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ORIGINAL PAPER

Health and relationship quality of sexual minorities in Europe

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Abstract

A growing body of literature investigates inequalities between sexual minorities and their heterosexual peers. This paper deals with disparities in health, health-related behaviours, and relationship quality among LGB+ individuals. We use a novel data set that allows for a wide cross-national analysis (27 EU member states) of disparities between sexual minorities and the rest of the population, as well as differences in reporting sexual orientation. We consider a rich set of social stressors, individual-specific behavioural factors, and health outcomes, as well as novel para-data (i.e., individuals' response times) that are not available in other large surveys. The results indicate that sexual minorities are more exposed to stigma-related social stressors (both in childhood and adulthood), report worse physical and mental health conditions, feel more lonely, and are more likely to engage in coping strategies aimed at reducing or adapting to stressful conditions. Some of these findings significantly differ across gay, lesbian, and bisexual individuals and with respect to household income, the country's enforcement of sexual minorities' rights, and relationship status.

Keywords LGB+ · Social stressors · Behavioural risks · Health · Loneliness

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1 Introduction

Improving the inclusion of sexual and gender minorities is high on the political agenda of most OECD and EU countries (see, e.g., European Commission 2020). Several advancements in non-discrimination policies and in the legal recognition of same-sex partnerships have been made over the past decades (OECD 2020). However, according to a recent survey, more than 40% of LGBTQIA+ people in Europe still report having experienced discrimination in some area of life, such as at work, in housing, healthcare, or social services (see, e.g., Drydakis 2009; Ahmed and Hammarstedt 2009; Patacchini et al. 2015; FRA 2020).[1] Furthermore, stigma-related social exclusion, prejudice, and discrimination against sexual minorities may increase the likelihood of experiencing adverse health conditions and make individuals engage more frequently in cognitive and behavioural coping strategies aimed at reducing or adapting to stressful conditions and associated emotional distress, such as smoking, drinking, unhealthy lifestyles, and high-risk sexual relationships (see, e.g., Lick et al. 2013; Meads 2020; Friedman 2020; Williams et al. 2021).

Despite the relevance of the topic, there is still little comparable evidence on how sexual minorities fare compared to heterosexual individuals. This is mainly because questions about sexual orientation are typically not included in large cross-country surveys. According to survey data from selected countries, however, important differences in socio-economic outcomes persist, with LGBTQIA+ individuals having on average less favourable labour market outcomes, poorer health, and lower life satisfaction than heterosexual individuals (Valfort 2017). The economics literature has widely documented the existence of differences in earnings and other labour market outcomes (see, e.g., Ahmed and Hammarstedt 2010; Aksoy et al. 2018; Burn 2020; Drydakis 2022b; Plug and Berkhout 2004), but much less is known about systematic differences in health outcomes, health-related behaviours, and the quality of social relationships. Moreover, most of the evidence so far stems from single-country studies focusing on the US and the UK (OECD 2019).

This paper exploits the first large EU-wide survey (EU-LS, henceforth) that includes a detailed question on sexual orientation, covering more than 25,000 individuals residing in all 27 European Union member states. While the survey does not consistently identify all gender minorities, and in particular transgender individuals, it allows us to consider LGB+ individuals, namely those that identify as gay, lesbian, bisexual, or having another sexual orientation different from heterosexual or straight. The data set contains a rich set of information on individuals' childhood experiences, health conditions, health-related behaviours, relationship quality, loneliness, and social media use. In addition, the availability of novel para-data, including individual-specific response times, represents an additional added value, allowing for the correction of the reporting bias on the sexual orientation question as well as on all the other variables considered in the analysis. Another original aspect of EU-LS data concerns the possibility of

[1] The LGBTQIA+ acronym is used to represent a range of sexual orientations and gender identities. It stands for lesbian, gay, bisexual, transgender, queer (or sometimes questioning), intersex, asexual, and others. The "+" represents other sexual orientations (including "pansexual" and "two-spirit").

analysing across-group processes and their associations with outcomes, which represents an advantage over many of the existing studies focusing on within-group differences. In addition to the non-probabilistic survey covering all the EU member states, we also rely on a companion online survey based on probability sampling that was carried out in parallel in four European countries, which includes also individuals without internet access. The main results, however, do not change significantly.

On average, 91% of respondents in our sample identify as heterosexual and 6.1% as lesbian, gay, bisexual, or having another sexual orientation (LGB+). These shares are slightly larger than what was found in a recent large survey in the US (Badgett et al. 2021) and in other surveys from OECD countries (OECD 2019), but are somewhat lower than estimates from some other country-specific online surveys, such as the LGBT+ Pride 2021 survey.

Even though the survey was carried out online to minimise a possible underreporting of the sexual orientation due to privacy issues, it is still likely that the true share of sexual minorities is underestimated in the data. Different reporting rates may be country-specific and significantly influenced by cultural norms and beliefs. We first present detailed evidence showing that more people identify themselves as LGB+ in more open and inclusive countries, as well as in cultures characterised by less stringent social norms and restrictions. Moreover, we show that respondents in countries with stronger protection of sexual minorities take significantly less time on average to answer the question on their sexual orientation. This indicates that the degree of confidence in declaring the "actual" sexual orientation may depend on the degree of inclusiveness of the national legislation. An interesting picture emerges from a multivariate analysis of the factors related to individual decisions to refuse to answer the question on sexual orientation. More precisely, lower-educated, less wealthy, more religious, and/or those living in rural areas are significantly more likely not to report their sexual orientation.

We then document substantial differences between LGB+ individuals and the rest of the population in terms of exposure to social stressors (both in childhood and adulthood), health-related behaviours and social media (ab)use, physical and mental health outcomes, and loneliness. In particular, we find that sexual minorities are more likely to have experienced a low relationship quality with parents in childhood and had fewer close friends during adolescence. They also can count less on the support from close family members and friends in adulthood. In addition, LGB+ individuals have a higher probability of smoking more than 10 cigarettes per day and are less averse to taking risks in health-related domains. We also document a more intense use of social media among LGB+ individuals who also report more often to neglect work, school, or family-related duties because of the time spent on social media. Moreover, sexual minorities are significantly more likely than heterosexual individuals to report adverse physical and mental health conditions, as well as loneliness experiences. Regarding mental health and emotional disorders, the differences are mainly driven by higher reported rates among bisexual individuals, while gay men report significantly higher smoking habits. Finally, we find some heterogeneous effects with respect to individual relationship status, household income, and country openness. Single and less wealthy LGB+ individuals suffer more from depressive symptoms and have worse overall health compared to those belonging to higher income quantiles or in a relationship.

Along similar lines, disparities among sexual minorities tend to be more pronounced in countries where sexual minority rights are less enforced. The results are robust to the inclusion of a rich set of controls, corrections for potential reporting biases based on individual-specific response times, and additional multiple hypothesis testing corrections to account for eventual "false positive" findings.

The rest of the article is organised as follows. Section 2 describes the EU-LS dataset. In Section 3, we show some descriptive statistics and discuss possible factors underlying significant heterogeneities in reporting sexual orientation, as well as the correlates of individuals' attitudes towards not revealing their sexual orientation. Section 4 presents the conceptual framework and related hypotheses, variables used, and empirical strategy. Section 5 shows the main result, followed by Section 6 in which we discuss limitations of this study and provide some directions for future research. Section 7 concludes.

2 The EU loneliness survey (EU-LS)

Our main data source is the EU Loneliness Survey (EU- LS), an online survey conducted in November and December 2022 targeting the general population aged 16 and above in all 27 EU Member States. Data were collected for a total of 25,646 respondents recruited from established consumer panels, with approximately 1000 respondents per country except for Cyprus, Luxembourg, and Malta (503, 370, and 529 respondents, respectively). While the survey is not based on probability sampling, quotas were used to achieve a sample that reflects the population of each country in terms of age, gender, educational attainment, and NUTS region of residence.[2] Moreover, we employ ex-post weights in all estimations to account for possible further under-representation of the above-mentioned socio-demographic groups. Post-stratification weights are aimed at reducing the sampling error and potential non-response bias. They, hence, replicate the distribution of the cross-classification of age group, gender, and education in the population and the marginal distribution for region in the population. The population distributions for the adjusting variables were obtained from Eurostat statistics.[3]

While the main focus of the EU-LS was to measure loneliness and social connectedness, individuals were also asked about their sexual orientation. In particular, they were asked the following question: *Which of the following best describes your sexual orientation?* The possible answers were: *Heterosexual/straight*, *Lesbian or gay*, *Bisexual*, *Other sexual orientation*, *Don't know* and *Prefer not to say*. We consider two different categorisations of sexual orientation: one with the aggregate category containing those identifying as gay/lesbian, bisexual, and other sexual orientations, and another with separate categories of sexual minorities.

[2] Simple, non-interlocking quotas were used following population shares from Eurostat statistics by male/female gender, 6 age groups, 3 education groups, and 2–16 geographical regions depending on the country.

[3] The same distributions as for quotas were used. To improve weighting efficiency, weights were trimmed at the value of 5. Due to this fact, however, the low-educated population and that of individuals aged 65+ remain under-represented in the weighted data in some countries.

The survey also includes a question on gender identity, allowing for the category *in another way* besides *male* and *female*. However, given that few respondents do not identify with the male or female gender identity and the survey does not allow to include the full range of sexual minorities and gender identities[4], in our main analysis, we only focus on sexual minorities and address the population of gay, lesbian, bisexual, and other sexual orientations as LGB+ category. Results for non-binary individuals that do not identify with the male or female gender identity are presented in a separate analysis (Table A.13, in the Supplementary material).

Besides sexual orientation, the EU-LS survey includes information on standard individual-specific demographic and socio-economic characteristics, as well as a rich set of social stressors, such as exposure to adverse experiences during childhood and adolescence, lack of support from family members and friends in adulthood, a battery of questions on unhealthy behaviours, individual-specific preferences in several domains, physical and mental health outcomes, loneliness, and several aspects related to social media use. Furthermore, the availability of individuals' response times to the sexual orientation question and all the other relevant variables represents an additional added value, allowing for correction of the reporting bias on the sexual orientation question as well as on all the other variables considered in the analysis. The plurality of information makes the EU-LS survey unique in the context of similar large surveys.

To assess the reliability of the EU-LS survey, we emphasise two important considerations. First, the survey mode and the degree of privacy and anonymity are generally found to matter substantially for the likelihood to declare as sexual minority (Robertson et al. 2018). For instance, in the US, the estimates of sexual minorities are found to be 60% higher when the question on sexual self-identification is completed anonymously by the respondents rather than by the interviewer (OECD 2019). This speaks in favour of asking about sexual identification through online surveys such as the EU-LS rather than through traditional surveys. However, there is evidence that the size of sexual minorities is underestimated also in anonymous online surveys asking a direct question on sexual orientation, perhaps because of a "social desirability bias", *i.e.,* the fact that individuals are not willing to provide honest answers in order to adhere to social norms (Coffman et al. 2017). Second, given the fact that the sampling of the survey was not probability-based, one could question whether the results are representative of the whole population of the 27 EU countries. In particular, individuals without internet access, who are more likely to be lower-educated, older, and part of marginalised communities, are not included in the sample.

Regarding the latter point, in addition to the non-probabilistic survey, we also rely on a companion online survey relying on probability sampling that was carried out in parallel in 4 of the 27 EU countries (*i.e.,* France, Italy, Poland, and Sweden), the EU 4 loneliness survey (EU4-LS). Also, this survey covered approximately 1000 respondents per country, who were recruited from online random probability-based panels part of the IPSOS *KnowledgePanel*. Probabilistic surveys are typically found to exhibit a higher accuracy than nonprobability samples (Cornesse et al. 2020) and allow to include the digitally excluded population in online surveys (Blom et al. 2015).

[4] Only 0.4% of the respondents in the EU-LS survey select the category *in another way* when answering the gender question. The survey does not include information about being transgender.

