern. First, partial sex-atypicality in trait-relevant dispositions raises the baseline for non-heterosexual women (Lippa, 2020; Luoto & Jonason, 2022). Second, sociosexuality-mediated pathways amplify scores on traits associated with short-term mating, given that bisexual women often show more unrestricted profiles than both heterosexual women and men (Semenyna et al., 2018, 2025a). Third, the socioecological conditions facing sexual minority women in Brazil, including discrimination and psychosocial strain (Malta et al., 2023; Szwarcwald et al., 2025), may calibrate interpersonal strategies toward heightened vigilance and strategic self-presentation. Their joint operation provides the most parsimonious account of why bisexual women's scores exceeded those of heterosexual women and, for certain traits, those of men as well.

The absence of a sex main effect for Machiavellianism deserves particular attention, even though prior work has long suggested that sex differences for Machiavellianism are typically smaller and less consistent than those reported for Psychopathy (Jonason et al., 2009; Paulhus, 2014). Several non-mutually exclusive considerations may help account for the present pattern. First, the DTDD captures Machiavellianism through items emphasizing strategic manipulation, deceit, and flattery, behaviors whose normative pressure operates across both sexes when interpersonal goals favor instrumental tactics. Second, the Brazilian socioecological context, marked by elevated competition, scarcity, and asymmetric power relations, may favor instrumental social cognition broadly rather than channel it along sex-typed lines. Third, the substantial proportion of sexual minority participants in the sample, several of whom show patterns consistent with partial gender shifts in trait expression, may have flattened any underlying sex contrast that might be observed in heterosexual-only or WEIRD samples. These possibilities are not definitive explanations, but they identify plausible mechanisms through which the canonical sex difference may be attenuated for Machiavellianism specifically, while remaining clearly evident for Psychopathy in the present data, where men exceeded women within the heterosexual stratum (Cohen's d = 0.40).

Interpreting why these profiles emerge requires care, both scientifically and ethically. The Dark Triad are dimensional traits with heterogeneous correlates, not clinical diagnoses, and group differences (especially small ones) do not warrant essentializing narratives about sexual minorities (Semenyna et al., 2025b). Nevertheless, the specific concentration of differences among bisexual women is not idiosyncratic to the present sample; it has appeared in independent datasets and has been discussed through multiple explanatory lenses, including gender-shift accounts, life-history perspectives, and sociosexuality-linked pathways (Jonason & Luoto, 2021; Semenyna et al., 2018, 2025a). These frameworks are not mutually exclusive.

We clarify that Life History Theory does not propose that non-heterosexual orientation itself confers adaptive benefits through faster life-history strategies. Rather, sexual minority status, particularly in societies marked by structural discrimination, is associated with exposure to socioecological conditions (e.g., unpredictability, social exclusion, reduced institutional support) that, according to LHT, shift

resource-allocation trade-offs toward faster, more opportunistic profiles (Del Giudice et al., 2016; Ellis et al., 2022). The elevated Dark Triad scores observed among certain sexual minority subgroups thus reflect a probabilistic response to environmental harshness rather than an orientation-linked adaptation, a distinction critical for avoiding essentializing interpretations.

We acknowledge that the theoretical frameworks invoked here (i.e., life history calibration, sociosexuality pathways, and pseudopathology accounts) describe plausible interpretive lenses rather than mechanisms directly tested by the present design. The constructs invoked, including sociosexuality, minority stress exposure, and mating effort, were not directly measured, and the cross-sectional and self-report nature of the data does not permit causal inference. The interpretations offered should therefore be understood as theoretically motivated accounts that are consistent with the empirical pattern but require prospective, multi-method research to evaluate directly.

