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Divorce and physical health: A three-level meta-analysis☆

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ABSTRACT

Divorce is often considered a major and stressful life transition. Given that divorcees are overrepresented in primary care and there is a association between individuals' physical health and psychological adjustment, potential post-divorce health problems are of concern. Yet, empirical evidence is lacking on the magnitude of the overall physical health risk after divorce, on possible differences across specific pathologies, and on factors that may increase or reduce this risk. The current meta-analysis addresses these issues. We identified 94 studies including u = 248 relevant effect sizes, based on N = 1,384,507 participants. Generally, compared to married individuals, divorcees showed significantly worse self-reported health (OR = 1.20, [1.08–1.33]), experienced more physical symptoms (OR = 1.34, [1.17–1.53]), and had a higher risk for diabetes (OR = 1.18 [1.05–1.33]), joint pathologies (OR = 1.24, [1.14–1.34]), cardiovascular (OR = 1.24, [1.09–1.41]) and cerebrovascular conditions (OR = 1.31, [1.14–1.51]), and sexually transmitted diseases (OR = 2.48, [1.32–4.64]). However, they had no increased risk of hypertension, hypercholesterolemia, cancer and cancer development, disabilities or limitations, or cognitive pathologies. Nor did divorcees significantly differ from married individuals when aggregating all pathologies to measure overall physical health problems (OR = 1.14, [0.85 to 1.54]). Yet, moderation analyses revealed that being female, unemployed, childless, or having a lower education constitutes a higher risk for overall physical health problems after divorce. The same applied to having a heavy alcohol consumption, lack of exercise, and being overweight. Our meta-analysis shows that divorcees are at heightened risk of certain pathologies, with sexually transmitted diseases as a particular post-divorce hazard. These findings call for more awareness among counsellors and physicians on divorcees' health conditions and the characteristics that make divorcees even more vulnerable to health problems.

Divorce and separation are highly prevalent in Western society, with divorce rates in most Western countries ranging between 25 and 60 percent (European Commission, 2018; Mason, 2024; Raley and Sweeney, 2020). Relationship dissolution is considered one of the greatest interpersonal stressors in people's lives, often accompanied by changes in finances, housing, social relationships, and, if children are involved, problems regarding co-parenting, care, and contact arrangements (Leopold, 2018; Whisman et al., 2016; Zineldin, 2019). Consequently, divorce has been associated with symptoms of profound sadness, loneliness, grief, anger, and insecurity (e.g., Akhtar and Blue, 2017). Initially, divorcees generally experience an intense period of stress, but the majority eventually adjust and successfully rebuild their lives after the breakup (Malgaroli et al., 2017). They experience few divorce-related symptoms, function well in their familial, social, and work roles, and develop identities that go beyond marriage (Amato, 2000). For some people, divorce may even bring a sense of relief and wellbeing after a relationship that caused dissatisfaction and suffering (Kiecolt-Glaser, 2018; Sander et al., 2020).

However, about ten to twenty percent of divorcees continue to suffer considerably and have significant difficulties in coping with the divorce, and their problems can become chronic. (Lin and Brown, 2020; Lorenz et al., 2006). Both physical and mental health are key to proper daily,

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personal, occupational, and social functioning (Sander et al., 2020). Physical health refers to the correct state of the body's organs and systems (e.g., immune, cardiovascular, and endocrine; Koipysheva et al., 2018), while mental health refers to an adequate state of mind and emotions (Defence Health Hub, n.d.). In fact, research has shown that compared to adults who are not divorced, divorcees more frequently require primary care services, and they usually report problems and complaints regarding both their mental and physical health (Bronselaer et al., 2008; Kiecolt-Glaser, 2018), which are interrelated (Amato, 2012; Sander et al., 2020). Accordingly, divorce has been linked to substantial health and societal costs (Amato, 2010; Sbarra et al., 2012). To substantiate empirically the magnitude of the potential risk for such health problems after divorce, a meta-analysis is warranted. By merging the results of studies covering a broad range of pathologies, this meta-analysis investigated whether divorcees exhibit an increased risk of health problems in general or only with respect to specific pathologies. Such a meta-analytic study is especially important by zooming in on physical health problems because these are relatively underrepresented compared to studies of mental health problems after divorce (e.g., Sbarra, 2015). This research can therefore provide an important source of knowledge for both health practitioners and policy makers.

Moreover, variability in the physical health risk of divorcees can depend, at least partly, on some of their characteristics and circumstances surrounding the divorce. Identifying those individuals who are most at risk can contribute to the adaption and targeted inclusion in prevention and intervention (Sander et al., 2020; Wilder, 2016). Thus, the overarching aims of the current meta-analysis were to: 1) test whether divorced individuals have a significant higher risk of physical health problems compared to their married counterparts and, if so, determine the magnitude of this risk; 2) identify which aspects of physical health (i.e., specific pathologies) may be more likely among divorcees; and 3) examine moderation of the increased health risk for divorcees by individual characteristics and circumstances.

1. The risk of divorce on physical health

Research has supported the idea that, compared to married individuals, divorced people tend to have a higher incidence of chronic pathologies such as hypertension and diabetes, cardiovascular and cerebrovascular diseases. In addition, they report higher levels of physical pain (Slatcher and Seluck, 2017; Whisman et al., 2016), increased difficulty coping with daily life activities (Kojima et al., 2020), and use more days of sick leave (Strizzi et al., 2021).

Sbarra et al. (2011) defined three pathways through which divorce can pose a risk to physical health. First, divorce often negatively affects financial and social resources (Malgaroli et al., 2017; Zulkarnain and Korenman, 2019), which can increase stress and reduce access to, for instance, sports facilities, healthy food, and healthcare (Mason and Sbarra, 2013). Second, after divorce, people tend to engage in more risky behaviors and unhealthy lifestyle habits, such as consuming more alcohol, tobacco, and other substances. Moreover, divorcees generally have poorer eating habits and lack healthy physical exercise habits (Bourassa et al., 2019). All such behaviors are associated with physical health problems (Sbarra et al., 2011; Shor et al., 2012; Stack, 2021). Third, divorce is related to a heightened risk of ex-partner conflict, constituting a major interpersonal stressor (Zineldin, 2019). High levels of stress following marital strains are often accompanied by a number of changes in the body's organic responses (immune, cardiovascular, and endocrine systems) that may lead to an increased risk for multiple health pathologies (Mason and Sbarra, 2013; Mattos dos Santos, 2020).