We can thus test the robustness of the main results presented to the different sampling methods applying the same ex-post weights as in the main survey. The share of individuals identifying as LGB+ is very similar in the two surveys (see Table A.2 in the Supplementary material).[5]

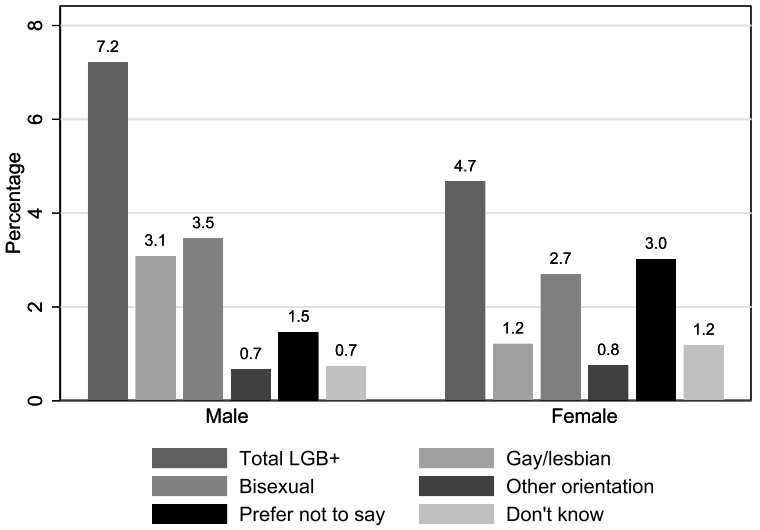
Comparing the estimates of sexual minorities with other surveys carried out in the 27 EU countries, we observe significant similarities as well as some discrepancies. In particular, an online survey carried out by IPSOS in 2021 (the LGBT+ Pride 2021 Global Survey) asked the question on sexual orientation in 27 countries, including 9 EU countries. The share of people identifying as LGB+ is very similar (*i.e.,* the difference is within 1 percentage point) for France, the Netherlands, and Sweden. In the other countries (*i.e.,* Belgium, Germany, Hungary, Italy, Poland, and Spain), the estimate of the LGB+ population from the EU-LS is lower than in the IPSOS survey. A possible explanation is that the IPSOS survey focused on LGBTQIA+ equality, and response rates may have been higher among people identifying as a sexual minority. On the other hand, the population estimates of sexual minorities from national surveys carried out either face-to-face or through telephone interviews tend to be substantially lower than in the EU-LS in France, Germany, Ireland, and Sweden (see Table A.2 in the Supplementary material and OECD 2019). Besides the survey mode, the difference may also come from the large time gap between the surveys given that younger generations are more likely to declare as LGB+ and that the rates of reporting a non-heterosexual orientation have increased over time, possibly due to improved attitudes toward sexual minorities (Badgett et al. 2021).

3 LGB+ population in Europe

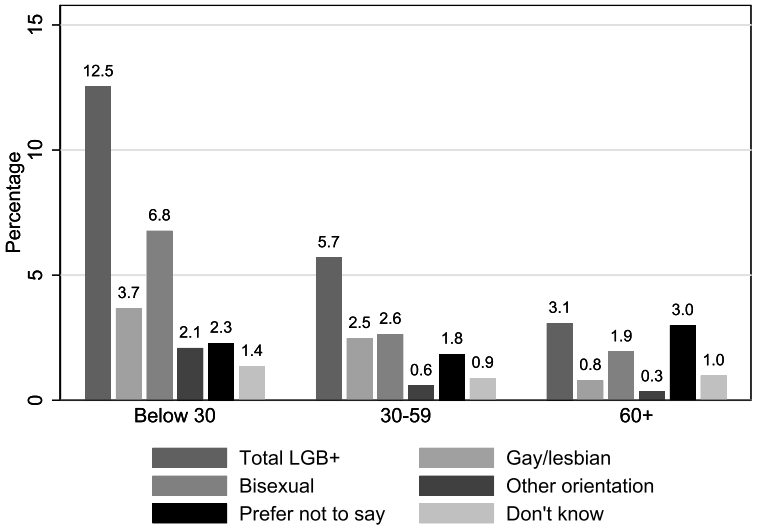
3.1 Patterns based on the EU-LS survey

The EU-LS is the first EU-wide survey on the overall population asking about sexual orientation. On average, 6.1% of people identify themselves as LGB+, 90.6% as heterosexual/straight, 1% don't know, and 2.3% prefer not to disclose their sexual orientation. Panel (a) of Fig. 1 shows that more men than women declare as LGB+ in the EU (7.2% vs. 4.7%). The difference is mainly due to a higher share of men identifying as gay (3.1%) than women identifying as lesbian (1.2%). However, the share of women refusing to answer this question is higher than those of men (3% vs. 1.5%), so that the share of those identifying as heterosexual is 91% for both sexes. Moreover, panel (b) of Fig. 1 shows that younger individuals are more likely to declare themselves as LGB+ than older ones: almost 13% of individuals between 16 and 30 do so, compared to 6% of those aged between 30 and 59 and just 3% of those aged 60 or older. The share of those answering don't know is also higher among those below the age of 30, consistent with the fact that especially younger people might still be exploring or questioning their sexual orientation. On the contrary, the share of those refusing to answer the question is higher among individuals above the age of 60.

[5] The largest difference is found for France, where the share of those declaring as LGB+ is circa 20% larger (7% vs. 6%) in the EU4-LS compared to the main survey.



(a) By gender



(b) By age groups

Fig. 1 Population declaring as LGB+ (%), by gender. Notes: EU-LS 2022 averages using EU27 sampling weights. The category "Heterosexual/straight" is not reported

Furthermore, several interesting patterns emerge when looking at the response to the sexual orientation question by other socio-demographic characteristics of respondents besides age and gender. In particular, correlates of non-response to this question are worth exploring. Less-educated individuals and those living in poorer households

are more likely to refuse to answer the question on sexual orientation, while those in a relationship are more likely to answer it (see Table A.3 in the Supplementary material). Moreover, those regularly attending religious services are 2 percentage points more likely to refuse answering the question and 1 percentage point more likely to state that they don't know their sexual orientation. Non-response to the sexual orientation question is also correlated to non-response to the income and relationship status question, indicating that some individuals prefer not to answer several personal questions jointly. This fact does not seem to be due to respondents speeding through the questionnaire, given there is a positive correlation between response time to the sexual orientation question and answering *prefer not to say* or *don't know*.[6]

Figure 2 shows that there are large differences across countries in the share of individuals declaring as LGB+, ranging from 4% in Cyprus, Czechia, Hungary, and Italy to over 10% in Ireland, Luxembourg, and Slovenia.[7] In general, shares tend to be high in Northern Europe and low in Southern and Eastern Europe (with the exception of Malta, Spain, Slovenia, and the Baltic countries). There are also differences between countries in the share of people that identify themselves with different LGB+ minority groups. For instance, in Croatia, Estonia, Latvia, Finland, and Sweden, the share of those identifying as lesbian or gay is below the EU average, while the share of those identifying as bisexual is above average. Moreover, the share of people preferring not to answer the question on sexual orientation is often relatively high in countries with an overall low share of people identifying as LGB+, such as Bulgaria, Hungary, and Romania.

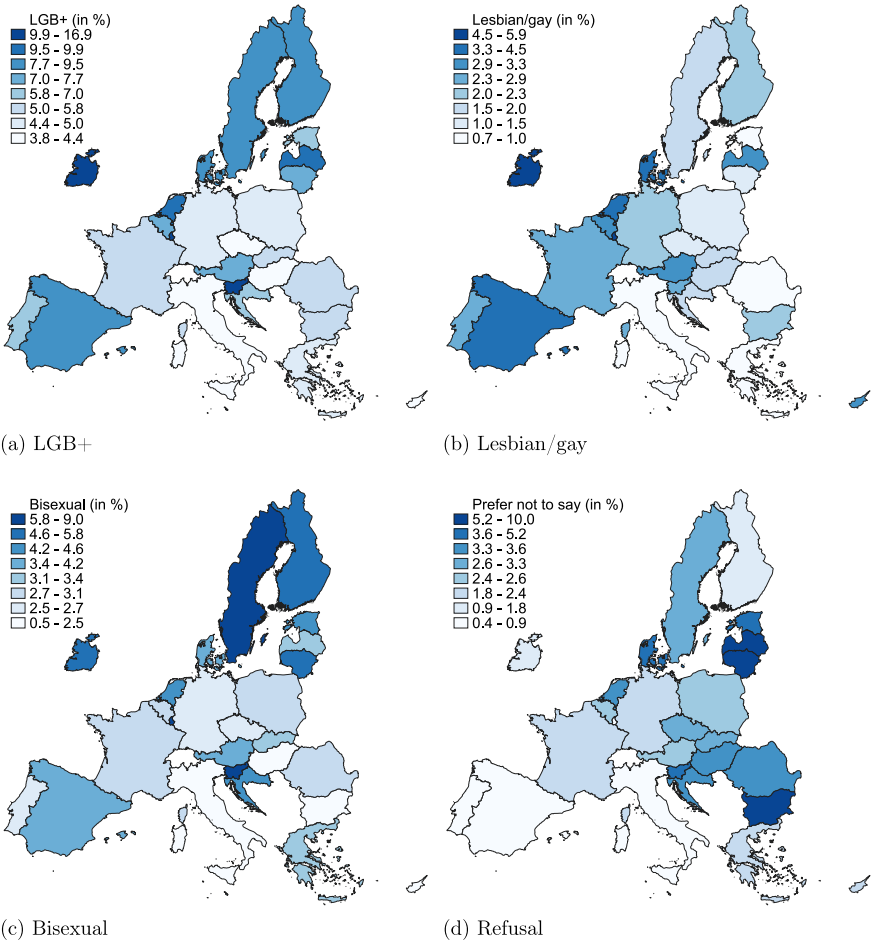
3.2 Inclusion of sexual minorities and contextual factors: country-level analysis

The previous discussion has shown that there are significant differences between EU countries in the share of respondents declaring themselves as LGB+. The question arises whether these differences are due to a different share of the population being non-heterosexual or rather to differences in openness about sexual orientation. The first case may arise, for instance, if sexual minorities are more likely to move to high-amenity locations (Black et al. 2002) or to places with less discrimination and more legal rights (Marcén and Morales 2022). However, geographic mobility across countries in the EU is not large enough to fully explain the cross-country differences in the reporting of sexual orientation.[8]

[6] We are aware of the fact that the option *prefer not to say* or *don't know* could be indicative of various factors, including discomfort with the available categories such as *other sexual orientation* or reluctance to self-identify within the constrained options provided, rather than a strict refusal to disclose sexual orientation. This is certainly a limitation of the EU-LS survey design.

[7] The high share of LGB+ people in Luxembourg (17%) may be due to the fact that the country has a relatively young and highly educated population. However, the survey failed to reach the targeted sample size for the older and less-educated population in the country, which could also contribute to the relatively high share of the LGB+ population. Given the small sample size for Luxembourg (1.4% of the total sample), results are not affected when excluding from the analysis individuals residing in the country.

[8] While the share of foreign-born individuals is higher among those identifying as LGB+ than heterosexual people (18% vs 8%), it is still not large enough to explain the differences in the share of people identifying as sexual minorities, which are larger than 200% between several EU countries.

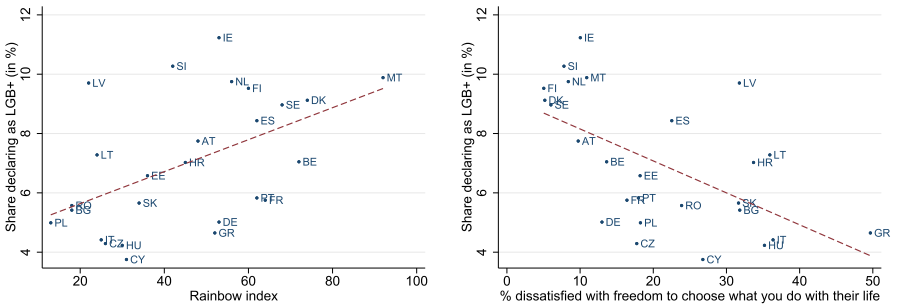


Source: EU-LS 2022.