These theoretical accounts converge on a broader integrative framework. Gender-shift hypotheses posit that non-heterosexual women may show partial masculinization on traits linked to agency and short-term mating, whereas life-history approaches situate these traits within faster strategic profiles characterized by elevated mating effort and intrasexual competition (Luoto et al., 2019; Semenyna et al., 2025a). Sociosexuality-based models complement these views by identifying behavioral mechanisms through which unrestricted mating orientations covary with Machiavellianism and Psychopathy across sexes (Semenyna et al., 2025a). The pseudopathology framework provides a bridge between evolutionary and social explanations, framing elevated Dark Triad scores as context-sensitive calibrations rather than indicators of dysfunction (Jonason & Luoto, 2021). This perspective is particularly salient in Brazil, where sexual and gender minorities face well-documented discrimination and violence (Malta et al., 2023; Vasconcelos et al., 2023; Veras et al., 2024) and where contexts marked by unpredictability, elevated threat, and asymmetric power relations may reinforce interpersonal strategies emphasizing vigilance, impression management, and strategic self-presentation (Chinazzo et al., 2025; Szwarcwald et al., 2025). Mapped onto the present cell means, this integrative account is consistent with heterosexual women anchoring the lower end of the distribution and bisexual women (along with some "other" groups) showing relative elevations. The key point is not that sexual minorities are "darker," but that trait expression and self-report may be partly contingent on the social environments in which identities are enacted and evaluated.

5. Limitations and further directions

Several limitations should be acknowledged. First, the cross-sectional design precludes causal inference and limits conclusions about developmental or contextual change. Longitudinal and person-centered designs are needed to examine whether Dark Triad traits reflect stable individual differences or context-sensitive calibrations that vary across life stages and socioecological conditions, as suggested by life history and minority-stress frameworks. Second, all variables were assessed via self-report, which may be influenced by social desirability and strategic self-presentation, particularly for socially aversive traits. Nonetheless, the demonstration of configural, metric, and scalar invariance across sex and sexual-orientation groups supports the validity of between-group comparisons. Future research would benefit from multi-method approaches, including informant reports and behavioral indicators, to triangulate these findings.

The "Other" sexual orientation category comprised individuals self-identifying with labels such as pansexual, asexual, queer, and questioning. Aggregation was necessary to maintain sufficient cell sizes for the factorial and invariance analyses, preserving analytic power. The trade-off, however, is substantive, since these identities differ in developmental trajectories, social positioning, and relational patterns, so aggregation may obscure within-group heterogeneity. For instance, asexual and pansexual individuals may present very different personality profiles, yet both are collapsed here into a single category. Future research with larger and more targeted samples should examine these identities separately.

Recruitment through social media platforms yielded a convenience sample that overrepresents young adults, students, and bisexual individuals relative to the general Brazilian population. This profile may have amplified the visibility of sexual-orientation effects and limit generalization to population-representative contexts. Although measurement invariance strengthens the internal validity of the group comparisons, the external validity of the specific effect sizes reported here should be interpreted with caution, and replication in probability-based samples is needed.

6. Conclusion

This study demonstrates that Dark Triad traits can be measured equivalently across sex and sexual-orientation groups in Brazil and that observed group differences, while small, are theoretically coherent and systematically patterned. These differences should not be interpreted as intrinsic or pathological properties of sexual minorities. Rather, they are more plausibly understood as probabilistic shifts in strategy expression shaped by social contingencies, gendered norms, and minority-status conditions. By integrating personality theory with socioecological and cultural perspectives in a non-WEIRD context, the present findings contribute to a more nuanced and ethically responsible understanding of individual differences across sexual diversity.

CRediT authorship contribution statement

Samuel Gualberto dos Santos: Writing – review & editing, Writing – original draft, Visualization, Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Emerson Do Bú:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgments

Fundação para a Ciência e a Tecnologia (2023.14666.TENURE.021/CP00017/CT00018).

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.paid.2026.113892.

Data availability

Datasets and supplementary materials used in this research have been deposited in the Open Science Framework platform: https://osf.io/qjynx/overview.

References

Allen, M. S., & Robson, D. A. (2020). Personality and sexual orientation: New data and meta-analysis. *Journal of Sex Research, 57*(8), 953–965. https://doi.org/10.1080/00224499.2020.1768204

Aluja, A., García, O., Rossier, J., Ostendorf, F., Glicksohn, J., Oumar, B., … Jonason, P. K. (2022). Dark Triad traits, social position, and personality: A cross-cultural study.

