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How to cite

JOLIDON, Vladimir Ernest et al. Lack of social support, gender and colorectal cancer screening participation across Europe: How do screening programmes mitigate the effect of social support for men and women? In: Sociology of health & illness, 2024, p. 1467–9566.13791. doi: 10.1111/1467-9566.13791

This publication URL: https://archive-ouverte.unige.ch/unige:177186

Publication DOI: 10.1111/1467-9566.13791

Received: 2 February 2023 | Accepted: 16 April 2024

DOI: 10.1111/1467-9566.13791

ORIGINAL ARTICLE

SOCIOLOGY OF HEALTH & ILLNESS

Lack of social support, gender and colorectal cancer screening participation across Europe: How do screening programmes mitigate the effect of social support for men and women?

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Funding information
Fonds Wetenschappelijk Onderzoek, Grant/Award Number: FWOOPR2018005701; Schweizerischer Nationalfonds zur Förderung der Wissenschaftlichen Forschung, Grant/Award Number: 176115

Abstract

This study investigates how a lack of social support differentially affects men and women's colorectal cancer (CRC) screening participation, considering different screening strategies implemented across European countries. Although health sociology has stressed gender differences in social support and its effects on health behaviours, this was overlooked by cancer screening research. Using a data set of 65,961 women and 55,602 men in 31 European countries, we analysed the effect of social support variables on CRC screening uptake. We found that living alone and lower perceived social support were associated with lower screening uptake for both men and women. These effects were, however, stronger among men. Population-based screening programmes mitigated these effects, particularly for women, but not for men living alone. In countries with opportunistic screening programmes, social support variables remained associated with screening uptake. We conclude that cancer screening

interventions should pay attention to social support and its gender-differentiated effects.

KEYWORDS
colonoscopy, faecal occult blood test, gender, living alone, opportunistic screening, organised population-based screening programme, perceived social support

INTRODUCTION

In 2020 in Europe, colorectal cancer (CRC) was the second most commonly diagnosed cancer in women and the third in men; it was the third leading cause of cancer deaths in women and the second in men (ECIS, 2020). However, CRC is preventable, not only by primary prevention, for example, healthy lifestyle, but also by screening and early detection which facilitate early colorectal adenoma removal, and treatment of early-stage malignant tumours (Brenner et al., 2014). Specifically, faecal occult blood test (FOBT) and lower gastrointestinal endoscopy were shown to importantly reduce CRC incidence and mortality, and to be cost-effective when implemented in screening programmes (Armaroli et al., 2015; Brenner et al., 2014; Gini et al., 2020; Lin et al., 2021; Ran et al., 2019). Based on this epidemiological evidence, the Council of the European Union has recommended that Member States implement population-based CRC programmes to systematically invite men and women aged 50–74 for screening (Council of the European Union, 2003).

CRC screening programmes have contributed to reducing CRC incidence and mortality, particularly in European countries with long-standing programmes (Cardoso et al., 2021). However, across Europe, some countries have implemented nationwide programmes covering the entire screening-eligible population; other countries have only implemented regional or pilot programmes or have not completed their programme rollout, and thus partially covered the target population; and others did not implement CRC programmes at all (IARC, 2017). This heterogeneity in screening implementation is reflected in differences in CRC screening uptake levels as well as in CRC burden across European countries (Cardoso et al., 2021).

In the context of ageing societies with increasing proportions of people living alone (Esteve et al., 2020), it is particularly relevant to examine how a lack of individual social support affects the CRC screening uptake of 50 to 74 year-old men and women to whom CRC screening has been recommended. As new screening technologies are implemented, older men and women affected by social disconnectedness or isolation may be at risk of "lagging behind" and less prone to adopt innovative preventive practices (Wang et al., 2010). However, research has focused on socioeconomic and demographic inequalities in CRC screening, such as education, age and gender (Fedewa et al., 2015; Willems & Bracke, 2018; Wools et al., 2016), and less attention has been paid to the role of social support. It should be stressed that social support is a crucial resource for health status and behaviours, which has been shown to affect health-care services and cancer screening use (Documet et al., 2015; Han et al., 2019; Messina et al., 2004; Takahashi & Nakao, 2021; Vozikaki et al., 2017). Additionally, social epidemiology and health sociology have highlighted differences in the way men and women build and rely on social support which, in turn, may have a different influence on their health status and behaviours

(Fuhrer & Stansfeld, 2002; Gallant, 2013). It is thus essential to consider gender differences in the role of social support in CRC screening uptake.

Cross-national research studies have suggested that cancer screening programmes may reduce socioeconomic inequalities in screening uptake since these programmes improve access by inviting all eligible individuals for screening (Palencia et al., 2010; Walsh et al., 2011; Willems & Bracke, 2018). However, studies have focused on socioeconomic inequalities and neglected screening inequalities shaped by differences in social support. Thus, the role of social support in screening programme contexts deserves to be further scrutinised as it may affect the effectiveness of cancer screening interventions. This is important since CRC incidence and mortality were found to be higher among individuals with lower social support (Coughlin, 2020; Ikeda et al., 2013; Pinquart & Duberstein, 2010). Consequently, if individuals who lack social support participate less in screening programmes, these programmes may reproduce inequalities in CRC outcomes.

In sum, to address the research gap, the present study examines the effect of individual social support on CRC screening uptake and its differentiated role in men and women, across 31 European countries that have implemented different (or no) CRC screening strategies.

BACKGROUND

Since CRC screening is population-based, that is, medical guidelines recommend it to all individuals aged 50–74, it is particularly relevant to investigate the role of social support in CRC screening uptake within this population using representative survey data. The recommendation of CRC screening to both men and women also provides an opportunity for gender analysis and comparison. Although some studies in public health have assessed the effect of social support on CRC screening uptake (Dominic et al., 2020; Dong & Liu, 2017; Khani Jeihooni et al., 2017; Kinney et al., 2005; Rogers et al., 2017; Takahashi & Nakao, 2021), these have been limited in terms of geographic scope, sample sizes or a focus on specific ethnic groups. Moreover, they have not addressed gender differences in the effect of social support on CRC screening uptake. In health sociology, research studies have examined different aspects of medical screening, including interactional and decision-making processes during consultations, individuals' perceptions and experiences with screening, and the knowledge production around screening (Armstrong & Eborall, 2012), as well as inequalities in cancer screening participation (Jolidon et al., 2021; Link et al., 1998; Missinne, 2015; Willems et al., 2020; Zapata-Moya et al., 2019, 2023). Nevertheless, no survey-based study has examined the effect of social support on screening participation with a gender comparison, despite qualitative research underscoring the crucial role of social support for screening uptake (Dobson et al., 2018; Hunleth et al., 2016; Mojica et al., 2023; Palmer et al., 2014).