Fig. 2 Population declaring as LGB+ (%), 27 EU member states. Source: EU-LS 2022

Conversely, differences across countries are more likely to stem from differences in the willingness to disclose one's sexual orientation or from societal restrictions affecting the possibility to explore or question one's sexuality. We descriptively investigate this particular social phenomenon by contrasting the average share of individuals declaring themselves as LGB+ with information about overall country-level attitudes towards LGBTQIA+ inclusion, enforcement of institutions aimed at protecting minority rights, and the importance attached to social norms and restrictions.[9]

[9] To the best of our knowledge, there are very few, if any, significant contributions in the literature dealing with specific country-level cultural or historical characteristics and contemporary attitudes towards sexual minorities. One exception is Brodeur and Haddad (2021) who find a higher share of same-sex couples and more favourable attitudes toward homosexuality in US counties that have experienced gold discoveries during the gold rushes, likely because of a lower religiosity and lack of places of worship in these locations.



(a) Rainbow Index (b) No freedom of choice (social norms)

Fig. 3 Population declaring as LGB+ (%) versus Rainbow index and satisfaction with freedom of choice from Gallup World Poll. Notes: The *y*-axis reports the average share declaring as LGB+ by country in the EU-LS. The *x*-axis reports country-level scores of the Rainbow Index in panel (**a**), and the share of the country population not satisfied with their freedom to choose what you do with their life in the Gallup World Poll (average across waves 1–17) in panel (**b**). The red dashed line displays a linear regression fit. The R-squared is 0.25 for panel (**a**) and 0.34 for panel (**b**). The figures exclude Luxembourg, which has a share of LGB+ of 17%. The correlation coefficient is 0.51 for the variables in panel (**a**) (0.50 including Luxembourg) and −0.56 for panel (**b**) (−0.58 including Luxembourg)

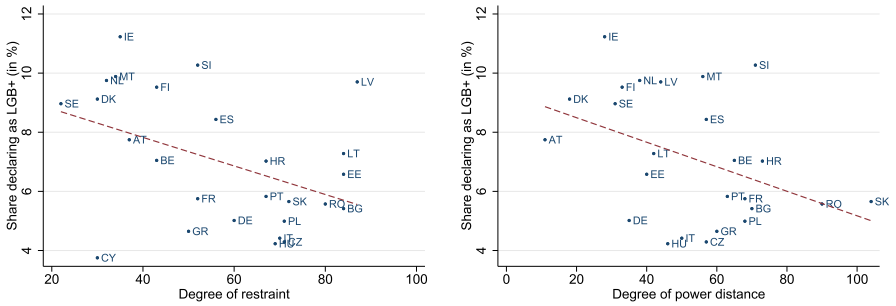
Figure 3 compares the average share of individuals identifying as LGB+ with the Rainbow index measuring equality and non-discrimination laws, legal gender recognition, bodily integrity, protection from hatred and violence, and family rights of sexual minorities in Europe (panel (a)),[10] and with another country-level measure of average satisfaction with of choice taken from the Gallup World Poll (panel (b)).[11] The share of individuals declaring as LGB+ tends to be lower in countries where more people are not satisfied with their freedom to choose how to live their own life and in societies characterised by lower protection of human rights for sexual and gender minorities. Moreover, we find a negative association between country openness and the share of respondents refusing to answer the question on sexual orientation in the EU-LS survey (see Fig. A.1 in the Supplementary material). This may be a further indication that LGB+ people are less likely to disclose or explore their sexual orientation in more conservative countries.

Furthermore, in Fig. 4, we plot the share of individuals declaring as LGB+ against the indices of restraint and power distance from Hofstede et al. (2010).[12] Restraint societies are characterised by strict social norms and prohibitions that hamper one's freedom of choice. The prevalent belief in these cultures is that everybody should align with rules and norms governing socially acceptable behaviours. This cultural dimen-

[10] The Rainbow index examines the laws and policies in 49 countries using 74 criteria, divided between seven thematic categories: equality and non-discrimination; family; hate crime and hate speech; legal gender recognition; intersex bodily integrity; civil society space; and asylum. For more information, see https://www.ilga-europe.org/report/rainbow-europe-2022/

[11] Gallup surveys residents in more than 150 countries and areas using randomly selected, nationally representative samples.

[12] The authors develop a six-dimensional model of national culture and discuss how these values relate to individual behaviour. The six-dimension data matrix is available at https://geerthofstede.com/research-and-vsm/dimension-data-matrix/. For further details, see Hofstede et al. (2010).



(a) Index of restraint (norms and restrictions) (b) Index of power distance (equality)

Fig. 4 Population declaring as LGB+ (%) versus cultural indices of restraint and power distance. Notes: The *y*-axis reports the average share declaring as LGB+ in the EU-LS. The *x*-axis reports the country-level indices of restraint and power distance from Hofstede's six-dimensional model of culture, ranging from 0 (low restraint) to 100 (high restraint). The red dashed line displays a linear regression fit. The R-squared is 0.19 for panel (**a**) and 0.17 for panel (**b**). The figures exclude Luxembourg, which has a share of LGB+ of 17%. In panel (**b**), Cyprus is also excluded due to missing data for the index of power distance. The correlation coefficient is −0.41 for the variables in panel (**a**) (−0.43 including Luxembourg) and −0.44 for panel (**b**) (−0.40 including Luxembourg)

sion (also known as "life-control") captures, hence, the degree to which individuals feel they have completely free choice over their lives (Minkov 2009; Hofstede et al. 2010). Power distance, on the other hand, captures the way individuals in a society relate to each other on a hierarchical scale: cultures that give great deference to a person of authority are characterised by "high power distance", while a culture that values the equal treatment of everyone is a "low power distance" society.

There is a clear negative association between the share of LGB+ and restraint, indicating that individuals originating from societies characterised by stricter social norms that fit individuals into predefined behavioural standards are, on average, less inclined to openly declare their sexual orientation. The correlation remains strong even when considering the degree of power distance. Societies that value equal treatment of everyone ("low power distance cultures") register significantly higher rates of openness. This is not surprising since more religious and conservative countries are generally less open towards homosexuality, which, in turn, translates into lower rates of disclosure or reporting. For instance, Janssen and Scheepers (2019) find that authoritarianism and conservative gender beliefs are related to rejection of homosexuality. This result is in line with some previous studies (Whitley 2001; Adamczyk 2017). In general, the literature suggests that individuals who are more exposed to traditional norms and values strongly reject homosexuality (Whitley 2009; Janssen and Scheepers 2019).

Finally, the EU-LS data contains unique information on the average response time to the sexual orientation question. This may allow us to gain additional insights into individuals' openness regarding their sexual orientation. More precisely, individuals respond faster when the offered responses involve less uncertainty (Moffatt 2005; Konovalov and Krajbich 2019). In other words, the choice becomes easier (and, hence, the response time shorter) when comparable alternatives are collocated more far away

from an individual's indifference point (Liu and Netzer 2023). Information on response time, therefore, may reveal how confident the respondents are (with respect to society and/or themselves) in declaring their "true" sexual orientation.

Figure 5 shows the average response time for each category of sexual orientation and for two clusters of countries, namely those guaranteeing stronger protection of sexual minorities (Rainbow Index above the median) and those where this protection is less enforced (Rainbow Index below the median). Overall, response times are significantly lower in the former group of countries (mean response time 7.41 s versus 9.87 s). The answer categories "don't know" and "prefer not to say" are particularly interesting, since the associated average response time is significantly higher with respect to heterosexual, gay/lesbian, and bisexual response times. These individuals, hence, may be more reluctant to declare the "true" value of their sexual orientation. On the contrary, we do not find any significant difference in the response times to a set of standard questions on gender, relationship status, and the presence of pets in the house, both across categories of sexual orientation and between countries above and below the median of the Rainbow Index (see Fig. A.2 in the Supplementary material).

At the same time, however, the differences between response times on sexual orientation and other standard questions in countries with lower enforcement of minority rights are statistically significant for all answer categories of sexual orientation (Fig. A.3, Panel (a), in the Supplementary material). In those countries, individuals dedicate

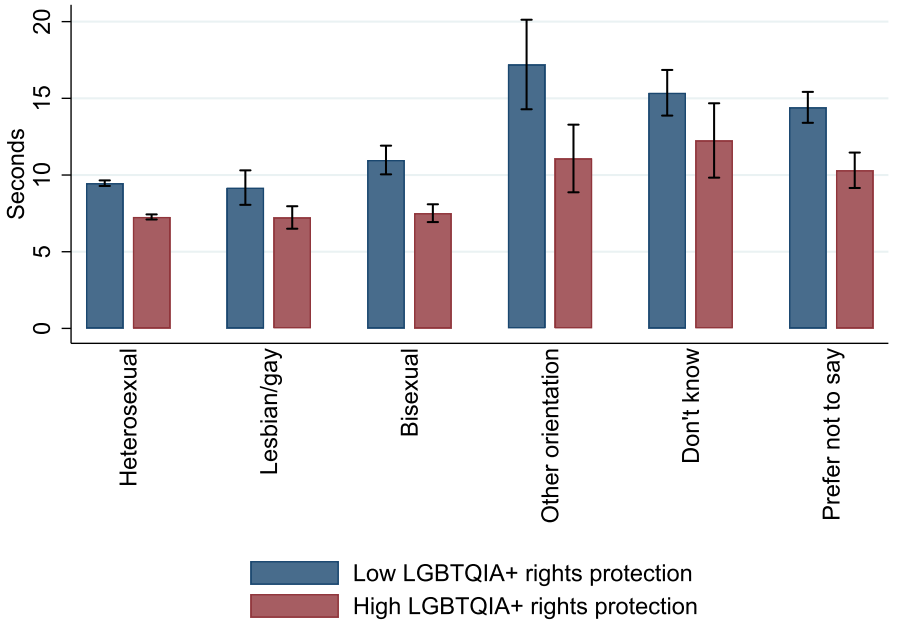


Fig. 5 Average response time to question on sexual orientation by Rainbow Index. Notes: The *y*-axis reports the average response time (in seconds) by sexual category in the EU-LS. Low LGBTQIA+ rights protection refers to respondents residing in countries with a Rainbow Index below the median, while high LGBTQIA+ rights protection to countries with an index above the median. The Rainbow Index is expressed on a scale ranging from 0 to 100, with a median value of 48

much more time to answering the question regarding their sexual orientation compared to less delicate issues. This is particularly pronounced for those identifying as being bisexual, having another sexual orientation, or those who don't know or refuse to say. On the other hand, more open societies with stronger protection of minority rights do not register significant differences in response times (Panel (b)), with the exception of don't know and refuse to say answer categories.

4 Social stressors, coping strategies, and health of sexual minorities

4.1 Conceptual framework and hypotheses

The existing literature suggests that sexual minorities report poorer physical and mental health outcomes compared to their heterosexual peers (Lick et al. 2013; Meads 2020; Williams et al. 2021). Moreover, they are also more likely to engage in risky behaviours such as smoking, drinking, drug consumption, unhealthy dietary habits, or high-risk sexual relationships (Meyer 2003; Goldbach et al. 2013; Slater et al. 2017; Schuler et al. 2018; Drydakis 2022a). One explanation for such patterns is provided by the minority stress framework (as part of a more general social stress theory), according to which stigma-related social exclusion, prejudice, and discrimination create a more hostile and stressful environment and exacerbate the vulnerability of sexual minorities, bringing them to experience a higher likelihood of emotional disorders and physical health comorbidity (Meyer 1995; Dohrenwend 2000; Meyer 2003; Rivers et al. 2018; Meyer et al. 2019; Hoy-Ellis 2023).

Minority stress refers to a set of factors at the societal and family level. Broader environmental factors include prejudice, homophobia, discrimination, and marginalization. As a result, sexual minorities often experience rejection from friends, conflict at the workplace, unfair treatment in education, limited access to healthcare services, and harassment (Frost 2011). Furthermore, societal norms and homophobic approaches to what is considered generally acceptable often lead to lower support from family members and close relatives both during childhood and in adulthood (Bouris et al. 2010; Pearson and Wilkinson 2013; Schnarrs et al. 2019). Indeed, sexual minorities are more likely to report having experienced (or still experience) lower relationship quality with parents and a higher incidence of physical abuse and emotional neglect. These adverse childhood experiences are generally associated with poorer health outcomes later in life (Brugiavini et al. 2022; Kovacic and Orso 2022). Moreover, stressful events in childhood may have a substantial impact on an individual's social development, which may increase the likelihood of experiencing loneliness in adulthood, which, in turn, further increases the likelihood of experiencing adverse physical and mental health outcomes (Guthmuller 2022; Casabianca and Kovacic 2024; Kovacic and Schnepf 2023).

