# Acceptance Towards LGB Persons Is an Independent Protective Factor Against Suicide on a Country Level

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## Abstract

**Background** Sexual minorities such as lesbian, gay, and bisexual (LGB) people have an increased risk for suicide, whose reasons are not sufficiently understood. We aimed to test if differences in LGB acceptance explain variations in general suicide rates on a country level.

**Methods** We used linear regression models to explain the variation in age-standardized suicide rates in 34 OECD countries based on LGB acceptance, which was recently assessed in large international surveys polling the general population about their attitude towards homosexuality. We included economic and sociological variables, which have been shown to be related to suicide rates in previous work, as covariates. We then used backward elimination, leave-one-out cross-validation, and the Bayesian information criterion to identify best-fitting models (i.e., to select relevant predictors).

**Results** All employed model selection methods favored a 4-predictor model, where higher LGB acceptance, fertility rate, religiosity, and unemployment rate were significantly related to lower suicide rates. Suicide rates were well explained by this sparse model ($R^2$ adjusted = 0.442). In the full model with all predictors, as well as in the selected four-predictor model, higher LGB acceptance was significantly related to lower suicide rates.

**Conclusions** Our findings suggest that low LGB acceptance, as measured by international surveys, might be a risk factor for suicide.

**Keywords** Suicide · Homosexuality · Discrimination · Public mental health · Prevention

## Introduction

Suicide is the 18th leading cause of death and responsible for 1.4% of all deaths worldwide in 2016. Among 15–29 year old, suicides are the second leading cause of death (WHO, 2018). Sexual minorities such as lesbian, gay, and bisexual people (LGB) show a substantially increased risk for suicidal behavior (di Giacomo, Krausz, Colmegna, Aspesi, & Clerici, 2018; Haas et al., 2011; Hatchel, Polanin, & Espelage, 2019; King et al., 2008; Liu et al., 2019; Meyer, 2003) and completed suicides (Bjorkenstam, Andersson, Dalman, Cochran, & Kosidou, 2016; Ream, 2019), whose reasons are not sufficiently understood.

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The minority stress framework (Hatzenbuehler & Pachankis, 2016; Meyer, 1995, 2003) provides a comprehensive framework to explain the reasons for the various (mental) health disparities related to sexual orientation. It postulates that sexual minorities are exposed to chronic stress which results from social stigma and is hence an additive to general stressors experienced by all people. Extra stressors emerge and interact at different societal levels, such that the societies' non-acceptance of sexual minorities is connected to a lack of systems providing support for LGB individuals and lacking acceptance and social support in the individual's close social network. This in turn could aggravate the non-acceptance of one's own sexual orientation (internalized stigma and homophobia) and worsen the mental health status of sexual minorities (Postuvan, Podlogar, Zadravec Sedivy, & De Leo, 2019).

Indeed, research based on questionnaires and interviews of LGB demonstrates that increases in suicidality are related to higher subjective ratings of victimization and a lack of acceptance in the social environment (Almeida, Johnson, Corliss, Molnar, & Azrael, 2009; Haas et al., 2011; Hatchel et al., 2019; Liu & Mustanski, 2012; Liu et al., 2019; Mustanski & Liu, 2013). While these studies empirically underpin the minority stress framework and provide valuable information on

the reasons for increased suicidality in sexual minorities, they suffer from the shortcoming that LGB discrimination was operationalized as a subjective feeling (e.g., the feeling of being rejected because of one's sexual identity) which is known to be biased by a variety of factors, e.g., affective states. Based on these data, it thus cannot be safely ruled out that the reported associations between suicidal thoughts and perceived discrimination arise because, for example, depressed study participants perceive behavior as more discriminating because of a negative cognitive bias and at the same time show increased suicidal thoughts. Moreover, these studies have related the perceived degree of discrimination to suicide ideas and past suicide attempts rather than investigating completed suicides. To improve our understanding for the increased suicide risk in sexual minorities, it is hence crucial to study the relationship between rates of completed suicides and a measure of LGB discrimination, which is independent of the subjective rating of the affected persons. The recently published OECD data on country-specific levels of LGB acceptance allow for such an analysis (Valfort, 2017), since they provide a representative average estimate on LGB acceptance for all OECD countries. A positive association between suicidality and LGB acceptance based on these data would therefore provide relevant new evidence for theories that explain the increased suicidality in sexual minorities with social discrimination or minority stress.

When relating country-specific LGB acceptance to suicide rates, variables that were shown to determine suicide rates and might also be related to LGB acceptance have to be taken into account to rule out possible confounding. For example, higher levels of religiosity are related to lower LGB acceptance on an individual and on a country level (Jackle & Wenzelburger, 2015). On the other hand, there is evidence to suggest a suicide-preventing effect of religiosity on both individual and country level (Koenig, 2009; Neeleman, Halpern, Leon, & Lewis, 1997). Hence, by lowering both measures, religiosity might conceal an existing relationship between LGB acceptance and country-specific suicide rates if not included as covariate. To account for such possible confounding, we included religiosity and several other sociological and economic variables, which were related to suicide rates in previous research according to an extensive literature search, as covariates into our analysis (Andres, 2005; Breuer, 2015; Koenig, 2009; Milner, McClure, & De Leo, 2012; Neeleman et al., 1997; Neumayer, 2003; Noh, 2009; Rehkopf & Buka, 2006; Stavrova, Schlösser, & Fetchenhauer, 2011).