Social support and preventive health-care uptake

Health sociology and psychology research studies have evidenced that the social support provided by social relationships can have a direct effect on various health behaviours (Cohen, 2004; Gallant, 2013; Potts et al., 1992; Thoits, 2011). Studies have shown that social support may promote cancer screening participation (Cadet et al., 2021; Documet et al., 2015; Han et al., 2019; Jensen et al., 2016; Messina et al., 2004; Rondet et al., 2013; Sarma, 2015; Stafford

et al., 2018; Vozikaki et al., 2017). However, cancer screening research has predominantly focused on socioeconomic and demographic determinants (Mosquera et al., 2020; Willems & Bracke, 2018; Wools et al., 2016). In their seminal article, Link and Phelan (1995) not only pointed out socioeconomic resources as a "fundamental cause" of health inequalities, but also stressed the importance of "interpersonal resources embodied in the concepts of social support and social network" (1995, p. 5).

Social support was defined as the perception or experience of being cared for, esteemed, and integrated in a supportive network, and it may facilitate participation in preventive health services (Gallant, 2013). Partners, family members and friends can offer tangible support to access health care, as well as encouragement to undertake screening. More interactions and discussions with others may influence screening behaviours through informational and emotional support (Ashida et al., 2010; Keating et al., 2011; Kelsey et al., 2000). Social support also increases individual self-efficacy which in turn may mitigate barriers to cancer screening uptake, including the fear of screening procedures (von Wagner et al., 2011). For example, the prospect of being accompanied when obtaining test results may reduce concerns with medical check-up and screening (Hoebel et al., 2014). Intimate relationships are particularly important for health and health behaviours (Pietromonaco et al., 2013; Uchino et al., 1996) and can directly affect preventive health uptake (Gram et al., 2021; Han et al., 2019; Hanske et al., 2016; Hughes & Waite, 2002; Lund et al., 2002; Manjer et al., 2015; Missinne et al., 2013; van Jaarsveld et al., 2006). Cohabiting partners or spouses may encourage each other's health-promoting behaviours, and their shared psychosocial and economic resources (a buffer against stressful events and financial difficulties) facilitate health-care access and use. Such health benefits were also interpreted as a result of the health-related social control provided by a (marital) partner—which tends to favour men's health, as explained in the next section (August & Sorkin, 2010; Umberson, 1992).

While having a (marital) partner and social support can be beneficial for health behaviours, those who live alone or lack social support may not benefit from such daily mutual support and resources. They may be at higher risk of social isolation and delaying or avoiding the use of preventive health-care services (Vozikaki et al., 2017). Importantly, our study considers the effects of both living alone (an individual's actual situation) and the subjective experience of (perceived) social support on CRC screening uptake. These factors are not necessarily correlated and may have independent effects on health and health behaviours (Cornwell & Waite, 2009; Sakurai et al., 2019). Hence, these should be accounted for and assessed jointly. Finally, research showed that *perceived* social support was more robustly associated with health than (actually) *received* support (Thoits, 2011; Uchino, 2009). That is, perceived support was found to have positive psychological effects, such as self-control, self-efficacy and proactive coping, which in turn may enhance health behaviours (Uchino, 2009). For example, perceived social support was shown to be associated with influenza vaccination (Ernsting et al., 2015), and cervical and breast cancer screening uptake (Documet et al., 2015; Messina et al., 2004).

Gender, social support and preventive health-care uptake

Patterns of preventive health behaviours vary between men and women. Generally, women are more prone to engage in preventive health behaviours than men (Gallant, 2013; Teo et al., 2016). They are more likely than men to participate in general and preventive health checks, and cancer screening, as stressed by systematic and narrative scoping reviews (Dryden

et al., 2012; Mosquera et al., 2020). This may relate to the fact that women usually have more health knowledge than men and more often monitor their own health (August & Sorkin, 2010). Moreover, men tend to have worse health-seeking behaviours and to be more reluctant to take part in health promotion activities (Teo et al., 2016; Thompson et al., 2012).

Gender, as a structural system defined by public policies, laws, community ties, and family and work relationships, shapes distinct constraints and opportunities for men and women, influencing their experiences and social ties (Bird & Rieker, 2008). Structural forces encourage men to prioritise physical and emotional strength, self-reliance, stoicism and to pay less attention to social relationships, while women are encouraged to prioritise social relationships and responsiveness to others' emotional needs (Erickson, 2005; Liebler & S&efur, 2002; Umberson et al., 2015). Thus, women generally maintain more connections with family, friends and neighbours (Cornwell & Schafer, 2016; Umberson et al., 1996). Gendered constraints affect both men and women's social connectivity, yet some kinds of constraints such as women's greater burden for kin-keeping and childcare may enhance social connections (Reczek & Umberson, 2016). Intimate relationships also affect men and women's social connectivity differently. While intimate relationships may limit women's social connections in early to middle adulthood (especially when children are involved), older women experience less isolation than men due to their stronger bonds with family and friends (Chatters et al., 2018). These stronger bonds explain why women's social support is less affected by their partnership status (Russell & Taylor, 2009). In contrast, as men typically view their partner as their primary source of support, their social networks are usually less intimate and intensive, with fewer close connections outside their intimate relationship (Taylor, 2012; Umberson et al., 2022). Consequently, men tend to be more isolated than women as they age, and their greater reliance on their partner to sustain social connections explains why men living with a partner are less socially isolated than unpartnered men (Umberson et al., 2022). In sum, men tend to rely more on their (marital) partner for social support, while women typically report higher social support levels and broader more diversified sources of support—they also provide support to others more often than men do (Powers & Bultena, 1976; Taylor, 2012).