Journal of Cross-Cultural Psychology, 53(3–4), 380–402. https://doi.org/10.1177/00220221211072816

Chinazzo, Í. R., Vaitses Fontanari, A. M., Riva, A., de Brito Silva, B., Rodrigues, L. P., Trajano, A. C., … Lobato, M. I. R. (2025). Coping strategies employed by transgender youth with higher and lower quality of life. *British Journal of Developmental Psychology, 43*(2), 470–484. https://doi.org/10.1111/bjdp.12524

Del Giudice, M. D., Gangestad, S. W., & Kaplan, H. S. (2016). Life history theory and evolutionary psychology. In D. M. Buss (Ed.), *The handbook of evolutionary psychology* (2nd ed., pp. 88–114). Wiley.

Diamond, L. M. (2021). The new genetic evidence on same-gender sexuality: Implications for sexual fluidity and multiple forms of sexual diversity. *Journal of Sex Research, 58*, 818–837. https://doi.org/10.1080/00224499.2021.1879721

Diamond, L. M., & Alley, J. (2019). Was it good for her? An alternative perspective on life history theory, female same-sex sexuality, and pleasure [commentary]. *Archives of Sexual Behavior, 48*, 1315–1320. https://doi.org/10.1007/s10508-018-1313-5

Ellis, B. J., Sheridan, M. A., Belsky, J., & McLaughlin, K. A. (2022). Why and how does early adversity influence development? Toward an integrated model of dimensions of environmental experience. *Development and Psychopathology, 34*(2), 447–471. https://doi.org/10.1017/S0954579421001838

Jonason, P. K., Li, N. P., Webster, G. D., & Schmitt, D. P. (2009). The dark triad: Facilitating short-term mating in men. *European Journal of Personality, 23*, 5–18. https://doi.org/10.1002/per.698

Jonason, P. K., & Luoto, S. (2021). The dark side of the rainbow: Homosexuals and bisexuals have higher dark triad traits than heterosexuals. *Personality and Individual Differences, 181*, Article 111040. https://doi.org/10.1016/j.paid.2021.111040

Jonason, P. K., & Webster, G. D. (2010). The dirty dozen: A concise measure of the dark triad. *Psychological Assessment, 22*(2), 420–432. https://doi.org/10.1037/a0019265

Kline, R. B. (2023). *Principles and practice of structural equation modeling*. Guilford Press.

Lakens, D. (2013). Calculating and reporting effect sizes to facilitate cumulative science: A practical primer for t-tests and ANOVAs. *Frontiers in Psychology, 4*, 863. https://doi.org/10.3389/fpsyg.2013.00863

Lippa, R. A. (2005). Sexual orientation and personality. *Annual Review of Sex Research, 16*, 119–153.

Lippa, R. A. (2010). Sex differences in personality traits and gender-related occupational preferences across 53 nations: Testing evolutionary and social-environmental theories. *Archives of Sexual Behavior, 39*(3), 619–636. https://doi.org/10.1007/s10508-008-9380-7

Lippa, R. A. (2020). Interest, personality, and sexual traits that distinguish heterosexual, bisexual, and homosexual individuals: Are there two dimensions that underlie variations in sexual orientation? *Archives of Sexual Behavior, 49*(2), 607–622. https://doi.org/10.1007/s10508-020-01643-9

Luoto, S., & Jonason, P. K. (2022). Reply to technical comment on Jonason, P. K., & Luoto, S. (2021). The dark side of the rainbow: Homosexuals and bisexuals have higher Dark Triad traits than heterosexuals. *Personality and Individual Differences, 187*, Article 111435. https://doi.org/10.1016/j.paid.2021.111435

Luoto, S., Krams, I., & Rantala, M. J. (2019). A life history approach to the female sexual orientation spectrum: Evolution, development, causal mechanisms, and health. *Archives of Sexual Behavior, 48*, 1273–1308. https://doi.org/10.1007/s10508-018-1261-0

Malta, M., da Silva, A. B., da Silva, C. M. F., et al. (2023). Addressing discrimination and violence against lesbian, gay, bisexual, transgender, and queer (LGBTQ) persons from Brazil: A mobile health intervention. *BMC Public Health, 23*, 2069. https://doi.org/10.1186/s12889-023-16857-4