As previously mentioned, the effect of environmental stressors may also affect health through their impact on sexual minorities' engagement in coping strategies aimed at reducing stressful conditions and associated emotional distress. These include smoking, drinking, drug use, an unhealthy diet, physical inactivity, and highly risky sexual behaviours (Friedman 2020). Several scholars have shown that the experience of

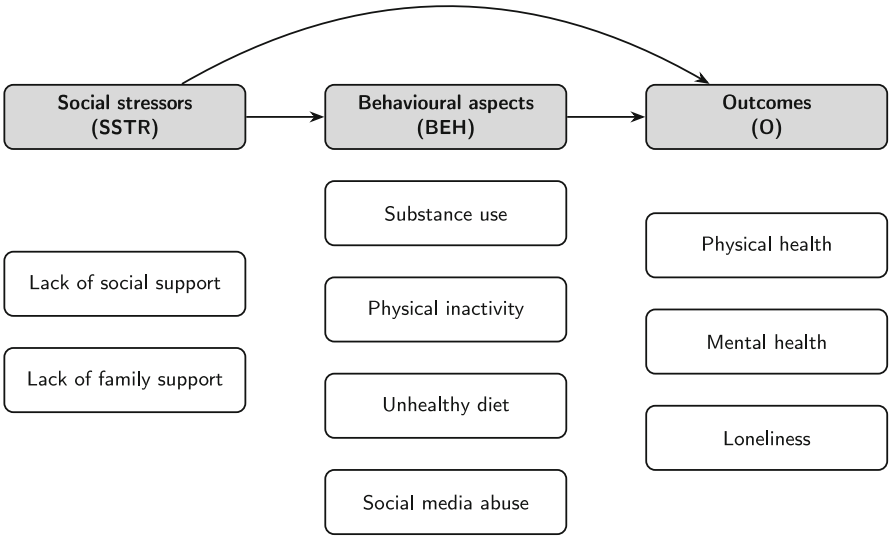


Fig. 6 Conceptual framework linking contextual factors to behavioural risks and health outcomes

discrimination (racial, ethnic, or sexual) is associated with a higher likelihood of substance use and substance use disorders (Amaro et al. 2021). These coping behaviours can mitigate the negative effects of minority stress on mental health in the short run through specific neurological mechanisms that relieve feelings of anxiety and stress but lead to worse physical health in the long run (Mezuk et al. 2013).[13] In addition, some recent studies argue that social pressures, low self-esteem, and peer comparisons, especially among younger individuals, may exacerbate the excessive use of social media, with potentially detrimental effects on mental health conditions (Twenge 2017; Braghieri et al. 2022; Orben et al. 2022) and loneliness (Allcott et al. 2020), with the latter further increasing the probability of experiencing emotional disorders (Casabianca and Kovacic 2024). Poorer health outcomes, hence, may be a direct consequence of unhealthy lifestyles. The mechanism linking contextual factors to risky behaviours and poorer performance in the health domain is depicted in Fig. 6.

Accordingly, we define the following hypotheses:

Hypothesis 1 *Sexual minorities experience less social and family support in childhood and adulthood compared to the general population.*

Hypothesis 2 *Sexual minorities are more likely to engage in cognitive and behavioural coping strategies aimed at reducing or adapting to stressful conditions and associated emotional distress, such as smoking, drinking, unhealthy lifestyles, and risky health behaviours, as well as excessive social media use, compared to the general population.*

[13] More precisely, substance use triggers the release of dopamine and beta-endorphins, which instantly relieve feelings of anxiety and stress. At the same time, however, they reinforce addictive behaviour through the reward system in the brain (Volkow et al. 2017), increasing morbidity and mortality over the life course.

Hypothesis 3 *Higher exposure to chronic stressors related to stigma, discrimination, and social exclusion of sexual minorities is associated with a higher likelihood of emotional disorders, loneliness, adverse physical health-related outcomes, and functional decline compared to the general population.*

4.2 Data

Social stressors

The exposure to social stressors in childhood and adulthood is measured by the following variables: individuals' early life conditions, *i.e.,* quality of relationship with parents during childhood, having had a few close friends in childhood, and support from family members and relatives in adulthood, *i.e.,* the number of close family members (two or less close family members), and frequency of meeting family members (less than once per week). The parent-child relationship quality is measured on a 10-point scale, ranging from 1 ("not close at all") to 10 ("very close"). We follow Brugiavini et al. (2022) and Kovacic and Orso (2022), and recode the answers into a dichotomous variable, where a value of 1 indicates that the individual has a low-quality relationship with either or both parents (answer categories 1–4). Having few close friends in childhood is measured with a binary variable indicating that individuals had rarely or never a group of friends that they felt comfortable spending time with. In addition, we consider the following social support factors: the number of close friends (two or fewer close friends), frequency of meeting close friends (less than once per week), availability of support in the case of worries or fears (yes or no), and having people to count on for doing something enjoyable most of the time (yes or no). As additional controls, we include a binary variable capturing whether the respondent grew up in the absence of one or both parents, has lived with close relatives with mental health issues, and/or has had drinking problems, as well as having had poor health in childhood.

Behavioural coping strategies

Individuals' behavioural aspects are captured by three indicators of unhealthy behaviour, *i.e.,* whether an individual smokes more than 10 cigarettes per day, has an unhealthy diet (few fruits and vegetables), or is physically inactive. In addition, we consider an indicator capturing the individuals' risk-taking attitudes in the health domain. Unfortunately, we do not have any information in our data on drug use and/or abuse. Finally, to capture an excessive use of social media, we consider a binary variable that equals one if a respondent spends more than 1 h per day on social media (distinguishing between social networks and instant messaging), another variable capturing whether respondents report to have neglected work or family duties due to excessive time spent on social media, as well as the reason for such a behaviour (feeling better).

Outcomes

Among the outcome variables, we consider the individuals' self-assessed overall health (SAH), whether they suffer from long-lasting health problems, and a set of mental/emotional disorders. Self-assessed health is measured on a five-point scale from

"very good" (score 1) to "very poor" (score 5).[14] This indicator has been dichotomised into a binary variable with a value of 1 if individuals declare that their health is "fairly poor" or "very poor", and 0 otherwise. Grouping the two worst options into one single category (instead of considering a lower cut-off, *i.e.*, "very poor" only) is more suitable for smaller reference groups (Plante et al. 2024).[15] Limitations are captured by another dichotomous variable indicating individuals suffering from long-lasting physical and mental health problems. We do not have any information in our data on single physical health issues. As for mental/emotional distress, we consider the following disorders: depressive symptoms, feelings of worthlessness, anger, nervousness, hopelessness, and being unhappy.

The survey also includes rich information about loneliness and the quality of social contacts and interactions. Loneliness is generally understood as the negative subjective experience arising when an individual perceives a significant mismatch between actual and desired social interactions (Perlman and Peplau 1981; Peplau et al. 1982; Erber and Gilmour 2013). We consider three different measures of loneliness, namely a direct question, a reduced UCLA scale, and De Jong measures of emotional and social isolation. The exact wording of the items in the UCLA loneliness scale is: *How often do you feel isolated from others?*, *How often do you feel you lack companionship?*, *How often do you feel left out?*. In each case, the available responses are: *1. Often, 2, Some of the time, 3. Hardly ever or never.* A sum score was computed; therefore, the scale ranges from 3 (not lonely) to 9 (very lonely). A multi-item measure that does not mention loneliness directly can be particularly useful because people are often reluctant to admit feeling lonely (Qualter et al. 2021), or there is variation in how people understand the term "loneliness". The 6-item De Jong Gierveld Loneliness Scale, on the other hand, captures emotional loneliness (stemming from the absence of an intimate relationship or a close emotional attachment) and social loneliness (stemming from the absence of a broader group of contacts or an engaging social network).

Explanatory and control variables

Among explanatory and control variables, we consider a set of individual-specific demographic and socio-economic characteristics, such as age, gender, marital status, employment situation, education, number of children, type of residence area (rural or urban), household income, and individuals' immigration status (first- or second-generation immigrants). We consider six age categories (16–25, 26–35, 36–45, 46–55, 56–65, and 65+); for individuals' relationship status, we distinguish between those

[14] Self-rated health is widely considered a valid and reliable indicator of overall health status. The literature shows a strong correlation between SAH and mortality or morbidity (Idler and Benyamini 1997) and with more complex health indices, such as functional ability or indicators derived from health service use (Undén and Elofsson 2006). Dichotomisation is a common practice to simplify the variable because the responses cannot be scored on a numerical scale due to the non-equidistant nature of the true scale between categories (Wagstaff et al. 2007).

[15] We, however, performed an additional robustness check on the alternative lower cut-off, and the results don't change significantly. We do not report these results for the sake of space and clarity. They are available upon request.

in a relationship, married or cohabiting, separated, and widowed (with singles as a reference category); working status comprises unemployed, retired, homemakers, and still in education (with employed individuals as a reference category); for income we consider five quintiles of household disposable income and a sixth category comprising non-response to the income question; immigration status is captured by two dummy variables indicating first- and second-generation immigrants; the children variables control for the presence of kids younger than 5 years old and those aged between 6 and 15.

Our final sample comprises 25,123 individuals (out of which 1851 identify as gay/lesbian, bisexual, or other sexual orientation, and 1034 don't know or prefer not to answer) residing in 27 EU member states who provide consistent information throughout the survey.[16] Table A.1 (in the Supplementary material) reports unweighted summary statistics.

4.3 Empirical strategy

In order to empirically validate Hypotheses 1 - 3, we estimate the following empirical model:

$$DV_i = \alpha_0 + \alpha_1 X_i + \alpha_2 (LGB+) + \alpha_3 FE + \epsilon_i, \quad (1)$$

where DV is a vector of indicators referring to social stressors ($SSTR$), behavioural aspects (BEH), and health-related outcomes and loneliness (O), *i.e.*, $i = \{SSTR, BEH, O\}$. DV_{SSTR} includes the indicators of social stressors related to individuals' childhood and adulthood: few friends in childhood, poor quality parent–child relationship during adolescence, lack of social support in adulthood (few close friends, rare contact with friends, lack of support in case of need), and lack of support from family members (few close relatives, rare contact with family members). DV_{BEH} contains smoking, unhealthy dietary habits, physical inactivity, risk-taking attitudes in the health domain, excessive use of social media, and the related attitudes to neglect work, school, or family-related duties. Finally, the set of indicators in DV_O accounts for physical and mental health outcomes (self-assessed health, long-lasting limitations, and emotional disorders) and experiences of loneliness.

X is a set of individual characteristics that includes (depending on the model): age, gender, education, type of the residential area (rural vs. urban), household disposable income (quintiles), relationship status, employment status, dummy variables indicating first- and second-generation immigrants, dummy variables for the presence of children in the household (any child younger than 5 years old and those between 6 and 15 years old), and response time to the sexual orientation question and average response time to other selected questions. In regressions of health-related behaviours and health outcomes, X also includes information on bad health in childhood. In regressions of social stressors in childhood, X also includes a set of additional childhood experiences, *i.e.*, absence of one or both parents, close relatives with mental health problems, and

[16] 523 respondents are excluded from the analysis because of missing values in the variables needed to calculate sampling weights (age, gender, and education) or because of an inconsistent lack of variation in the answers to a set of multiple questions (*i.e.*, *straightlining*).

close relatives with drinking problems. FE are fixed effects for the country of current residence.

In order to show that the impact of social stressors (lack of social and family support) and of unhealthy behaviour on health outcomes is more pronounced for LGB+ individuals, we estimate the following regression models:

$$DV_O = \beta_0 + \beta_1 X_i + \beta_2 (LGB+) + \beta_3 DV_{SSTR,BEH} + \beta_4 (LGB+) \times DV_{SSTR,BEH} + \beta_5 FE + \epsilon_i, \quad (2)$$

We expect that being exposed to social stressors in childhood and/or adulthood and the probability of unhealthy behaviour increase adverse health outcomes to a greater extent for sexual minorities compared to the rest of the population.