Differences in how men and women build, lean on and provide social support may influence their health status and behaviours distinctively (Donato et al., 2018; Fuhrer & Stansfeld, 2002; Haines et al., 2008; Shumaker & Hill, 1991; Umberson et al., 2022). Namely, women tend to exert more control over their male partners' health behaviours than the opposite, resulting in male partners generally obtaining greater health benefits from a (marital) relationship (August & Sorkin, 2010; Umberson, 1992). This is consistent with the fact that, as mentioned earlier, women usually have more health knowledge and monitor their health more than men. Consequently, men benefit from health behaviours learned within a relationship, and from their partner's effort to improve health (Umberson, 1992). Additionally, research has indicated that women's stronger reliance on broader social support networks may have a stronger effect on their health compared to men, although the evidence has been mixed (Fuhrer & Stansfeld, 2002; Shumaker & Hill, 1991; Shye et al., 1995).

Notwithstanding differences in men and women's social support sources and networks, a clear gender pattern on how this relates to health and health behaviours has not emerged from past research studies (Donato et al., 2018; Gallant, 2013; Han et al., 2019). Very few studies have examined the gendered role of social support in screening participation, comparing samples of men and women. These studies have reported contradictory results, particularly concerning the effect of perceived social support and social networks on screening uptake (Blakoe et al., 2023; Han et al., 2019; McFall & Davila, 2008). Nevertheless, given the considerable gender

differences in reported social support and its effects on health outcomes, as highlighted in previous research studies, we expect to find gender differences in the association between social support and CRC screening uptake. Particularly, we expect men to be negatively affected in their CRC screening uptake if they live alone, as their health behaviours are strongly influenced by their cohabitation with a (marital) partner and they tend to have worse preventive health behaviours than women.

Countries' CRC screening strategies as context-level determinant of screening uptake

It is essential to consider countries' CRC screening strategies as a contextual determinant of cancer screening participation. In 2003, the European Council recommended that Member States implement population-based CRC screening programmes (Council of the European Union, 2003). By 2014, 4 European countries had fully rolled-out nationwide CRC screening programmes, 11 countries had programmes which were regional, being rolled-out or piloting (and thus did not fully cover the screening-eligible population), 7 countries had opportunistic programmes (which do not systematically invite all individuals from the target population, for example, ad hoc screening), and 9 countries did not have a programme (Cardoso et al., 2020; IARC, 2017). In countries with population-based screening programmes, all individuals from a target population (of specific age range and sex) are systematically invited for screening at specific time intervals. When screening is not "organised" through such population-based programmes, screening uptake is "opportunistic." Namely, it is based on individuals' initiative to undergo screening and on physicians' recommendation to their patients.

Organised screening programmes involve explicit policies on a target population, screening intervals and tests. They have organisational structures including teams responsible for planning, implementation, quality assurance, monitoring and evaluation, and they usually offer free testing to avoid individuals' out-of-pocket expenses (Miles et al., 2004). These features, which are lacking in opportunistic screening contexts, offer more equal access to screening and may explain why previous research studies found that countries with screening programmes have smaller inequalities in cancer screening participation compared to countries where screening is opportunistic (Palencia et al., 2010; Willems & Bracke, 2018).

By considering countries' CRC screening strategies, we go beyond the individual-level approach on screening uptake and draw on an institutional approach to health inequalities (Beckfield et al., 2015). From this perspective, individual-level resources not only shape screening participation, but these resources may also interact with context-level determinants, such as screening programmes. That is, if a lack of (social support) resources can hinder individuals' screening uptake, a screening programme may compensate for this disadvantage and encourage their uptake (Willems & Bracke, 2018). Screening programmes may thus contribute to reducing inequalities in screening uptake by increasing the participation of disadvantaged individuals with lower (social support) resources.

To our knowledge, no study has examined the gender-differential role of social support in CRC screening uptake, while simultaneously considering the effect of countries' CRC screening strategies. Social support is a key form of individual resource, whose importance for CRC screening uptake may vary in men and women and should also be examined in relation to specific contexts shaped by screening programmes. Hence, this study focuses on the following research questions:

1. How does CRC screening uptake relate to living alone and low perceived social support in men and women?
2. How does the association between CRC screening uptake and living alone/low perceived social support differ across countries with different CRC screening strategies?

DATA AND METHODS

We analysed data from the second wave (2014) of the European Health Interview Survey (EHIS). The EHIS consists of four modules on health-care use, health status, health determinants and socioeconomic background and it focuses on the population aged 15 and older living in private households (Eurostat, 2018). Data collection took place between 2013 and 2015 in 30 European countries, based on nationally representative population samples. We added data from Switzerland from the 2012 Swiss Health Interview Survey (SHIS) since the study's variables matched between the two surveys. Thus, our final sample comprised 31 countries. The sample was restricted to 50 to 74 years-old individuals, which corresponds to the recommended age for CRC screening in European guidelines (IARC, 2017). Since the United Kingdom had a fully rolled-out nationwide CRC screening programme limited to 60 to 74 years-old individuals, its sample was restricted to this age range (Cardoso et al., 2020). Cases with missing information (N = 4858; 2.8%) were excluded and the final sample consisted of 65,961 women and 55,602 men.

Measures

The EHIS asked respondents when they last had a FOBT (within the past 12 months, 1 to less than 2 years ago, 2 to less than 3 years ago, more than 3 years ago or never) and a colonoscopy (within the past 12 months, 1 to less than 5 years ago, 5 to less than 10 years ago, more than 10 years ago or never), in two separate questions. Similarly, the SHIS asked for the date of respondents' most recent FOBT and colonoscopy. Following European screening guidelines which recommend a FOBT every 2 years or a colonoscopy every 10 years, we created the following binary dependent variable: "FOBT in past 2 years or a colonoscopy in past 10 years," coded as (0) no, (1) yes.

The EHIS collected information on "household type" (one-person household, single-parent, couple with child(ren), couple without child(ren), other type of household). We considered respondents living in a "one-person household" as "living alone" and computed our predictor of interest as a binary variable: "living alone" and "not living alone" (reference category). We created the predictor of interest "low perceived social support" based on three questions: "How easy is it for you to get practical help from neighbours if you should need it?" (very easy, easy, possible, difficult, very difficult), "How many people are so close to you that you can count on them if you have serious problems?" (none, 1–2, 3–5, 6 or more) and "How much concern do people show in what you are doing?" (a lot, some, uncertain, little, no concern). The summarised standardised z-score of each item was added up into a total score to compute the Oslo 3-item Social Support Scale (OSS-3) (Meltzer, 2003). We reversed the score scale so that a higher score indicates lower perceived social support. The OSS-3 was recommended as an instrument to compare countries' national health data. It was tested and used in studies confirming its reliability and validity as a social determinant of health measure in the general population

(Kocalevent et al., 2018; Meltzer, 2003). It was used in a previous population health study and shown to be independently associated with participation in general health checks (Hoebel et al., 2014).