Medeiros, E. D. D., Monteiro, R. P., Gouveia, R. S. V., Nascimento, B. D. S., & Gouveia, V. V. (2017). Dark Triad Dirty Dozen: Avaliando seus parâmetros via TRI. *Psico-USF, 22*, 299–308. https://doi.org/10.1590/1413-82712017220209

Paulhus, D. L. (2014). Toward a taxonomy of dark personalities. *Current Directions in Psychological Science, 23*(6), 421–426. https://doi.org/10.1177/0963721414547737

Paulhus, D. L., & Williams, K. M. (2002). The dark triad of personality: Narcissism, Machiavellianism, and psychopathy. *Journal of Research in Personality, 36*(6), 556–563. https://doi.org/10.1016/S0092-6566(02)00505-6

Putnick, D. L., & Bornstein, M. H. (2016). Measurement invariance conventions and reporting: The state of the art and future directions for psychological research. *Developmental Review, 41*, 71–90. https://doi.org/10.1016/j.dr.2016.06.004

Semenyna, S. W., Belu, C. F., Vasey, P. L., & Lynne Honey, P. L. (2018). Not straight and not straightforward: The relationships between sexual orientation, sociosexuality, and dark triad traits in women. *Evolutionary Psychological Science, 4*(1), 24–37. https://doi.org/10.1007/s40806-017-0111-y

Semenyna, S. W., Vasey, P. L., & Lynne Honey, P. L. (2025a). Relationships among sex, sexual orientation, dark triad traits, sociosexuality, and sexual excitation/inhibition. *Archives of Sexual Behavior*. https://doi.org/10.1007/s10508-025-03092-8. Advance online publication.

Semenyna, S. W., Vasey, P. L., & Lynne Honey, P. L. (2025b). Sex and sexual orientation differences in dark triad traits, sexual excitation/inhibition, and sociosexuality. *Archives of Sexual Behavior, 54*(8), 2907–2919. https://doi.org/10.1007/s10508-024-02895-5

Skoog, T., Claesdotter-Knutsson, E., Håkansson, A., Kapetanovic, S., & Gerdner, A. (2025). Sexual orientation and personality dimensions measured by the Junior Temperament and Character Inventory among adolescents. *Archives of Sexual Behavior, 54*, 2321–2332. https://doi.org/10.1007/s10508-025-03180-9

Szwarcwald, C. L., de Souza, P. R. B., Júnior, Almeida, W. D. S., & Castilho, E. A. (2025). Sexual orientation-motivated violent victimizations in Brazil: Using representative data from the 2019 National Health Survey. *Journal of Interpersonal Violence, 40*(23–24), 5377–5401. https://doi.org/10.1177/08862605241303957

Tukey, J. W. (1949). Comparing individual means in the analysis of variance. *Biometrics, 5*, 99–114. https://doi.org/10.2307/3001913

Urganci, B., Sevi, B., Dogruyol, B., & Sakman, E. (2025). Examining the role of dark and light triad traits on sociosexuality. *Sexual and Relationship Therapy*. https://doi.org/10.1080/14681994.2025.2507789. Advance online publication.

Valentova, J. V., Junior, F. P. M., Štěrbová, Z., Varella, M. A. C., & Fisher, M. L. (2020). The association between dark triad traits and sociosexuality with mating and parenting efforts: A cross-cultural study. *Personality and Individual Differences, 154*, Article 109613. https://doi.org/10.1016/j.paid.2019.109613

Vasconcelos, N. M., Alves, F. T. A., Andrade, G. N., Pinto, I. V., Soares Filho, A. M., Pereira, C. A., & Malta, D. C. (2023). Violence against LGB+ people in Brazil: Analysis of the 2019 National Survey of Health. *Revista Brasileira de Epidemiologia, 26*(Suppl. 1), Article e230005. https://doi.org/10.1590/1980-549720230005.supl.1

Veras, M. A. S. M., Menezes, N. P., Mocello, A. R., et al. (2024). Correlation between gender-based violence and poor treatment outcomes among transgender women living with HIV in Brazil. *BMC Public Health, 24*, Article 791. https://doi.org/10.1186/s12889-024-18224-3