2. Previous reviews and meta-analyses

Few literature reviews have considered the risk of divorce on physical health. The two notable exceptions to this paucity are the works of Sbarra (2015) and Sbarra et al. (2015). In both reviews, the authors described that divorce confers a risk for poor health outcomes and sought to explain the factors that may influence the differential impact of divorce on health (e.g. previous physical and psychological pathologies, time elapsed since divorce, having a new partner, feelings towards the ex-partner, self-concept, coping strategies, and health behaviours). One prior meta-analysis revealed that divorcees had increased odds of cardiovascular heart disease, suggesting that marital status should be considered in risk assessments for cardiovascular disease (Wong et al., 2018). In another line of research, Sbarra et al. (2011; N = 32; follow-up $M = 14.8$ years) and Shor et al. (2012; N = 104; follow-up $M = 6.5$ years) conducted a meta-analysis, and both reported an increased mortality risk for divorcees (HR 1.20, and HR 1.30, respectively). Although this may be due, in part, to physical health problems, many other factors such as suicide or risky behaviours may also play a role.

Although these previous literature reviews and meta-analyses have increased our knowledge in important ways, they also have notable limitations. First, the field could benefit from more detailed information on various post-divorce pathologies, in addition to merely cardiovascular health and mortality. Second, previous work lacks the distinction between unmarried people in general and divorcees specifically (e.g., Wong et al., 2018). This means that they, for instance, also included widowed individuals, which may obscure the divorce findings. Third, previous meta-analyses merely used studies published until 2020, constituting a relatively narrow timeframe, and potentially lacking important data. Hence, an up-to-date meta-analytic overview on overall post-divorce health risk, covering a broad range of different pathologies is warranted.

3. The current meta-analysis

This research examined whether divorce poses a risk for individuals' physical health and, if so, the magnitude of this risk. Based on previous literature, divorced people were expected to have a higher risk of physical health problems compared to married people. Adding to already existing reviews and meta-analyses (Sbarra, 2015; Sbarra et al., 2011, 2015; Shor et al., 2012; Wong et al., 2018), the current meta-analysis examined both general health problems and various specific pathologies and health complaints. This provides a more detailed understanding of post-divorce health conditions. In that regard, the present meta-analysis included substantially more pathologies compared to previous work. For instance, physical pain, chronic conditions, self-reported health, and daily life limitations are some of the most common reasons for using primary care services (Kiecolt-Glaser, 2018), though these complaints were not addressed in previous meta-analyses. Similarly, sexually transmitted diseases, joint pathologies, and cognitive diseases are highly prevalent health conditions, which may be relevant to include in meta-analytic research. In addition, previous research on this topic often included (randomly) selected or averaged effect sizes, resulting in the loss of important data (Assink and Wibbelink, 2016; Assink et al., 2018; Cheung and Chan, 2008). To include all data while accounting for within-study dependency of effect sizes, this research incorporated used three-level models.

4. Potential moderators

Despite our expectation that divorcees are at risk for physical health problems, divorces are complex, and their impact depends on many factors, resulting in wide variation in adjustment after divorce (Wilder, 2016; Zulkarnain and Korenman, 2019). According to the Divorce-Stress-Adjustment perspective (Amato, 2000), divorce is a process that begins when the couple is still married and may continue for years after the legal separation. The severity and duration of the negative consequences varies depending on several intra- and inter-personal moderating factors (Strizzi et al., 2022), which may be socioeconomic, behavioral, and sociodemographic in nature (Malgaroli et al., 2017; Tosi & Van den Broek, 2020).

4.1. Socioeconomic factors

After the breakup, couples often face socioeconomic deterioration because of the need to move and divide household-related costs. This higher financial risk is also related to education level, as a higher level of education enables better-positioned jobs (Hogendoorn et al., 2020; Malgaroli et al., 2017). Lower income and poorer socioeconomic status have been associated with higher levels of stress, which can negatively affect physical health (Sbarra and Whisman, 2022; Wolfe and Thomeer, 2020).

In addition to potential financial strains, couples may experience a loss of support, as common friends usually tend to take sides (Aeby and Van Hooff, 2019; Lampraki et al., 2019). So, for some people, divorce means a distancing from certain friendships, in-laws (Sarmadi and Khodabakhsi-Kooláee, 2023), and even neighbours in the case of moving (Amato, 2000). Furthermore, for many, the breakup implies the loss of their main source of support (Kolodziej and Przybyla, 2016; Shor et al., 2012), which is linked to feelings of loneliness and distress (Scheppingen and Leopold, 2020; Wright et al., 2020). However, some people may find a great deal of social support in other networks of friends and family members, which can help to cope more adequately with the divorce (Van Gasse and Mortelmans, 2020; Wilder, 2016). In addition, different studies have shown that when people establish a new relationship after the breakup, they experience great improvement in their wellbeing and better adjustment to divorce, alleviating its impact (Sbarra et al., 2014). Hence, social support plays an important role in post-divorce adjustment.

Moreover, when children are involved, ex-partners continue to share the responsibility of their children as co-parents, and they need to make contact and care arrangements. In cases of single custody, it can lead to an overload of responsibilities for the caregiver and a loss of contact with the child for the other parent (Leopold, 2018; Sander et al., 2020; Zineldin, 2019). Either situation can greatly increase the stress experienced by parents, likely affecting their health (Ferraro and Lucier-Greer, 2022). Taken together, we expect that people with a lower socioeconomic status, less social support from friends, family, or a new partner, and those without children will be at greater risk for post-divorce health problems.

4.2. Behavioural factors

For some people, divorce can lead to more unhealthy habits such as smoking, alcohol consumption, or lack of physical exercise (Bourassa et al., 2019; Kalmijn, 2017; Robles, 2014). Along the same lines, divorce has been linked to changes in weight. Although some people tend to gain weight, which, in part, may be related to the worsening of their lifestyle habits (Sharma, 2014), others tend to lose weight due to the stress of the divorce process (Leopold, 2018; Teachman, 2016). Hence, we anticipated that individuals with less healthy lifestyle habits, and people who are overweight or underweight, are expected to have more physical consequences post-divorce.