We controlled models for education level (primary, upper secondary and higher education level), age (5-year age ranges), self-rated health (very good, good, fair, bad, very bad), area of residence (urban, rural), and a visit to a general practitioner (GP) or a specialist in the past 12 months (yes, no), as these were shown to relate to CRC screening uptake (Willems & Bracke, 2018; Wools et al., 2016). All models included country fixed-effects (one dummy variable for each country except one) to control for country-level heterogeneity. We adjusted models for education level as this variable was shown to be a robust proxy of individual socioeconomic status in cross-national health research (Mackenbach et al., 2008; Willems & Bracke, 2018). In sensitivity analyses, we replicated our models adding the income level variable, and results did not change in a way that would affect the study conclusions.

Statistical analyses

We used logistic regression models since we had a binary outcome variable. We reported average marginal effects (AMEs) for ease of result interpretation since these allow for comparing coefficients across logistic models with different samples (Mood, 2009). Analyses were stratified by groups of countries with different CRC screening strategies, based on the classification of Cardoso et al. (2020) and International Agency for Research on Cancer information (IARC, 2017) (Table S1). The group of countries with fully rolled-out nationwide screening programmes was labelled "Programme"; countries with regional, pilot or partially rollout programmes were labelled "Regional/Rolling out/Piloting," countries with opportunistic programmes: "Opportunistic programme," and finally those without programme: "No Programme." All analyses were performed for women and men separately. We did not fit models with men and women in the same sample since covariates, such as education level, can have strong gender-dependent effects on the outcome (CRC screening uptake). For instance, this may lead to biased estimates of interaction terms (Buckley et al., 2017). Hence, we chose to stratify our analyses by gender to examine differences between men and women. We used seemingly unrelated estimation (SUEST) to compare coefficients across models since this method computes cross-model covariance (Mize et al., 2019).

First, we calculated CRC screening uptake proportions in the four groups of countries with different CRC screening strategies. Second, we examined the relationship between social support variables and CRC screening uptake in the full sample of countries, for men and women separately. We performed statistical models stepwise and reported the models' Bayesian information criterion (BIC) to compare their goodness of fit. A BIC decrease of at least 10 when a variable is added to a model is considered as very strong evidence in favour of the model (Kass & Raftery, 1995). Model 1 included all control variables and excluded living alone and low perceived social support variables. Model 2 added the living alone variable to model 1. Model 3 added low perceived social support variable to model 1. Finally, model 4 included all social support and control variables. Third, the same analyses were performed for the four groups of countries with different CRC screening strategies. The analyses were conducted in Stata 16.

RESULTS

Table 1 presents descriptive statistics for all variables in the study. A higher proportion of women (24%) lived alone compared to men (17%). Men reported lower perceived social support (mean = 0.07, SD = 2.16) than women (mean = 0.06, SD = 2.16), with higher scores indicating lower perceived social support. For control variables, more women visited a GP (81%) and a specialist (58%) in the past year than men (75% and 49%, respectively). More women resided in urban areas, while more men attained upper secondary and tertiary education. Regarding the dependent variable, approximately 39% of participants underwent CRC screening within the recommended timeframe, with a marginally higher rate observed in men. As shown in Figure 1, about 60% of the eligible population had undertaken CRC screening in the group of countries with CRC screening programmes; this proportion was 33% in countries with regional, rolling out or piloting screening programmes, 56% in countries with opportunistic programmes and 21% in countries without programmes.

In Table 2, models 1a and 1b adjusted for all individual-level covariates except social support variables (full table in supplementary materials, Table S2). The BICs were 74,318 and 62,115 in the women and men samples, respectively. We added "living alone" and "low perceived social support" variables stepwise in models 2, 3 and 4. As expected, both variables were significantly associated with lower CRC screening uptake in both men and women. However, they improved the model fit more for men than for women, with "low perceived social support" not improving the model fit for women. For men, the model including both social support variables (model 4b) showed the best fit, with a BIC of 62,026, which was reduced by more than 10 compared to models 1b, 2b and 3b. The effect size of both variables was significantly bigger for men in model 4 (living alone: Wald = 7.18, $p < 0.01$; low perceived social support: Wald = 8.18, $p < 0.01$), as revealed by a Wald test using SUEST method. The AMEs of living alone were −0.035 (SE = 0.005) for men and −0.018 (SE = 0.004) for women, respectively. This indicates that men and women living alone were 3.5% and 1.8% less likely, respectively, to undergo CRC screening. For perceived social support, the AMEs were −0.006 (SE = 0.001) for men and −0.003 (SE = 0.001) for women. Given the range of the perceived social support scale (7.858 to (−3.727) = 11.585), this translates to a 7.0% decrease (−0.006 × 11.585) in CRC screening uptake for men and a 3.5% decrease (−0.003 × 11.585) for women with the lowest perceived social support, compared to those with the highest level of perceived social support.

In Table 3, the association between social support variables and CRC screening uptake was examined across groups of countries with different CRC screening strategies. In countries with fully rolled-out nationwide screening programmes, only "living alone" among men was associated with lower CRC screening uptake (AME = −0.074, SE = 0.016), and this variable strongly contributed to improving the model fit. That is, the BIC of model 1b was 8943, which reduced to 8927 in model 2b. Among women, none of the social support variables was significantly associated with CRC screening uptake. In countries with regional, piloting or rolling out programmes, living alone (AME = −0.022, SE = 0.009) and low perceived social support (AME = −0.006, SE = 0.002) were associated with lower screening uptake in men; however, the model fit did not improve importantly with the inclusion of these variables in the models. These variables were not associated with women's uptake. In countries with opportunistic screening programmes, both social support variables were associated with lower screening uptake in men (living alone: AME = −0.056, SE = 0.010; low perceived social support: −0.008, SE = 0.002) and women (living alone: AME = −0.030, SE = 0.008; low perceived social support: AME = −0.007, SE = 0.002). In models 4a and 4b, which included both social support variables, the model fit

TABLE 1 Descriptive statistics for 50 to 74 year-old men and women in a sample of 31 European countries.