For each dependent variable, we also disaggregate the LGB+ category into gay, lesbian, bisexual, and other sexual orientations and estimate the models on the entire sample and separately for men and women. We also include individuals who answered "*don't know*" to the sexual orientation question and those who refused to answer this question. The same applies to all independent variables. We do not show these additional categories in our regression results tables for the sake of space and clarity. Moreover, in all model specifications, we control for the average response time to the sexual orientation question, as well as for the "refuse to answer" and "don't know" answers to all independent variables. Depending on the type of the dependent variable, the estimation technique is either OLS, logit, or ordered logit model. In the case of non-linear estimation, average marginal effects are reported. We employ post-stratification weights in all regression models as described in Section 2 and cluster the robust standard errors at the country of residence level. Furthermore, following (Romano and Wolf 2005), we provide multiple hypothesis testing corrections controlling for the family-wise error rate (FWER) for all dependent variables. In such a way, we are able to address potentially erroneous "significant" findings due to the high number of outcome variables considered. Finally, in all regression models, robust standard errors are bootstrapped and clustered at the country of residence level.[17]

5 Results

In this section, we present the evidence documenting disparities in the exposure to social stressors, behavioural risks, health-related outcomes, and loneliness of sexual minorities. This is a significant contribution to the literature since inequalities in these dimensions represent an important public health issue and have been widely understudied, especially in the European context. Moreover, different from many other studies examining within-group processes and their associations with outcomes, our data allows us to explore differences between sexual minorities and the rest of the population. As already mentioned in Section 2, since the share of non-binary individuals that do not identify with the male or female gender identity is very low (0.4%), we consider only the population of gay, lesbian, bisexual people, and those with other

[17] We apply the wild bootstrap as recommended by Cameron et al. (2008) for estimates with clustered standard errors and few clusters.

sexual orientations (LGB+) as a reference category for sexual minorities. Results for non-binary individuals are presented in a separate analysis. In all regression results tables, the reported coefficients are average marginal effects expressed as percentage point differences or, in the case of non-binary outcome variables, average variations in levels. For the sake of clarity, when discussing the results, in some cases we also refer to the size effects.[18]

5.1 Exposure to social stressors of LGB+ individuals

According to our conceptual framework (Fig. 6), social stressors can be grouped into two broad categories: factors related to individuals' childhood and those experienced during adulthood. Lower support from family members and friends in childhood is captured by an adverse parent-child relationship and having rarely or never had a group of friends that the respondents felt comfortable spending time with during adolescence. The evidence in Table 1 suggests that LGB+ individuals are significantly more likely to have experienced a low relationship quality with parents as well as having had few close friends. This effect is mainly driven by LGB+ males, while the difference between LGB+ women and their heterosexual peers is smaller and marginally significant. The disadvantage in terms of adverse relationships with parents is particularly pronounced for bisexual men, who have a 7 percentage points higher probability of reporting this issue compared to their heterosexual peers, which represents a difference of 35%.[19] Gay men, on the other hand, are 7.5 percentage points more likely to have had smaller social networks in childhood compared to heterosexual men, which represents a difference of circa 90%. Finally, males declaring having sexual orientation other than gay or bisexual are even more disadvantaged, with a 11.7 higher likelihood of having had few close friendships in childhood compared to heterosexual individuals, while, at the same time, they do not differ in terms of adverse relationships with parents. These results represent a fundamental risk factor for sexual minorities, which may increase the likelihood of emotional disorders and physical health comorbidity later in life (Brugiavini et al. 2022; Kovacic and Orso 2022; Kovacic and Schnepf 2023).

Similar evidence is observed when considering the prevalence of social stressors in adulthood (Table 2). Sexual minorities are significantly more likely to have less than three close family members and/or friends, to meet family members and friends less than once a week, and to not have someone to count on in case of need. The disparity in terms of the number of close family members is particularly large for both LGB+ men (10 percentage points) and LGB+ women (7 percentage points), representing a

[18] The regression results tables reporting size effects are not included in the manuscript but are available upon reasonable request.

[19] This is calculated by relating the probability of reporting adverse relationships of bisexual men (27%) to the respective probability for heterosexual men (20%). The regression tables reporting probabilities in percent are not included in the manuscript and are available upon request.

Table 1 Social stressors in childhood of LGB+ individuals

	Adverse relationship parents			Few close friends		
	All	Male	Female	All	Male	Female
LGB+	0.047***	0.063***	0.028*	0.033***	0.055***	0.005
	(0.013)	(0.017)	(0.015)	(0.010)	(0.011)	(0.006)
Lesbian/gay	0.047***	0.035**	0.077**	0.065***	0.075***	0.013
	(0.014)	(0.013)	(0.032)	(0.015)	(0.016)	(0.015)
Bisexual	0.045**	0.069**	0.026	0.009	0.021	0.002
	(0.020)	(0.029)	(0.020)	(0.009)	(0.014)	(0.005)
Other SO	0.056	0.163	−0.026	0.055***	0.117***	0.009
	(0.061)	(0.097)	(0.053)	(0.017)	(0.034)	(0.012)
No. of observations	24,528	11,745	12,783	24,854	11,904	12,950

Notes: The table shows the percentage points differences in reporting poor relationships with parents in childhood and rarely or never having a close group of friends during school years. For each dependent variable, two separate regression models are estimated: one with the aggregate LGB+ category containing lesbian, gay, bisexual people, and those with other sexual orientations, and another with separate categories of LGB+ individuals. The reference category is heterosexuals. All models contain the full set of demographic and socio-economic characteristics, as well as a binary variable capturing whether the respondent grew up in the absence of one or both parents, has lived with close relatives with mental health issues and/or those with drinking problems, and having had poor health in childhood. The full set of explanatory and control variables includes: age, gender, education, working status, kids under 5 years old, kids aged between 6 and 15 years, rural versus urban area, first- and second-generation immigrants dummy, household income quintiles, and response time to the sexual orientation question and average response time to other selected questions. The method of estimation is Logit. Robust standard errors bootstrapped and clustered at the country of residence level are reported in parentheses. Significance levels: $*p < 0.1$; $**p < 0.05$; $***p < 0.01$

difference of circa 32% and 24%, respectively, compared to their heterosexual counterparts. Within genders, this discrepancy is highest for gay men (14.5 percentage points) and bisexual women (8.5 percentage points). On the contrary, the disparity in terms of the number of close friends and frequency of interactions with them is large and significant only for LGB+ men and not for LGB+ women.[20]

Interestingly, bisexual individuals seem particularly stressed compared to the rest of the population regarding the lack of support with private worries or fears, while gay and lesbian individuals have, on average, fewer close friends and family members. Furthermore, social contacts for sexual minorities are generally less frequent, both with friends and their families. Bisexual and lesbian women, on the other hand, do not differ significantly from their heterosexual peers concerning the number of close friends and frequency of contact, while they register some disparity in the family context. Gay and lesbian individuals, unlike bisexual individuals, do not differ significantly from their heterosexual counterparts in cases of a need for support with private worries or fears and in terms of having company.

[20] The difference between the coefficients for LGB+ men and LGB+ women is statistically significant at the 95% confidence level for both having few close friends and infrequent contacts with them. Significance tests for differences by gender are not included in the manuscript and are available upon request.

Table 2 Social stressors in adulthood of LGB+ individuals

	Close family members (<3)			Few meetings: family		
	All	Male	Female	All	Male	Female
LGB+	0.090***	0.103***	0.069***	0.073***	0.101***	0.039**
	(0.015)	(0.024)	(0.022)	(0.017)	(0.026)	(0.016)
Lesbian/gay	0.122***	0.145***	0.073**	0.092***	0.113***	0.046
	(0.023)	(0.031)	(0.028)	(0.029)	(0.034)	(0.027)
Bisexual	0.087***	0.079**	0.085**	0.060***	0.088***	0.033**
	(0.024)	(0.029)	(0.036)	(0.015)	(0.028)	(0.014)
Other SO	0.024	0.035	0.011	0.082	0.112	0.056
	(0.016)	(0.039)	(0.010)	(0.106)	(0.156)	(0.132)
No. of observations	23,513	11,181	12,332	24,792	11,887	12,905
	Close friends (<3)			Few meetings: friends		
	All	Male	Female	All	Male	Female
LGB+	0.048**	0.064***	0.021	0.048**	0.096***	−0.008
	(0.016)	(0.021)	(0.029)	(0.022)	(0.037)	(0.043)
Lesbian/gay	0.067***	0.086***	0.003	0.068**	0.098***	0.010
	(0.020)	(0.027)	(0.002)	(0.035)	(0.041)	(0.061)
Bisexual	0.053**	0.071**	0.035	0.047**	0.085	0.014
	(0.023)	(0.025)	(0.067)	(0.021)	(0.059)	(0.013)
Other SO	−0.016	−0.055	0.003	0.001	0.145	−0.107
	(0.019)	(0.061)	(0.007)	(0.001)	(0.170)	(0.062)
No. of observations	23,303	11,122	12,181	24,748	11,859	12,889
	Low support: worries			Low support: company		
	All	Male	Female	All	Male	Female
LGB+	0.068**	0.062	0.072***	0.044**	0.076**	0.010
	(0.030)	(0.088)	(0.025)	(0.018)	(0.035)	(0.010)
Lesbian/gay	0.034	0.010	0.066	0.017	0.040	−0.028
	(0.283)	(0.012)	(0.048)	(0.064)	(0.263)	(0.119)
Bisexual	0.082**	0.093*	0.075**	0.072***	0.110***	0.043
	(0.033)	(0.055)	(0.032)	(0.020)	(0.032)	(0.043)
Other SO	0.097**	0.140	0.072*	0.001	0.073	−0.043
	(0.037)	(0.100)	(0.036)	(0.004)	(0.803)	(0.099)
No. of observations	24,014	11,445	12,569	24,210	11,545	12,665

Notes: The table shows disparities between LGB+ and heterosexual individuals for several social stressors in adulthood. For each dependent variable, two separate regression models are estimated: one with the aggregate LGB+ category containing lesbian, gay, bisexual people, and those with other sexual orientations, and another with separate categories of LGB+ individuals. The reference category is heterosexuals. All models contain the full set of demographic and socio-economic characteristics which includes: age, gender, education, working status, kids under 5 years old, kids aged between 6 and 15 years, rural versus urban area, first- and second-generation immigrants dummy, household income quintiles and response time to the sexual orientation question and average response time to other selected questions. The method of estimation is Logit. Robust standard errors bootstrapped and clustered at the country of residence level are reported in parentheses. Significance levels: *$p < 0.1$; **$p < 0.05$; ***$p < 0.01$

5.2 Attitudes and risky behaviours of LGB+ individuals

Previously documented disparities in exposure to social stressors in childhood and adulthood may translate into a higher probability of vulnerable groups engaging in coping strategies aimed at reducing stressful conditions. These include risky behaviours such as smoking, physical inactivity, unhealthy diets, substance use, and, in general, a lower aversion to risk-taking in the health domain. Moreover, the individual's reaction to stress may also translate into an excessive use of social networks, with related consequences in terms of relationship quality, mental health, and loneliness.

The results in Table 3 suggest that odds of scoring higher on the risk-taking scale in the health domain increase by 0.21 for LGB+ individuals compared to their heterosexual peers, which is generally in line with some existing research in the field (Smalley et al. 2015; Legate and Rogge 2019). In particular, lesbian women and people with other sexual orientations have a significantly higher tolerance to risk taking in the health domain than their heterosexual counterparts (differences of 43 and 41 percentage points, respectively). This result seems to be reflected by a generally higher risk tolerance in the other two domains (*i.e.,* adventure and financial risk taking) as well as in long-term preferences, where lesbian women result less averse compared to heterosexual individuals (Table A.4, in the Supplementary material).[21] This is important evidence that further calls for the attention of policymakers. Interestingly, gay men and bisexual individuals, on average, do not significantly differ in terms of health and other risk-taking behaviours compared to heterosexuals.