4.3. Sociodemographic characteristics of the participants

Finally, research on divorce has considered other factors such as the gender, age, and ethnicity of participants. First, previous findings on potential gender differences are controversial. On the one hand, women are more affected financially because of social structures. Even though women are currently better positioned in terms of education and employment, they still have more precarious conditions than men (Raley and Sweeney, 2020). Moreover, they tend to resume more household and childcare responsibilities, complicating the balance between family and work life (Kalmijn and Poortman, 2006; Parker et al., 2021). Consequently, they may experience more stress and health consequences after divorce (Sbarra and Whisman, 2022; Wolfe and Thomeer, 2020). On the other hand, men may be more affected by divorce in the long-term. For men, their partner is generally the main source of emotional support, so a divorce may involve the loss of this key resource, whereas women generally find more support from friends and/or family, and thus a way to cope with post-divorce distress (Kolodziej and Przybyla, 2016; Shor et al., 2012). Compared to women, men are also more likely to engage in unhealthy lifestyle behaviours after the breakup (Kalmijn, 2017; Robles, 2014; Salvatore et al., 2020), and in previous meta-analyses divorced men had a higher risk for more cardiovascular health problems (Wong et al., 2018) and mortality (Sbarra et al., 2011; Shor et al., 2012).

In terms of age, study findings are also contradictory. Divorce in later life may have a greater impact on physical health, as it may be less accepted and normalized due to the traditional conception of marriage and the greater taboo towards divorce among the older generations (Bronselaer et al., 2008). Also, older people may feel lonelier after divorce (Mudrazija et al., 2020; Tillburg et al., 2015). In contrast, some studies have reported greater distress among young divorcees (Leopold, 2018; Sander et al., 2020). This may be due to the idealised conception of marriage, so that divorce implies a break in the plans and desires for the future they have constructed. At the same time, young people are generally in a less stable economic position, which may deteriorate after the breakup (Mortelmans, 2020). Meta-analyses (Sbarra et al., 2011; Shor et al., 2012) also showed that younger people generally suffered from more health consequences in the first year after divorce. Due to these contradictory findings for gender and age, we did not formulate hypotheses regarding these moderators.

Finally, ethnic differences in relationship formation and dissolution trends have received some attention, although to a lesser extent. Based on research conducted in the United States, Black people are less likely to marry and more likely to divorce than White people. Hispanic people, especially Mexican Americans, have higher marriage rates, more positive attitudes toward marriage, and lower divorce rates (Smock and Schwartz, 2020). This suggests that both structural and cultural factors may play a role in differential marriage rates and outcomes for minorities. Both Black and Hispanic people tend to be in similar socioeconomic positions (Cuevas et al., 2020), but for Hispanic people the traditional perspective of marriage is culturally very important, and divorce is still less accepted (Cabrera et al., 2020). Therefore, it can be expected that Hispanic people are more affected than White or Black people in their health after divorce, due to greater emotional and financial stress (Padilla and Borrero, 2005).

5. Method

5.1. Search procedure

To select studies, we searched the electronic databases PsychINFO, Web of Science, the Educational Resources Information Centre, Google Scholar, and Océano. The literature search included all studies published before June 2023 that were written in English and available in peer-reviewed journals. Hence, we excluded all books, encyclopedia, and dissertations.

5.2. Selecting the studies

First, all studies had to include a group of divorced men and/or women and an equivalent group of married people. To identify such sources, we searched for the keywords: *divorc*, marital separation, marital dissolution, relationship dissolution, (parent* adj3 separat*), (couple* adj3 separat*), marital disruption, breakup, break-up*. Second, all studies had to include a physical health outcome, so we searched for artlces using the key words: *physical health, disease, illness*, diagnos*, health outcome*, self-reported health, morbidity, cancer, cardiovascular, blood pressure, pain, disab*, patholo*, ache, sick**, etc. We searched for keywords in titles, abstracts, and keywords of studies. The complete search strings can be found in Appendix A.

We included cross-sectional and longitudinal studies, as well as experimental and observational studies when they met the following criteria: 1) they involved at least one group of divorced or separated participants and a comparison group of married people; 2) they examined health differences between participants that were married or in a relationship and those that were divorced or separated; 3) they included physical health measures, either provided by the participant, another person close to the participant (subjective measures), or a health professional (objective measure). These latter data could be registered by health diagnosis, official records, and/or medical examinations; and 5) they reported the necessary statistics (odds ratios (OR), beta's (β), risk ratios (RR), confidence intervals (CI), and standard errors (SE), and the number of married/divorced participants) to calculate effect sizes. We excluded studies that: 1) examined risk factors for certain diseases (e.g., physical activity, tobacco and other substance consumption, stress, etc.), although we extracted these data as factors for moderatation, when studies measured a physical health outcome; 2) were non-empirical (e.g., literature reviews, meta-analyses); 3) used general wellbeing as a single measure (combining both mental and physical health); and 4) only focused on mortality. The process of selecting the studies is schematically depicted in Fig. 1. First, we removed duplicates from our search. Second.

we screened articles based on title and abstract by two coders, who showed a moderate interrater agreement rate $\kappa = 0.58$ (Cohen, 1960). Most of the disagreements were due to confusion related to the inclusion and exclusion of some pathologies or conditions that may or may not fall into any of the categories considered. After having analyzed the discrepancies, a common agreement was reached on the certain pathologies that should be included in each category. Third, we assessed full-text articles for eligibility based on their sample, measured concepts, and the provided statistics.

In a substantial number of cases, we had to email the author(s) for (additional) information. We contacted authors whose full-text article was not available but potentially should be included after reviewing the title and abstract. Also, we contacted the authors of studies that reported information about physical health outcomes without reporting the association with marital status, or studies that reported the ORs or RRs without associated confidence intervals. Some studies also lacked information about the total sample size and/or the number of participants who did not have the disease. Lastly, a couple studies used total scores of physical health including different outcomes recorded in the meta-analysis (e.g., physical pain, chronic conditions, etc.), so we requested the information for each outcome separately. If contact information was available, we contacted the first, second, and last author simultaneously. For 6.7% of these sources we were unable to find the correct contact information, or the author(s) had passed away. In total, we contacted the authors of $n = 120$ articles for either the full-text or additional information. Of those, 83.3% replied and were able to provide us with the necessary information, whereas 16.6% did not reply to our email or reminder.