	Women (N = 65,961)		Men (N = 55,602)		
	N	%	N	%	p-value[a]
Dependent variable					
FOBT in past 2 years or a colonoscopy in past 10 years					
No	40,319	61.13	33,622	60.47	<0.05
Yes	25,642	38.87	21,980	39.53	
Independent variables (categorical)					
Living alone					
Not living alone	50,162	76.05	46,244	83.17	<0.001
Living alone	15,799	23.95	9358	16.83	
Age					
50–54	13,927	21.11	12,036	21.65	<0.05
55–59	13,528	20.51	11,548	20.77	
60–64	14,187	21.51	11,955	21.50	
65–69	13,547	20.54	11,329	20.38	
70–74	10,772	16.33	8734	15.71	
Education level					
Primary	24,858	37.69	17,335	31.18	<0.001
Upper secondary	27,619	41.87	24,802	44.61	
Tertiary	13,484	20.44	13,465	24.22	
Area of residence					
Urban	42,792	64.87	34,969	62.89	<0.001
Rural	23,169	35.13	20,633	37.11	
Had a GP visit					
In past 12 months	53,434	81.01	41,798	75.17	<0.001
Over past 12 months	12,527	18.99	13,804	24.83	
Had a specialist visit					
In past 12 months	38,463	58.31	27,291	49.08	<0.001
Over past 12 months	27,498	41.69	28,311	50.92	
	Mean (SD)	**Min; max**	**Mean (SD)**	**Min; max**	**p-value[b]**
Independent variables (continuous)					
Low perceived social support[c]	−0.06 (2.16)	−3.73; 7.86	0.07 (2.16)	−3.73; 7.86	<0.001
Self-rated health	2.46 (0.91)	1; 5	2.38 (0.90)	1; 5	<0.001

[a]Chi-square test.

[b]t-test.

[c]Score calculated as the sum of standardised z-scores from three perceived social support items (Meltzer, 2003).

Source: European Health Interview Survey (EHIS) round 2014 and Swiss Health Interview Survey (SHIS) wave 2012.

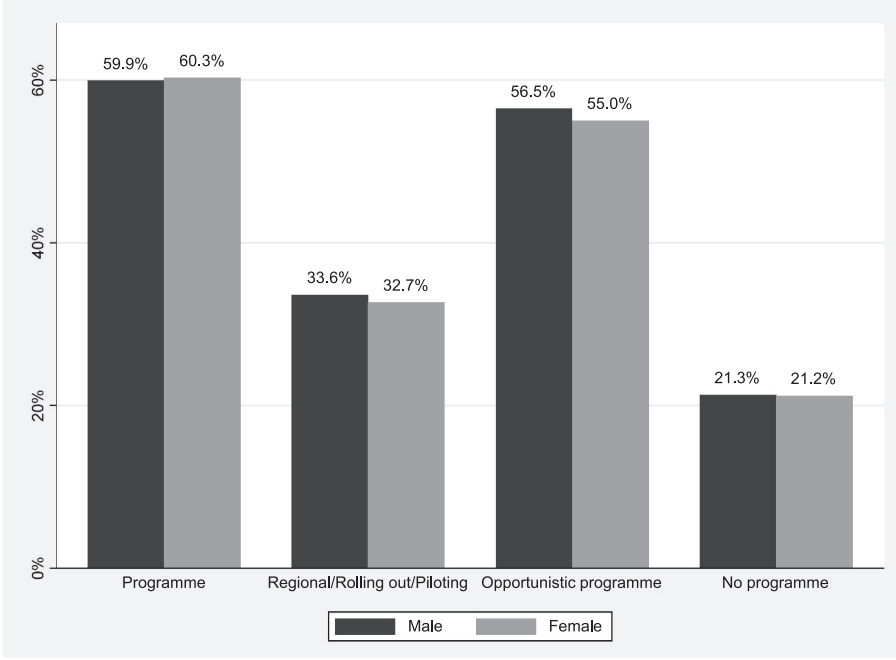

FIGURE 1 CRC screening uptake proportions in groups of countries with different CRC screening strategies. *Source*: European Health Interview Survey round 2014 and Swiss Health Interview Survey wave 2012. CRC, colorectal cancer.

TABLE 2 Associations of social support variables with CRC screening uptake, results of logistic regression analysis, average marginal effects and standard errors.

	Women (N = 65,961)				Men (N = 55,602)			
	Model 1a AME (SE)	Model 2a AME (SE)	Model 3a AME (SE)	Model 4a AME (SE)	Model 1b AME (SE)	Model 2b AME (SE)	Model 3b AME (SE)	Model 4b AME (SE)
Living alone/not alone (ref: not alone)								
Living alone		−0.018*** (0.004)		−0.018*** (0.004)		−0.040*** (0.005)		−0.035*** (0.005)
Low perceived social support (continuous)			−0.003*** (0.001)	−0.003** (0.001)			−0.007*** (0.001)	−0.006*** (0.001)
BIC	74,317.5	74,308.3	74,317.5	74,309.8	62,114.6	62,058.6	62,065.5	62,026.0

Note: All models are adjusted for individual-level covariates (age, education level, area of residence, self-rated health, a GP visit and specialist visit in the past 12 months) and country fixed-effects (country dummy variables).

Abbreviations: AME, average marginal effect; BIC, Bayesian information criterion; CRC, colorectal cancer; GP, General Practitioner.

*p value ≤ 0.05, **p value ≤ 0.01, ***p value ≤ 0.001 (two-tailed test).

TABLE 3 Associations of social support variables with CRC screening uptake in country subsamples, results of logistic regression analysis, average marginal effects and standard errors.