As for the other unhealthy habits, lesbian and bisexual women are generally more likely to be heavy smokers. The results do not change significantly when we control for smoking behaviour of parents or close relatives in childhood.[22] This evidence is in line with the existing literature (Carpenter and Sansone 2021). Regarding physical inactivity, we find significant differences with respect to heterosexual individuals only for gay men and not for women and other sexual categories. This is not surprising since the existing evidence is rather mixed. Whybrow et al. (2012), for instance, find very similar levels of physical activity between sexual minorities and heterosexual individuals, while Calzo et al. (2013) report significantly fewer hours of exercise. However, differently from some literature in the field (Drydakis 2022a), we do not observe significant disparities in unhealthy behaviours within the LGB+ category, *i.e.,* between gay and lesbian people, bisexual people, and other sexual orientations (Table A.5, in the Supplementary material), with the exception of individuals declaring sexual orientation other than LGB who are less likely to smoke and follow a diet poor in fruits and vegetables. This latter result, combined with similar evidence for other sexual minorities from Table 3 is in line with Booker et al. (2017), who find that among young individuals in the UK, sexual minorities other than gay/lesbian and bisexual people were significantly less likely to be current or former smokers.

[21] To the best of our knowledge, there is no empirical study focusing on the economic preferences and attitudes of sexual minorities. One exception is Buser et al. (2018), who show that gay men have weaker attitudes towards competition than straight men, while lesbian women compete as much as heterosexual women. This evidence, according to the authors, explains part of the earnings differentials between gay and straight men but does not explain the earnings premium for lesbian women.

[22] We don't show these results for the sake of space and clarity. They are available upon reasonable request.

Table 3 Health-related behaviour of LGB+ individuals

	Smoking (>10 sig/day)			Diet (no fruits and vege)		
	All	Male	Female	All	Male	Female
LGB+	0.030***	0.032	0.024***	0.008	−0.004	0.009
	(0.011)	(0.025)	(0.008)	(0.015)	(0.008)	(0.096)
Lesbian/gay	0.071**	0.069	0.064**	0.013	−0.020	0.073
	(0.029)	(0.043)	(0.024)	(0.021)	(0.073)	(0.083)
Bisexual	0.024**	0.027	0.022**	0.021	0.031	−0.003
	(0.011)	(0.030)	(0.009)	(0.016)	(0.021)	(0.188)
Other SO	−0.061	−0.114*	−0.022	−0.057**	−0.104*	−0.033
	(0.039)	(0.059)	(0.026)	(0.026)	(0.051)	(0.035)
No. of observations	24,825	11,873	12,952	24,726	11,814	12,912
	Physically inactive			Health risk taking		
	All	Male	Female	All	Male	Female
LGB+	0.021	0.033**	−0.003	0.209***	0.176	0.234***
	(0.020)	(0.015)	(0.004)	(0.075)	(0.128)	(0.081)
Lesbian/gay	0.013	0.035**	−0.029*	0.247**	0.166	0.432**
	(0.011)	(0.013)	(0.017)	(0.118)	(0.145)	(0.186)
Bisexual	0.023	0.020	0.008	0.135	0.125	0.133
	(0.039)	(0.027)	(0.026)	(0.140)	(1.028)	(0.111)
Other SO	0.034	0.083	−0.009	0.413***	0.456*	0.346**
	(0.211)	(0.107)	(0.045)	(0.151)	(0.240)	(0.143)
No. of observations	23,657	11,437	12,220	24,291	11,639	12,652

Notes: The table shows the percentage points differences in engaging in unhealthy behaviour between LGB+ and heterosexual individuals. For each dependent variable, two separate regression models are estimated: one with the aggregate LGB+ category containing lesbian, gay, bisexual people and those with other sexual orientations, and another with separate categories of LGB+ individuals. Reference category is heterosexuals. All models contain the full set of demographic and socio-economic characteristics, as well as a dummy variable whenever individuals experienced adverse health conditions in childhood. The full set of explanatory and control variables includes: age, gender, education, working status, kids under 5 years old, kids aged between 6 and 15 years, rural versus urban area, first- and second-generation immigrants dummy, household income quintiles, and response time to the sexual orientation question and average response time to other selected questions. The method of estimation is logit for smoking, diet, and physical inactivity (binary dependent variables) and ordered logit for risk-taking behaviour (categorical dependent variable). Robust standard errors bootstrapped and clustered at the country of residence level are reported in parentheses. Significance levels: *$p < 0.1$; **$p < 0.05$; ***$p < 0.01$

Turning to social media use, LGB+ individuals result significantly more likely to spend more time on social networking sites and instant messaging tools (Table 4). One of the reasons why they do so is to improve their overall satisfaction and feel better. However, an intensive use of social media brings them more frequently to neglect work, school, or family-related duties. For instance, compared to their heterosexual peers, who have 34.2% probability of spending more than one hour per day on social networks, LGB+ individuals are 4.2 percentage points more likely to do so. This effect is highest for bisexual men and lesbian women. Moreover, bisexual men are 7.7 percentage points more likely to neglect work or family than their heterosexual

Table 4 Social media use of LGB+ individuals

	Social networks: >1 h/day			Messaging: >1 h/day		
	All	Male	Female	All	Male	Female
LGB+	0.042***	0.046***	0.032	0.016***	0.026*	0.003
	(0.011)	(0.015)	(0.022)	(0.005)	(0.014)	(0.002)
Lesbian/gay	0.047	0.031	0.084	0.037**	0.025	0.055**
	(0.032)	(0.023)	(0.127)	(0.015)	(0.020)	(0.027)
Bisexual	0.043***	0.076***	0.008	0.007	0.027	−0.009
	(0.012)	(0.026)	(0.006)	(0.006)	(0.022)	(0.027)
Other SO	0.023	−0.020	0.048	−0.003	0.026	−0.021
	(0.025)	(0.043)	(0.073)	(0.007)	(0.027)	(0.698)
No. of observations	24,908	11,931	12,977	24,875	11,910	12,965
	Social media: neglect			Social media: feel better		
	All	Male	Female	All	Male	Female
LGB+	0.055*	0.070**	0.035	0.076***	0.093***	0.049**
	(0.031)	(0.031)	(0.056)	(0.014)	(0.020)	(0.019)
Lesbian/gay	0.060	0.054	0.074	0.078***	0.099***	0.011
	(0.046)	(0.062)	(0.047)	(0.025)	(0.035)	(0.011)
Bisexual	0.067**	0.077**	0.055	0.076***	0.092***	0.060**
	(0.029)	(0.031)	(0.046)	(0.012)	(0.021)	(0.023)
Other SO	−0.006	0.108	−0.072**	0.071	0.073	0.066
	(0.005)	(0.104)	(0.033)	(0.108)	(0.480)	(0.084)
No. of observations	24,657	11,813	12,844	24,645	11,809	12,836

Notes: The table shows the percentage points differences in intense social media use and the motives behind their use between LGB+ and heterosexual individuals. For each dependent variable, two separate regression models are estimated: one with the aggregate LGB+ category containing lesbian, gay, bisexual people and those with other sexual orientations, and another with separate categories of LGB+ individuals. Reference category is heterosexuals. All models contain the full set of demographic and socio-economic characteristics. The full set of explanatory and control variables includes: age, gender, education, working status, kids under 5 years old, kids aged between 6 and 15 years, rural versus urban area, first- and second-generation immigrants dummy, household income quintiles, and response time to the sexual orientation question and average response time to other selected questions. The method of estimation is Logit. Robust standard errors bootstrapped and clustered at the country of residence level are reported in parentheses. Significance levels: $*p < 0.1$; $**p < 0.05$; $***p < 0.01$

counterparts due to intense social media use, which represents a difference of almost 20%. On the other hand, women declaring having sexual orientation other than lesbian or bisexual seem to have a lower likelihood of neglect compared to the rest.

The reason for the discrepancy between gay, lesbian, and bisexual individuals regarding the negative effects of social media use in terms of neglect of family or work may lie in different underlying motivations. More precisely, social media may represent a useful tool for gay and lesbian individuals to disclose their sexuality and become more socially involved within their own community since web-based environments represent safe spaces for peer connection (Berger et al. 2022). If this is correct, then the intensive use of social media does not necessarily have negative repercussions.

This may not be the case for bisexual individuals because their primary objective may not be to actively look for identity exploration and social support. Unfortunately, we don't have enough information to explore this interesting aspect of social behaviour further. In general, the effects of intensive social media use on sexual minorities may be both positive and negative. Among its negative effects, the literature suggests that it is associated with increased feelings of loneliness and mental health conditions (Ceglarek and Ward 2016). We will turn to this point in the next section.

Finally, when comparing the attitudes towards social media use within the category of LGB+ individuals, we do not observe any significant difference between gay/lesbian and bisexual individuals and other sexual minorities (Table A.5, in the Supplementary material).

5.3 Health and loneliness of LGB+ individuals

According to the minority stress framework, being exposed to a more hostile and stressful environment may exacerbate the vulnerability of sexual minorities and increase the likelihood of emotional disorders and physical health comorbidities. In what follows, we empirically test these conjectures. We first report the direct associations between identifying as a sexual minority and health-related or loneliness outcomes. As a second step, we interact the individual's sexual orientation with the main social stressors and risky behaviours and report the differential effects of LGB+ individuals in terms of health and loneliness with respect to the rest of the population experiencing similar conditions.

Table 5 shows the associations between overall health and long-lasting limitations due to physical and/or mental health issues and the individual's sexual orientation. LGB+ individuals have, on average, 6.4 percentage points higher probability to report worse general health compared to their heterosexual peers (ca. 42%). This effect is highest for men having a sexual orientation other than gay, bisexual or heterosexual, and for bisexual women. Moreover, in terms of long-lasting limitations due to physical and mental health conditions, the difference is 12.1 percentage points (ca. 32%) between LGB+ and heterosexual people and even 14.4 percentage points (ca. 42%) between gay and heterosexual men. These findings are generally in line with the existing literature (Meads 2020; Williams et al. 2021; Drydakis 2022a). At the same time, we do not observe any significant difference in physical health within the LGB+ category, *i.e.,* between gay and lesbian people, bisexual people, and other sexual orientations (Table A.5, in the Supplementary material).

In addition to self-perceived overall health, LGB+ individuals are also more affected by mental health disorders (Table 6). For instance, sexual minorities are 4.5 percentage points more likely to have experienced a major depressive episode in the year preceding the survey. This gap is particularly pronounced for bisexual individuals, and it is higher for males. Indeed, the probability of experiencing depressive symptoms for bisexual males is 7.7 percentage points (ca. 63%) higher than that of heterosexuals. In addition, bisexual people are 5.2 percentage points more likely to experience depressive feelings when compared to gay and lesbian people (Table A.5, in the Supplementary material). Relatively higher incidence of emotional disorders for bisexual people is

Table 5 Overall self-assessed health and long-lasting limitations of LGB+ individuals

	SAH - poor health (Y/N)			Limitations (Y/N)		
	All	Male	Female	All	Male	Female
LGB+	0.064***	0.057***	0.066***	0.121***	0.129***	0.102***
	(0.011)	(0.017)	(0.014)	(0.022)	(0.034)	(0.017)
Lesbian/gay	0.054***	0.045**	0.072**	0.118***	0.144***	0.058
	(0.014)	(0.019)	(0.029)	(0.044)	(0.040)	(0.043)
Bisexual	0.071***	0.052**	0.081***	0.120***	0.119***	0.113***
	(0.013)	(0.021)	(0.019)	(0.022)	(0.037)	(0.024)
Other SO	0.064**	0.129*	0.018	0.131***	0.106	0.129***
	(0.026)	(0.072)	(0.012)	(0.035)	(0.118)	(0.039)
No. of observations	24,902	11,918	12,984	21,817	10,512	11,305

Notes: The table shows the percentage points differences in reporting bad overall health and having long-lasting limitations between LGB+ and heterosexual individuals. For each dependent variable, two separate regression models are estimated: one with the aggregate LGB+ category containing lesbian, gay, bisexual people and those with other sexual orientations, and another with separate categories of LGB+ individuals. Reference category is heterosexuals. All models contain the full set of demographic and socio-economic characteristics, as well as a dummy variable whenever individuals experienced adverse health conditions in childhood. The full set of explanatory and control variables includes: age, gender, education, working status, kids under 5 years old, kids aged between 6 and 15 years, rural versus urban area, first- and second-generation immigrants dummy, household income quintiles, and response time to the sexual orientation question and average response time to other selected questions. The method of estimation is Logit. Robust standard errors bootstrapped and clustered at the country of residence level are reported in parentheses. Significance levels: $*p < 0.1$; $**p < 0.05$; $***p < 0.01$

well documented in the literature (Jorm et al. 2002; Semlyen et al. 2016; Harry Cross and Llewellyn 2023). This is interesting evidence that can be attributed to so-called "biphobia" (Meyer 2003), *i.e.*, experiences of discrimination and prejudice from both heterosexuals and other sexual minorities, on top of the existing social stressors internalised by the entire LGB category (Friedman et al. 2014; Mereish et al. 2017), putting bisexual people at increased risk of developing negative psychological problems and physical health outcomes (as documented in Table 5). Bisexual individuals seem to be particularly affected by other emotional disorders, such as feelings of worthlessness, nervousness, hopelessness, and unhappiness. On the contrary, gay and lesbian individuals, as well as other sexual minorities, generally do not differ from their heterosexual peers with respect to these characteristics. The results remain robust even when we control for the presence of close relatives with mental health issues in childhood.[23] This is an important piece of evidence since adverse mental health conditions may also spill over into the physical health domain, increasing the likelihood of the occurrence of cardiovascular diseases and obesity (Hatzenbuehler et al. 2014).