5.3. Coding the data

The studies included in the meta-analysis are listed in the references, marked with an asterisk. In addition to coding study characteristics, we coded potential moderators (e.g., children, social support, cohabitation, healthy behaviors). 42.5% of the effect sizes were coded by two independent raters, and interrater reliability was substantial (Cohen's $\kappa = 0.72$; Cohen, 1960). Disagreements mainly involved the data reported in the studies on moderating factors. In many cases, articles reported data in different ways than our initial coding scheme (e.g., numbers instead of percentages, or income and education level in ranges, without specifying what was considered high/medium/low). After reviewing the discrepancies, agreement was reached on how to include the data and what cut-off points to set in cases of doubt. The coding scheme was aligned to those accommodations. There were no discrepancies regarding the coding of key outcomes.

5.4. Physical health

Physical health is understood as any disease, pathology, pain, condition, and/or impairment that a person can suffer. Both subjective measures (health and/or pain perception) and objective measures (diagnosis, records, and/or tests) were included. Physical health

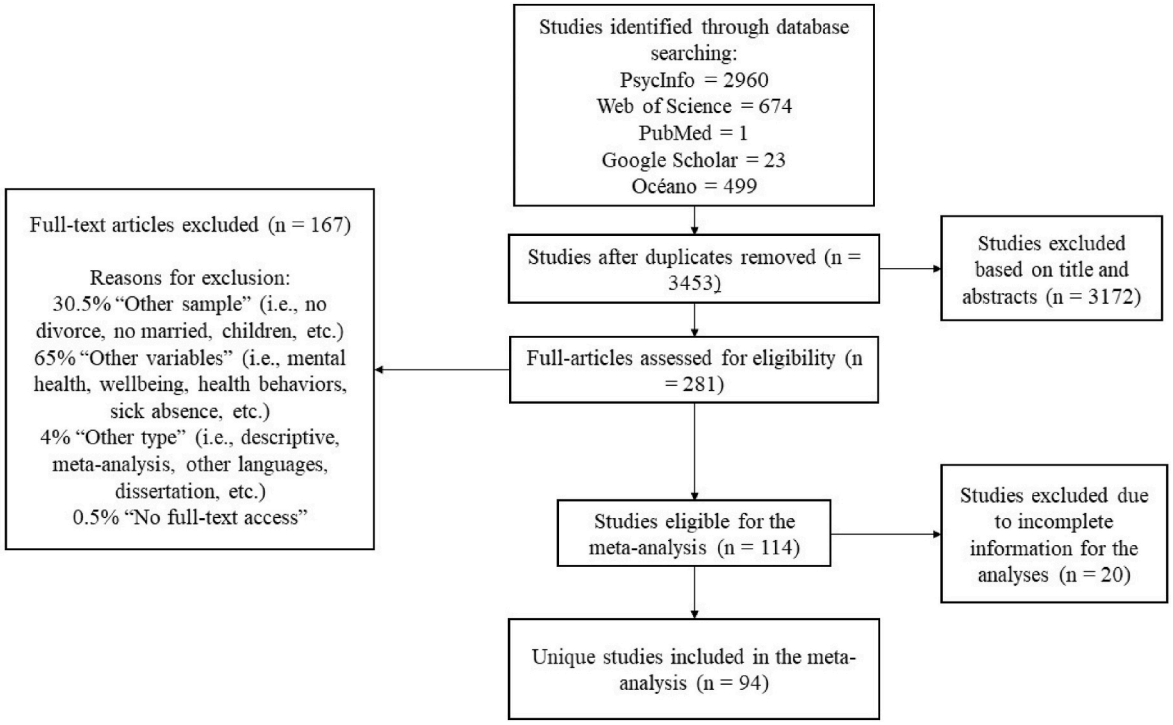

Fig. 1. Schematic representation of selecting the studies.

outcomes were divided into four categories: 1) *self-reported physical health*, which considers health as perceived by the participant or by a person close to the participant, on a Likert scale ranging from poor health to very good health; 2) *physical illnesses*, which included a) hypertension, b) hypercholesterolemia, c) diabetes, d) cancer, e) cancer progression, f) joint pathologies, g) cardiovascular diseases, h) cerebrovascular diseases, i) sexually transmitted diseases, and j) cognitive pathologies, such as dementia or Alzheimer's disease; 3) *physical symptomatology*, which included chronic conditions or illnesses, physical pain, somatic conditions into one sole category; and 4) *physical disability or limitation*, including any limitation in daily life activities due to physical functioning (e.g., difficulties in walking, dressing, showering, etc.), and also visual and/or hearing impairment.

5.5. Description of studies included in the analysis

The present meta-analysis included $k = 94$ studies from which $u = 248$ effect sizes were extracted. The key study characteristics can be found in Appendix B. To assess physical health outcomes, 57% of the studies included self-reported and proxy-reported questionnaires regarding health status, chronic conditions, or pain outcomes, 30% obtained information from records or assessment by healthcare professionals, and 13% used (medical) tests, such as blood tests, blood pressure measurement, or glucose testing. 69% of the studies included an adjusted model, and 31% included unadjusted models. Cross-sectional (51%), longitudinal (44%) studies, and case-control studies (5%) were included. In total, our analyses included 1,384,507 participants (44% men), with an average age of 55 years old. Of these participants, 68% were White, 61% had a minimum education level (high school or higher), 62% were employed, and 75% had children. The studies were published between 1976 and 2023 and were conducted in the United States (49%), Europe (35%), Asia (10%), Africa (3.7%), Australia (2.2%), and South America (0.4%). 74% of the studies recruited participants from community samples and 26% from clinical contexts, such as hospitals or other health care centres.

5.6. Effect size information

OR was chosen as the effect size since it represents the odds that an outcome (e.g., disease or disorder) will occur given a particular exposure (e.g., divorce), compared to the odds of the outcome occurring in the absence of that exposure. The 95% Confidence Interval (CI) is used to estimate the precision of the OR. A large 95% CI indicates a low level of precision of the OR, whereas a small CI indicates a higher precision of the OR (Szumilas, 2010). For studies that provided estimates based on different multivariate models, we prioritized the unadjusted models or those with the fewest covariates, in order to optimize comparison. If a study reported analyses for separate groups due to characteristics of the participants (i.e., men and women, White and Black people, young and middle-aged participants, manual and non-manual workers), and contextual factors (i.e., rural and urban, West and East Germany) those were treated as different samples within that study. Finally, we only included data in which the divorce occurred before the physical health measure was administered. More detailed information on the effect sizes and their registration can be found in Appendix C.