	Women				Men			
	Model 1a AME (SE)	**Model 2a AME (SE)**	**Model 3a AME (SE)**	**Model 4a AME (SE)**	**Model 1b AME (SE)**	**Model 2b AME (SE)**	**Model 3b AME (SE)**	**Model 4b AME (SE)**
Countries with nationwide screening programmes	$N = 8057$				$N = 7143$			
Living alone/not alone (ref: not alone)								
Living alone		−0.020 (0.013)		−0.020 (0.013)		−0.076*** (0.015)		−0.074*** (0.016)
Low perceived social support (continuous)			−0.004 (0.003)	−0.004 (0.003)			−0.004 (0.003)	−0.003 (0.003)
BIC	10,152.8	10,159.3	10,158.7	10,165.3	8942.7	8926.9	8949.1	8934.8
Countries with regional/rolling out/pilot screening programmes	$N = 19,653$				$N = 17,415$			
Living alone/not alone (ref: not alone)								
Living alone		−0.014 (0.008)		−0.014 (0.008)		−0.027** (0.009)		−0.022* (0.009)
Low perceived social support (continuous)			−0.001 (0.002)	−0.000 (0.002)			−0.007*** (0.002)	−0.006*** (0.002)
BIC	23,631.7	23,638.5	23,641.5	23,648.3	20,993.8	20,994.7	20,986.2	20,990.2

TABLE 3 (Continued)

	Women				Men			
	Model 1a AME (SE)	**Model 2a AME (SE)**	**Model 3a AME (SE)**	**Model 4a AME (SE)**	**Model 1b AME (SE)**	**Model 2b AME (SE)**	**Model 3b AME (SE)**	**Model 4b AME (SE)**
Countries with opportunistic screening programmes	$N = 18{,}522$				$N = 14{,}900$			
Living alone/not alone (ref: not alone)								
Living alone		−0.032*** (0.008)		−0.030*** (0.008)		−0.063*** (0.010)		−0.056*** (0.010)
Low perceived social support (continuous)			−0.007*** (0.002)	−0.007*** (0.002)			−0.010*** (0.002)	−0.008*** (0.002)
BIC	22,447.9	22,441.2	22,440.0	22,434.9	17,715.7	17,683.2	17,697.7	17,675.0
Countries without screening programmes	$N = 19{,}729$				$N = 16{,}144$			
Living alone/not alone (ref: not alone)								
Living alone		−0.008 (0.007)		−0.007 (0.007)		−0.015 (0.008)		−0.011 (0.009)
Low perceived social support (continuous)			−0.001 (0.001)	−0.001 (0.001)			−0.006*** (0.002)	−0.006*** (0.002)
BIC	18,123.9	18,132.4	18,133.4	18,142.0	14,523.5	14,530.0	14,518.6	14,526.7

Note: All models are adjusted for individual-level covariates (age, education level, area of residence, self-rated health, a GP visit and specialist visit in the past 12 months) and country fixed-effects (country dummy variables).

Abbreviations: AME, average marginal effect; BIC, Bayesian information criterion; CRC, colorectal cancer; GP, General Practitioner.

*p value ≤ 0.05, **p value ≤ 0.01, ***p value ≤ 0.001 (two-tailed test).

improved compared to models 1, 2 and 3 for both men and women. The effect of "living alone" was stronger in men (Wald = 4.45, $p = 0.035$) and no difference in effect size between men and women was found for low perceived social support (Wald = 0.24; $p = 0.621$). In countries without screening programmes, "low perceived social support" (AME = −0.006, SE = 0.002) was associated with lower CRC screening uptake among men, yet this variable did not improve the model fit. No association was found among women for social support variables.

DISCUSSION

This study examined how a lack of individual social support shapes men and women's CRC screening uptake across 31 European countries that rely on different CRC screening strategies. It yielded three important results. First, it evidenced that living alone and low perceived social support were independently associated with lower CRC screening uptake in both men and women. Second, these two variables' negative effect on CRC screening uptake was evidenced in countries with opportunistic screening programmes for both men and women, while it appeared to reduce and even fade away in countries with other screening strategies. Third, living alone and low perceived social support more strongly affected men's than women's CRC screening uptake in the full 31 countries sample. Men living alone had a lower screening uptake in countries with nationwide screening programmes, and so did men with lower perceived social support in countries with regional/rolling out/pilot programmes, while this was not the case for women.

Social support and CRC screening

Our findings are consistent with previous research that revealed associations between individual social support and the use of cancer screening (Cadet et al., 2021; Documet et al., 2015; Han et al., 2019; Jensen et al., 2016; Messina et al., 2004; Rondet et al., 2013; Sarma, 2015; Stafford et al., 2018; Vozikaki et al., 2017), as we found that more socially isolated individuals had lower CRC screening uptake. A lack of awareness and knowledge on cancer and cancer screening, and negative views and attitudes towards screening, were pointed out as crucial barriers to CRC screening uptake, particularly among those living alone and with lower social support (Honein-AbouHaidar et al., 2016; Wools et al., 2016). Such barriers are directly affected by the influence of family and friends who can provide screening awareness and information, thereby enhancing the knowledge of screening benefits and lowering barriers related to misconceptions, negative attitudes and fear of cancer or of an unpleasant test (Honein-AbouHaidar et al., 2016). Some of these barriers might be related to CRC screening procedures, that is, stool sample collection and endoscopic gastrointestinal examination, which were shown to relate to negative attitudes and to be perceived as unpleasant or uncomfortable (Lo et al., 2013; Molina-Barcelo et al., 2011; Teo et al., 2016). Previous research showed that screening barriers related to fear of cancer and concerns with screening procedures were reduced when individuals could better perceive the benefits of asymptomatic screening (Kotzur et al., 2020; Wools et al., 2016). In this sense, we suggest that social relations and social support play a key role in lowering barriers to CRC screening uptake by providing access to information on the benefits of screening.

Our results showed that living alone has a negative effect on CRC screening uptake, which is consistent with previous research studies that showed that marriage and partnership have a positive effect on cancer screening uptake (Gram et al., 2021; Hanske et al., 2016; Missinne et al., 2013; Stafford et al., 2018; van Jaarsveld et al., 2006). Nevertheless, we went beyond these previous studies by simultaneously accounting in our models for both the actual condition of living alone and broader (perceived) social support.

Social support and CRC screening programmes

Previous cross-national research studies showed that organised screening programmes may contribute to reducing socioeconomic inequalities in screening uptake (De Prez et al., 2023; Jolidon et al., 2022; Palencia et al., 2010; Willems & Bracke, 2018). Our findings support this inequality-reducing effect of screening programmes as we found that social support inequalities in screening uptake faded away in countries with screening programmes—except for men living alone as it will be discussed below—while these persisted in countries with opportunistic screening programmes. In opportunistic screening contexts, screening uptake depends on individuals' initiative and doctors' recommendation to their patients, and thus individual resources, such as social support, may carry more weight, while organised programmes, by systematically inviting all individuals from the eligible population, offer more equal access to screening (Palencia et al., 2010; Willems & Bracke, 2018). In addition, we suggest that screening programmes may compensate for the role of family members, friends and acquaintances in providing information and awareness of CRC screening, thereby supporting screening access for those who lack social support.