LGB+ individuals are also 5.9 percentage points (almost 50%) more likely to experience feelings of loneliness and social isolation than heterosexual individuals. Interestingly, gay men seem more affected by loneliness than lesbian women, especially in the emotional domain (Table 7). The prevalence of loneliness and social isolation, however, is highest for bisexual individuals. More precisely, they score, on

[23] These additional results are available upon reasonable request.

Table 6 Mental/emotional disorders of LGB+ individuals

	Depressed			Worthless			Angry		
	All	Male	Female	All	Male	Female	All	Male	Female
LGB+	0.045***	0.051***	0.040**	0.057***	0.038**	0.073***	0.005	0.019	−0.013
	(0.009)	(0.017)	(0.015)	(0.010)	(0.013)	(0.017)	(0.005)	(0.033)	(0.039)
Lesbian/gay	0.020	0.025	0.005	0.043**	0.032	0.060	0.016	0.030	−0.020*
	(0.018)	(0.052)	(0.014)	(0.017)	(0.024)	(0.041)	(0.057)	(0.052)	(0.010)
Bisexual	0.064***	0.077***	0.058**	0.068***	0.046***	0.082***	0.007	0.027	−0.009
	(0.013)	(0.020)	(0.023)	(0.013)	(0.015)	(0.023)	(0.005)	(0.044)	(0.009)
Other SO	0.041**	0.055	0.023	0.053**	0.034	0.062*	−0.027	−0.047	−0.013
	(0.018)	(0.063)	(0.015)	(0.024)	(0.029)	(0.033)	(0.061)	(0.044)	(0.050)
No. of observations	24,868	11,900	12,968	24,827	11,876	12,951	24,897	11,908	12,989
	Nervous			Hopeless			Unhappy		
	All	Male	Female	All	Male	Female	All	Male	Female
LGB+	0.049***	0.050**	0.041*	0.030***	0.022	0.038***	0.031***	0.030***	0.037*
	(0.015)	(0.018)	(0.021)	(0.008)	(0.017)	(0.011)	(0.009)	(0.009)	(0.018)
Lesbian/gay	0.033	0.021	0.044	0.016	0.017	0.006	0.027*	0.014	0.053
	(0.046)	(0.036)	(0.227)	(0.047)	(0.110)	(0.165)	(0.014)	(0.012)	(0.047)
Bisexual	0.063***	0.075***	0.051**	0.044***	0.024*	0.062***	0.041***	0.043***	0.050*
	(0.018)	(0.022)	(0.023)	(0.011)	(0.012)	(0.019)	(0.014)	(0.013)	(0.027)
Other SO	0.037	0.067	0.007	0.015	0.034	−0.001	0.002	0.040*	−0.023
	(0.027)	(0.065)	(0.011)	(0.013)	(0.109)	(0.001)	(0.001)	(0.019)	(0.028)
No. of observations	24,923	11,923	13,000	24,849	11,895	12,954	24,908	11,912	12,996

Notes: The table shows the percentage points differences in reporting mental/emotional disorders between LGB+ and heterosexual individuals. For each dependent variable, two separate regression models are estimated: one with the aggregate LGB+ category containing lesbian, gay, bisexual people and those with other sexual orientations, and another with separate categories of LGB+ individuals. Reference category is heterosexuals. All models contain the full set of demographic and socio-economic characteristics, as well as a dummy variable whenever individuals experienced adverse health conditions in childhood. The full set of explanatory and control variables includes: age, gender, education, working status, kids under 5 years old, kids aged between 6 and 15 years, rural versus urban area, first- and second-generation immigrants dummy, household income quintiles, and response time to the sexual orientation question and average response time to other selected questions. The method of estimation is Logit. Robust standard errors bootstrapped and clustered at the country of residence level are reported in parentheses. Significance levels: $*p < 0.1$; $**p < 0.05$; $***p < 0.01$

Table 7 Loneliness of LGB+ individuals

	Direct question			R-UCLA		
	All	Male	Female	All	Male	Female
LGB+	0.059***	0.061***	0.052***	0.520***	0.530***	0.483***
	(0.007)	(0.011)	(0.014)	(0.061)	(0.086)	(0.090)
Lesbian/gay	0.049***	0.052**	0.023	0.332***	0.418***	0.066
	(0.012)	(0.021)	(0.015)	(0.099)	(0.133)	(0.160)
Bisexual	0.075***	0.083***	0.068***	0.709***	0.698***	0.709***
	(0.009)	(0.018)	(0.018)	(0.077)	(0.117)	(0.117)
Other SO	0.031*	0.017	0.041	0.265	0.199	0.302
	(0.017)	(0.024)	(0.027)	(0.186)	(0.277)	(0.197)
No. of observations	24,247	11,597	12,650	24,440	11,695	12,745
	De-Jong SOCIAL			De-Jong EMOTIONAL		
	All	Male	Female	All	Male	Female
LGB+	0.199***	0.192***	0.188***	0.319***	0.373***	0.242***
	(0.041)	(0.063)	(0.061)	(0.047)	(0.062)	(0.067)
Lesbian/gay	0.143	0.178	0.052	0.320***	0.373***	0.172
	(0.087)	(0.124)	(0.110)	(0.070)	(0.084)	(0.107)
Bisexual	0.252***	0.179***	0.295***	0.365***	0.388***	0.339***
	(0.041)	(0.061)	(0.064)	(0.051)	(0.078)	(0.072)
Other SO	0.132	0.323*	0.018	0.130	0.299	0.007
	(0.115)	(0.160)	(0.136)	(0.077)	(0.198)	(0.113)
No. of observations	24,587	11,747	12,840	24,276	11,629	12,647

Notes: The table shows the percentage points differences in reporting feelings of loneliness. For each dependent variable, two separate regression models are estimated: one with the aggregate LGB+ category containing lesbian, gay, bisexual people and those with other sexual orientations, and another with separate categories of LGB+ individuals. Reference category is heterosexuals. All models contain the full set of demographic and socio-economic characteristics, including age, gender, education, working status, kids under 5 years old, kids aged between 6 and 15 years, rural versus urban area, first- and second-generation immigrants dummy, household income quintiles, and response time to the sexual orientation question and average response time to other selected questions. The method of estimation is Logit for the direct question and OLS for the remaining three scales of loneliness. Robust standard errors bootstrapped and clustered at the country of residence level are reported in parentheses. Significance levels: *$p < 0.1$; **$p < 0.05$; ***$p < 0.01$

average, 0.71 points higher on the reduced UCLA loneliness scale (ranged between 0 and 6) than heterosexuals, compared to 0.33 points registered by their gay and lesbian counterparts. Differentials with heterosexuals are particularly pronounced in social isolation, while they score almost as well as gay and lesbian individuals in the sphere of emotional isolation. These results complement the existing findings on the relationship between loneliness and sexual orientation (Gorczynski and Fasoli 2021; Buczak-Stec et al. 2022) and require attention from policymakers for two main reasons. First, loneliness is one of the main mediating factors between sexuality-related stressors (discrimination, rejection, and homophobia) and individual psychological and physical distress (Mereish and Poteat 2015; Mereish et al. 2017; Herrmann et al. 2023). Second, experiences of loneliness are not orthogonal to physical and mental health. Indeed, Casabianca and Kovacic (2024) show that more loneliness causes depression, suicidal thoughts, and sleeping problems, as well as a higher body mass index. Since loneliness poses a serious threat to health, both directly and indirectly, with repercussions from a social and economic point of view, when designing loneliness interventions, policymakers should account for the diverse ways in which individuals belonging to sexual minorities experience loneliness.

Emotional disorders among LGB+ people are not limited only to the private sphere; rather, they also affect their working environments. The results in Table 8 suggest that bisexual men are significantly more likely to feel isolated when working compared to their heterosexual peers. Gay men, on the other hand, are more likely to have experienced severe conflict episodes during their working careers.

Table 8 Loneliness and conflict episodes at work of LGB+ individuals

	Lonely at work			Conflict at work		
	All	Male	Female	All	Male	Female
LGB+	0.053***	0.063**	0.037	0.034**	0.056**	0.012
	(0.017)	(0.025)	(0.025)	(0.015)	(0.021)	(0.010)
Lesbian/gay	0.006	0.002	−0.005	0.044**	0.075***	−0.015
	(0.016)	(0.006)	(0.035)	(0.018)	(0.028)	(0.020)
Bisexual	0.083***	0.124***	0.050	0.030	0.051	0.016
	(0.024)	(0.036)	(0.033)	(0.024)	(0.032)	(0.024)
Other SO	0.072	0.096	0.051	0.016	−0.028	0.036*
	(0.043)	(0.062)	(0.057)	(0.012)	(0.036)	(0.020)
No. of observations	15,633	7,934	7,699	16,150	8,159	7,991

Notes: The table shows the percentage points differences in reporting feelings of loneliness at the current job and the probability of having ever experienced severe conflict episodes at work during the working career. For each dependent variable, two separate regression models are estimated: one with the aggregate LGB+ category containing lesbian, gay, bisexual people and those with other sexual orientations, and another with separate categories of LGB+ individuals. Reference category is heterosexuals. All models contain the full set of demographic and socio-economic characteristics, including age, gender, education, working status, kids under 5 years old, kids aged between 6 and 15 years, rural versus urban area, first- and second-generation immigrants dummy, household income quintiles, and response time to the sexual orientation question and average response time to other selected questions. The method of estimation is Logit. Robust standard errors bootstrapped and clustered at the country of residence level are reported in parentheses. Significance levels: $*p < 0.1$; $**p < 0.05$; $***p < 0.01$

In order to get a sense of to what extent the explanatory and control variables influence the results, in Table A.6 (in the Supplementary material), we estimate Eq. 1 for the main outcome variables and gradually increase the set of controls. Column 1 accounts only for country-fixed effects and shows that the difference between LGB+ and heterosexual individuals is 12 percentage points in the case of self-assessed health, 11 percentage points for depressive symptoms, and 0.8 points on the reduced UCLA loneliness scale. This is about as double as large as our baseline estimates, which are reported in column 5.

The point estimates remain very similar when including key demographic characteristics such as gender, age, education, and living in a rural/urban area (column 2), as well as socio-economic characteristics such as working status and household disposable income quintiles (column 3) and with the main set of control variables described in Section 4.2 (column 4). A significant drop in the coefficients is observed when self-assessed health in childhood is added (column 5). The reduction of the coefficient of LGB+ in the presence of adverse childhood physical or mental health may be explained in two ways. First, as documented in Section 5.1, LGB+ individuals are significantly more likely to report low-quality relationships with parents and friends during adolescence, which is positively correlated with worse mental health conditions (both in childhood and adulthood). Second, the retrospective information elicited from individuals belonging to minority groups may be subject to recall bias or "colouring". More precisely, disadvantaged groups may recall their past events with a negative connotation. This applies for both the outcome conditions (health or loneliness) and to the sexual orientation.