5.7. Main analyses

The analyses for this meta-analysis were carried out using the software environment R (version 4.2.2.; R Core Team, 2022), and the Metafor R package (Viechtbauer, 2010). Most studies reported more than one physical health outcome in relation to divorce. Consequently, multiple effect sizes could be extracted from one primary study. First, the effect sizes were calculated for the different health categories separately and the Odds Ratio were converted to log Odds Ratio to apply the normal distribution for statistical testing and estimation of confidence intervals. We then converted these log odds back to their original measures to facilitate interpretation. For each health outcome, we used a two-level random effects model (DerSimonian and Laird, 1986; Konstantopoulos, 2011). This method was selected because of the expected high degree of heterogeneity based on the differences in characteristics and cultural backgrounds regarding marriage and divorce across the included studies and the high variation between the measures used to assess physical health conditions. This method includes, apart from the variance within studies due to random sampling error, the variability between studies, which represents the deviation of each study from the mean effect size. For each outcome, heterogeneity was tested using the Cochran Q statistic, with a $p < 0.01$ indicating that there is heterogeneity (Cochran, 1954), and quantified with the I-squared (I^2) statistic, which describes the variation in the effect size attributable to the heterogeneity across studies. In this case, values of <25%, 25–75%, and >75% indicate low, moderate, and high degrees of heterogeneity, respectively (Higgins and Thompson, 2002).

Second, we calculated an overall effect size that pooled all the health conditions, using a three-level meta-analysis. Three-level meta-analytic models allow, in addition to random sampling variance (level 1) and the between-study variance (level 3), to measure variance between effect sizes from the same study or within-study variance (level 2) (Assink and Wibbelink, 2016). This approach improves upon previous methods, such as randomly selecting one effect size from each study, averaging multiple effect sizes, or simply ignoring the within-study dependency, can potentially bias the results (Cheung and Chan, 2008).

To determine whether the within-study (level 2) and between-study (level 3) variance were significant, two separate log-likelihood-ratio tests were performed. These analyses allow us to determine whether accounting for within-study variance in the meta-analytic model is necessary. In the first, the fit of the original model, in which the variance at both level 2 and 3 are freely estimated, was compared to the fit of a model in which only the variance at level 3 was freely estimated (variance at level 2 was manually fixed to zero). The same was done for the between-study variance, but in this case only the variance at level 2 was freely estimated whereas variance at level 3 was manually fixed to zero. In both cases, if the within- and/or between-study variance was smaller than zero (the null hypothesis was rejected), then the fit of the three-level model is statistically better than the two-level model, indicating that there is a significant variability within and/or between studies. In case the null hypothesis is accepted (i.e., the two-level model is a better fit), we would choose to work with the two-level model, as it would not make sense to consider between- and within-study variability in such depth. If it is demonstrated that there is a need to consider this variability within and between studies, moderator analyses can determine which variables may explain this variance (Assink and Wibbelink, 2016).

5.8. Moderator analyses

Third, moderator analyses were conducted for overall health to test which factors explain the heterogeneity of study findings. Specifically, moderators related to sociodemographic characteristics of the participants: 1) average age, 2) gender (% of male), 3) socioeconomic factors (% of people with minimum education level, average household income (per year) and % of people with low household income, % of employed participants), 4) social outcomes (% of people with social support, % of people living with others, % of people with children), and 5) behavioural factors (% of smokers, % of people with high alcohol consumption, % of people who usually do physical exercise, % of underweighted and overweighed people). We also evaluated methodology-related moderators: 1) sample size; 2) type of measures (objective measures, self-reported measures, ad hoc scales, and/or Records); 3) year of publication; and 4) the place where the study was conducted (USA, Canada, Australia, Saudi Arabia, Iran, and some European, South American, and Asian countries).

All moderators were first tested separately (Van den Noortgate et al., 2015). Moderators were added to the overall model and an omnibus chi-square test showed if the regression coefficient was statistically different from zero. Next, a multiple moderator analysis was performed only including the moderators that were significant in the univariate models (Hox, 2010). In many cases, these variables are interrelated, which leads to a multicollinearity in the analysis. Therefore, it can be relevant to examine multiple moderators simultaneously after having tested the (potential) effects separately in a univariate model (Assink and Wibbelink, 2016; Vu et al., 2016; Van Eldik et al., 2020).

5.9. Analysis of bias

To avoid bias, we aimed to include as many primary studies as possible regarding divorce and physical health. Also, we assessed potential publication bias. First, a funnel plot (Fig. 2) was constructed to study the distribution of studies according to effect size. The funnel plot appears symmetrical, indicating no publication bias. Second, the Egger's test (Egger et al., 1997) was performed, showing a non-significant result (t = 0.896, p = 0.371), also pointing towards no bias (Higgins and Green, 2011).

6. Results

6.1. Effect sizes for specific pathologies

The estimated effect size for each physical health outcome separately can be found in Table 1. When compared to married people, divorcees were significantly more likely to show lower levels of self-reported health, experience more physical symptoms, and have a higher risk for diabetes, joint pathologies, cardiovascular and cerebrovascular conditions, and sexually transmitted diseases. According to certain rules of thumb (Cohen, 1988; Chen et al., 2010), the ORs ranging from 1 to 3 are of small effect size. Yet, when considering the largest OR, divorced people are more than twice as likely to suffer from a sexually transmitted disease, which is quite a substantial risk in daily life. Moreover, divorcees and married people did not differ in the risk of hypertension, cancer or cancer development, hypercholesterolemia and disabilities or physical limitations, or cognitive pathologies.

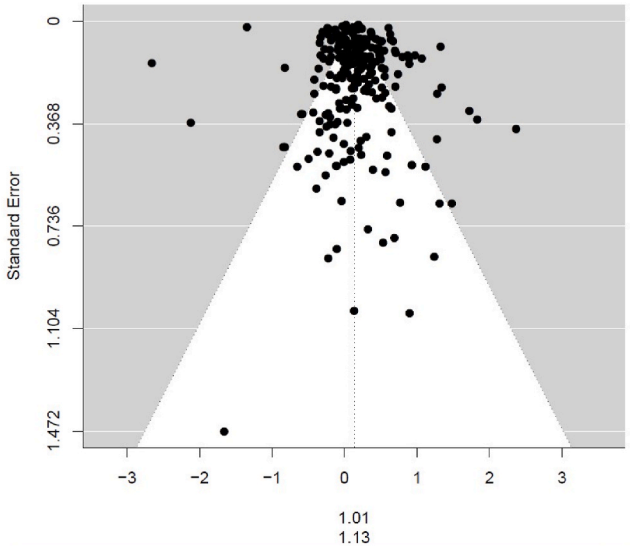

Fig. 2. Funnel plot to visually inspect publication bias.
Note. OR = 1.13; log OR = 1.01.