In line with this reasoning, we would expect to find screening inequalities shaped by social support in countries without CRC screening programmes, which was not the case in our results. We suggest that screening inequalities have not emerged yet in countries without screening programme, since their CRC screening prevalence was lower (about 21% of the eligible population) than in countries with other screening strategies. According to Zapata-Moya et al. (2019), screening inequalities may not manifest in the early stage of a preventive technology's diffusion, when knowledge and adoption in the population are low, but they develop at later diffusion stages with the spread of the preventive practice through society. This is supported by their finding that screening tests with the lowest prevalence (early diffusion stage), such as CRC screening, showed fewer screening inequalities than other screening tests.

Gender, social support and CRC screening

Social epidemiology and health sociology showed that, generally, men have worse health behaviours than women (Dryden et al., 2012; Gallant, 2013; Mosquera et al., 2020). Moreover, men tend to rely on their (marital) partner for social support, and thus living with a partner has a particularly positive influence on their health and health behaviours (August & Sorkin, 2010). Conversely, those who live alone may not benefit from such health-enhancing support. Hence, we expected men who live alone to have a lower CRC screening uptake than those who do not live alone, which was confirmed by our results. This is in line with studies and systematic reviews that pointed out that the partner's role is a key facilitator of CRC screening uptake among men (Hanske et al., 2016; Honein-AbouHaidar et al., 2016; Teo et al., 2016; Thompson

et al., 2012), and this contributes to explaining the persistence of the negative effect of living alone on men's CRC screening in contexts with screening programmes. Additionally, our finding that perceived social support affected men's screening uptake more than women's aligns with previous studies (Blakoe et al., 2023; Han et al., 2019). However, our study is the first to compare the effect of social support on CRC screening uptake in representative samples of both men and women.

We found that women with lower perceived social support had a lower CRC screening uptake, yet the evidence of this effect was not strong (except in opportunistic screening programme contexts). Previous studies showed that social support affected women's cervical and breast cancer screening uptake (Cadet et al., 2021; Documet et al., 2015; Jensen et al., 2016; McFall & Davila, 2008; Messina et al., 2004; Rondet et al., 2013). However, other studies found that women's screening uptake was only modestly or not related to social support (Allen et al., 2008; Blakoe et al., 2023; Han et al., 2019; Manjer et al., 2015; Price et al., 2010), and not associated with their close friends' screening uptake (Keating et al., 2011). A possible interpretation of our results is that women have been exposed to long-standing recommendations on cervical and breast screening, and to Pap smear and mammography programmes which were implemented in most European countries before CRC screening programmes. This may have contributed to their cancer screening awareness and knowledge, making them less dependent on social support and more autonomous in their decision to undergo screening. Moreover, as previous research showed, women usually have better health knowledge than men and are more inclined to engage in preventive health care and seek medical care (August & Sorkin, 2010). This may also have contributed to a more nuanced association between social support and CRC screening among women.

Male-specific barriers to CRC screening uptake may explain why lacking social support particularly matters for men's CRC screening. A systematic review found that masculinity attributes, such as avoidance of femininity and self-reliance, were amongst the most reported male's screening barriers, as well as the specific nature of CRC screening procedures (Teo et al., 2016). That is, for a masculine identity, talking about health and seeking medical help can be perceived as "feminine" and "weak" and this was found to relate to reluctant attitudes to seek medical attention for asymptomatic conditions among men, as well as avoidance and denial of illness (Teo et al., 2016). Contrarily, women tend to show higher concerns about their own health and their family's, and more often assume a caregiver role, which was related to a higher value attributed to self-care and early detection (Molina-Barcelo et al., 2011; Thompson et al., 2012). Additionally, a qualitative study highlighted the particular "avoidant procrastination" attitude of men towards CRC screening (Ritvo et al., 2013). That is, prevention of a potential (deadly) disease is an anxiety-provoking issue from which men tend to emotionally distance themselves by denying its importance. Such distancing, related to male's particular socialisation process and role, translates into more passive attitudes towards preventive health care, as well as into vague decision-making and (in)action in screening. As emotions associated with screening uptake remain ambiguous, definite actions are impeded. This could explain why men "ambiguously procrastinate" in undertaking CRC screening, compared to women who take more definite decisions on their screening participation (Ritvo et al., 2013).

In sum, past research studies highlighted male-specific barriers to CRC screening uptake combining men's perceptions of unnecessary health care, avoidant procrastination in screening and fatalistic attitudes towards cancer and prevention. Additionally, men reported less consistent relationships with their physician than women, and to be less knowledgeable about cancer and cancer screening (Ritvo et al., 2013). CRC screening procedures were also identified

as a key barrier among men, often perceived as invasive or uncomfortable, and research showed that such feelings of discomfort may be increased with opposite-sex health-care providers (Khara et al., 2021). To conclude, we suggest that social support may help men overcome these specific barriers and, conversely, lacking social support may reinforce male-specific barriers to CRC screening uptake. Following Teo et al. (2016), we stress the importance to take into account the characteristics of a disease-specific screening procedure (e.g. CRC screening), to apprehend the specific barriers faced by men and women in their screening uptake.