Given that our main results are based on a survey conducted on online panels relying on non-probability sampling, it is questionable whether our results can be generalised to the overall EU population, including marginalised communities without internet access. Luckily, we can test the robustness of the results for 4 of the 27 EU countries (*i.e.*, France, Italy, Poland, and Sweden) using a companion survey, the EU4-LS, which is based on probability sampling and covers the digitally excluded population. Table A.7 (in the Supplementary material) reports the results for the main health and loneliness outcomes on the sub-sample of individuals residing in the 4 countries covered by both surveys. The main estimates of the difference between LGB+ and heterosexual individuals for self-assessed health and feeling depressed remain sizable and significant for this smaller sample in both surveys. However, the results for loneliness are similar in size and statistically significant in the EU4-LS only for bisexual individuals. Moreover, the estimates of the health disadvantage for lesbian and gay individuals are small and insignificant in this survey, possibly due to the small sample size (based on only 67 observations for this group). It would thus be important to test the robustness of the results for gay and lesbian people in future studies, possibly based on larger probability-based samples.

Finally, to test Hypothesis 3, in Tables A.8 and A.8 we interact individual sexual orientation (aggregate category of LGB+) with social stressors and risky behaviours and estimate the models for health-related outcomes and loneliness. While most of the coefficients of the interaction terms are of the expected sign, relatively few are statistically different from zero. More precisely, having a few close friends in childhood is associated with a significantly higher probability of having limitations due to

mental or physical health conditions later in life for LGB+ individuals. Indeed, being LGB+ increases the difference in odds of having health-related limitations from 4.9 to 14.3 percentage points. Having fewer close friends in adulthood combined with a sexual minority status translates into a 1.048 higher score on the UCLA loneliness scale compared to an average score of 0.785 points for heterosexual individuals.[24] As for the behavioural habits, the net effect of being LGB+ and following an unhealthy diet increases the likelihood of depressive feelings by 8.7 percentage points, compared to 3.1 percentage points for heterosexual individuals. Similarly, the overlap between sexual minority status and an unhealthy diet increases the loneliness scale by 0.674 points, compared to an average increase of 0.292 for heterosexuals. Finally, sexual minorities with a lower aversion to risk-taking in the health domain register a significantly higher likelihood of having health-related limitations compared to their heterosexual risk-loving peers.

5.4 Heterogeneous effects

This section reports heterogeneous estimates of differences in the disparity between LGB+ individuals and their heterosexual counterparts, with respect to relationship status, age, family income, and according to the level of enforcement of sexual and gender minorities' rights in the individuals' country of residence. The objective is to assess whether there are significant differences in the disadvantage relative to heterosexual individuals between single and in-relationship non-heterosexual individuals, for older and younger age groups, and those living in wealthier and economically more disadvantageous households.

The results from Tables A.10 and A.11 (in the Supplementary material) suggest that the estimate of the difference between LGB+ and heterosexuals experiencing worse health conditions is larger in size among single individuals and those with lower levels of household income, even if those differences are not statistically significant with the exception of less wealthy bisexual individuals and singles declaring a sexual orientation other than LGB. Similarly, single and less wealthy LGB+ individuals suffer more than their heterosexual peers from depressive symptoms. The differential effect of non-heterosexuals is twice as high among single LGB+ people compared to those in relationships. Wealthier LGB+ individuals, on the other hand, do not differ significantly from their heterosexual peers, while more disadvantageous individuals have a 7 percentage point higher probability of experiencing emotional distress. We do not find significant age heterogeneities, as both younger and older LGB+ individuals appear to be disadvantaged in terms of health and depressive symptoms.

As for loneliness (Table A.12, in the Supplementary material), while each category of individuals defined by relationship status, age, or wealth is significantly more lonely than heterosexual individuals, we do not observe any statistical difference within categories, with the exception of their economic conditions, with more disadvantaged LGB+ individuals feeling significantly more lonely than their wealthier peers when

[24] The effect of 1.048 for LGB+ individuals is obtained as the sum of the coefficients of the few close friends in adulthood variable and its interaction with the LGB+ dummy.

it comes to the comparison with the rest of the population. Significant differences are found, especially among bisexual individuals.

Turning to high versus low-enforcing LGBTQIA+ rights countries, we observe a clear heterogeneous effect in the incidence of adverse health conditions (Table A.10, in the Supplementary material). LGB+ women are particularly vulnerable in societies where sexual and gender minorities' rights are less enforced. As for depression and loneliness, we do not observe any significant difference between individuals living in countries with a different degree of protection (Tables A.11 and A.12, in the Supplementary material). It must be highlighted, however, that sexual minorities may be less likely to disclose their sexual orientation in the survey in countries where LGBTQIA+ rights are less enforced. In fact, we show suggestive evidence in section 3.2 that respondents are more likely to refuse to respond to the sexual orientation question and need on average more time to respond to it compared to other questions. If LGB+ individuals not willing to identify as such are more disadvantaged in terms of health and well-being, the results reported may underestimate the bigger disadvantage of sexual minorities in countries with a lower enforcement of LGBTQIA+ rights.

We conclude our results section with two additional considerations. First, in Table A.13 (in the Supplementary material) we distinguish between individuals declaring as LGB+ and those with more than one gender or no gender, or having a fluctuating gender identity (non-binary individuals). The results indicate that non-binary individuals are particularly vulnerable regarding loneliness compared to cisgender heterosexual individuals.[25] This estimate, however, is not statistically different from the one for LGB+ individuals. Second, all estimates of the difference between LGB+ and heterosexual individuals presented so far are robust to multiple hypothesis testing corrections (see Table A.14, in the Supplementary material). Specifically, we control for the family-wise error rate (FWER) for all dependent variables within the set of social stressors, behavioural aspects and attitudes, and health/loneliness outcomes, following the approach of Romano and Wolf (2005).

6 Discussion

Documented disparities in the physical and mental health and loneliness of LGB+ and non-binary individuals are a significant public health issue, particularly because non-heterosexuals frequently face discrimination in access to healthcare services (Hswen et al. 2018), which may reduce their well-being and have negative consequences in other economic dimensions (Badgett et al. 2019). This is certainly a negative externality attributable to marginalisation and, as such, socially unacceptable.

Even though the evidence reported so far is generally in line with the existing literature, especially regarding risky behaviours, overall health conditions, emotional disorders, and loneliness, some caution is required when interpreting the results. First, the COVID-19 pandemic and the related social isolation and distancing have

[25] The differences compared to cisgender heterosexuals are considerable also for some other characteristics, such as long-lasting limitations due to physical and/or mental health issues, even if they are mostly not statistically significant. The lower precision of the estimates is mainly due to the small number of respondents declaring as non-binary (around 100 individuals).

created additional stress, which may have further exacerbated the existing vulnerability of sexual minorities in terms of emotional disorders and physical comorbidities (Sachdeva et al. 2021). Even though the data on the effects of the pandemics within the LGB+ community are generally poor and incomplete (Cahill et al. 2020), a higher before-pandemics exposure of sexual minorities to social stressors as well as a marked prevalence of physical and mental health problems makes it reasonable to suspect that this specific minority group may have internalised the negative effects of social distancing and isolation with respect to heterosexual individuals (Nowaskie and Roesler 2022). Second, the data collected in the EU-LS survey are not longitudinal. The coefficients, therefore, can be interpreted only as associations and not as independent causal effects.

Furthermore, future research should focus more on how the intersectionality between sexual minorities, transgender individuals, and non-binary individuals impacts the determinants of poorer mental health in order to design suitable policy interventions across a range of sexual and gender minority identities. In general, more effort is needed, both through data collections and research designs, to understand the relative performances of different subgroups. This is certainly a critical aspect of our study and some other large-scale surveys that find reporting on sexual and gender minorities very challenging (Russell et al. 2020). We lack systematic evidence on transgender, bisexual, and asexual individuals. More effort is needed in disentangling the mechanisms underlying the relatively worse performance of bisexual individuals, aside from the well-documented "biphobia" channel. Similarly, the knowledge about asexual and intersex individuals is almost absent, which calls for attention since their identity does not fit within and outside the LGBT minority. Future survey designs some questions to elicit asexuality and intersex conditions (National Academies of Sciences and Medicine 2020).

In addition to the above-mentioned need to include a detailed question on sexual and gender identity in large surveys, we need to learn better what drives social relationships among sexual and gender minorities, as well as the role played by social media in shaping their social behaviour and mental health. While the EU-LS survey represents an important step in this direction, more research is needed in this regard. Furthermore, the literature on the social and economic performance of older individuals belonging to sexual and gender minorities is very scarce. As suggested by Braghieri et al. (2022), this is an important aspect since older LGBTQ+ couples and individuals may make different choices than heterosexuals due to differences in fertility, occupation, income and wealth, health, and geography. The same is true for the other intersectional aspects, such as race, ethnicity, and disability.

Even though the results reported in this research and in numerous other studies provide significant directions for policy action, we still lack evidence on other relevant aspects of health and health-related behaviour, such as the prevalence of drug use and polypharmacy and specific physical health conditions. Moreover, longitudinal and cohort studies are needed to better understand how experiences across the life course affect the lives of sexual and gender minorities, not only by describing the accumulation of minority stressors but also by exploring identity formation, access to social support, adaptive coping strategies, family formation, and healthy ageing. Finally, more research is needed to better understand the role played by structural

factors, including power structures and legal protections, as well as social norms and attitudes.

Last but not least, another critical issue related to research prospects for sexual and gender minorities is the availability of high-quality survey data and the possibility of relying on administrative data sources. Probabilistic surveys typically exhibit higher accuracy than non-probability ones and allow for the inclusion of the digitally excluded population in online surveys, in particular the lower-educated, older, and those belonging to marginalised communities. Administrative data, on the other hand, may be particularly useful for analysis of same-sex couples (married or in legal union), but is less useful for understanding the disadvantages of single minority categories. This latter aspect concerns particularly bisexual individuals, who are particularly vulnerable when it comes to emotional disorders and loneliness. Finally, the last frontier of data collection on sexual minorities concerns some recent attempts to include a question on sexual orientation and gender identity in national censuses. Even though they are at a very embryonic stage and present in very few countries, these data may significantly improve the accuracy of the collected information and analysis.

7 Concluding remarks

This paper deals with disparities in health, health-related behaviour, and relationship quality among LGB+ individuals and represents the first wide and comprehensive study on disadvantages of sexual minorities in Europe. We rely on a novel data set that allows for a wide cross-national analysis of differences in reporting sexual orientation and inequalities in exposure to a rich set of individual-specific outcomes that go beyond commonly considered economic outcomes such as education and earnings potential.

We find large differences across countries in the share of individuals declaring themselves LGB+. In general, shares tend to be high in Northern Europe and lower in Southern and Eastern Europe. We show that differences in the willingness to disclose one's own sexual orientation are associated with the overall level of openness of society as well as with the importance of social norms and restrictions that fit individuals into predefined behavioural standards. The results suggest that individuals originating from restraint societies are, on average, less inclined to openly declare their sexual orientation.

As for socio-economic disparities, the results indicate that LGB+ individuals are significantly more exposed to social stressors, both in childhood and adulthood. As a result, they have a higher probability of reporting adverse physical and mental health conditions and are more likely to take health-related risks, including smoking and excessive use of social networks, which is one of the reasons why they frequently neglect work and family duties. Compared to their heterosexual peers, they also have lower-quality social relationships and are more likely to experience feelings of loneliness. Some of these effects significantly differ across gay men, lesbian women, bisexual individuals, and those with other sexual orientations, with bisexual people being even more disadvantaged than other sexual minorities in terms of mental health and loneliness. Finally, we find some heterogeneous effects with respect to individual relationship status, household income, and country openness. Single and less wealthy

LGB+ individuals suffer more from depressive symptoms and have worse overall health compared to those belonging to higher income quantiles or in a relationship. Along similar lines, disparities among sexual minorities tend to be more pronounced in countries where sexual minority rights are less enforced. The results are robust to the inclusion of a rich set of controls, corrections for potential reporting biases based on individual-specific response times, and additional multiple hypothesis testing corrections.

The documented disparities of sexual minorities represent a significant contribution to the literature since they are an important public health issue and have been widely understudied, especially in the European context. Still, the inclusion of information on sexual orientation and gender identity in large representative surveys with possibly a longitudinal dimension is strongly encouraged to better understand the causes of these disparities, including the potential role of stigmatisation, discrimination, and harassment of sexual and gender minorities.

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Code availability Available upon reasonable request.

Declarations

Conflict of interest The authors declare no competing interests.

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