6.2. Overall effect size

The estimated overall effect of divorce in physical health across all studies was OR = 1.14, 95%CI [0.85 to 1.54], p = 00.378. Hence, when aggregating all the outcomes, divorced people did not have a higher risk of health problems than their married counterparts.

The forest plot (see Appendix D) reflects the distribution of effect sizes across studies. After conducting the three-level meta-analysis, a large variability could be observed both between- ($\sigma^2_{level2} = 0.331$) and within-studies ($\sigma^2_{level3} = 0.134$), with p-values <00.001. This means that effect sizes both regarding each study separately and when comparing the different studies exhibited great variation. We also examined how the total variance is distributed over the three levels of the meta-analytic model. Around 71% of the total variance can be attributed to differences in effect sizes within the same study (level 2) and around 29% could be attributed to differences between studies (level 3). The rest of the variance (<1%) could be attributed to random sampling variability (level 1). Having established that a substantial amount of variability can be attributed to both within- and between-study differences in effect sizes, moderator analyses may be relevant to test which variables influence these results.

6.3. Moderator analyses

6.3.1. Socioeconomic factors

As depicted in Table 2, among the sociodemographic factors, results showed that divorcees who had not completed high school or those who were unemployed had a higher risk for physical health problems after divorce. The same applied to childless people. Divorcees' income, social support, and cohabitation did not moderate the association between divorce and health outcomes.

6.3.2. Behavioural factors

Regarding behavioural factors, alcohol consumption, lack of physical exercise, and being overweight were significantly associated with a higher risk of physical pathologies among divorced people compared to their married counterparts. Smoking and being underweight did not significantly moderate the association between divorce and physical health.

6.3.3. Sociodemographic characteristics of the participants

Regarding sociodemographic characteristics, gender was the only factor that significantly moderated health problems in divorcees. More specifically, the difference in physical health between divorcees and married individuals was larger for women compared to men. Age and ethnicity did not significantly moderate the association between divorce and physical health.

6.3.4. Methodological factors

Finally, no methodological factors (i.e., sample size, study site, and type of measurement used) significantly moderated the association between divorce and physical health.

6.4. Multivariate moderator analyses

In addition to univariate moderation test, we conducted multivariate analyses with those moderators shown to be significant. As the R package does not allow for multivariate analyses including more than four moderators, we ran two multivariate models, grouping the moderators based on whether they belonged to socioeconomic or behavioural factors. Gender was considered in both groups, as it has been related to both types of factors. Because gender differences can be explained by multiple factors, it was included in both multivariate models. The first model contained the significant socioeconomic factors: Education, employment, presence of children, and gender. The second model contained the significant behavioural or lifestyle-related factors:

Table 1
Effect sizes for each pathology.

Outcome	Number of studies	Number of effect sizes	Pooled odds ratio (95%CI)	p-value	Heterogeneity	
					I^2	p-value
Self-reported health	24	44	1.20 (1.08–1.33)	<0.001	97.96%	<0.001
Physical symptoms	23	36	1.34 (1.17–1.53)	<0.001	96.09%	<0.001
Hypertension	19	30	1.06 (0.90–1.25)	0.467	94.54%	<0.001
Diabetes	21	29	1.18 (1.05–1.33)	0.006	80.49%	<0.001
Hypercholesterolemia	4	6	0.83 (0.60–1.15)	0.264	89.86%	<0.001
Cancer	8	10	0.83 (0.44–1.56)	0.569	99.37%	<0.001
Cancer development	3	3	1.13 (0.89–1.45)	0.314	94.33%	<0.001
Joint pathologies	4	6	1.24 (1.14–1.34)	<0.001	15.23%	0.325
Cardiovascular conditions	16	23	1.24 (1.09–1.41)	<0.001	81.64%	<0.001
Cerebrovascular conditions	8	13	1.31 (1.14–1.51)	<0.001	27.31%	0.184
Disabilities	17	22	1.15 (0.93–1.43)	0.201	98.58%	<0.001
Cognitive pathologies	11	20	1.11 (0.99–1.26)	0.081	83.07%	<0.001
STDs	3	6	2.48 (1.32–4.64)	0.005	50.84%	0.595

Note. Disabilities = Physical disabilities and limitations; STDs = Sexually Transmitted Diseases.

Table 2
Moderator analyses.

Moderator	F-statistic	B	p-value
Socioeconomic factors			
Education level	F(1,103) = 9.864	−0.007	0.002
Employment	F(1,50) = 20.060	−0.015	<0.001
Income	F(1,28) = 1.020	0.008	0.321
Social support	F(1,10) = 0.110	−0.002	0.747
Cohabitation	F(1,35) = 0.902	0.004	0.349
Children	F(1,33) = 8.025	−0.011	0.008
Behavioural factors			
Smoker	F(1,89) = 1.816	−0.003	0.181
Alcohol	F(1,57) = 47.319	0.032	<0.001
Excercise	F(1,44) = 28.525	−0.032	<0.001
Overweight	F(1,52) = 25.345	0.009	<0.001
Underweight	F(1,12) = 0.343	0.006	0.569
Sociodemographic characteristics			
Age	F(1,212) = 0.102	0.001	0.749
Gender	F(1,230) = 26.870	−0.002	<0.001
Ethnicity	F(1,94) = 0.007	−0.000	0.933
Methodological factors			
Sample size	F(1,246) = 3.772	−0.000	0.053
Place of study	F(1,246) = 3.273	0.052	0.072
Type of measures			
Ad hoc scale	F(1,246) = 0.832	−0.104	0.363
Records	F(1,246) = 0.605	−0.071	0.437
Self-reported/Proxy	F(1,246) = 0.020	0.012	0.888
Tests	F(1,246) = 0.023	0.019	0.881

Note. Reference Categories (=0) were: men, White people, minimum education level, employed people, low income, people with social support, people who cohabit, having children, people who smoke, people with a high alcohol consumption, people who practice high amount of physical exercise, overweight people, underweight people.