The limitations of this study should be pointed out. We used a general measure of perceived social support that does not distinguish between different types of social support, for example, from family or friends. Nevertheless, previous research studies showed that perceived social support contributed to explaining preventive and screening behaviours independently of the actual existence, size or type of social networks (Gallant, 2013). We were not able to distinguish between the role of social support in initiating screening uptake or regularly maintaining it over time since the EHIS is a cross-sectional survey and did not collect information on respondents' past screening uptake. Further research may examine this important aspect in order to inform cancer screening interventions aimed at either initiating uptake or promoting repeated uptake over time. Further country-level determinants may affect screening uptake, such as health-care systems or social policies (Jolidon et al., 2021). However, our fixed-effect models controlled for country-level unobserved heterogeneity. Future research studies may investigate how specific features of health-care systems, particularly primary care systems, moderate the role of social support in CRC screening uptake. In the EHIS, CRC screening uptake and social support were self-reported and might thus be affected by social desirability bias. Social desirability may lead to overestimation of both CRC screening uptake and social support, yet it may not have substantially affected the association between these variables, which was the main focus of this study. We should note that this study focused on the role of social support independently of its association with other determinants of screening uptake. Individual social support may be associated with socioeconomic status, and socioeconomically disadvantaged individuals are also known to underuse health-care services and cancer screening. Hence, further studies may examine the interaction effects between social support and socioeconomic status variables in their association with screening uptake. Vulnerable population subgroups, such as migrants and LGBTQ+ individuals, may face specific barriers to screening uptake due to their social conditions, an aspect not specifically examined in our study. Future research studies should focus on these groups to identify potential inequalities in screening access and explore how these vary across countries with different screening strategies. Finally, our study did not consider the variations in social support between retirees and individuals still in the workforce. This distinction is important because social support levels can differ significantly between these groups. Particularly, for men, social networks formed in the workplace provide a significant source of support. These networks usually shrink post-retirement, potentially leading to increased social isolation, especially for those living alone (Fischer & Beresford, 2015; McDonald & Mair, 2010). Hence, we conducted sensitivity analyses controlling for employment status, yet our main results remained consistent. This may be attributed to our models controlling for age, which acts as a proxy for retirement status. Nevertheless, further investigation is needed to explore the effect of social support on the screening participation across later adulthood stages, including potential gender differences.

Further limitations arise from the EHIS data set. Regional (sub-national) disaggregation was not possible with the EHIS data (NUTS-2 level information was not provided). Thus, we were not able to consider regional differences or control for regional-level factors such as physician

density. However, our models adjusted for rural/urban residential areas, which are a sensible proxy for the regional density of primary care physicians. The EHIS did not collect information on respondents' reasons for screening or their cancer history. Thus, we were not able to control for individuals' screening uptake due to previous diagnosis, treatment, symptoms or family cancer history. Nonetheless, our models controlled for individuals' health-care utilisation and health status. Finally, causal inference cannot be claimed due to the cross-sectional nature of the data and our statistical models, and thus analyses may have potentially been affected by reversed causality bias.

This study also has essential strengths. It is the first to investigate the role of social support in CRC screening uptake, comparing men and women across European countries with different screening strategies (i.e. screening programmes). We exploit the availability of a large European data set which offers a unique opportunity to generalise results across different countries, provide broader insights and go beyond a perspective focusing on a single country. With this cross-national perspective, we are able to examine the role a country-level factor, that is, CRC screening strategies, plays in the association between social support and screening uptake. Importantly, our analyses simultaneously considered two key aspects of social support: living alone and low perceived social support. Thus, our models accounted for the distinct contribution of social connectedness and perceived social support, which are potentially related sources of social support yet are also known to have independent effects on health.

CONCLUSION

This study revealed that a lack of social support negatively affected men and women's CRC screening uptake across 31 European countries that have implemented different CRC screening strategies. Results suggested that this effect was more important among men and that "living alone" was particularly negative for men's CRC screening uptake. This is consistent with past health sociology findings which revealed that men have worse health behaviours than women and obtain more health benefits than women from an intimate partner. We suggest that men also benefit more from supportive ties in their CRC screening uptake, and that these may help them overcome specific barriers related to CRC screening procedures which were pointed out by previous research studies. In countries with fully rolled-out nationwide screening programmes, the effect of social support on CRC screening uptake faded away (except for men "living alone"), while it persisted in countries with opportunistic screening programmes. This supported the argument that screening programmes may help reduce screening inequalities between individuals with lower and higher levels of social support.

While past cross-national research on cancer screening participation has focused on socioeconomic inequalities, our study stressed the role of social support, as well as its gender differential. This is particularly relevant since men and women differ in the way they build and rely on social support. The independent effect of social support should be stressed since it may enhance access to cancer screening by helping individuals to overcome well-known screening uptake barriers, such as lack of knowledge and awareness of cancer prevention, embarrassment, fear, misconceptions and negative attitudes towards screening procedures and results. This is particularly important in ageing societies with increasing number of individuals living alone, at risk of social disconnectedness and isolation, and who may not keep up with innovative preventive practices.

Consequently, for screening interventions to be effective, they should be sensitive to gender and social support and incorporate these dimensions into their strategies to enhance equal access to screening. Otherwise, if socially isolated individuals benefit less from screening programmes, this may reproduce inequalities in cancer outcomes and may be inefficient from a public health perspective. Primary care physicians and policymakers involved in cancer screening promotion should consider the results of the present study. As they promote screening, they should take into account that screening participation goes beyond individuals whose decisions are influenced by acquaintances, friends and families, and by how much support they perceive they can get from them. Importantly, these shape their social and health behaviours in ways that vary between men and women.

AUTHOR CONTRIBUTIONS

Vladimir Jolidon: Conceptualisation, data curation, methodology, formal analysis, visualisation, writing—original draft, writing—review and editing. **Vincent De Prez**: Conceptualisation, writing—review and editing. **Piet Bracke**, **Stéphane Cullati** and **Claudine Burton-Jeangros**: Conceptualisation, writing—review and editing, supervision, funding acquisition, project administration. All authors approved the final version of the manuscript.

ACKNOWLEDGEMENTS

This research study was conducted within the project "PREVENT—Social inequalities in cancer prevention care and fundamental social causes: a comparative study of innovative technologies and (in)effective policies" which is funded by the Research Foundation—Flanders (grant number FWOOPR2018005701) and the Swiss National Science Foundation (grant number 176115). The funding bodies had no involvement in the study design, the collection, analysis, and interpretation of data, the writing of the manuscript, nor in the decision to submit the manuscript for publication.

Open access funding provided by Universite de Geneve.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data from the European Health Interview Survey used in this study is available from Eurostat. However, restrictions apply to the availability of this data, which was used under licence for this study. To be granted access to the data, the Eurostat requires an application by a recognised research entity and submission of a research proposal. The data from the SHIS is available for a fee (1600 Swiss Francs, plus 7.7% tax). Users must request permission from the Swiss Federal Statistical Office (sgb@bfs.admin.ch) and sign a data contract.

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How to cite this article: Jolidon, V., De Prez, V., Bracke, P., Cullati, S., & Burton-Jeangros, C. (2024). Lack of social support, gender and colorectal cancer screening participation across Europe: How do screening programmes mitigate the effect of social support for men and women? *Sociology of Health & Illness*, 1–26. https://doi.org/10.1111/1467-9566.13791