Alcohol consumption, physical exercise, overweight, and gender. The results of the multivariate analyses are presented in Table 3. They reveal that in both models none of the separate moderators were significant when entered jointly.

Table 3
Multiple moderator analyses.

Moderator	F-statistic	B
Sociodemographic characteristics	F(4,1) = 4.999	
Gender		0.006
Education		−0.023
Children		0.032
Employment		−0.016
Behavioral factors	F(3,8) = 1.077	
Gender		−0.004
Alcohol		0.035
Exercise		0.000
Overweight		−0.068

7. Discussion

Divorce can be considered a major interpersonal stressor in people's lives, which may have consequences not only for mental health (Ferraro and Lucier-Greer, 2022), but also physical health (Leopold, 2018; Kiecolt-Glaser, 2018; Zineldin, 2019). Although many divorced individuals seek out primary care for physical health problems (Bronselaer et al., 2008), knowledge on the health risk of divorce, both in general and for various specific pathologies, has been lacking.

The findings of our three-level meta-analyses showed an increased risk in divorcees for about half of the pathologies that were examined. When all pathologies were taken together (i.e., aggregating all pathologies), divorcees did not significantly differ from married people in their overall physical health. The moderator analyses revealed that being a female, having a low education level, being unemployed, being childless, consuming alcohol frequently, exercising infrequenstly, and being overweight increased the risk for physical health problems after divorce.

7.1. Divorce and specific physical health pathologies

Overall, the findings showed an increased risk for seven out of thirteen recorded pathologies in divorcees. In line with previous studies, divorcees had lower self-reported health (Sbarra, 2015) and experienced more physical symptoms, such as physical pain and chronic conditions, compared to married individuals (Choi et al., 2017; Pozo-Rosich, 2012; Sjøgren et al., 2009). After divorce, people tend to experience a decrease in life satisfaction and an increase in stress, which may lead to a poorer perception of their own physical health (Sbarra et al., 2015) and more symptoms, such as headaches, gastrointestinal problems, or muscle aches and pains (Slatcher and Seluck, 2017; Whisman et al., 2016).

Divorcees also had an increased risk for cardiovascular and cerebrovascular conditions, that among others include myocardial infarction and stroke (Slatcher and Seluck, 2017). This is in line with consistent findings on the association between the cardiovascular system and stress. Stress puts people into a state of alertness, which pushes the heart to work harder, thus increasing its vulnerability and the risk of related diseases (O'Connor et al., 2021). Moreover, these conditions have consistently been linked to poor lifestyle habits, which may be likely after divorce (Wong et al., 2018).

In addition, divorce seems to increase the risk of diabetes (Ramezankhani et al., 2019) and joint pathologies, such as arthritis and arthrosis (Mili et al., 2002; Shih et al., 2006). It has been shown that stressful situations can affect the immune system, by causing inflammation in the body. Both diabetes and joint diseases are considered autoimmune conditions, which appear as a response to body inflammation (Nedunchezhiyan et al., 2022; Rohm et al., 2022). In line with

previous findings, diabetes has also been linked to a higher probability of suffering from cardiovascular diseases (Wong et al., 2018).

Finally, our findings marked sexually transmitted diseases as a particular post-divorce hazard, since divorced people were more than twice as likely to suffer from them compared to married individuals (Idso, 2009; Smith et al., 2020). This finding may be explained by divorcees having more sexual partners and thus more exposure to sexual transmitted diseases in the first place. This increased exposure might also be due to divorcees' engagement in more risky behaviors, including (unprotected) sexual activities, compared to married individuals. Additionally, divorcees may suffer from a detoriated immune system in case of chronic or acute stress (Scheidell et al., 2020), making them more vulnerable for getting infected by a sexually transmitted disease.

We found no significant differences between divorced and married people in hypertension, hypercholesterolemia, cancer and cancer development, disabilities, and cognitive pathologies. Although these conditions could be triggered by divorce-related stress, other factors may be more important, such as pesticides, certain biomarkers, or the living habits of family members or close people (Cigan et al., 2023; Engman and Cranford, 2016; Febriani, 2018), genetics (Martínez-Jiménez et al., 2020; Vrablik et al., 2020), and a history of other physical and psychological pathologies (Dafsari and Jessen, 2020; Kodera et al., 2023), or ageing (Gonzales et al., 2022). Thus, these other factors may outweigh the potential effects of divorce-related stress.

We found that the risk for certain post-divorce pathologies varies among individuals. This is in line with the moderate to substantial heterogeneity in effect sizes of all pathologies studied, except joint pathologies and cerebrovascular conditions. This heterogeneity might be due to the many factors affecting the potential impact of divorce on physical health. That is, the circumstances surrounding the divorce (Krumei et al., 2007; Sbarra and Whisman, 2022; Wilder, 2016), as well as certain socioeconomic, behavioural, and personal characteristics are important. Yet, there were too few studies available to conduct moderation analyses for all the different pathologies. We did however examine such influential factors for overall physical health problems.

7.2. Divorce and overall physical health problems

Compared to married individuals, divorced people did not significantly differ in overall health problems. This may be due to their increased risk of suffering from certain pathologies, but not others. Indeed, only for approximately half of the recorded diseases were divorced people at increased risk. This emphasizes the need to differentiate between different pathologies. Three pathways can help explain why and how divorce can constitute a risk for physical health: Reduced financial and social resources, risky behavior and unhealthy lifestyle, and (interpersonal) stressors after divorce (Sbarra et al., 2011).

7.3. Moderators

7.3.1. Socioeconomic factors

First, we found that lower education level and unemployment put people at risk for more adverse health after divorce. A lack of education relates to less access to well-paid jobs, and thus greater financial difficulties (Malgaroli et al., 2017). Hence, elevated stress due to financial struggles might explain the increased health risks for lower educated and unemployed people after divorce.

Contrary to what we expected, people *without* children had a higher risk of post-divorce physical health problems. Although co-parenting after divorce can pose various challenges and is considered stressful (Leopold, 2018; Sander et al., 2020; Zineldin, 2019), children may also be an incentive to recover from the impact of divorce. Focusing on the care and wellbeing of children may force parents to put their own distress aside. Childless divorcees, however, may experience higher levels of loneliness (Penning et al., 2022), increasing their risk of certain health problems. Future research is needed to examine such differences more thoroughly.

Social support was not a significant moderator, but this may be explained by the lack of studies (7%) that considered this factor. A different explanation could be that we focused on the quantity of the support network, rather than the quality of relationships. That is, the impact of the social network in the divorce process is not only dependent on the number of social ties, but also on its quality (Kolodziej and Przybyla, 2016).

7.3.2. Behavioral factors

Second, as expected, heavy alcohol consumption, a lack of physical exercise, and being overweight all increased divorcees' risk for physical health problems. Research has shown that divorced people sometimes try to alleviate divorce-related stress by developing unhealthy habits such as alcohol consumption (Shor et al., 2012; Stack, 2021). Also, having a partner generally encourages more healthy lifestyle habits, such as physical exercise. It is common for people to abandon these beneficial behaviors after a break-up (Bourassa et al., 2019). The current meta-analysis emphasizes that such behavioral patterns can increase their risk of post-divorce health problems.

For tobacco use and being underweight the moderation results were not significant, but only a small number of studies included information on whether people were underweight. Despite evidence that smoking is directly related to health (Bourassa et al., 2019), most studies only measured whether people smoked or not, rather than considering the amount of cigarettes individuals typically smoked (Pisinger and Godtfredsen, 2007), when they started smoking (Xue et al., 2011), or the type of tobacco they used (Blot et al., 2011; Sahu et al., 2023). These factors may be more important to the development of physical health problems.

7.3.3. Sociodemographic characteristics of the participants

Finally, the risk of health problems after divorce was greater for women compared to men. This is in line with the idea that the existing social structures still promote gender patterns whereby men are better positioned economically and have better access to well-paid jobs, such that women may experience greater financial stress after divorce (Kreyenfeld and Trappe, 2020). Also, women generally assume a higher load of responsibilities related to daily childcare and the household compared to men (Shor et al., 2012), making it more difficult to find work-family balance (Van den Eynde et al., 2019).

Conversely, ethnicity and age were not significant moderators. Although some studies have reported differences in the impact of divorce depending on age (Bronselaer et al., 2008; Steptoe et al., 2013; Tillburg et al., 2015), the results have been mixed. Thus, the lack of significance of this moderator was not surprising. Regarding ethnicity, the majority of participants in the included studies were White and mostly from Western countries, likely resulting in a too homogeneous a sample to examine ethnicity as a moderator. This also means that the sociodemographic and socioeconomic conditions were probably quite similar. Since it has been shown that social, cultural, and financial factors play a role in the differential impact of stress and divorce (Cuevas et al., 2020; Mattos dos Santos, 2020; Padilla and Borrero, 2005), future research on post-divorce physical health should include more ethnically diverse samples.

7.4. Strengths and limitations

This study should be considered in light of its limitations. First, the vast majority of people with adjustment difficulties in the divorce process, and who suffer the most health consequences, come from conflictual divorces (Mason and Sbarra, 2013; Hald et al., 2019; Sander et al., 2020). We could not examine conflict as a moderator due to a lack of information on potential conflicts in the included studies, which often did not focus on divorce specifically, but rather considered it as one risk factor among others for the incidence or development of certain

pathologies. The same applies for the time elapsed after divorce, as the risk for certain pathologies due to divorce-related stress may vary across time (Malgaroli et al., 2017; Pudrovska and Carr, 2008).

Second, although the results indicate that divorced people tend to be at higher risk of certain pathologies, we cannot draw causal conclusions from our research. For instance, people with poor physical health are also more likely to divorce (Brüggmann, 2023; Sbarra and Whisman, 2022). We therefore encourage future research to consider people's physical health longitudinally (i.e., before and after divorce) and include pre-existing health conditions as a potential moderator.

Third, there is a great overlap in psychological and physical symptoms in primary care (Fillingim et al., 2020). For example, people with anxiety and depression also tend to experience physical symptoms (Suls and Howren, 2012). Thus, future research can also consider the incidence of psychological pathologies in people attending these services for physical complaints, and vice versa.

Despite these limitations, this is the first meta-analysis to examine the associations between divorce and both general physical health and specific diseases. Through combining data from different sources, samples, and methods, our conclusions are considered more robust compared to single empirical studies. In addition, our focus on various specific pathologies offers a more detailed picture of the potential impact of divorce on individuals' physical health. Moreover, a great set of potential moderators was included, which quantifies the complexity and multifactorial character of divorce and helps unravel the differential impact divorce may have on individuals' the physical health (Krumei et al., 2007; Wilder, 2016). By using a three-level meta-analysis methodology, we were also able to make full use of the data available, compared to more traditional meta-analytic methodologies (Assink and Wibbelink, 2016).

8. Conclusion and study implications

The current meta-analysis has important implications for future research and clinical practice. Overall, divorcees appear to be at heightened risk of various pathologies, with sexually transmitted diseases as a particular post-divorce hazard. These findings call for more awareness among counsellors and physicians on divorcees' specific health conditions. This meta-analysis also suggests that divorce is a risk factor that needs more in-depth studies considering these specific pathologies, especially with more longitudinal designs and more diverse samples regarding sociodemographic and cultural characteristics.

By identifying multiple factors place divorcees at increased risk of health problems, the current meta-analysis supports the conclusion that divorce is a complex and multifactorial phenomenon. Its potential impact depends on various personal, socioeconomic, and behavioral factors. More specifically, the findings encourage researchers and health professionals to pay close attention to factors that make divorcees more vulnerable to health problems, such as being female, unemployed, childless, or having a lower education level. Intervention and prevention efforts aimed at reducing heavy drinking and encouraging physical exercise in divorcees may prove worthwhile and should be considered in future research and clinical practice.

Statement

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CRediT authorship contribution statement

Inés Pellón-Elexpuru: Writing – original draft, Methodology, Formal analysis, Data curation, Conceptualization. **Rianne Van Dijk:** Writing – review & editing, Validation, Supervision, Methodology. **Inge Van der Valk:** Writing – review & editing, Validation, Supervision, Methodology. **Ana Martínez-Pampliega:** Writing – review & editing, Validation, Supervision, Conceptualization. **Asier Molleda:** Methodology. **Susana Cormenzana:** Writing – review & editing, Validation, Supervision, Conceptualization.

Data availability

Data will be made available on request.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.socscimed.2024.117005.

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