In order to not miss potential confounders, we started with a wide selection of potential variables and then selected a subset of statistically relevant variables. When building comprehensive models with many potential predictors, it can be challenging to identify the subset of predictors with independent statistical associations to the dependent variable. Various statistical methods for predictor selection have been developed for this purpose. In this work, we applied three different techniques, backward predictor elimination (Yan, 2009), cross-validation (Picard & Cook, 1984), and the Bayesian information criterion (Schwarz, 1978), to select a sparse model with high explanatory power and generalizability to new data. For this selected model, as well as for the full model with all possible predictors, we tested relationships between LGB acceptance and suicide rates. Here, we hypothetized based on the assumptions of the minority stress framework that low LGB acceptance in the general population of a country would be associated with increased suicide rates.

## Methods

### Indicators and Countries

We used regression models to uncover relationships between country-specific age-standardized suicide rates as published by the WHO 2016 and LGB acceptance according to 2017 OECD estimates (Valfort, 2017). The OECD LGB acceptance index combines information from four data sources (AsiaBarometer, European Values Survey, Latinobarometro, and the World Values Survey) and calculates the country-specific average response to the question "Please tell me whether you think homosexuality can always be justified, never be justified, or something in between" (on a scale from 1 to 10).

Several socio-economic and cultural indicators, which have previously been related to variance in suicide rates, were included as covariates. Selection of covariates was based on a systematic literature research in PubMed and Google Scholar (search tag "predictors country suicide rates"). Religiosity was included as a covariate (operationalized as the country-specific percentage of "yes" responses on the question "Is religion important in your daily life?", which is part of the global Gallup Poll 2009). A protective impact of religiosity against suicides has repeatedly been demonstrated (Koenig, 2009; Neeleman et al., 1997). Female labor force participation (in percent, modeled estimate of the International Labour Organization provided by the World Bank 2017) was included, because a high proportion of working women was shown to be correlated with increased suicide rates (Milner et al., 2012; Neumayer, 2003). Similarly, countries' fertility rates (average number of children per woman, World Bank 2017) were included, because higher fertility rates have repeatedly been linked to lower suicide rates (Andres, 2005; Noh, 2009). Health expenditure per capita (in purchasing power parity corrected the international US dollars, OECD 2017) was included, because high health expenditures have been related to lower suicide rates (Milner et al., 2012; Neumayer, 2003). Finally, indicators of the countries' economic situation were included: gross domestic product (GDP) based on purchasing-

power-parity per capita (in the US dollars, international monetary fund 2016) was included, which has been shown to be negatively related to suicide rates (Neumayer, 2003). Unemployment rate (in percent, OECD labor market statistics quarter 3 of 2017) was included, where several positive and negative associations with suicide rates have been described depending on country and controlled covariates (Breuer, 2015; Neumayer, 2003; Noh, 2009; Rehkopf & Buka, 2006; Stavrova et al., 2011). Income inequality (Gini coefficient, the newest available world bank estimate for each country) was included, because relationships to adverse health outcomes have convincingly been demonstrated (Pickett & Wilkinson, 2015) (although associations with suicide rates are less consistent (Andres, 2005)).

Countries with available information on all indicators were included in the analyses. This applied for all 35 OECD countries except of Iceland, where no religiosity measure was available and which was excluded from analysis. In this way, complete data was available for all countries and no data had to be imputed, which is particularly desirable if cross-validation is to be used. All of the variables used are publicly accessible, have been downloaded from the sources indicated, and have not been further processed. The final table with all data used for analysis can be downloaded as Supplementary Material.

### Model Selection and Regression Analysis

We applied three different model selection methods to select a subset of predictors with independent explanatory power about variance in country-level suicide rates.

We performed backward elimination of predictors until only significant predictors were left in the model using the backward elimination of insignificant predictors as implemented in the stepwise routine of the Matlab Statistics and Machine Learning Toolbox (stepwise removal of predictors with $p < 0.10$).

For the next two selection methods (cross-validation and Bayesian information criterion BIC), a model space with all possible combinations of included predictors (including a constant only model) was created, which hence comprised $2^8 = 256$ candidate models. Then, for all of these possible combinations of predictors, the mean squared error in a leave-one-out cross-validation and the BIC was computed (Supplementary Table 1).

We used leave-one-out cross-validation based on the crossval function of the Matlab Statistics and Machine Learning Toolbox. Briefly, this technique enforces models with low generalization error to new data. The data set is split into 34 training and test sets, in each of which a linear model is fit on 33 countries and its accuracy is tested on the one remaining (left out) country. Subsequently, the root mean squared error (RMSE) of the respective models in the test

country is computed. Then, the model with the lowest RMSE in the test countries (i.e., with the lowest generalization error to new data) is selected.

Finally, we used the Bayesian information criterion (BIC) for model selection. This approach balances model fit (explained variance) and complexity (number of free parameters) through a fixed complexity punishment term (Schwarz, 1978).

## Results

### Model Selection

All applied model selection methods favored a 4-predictor model, in which LGB acceptance, fertility rate, unemployment rate, and religiosity were included as significant predictors, while Gini coefficient, GDP per capita, health expenditure per capita, and female labor force participation were excluded. Supplementary Table 1 shows cross-validation results and BIC for all 256 models in the model space (all possible combinations of predictors). Notably, the selected model explained variance in suicide rates well despite its sparsity ($R^2 = 0.510$, adj. $R^2 = 0.442$, $p < 0.001$). The statistics of the full and the selected model and their coefficients are summarized in Table 1. We investigated relationships between LGB acceptance and suicide rates for both models.

### Determinants of Suicide Rates

Higher LGB acceptance was the only variable significantly related to lower suicide rates in the full model. In the selected model, higher fertility rates, LGB acceptance, unemployment rates, and religiosity were related to lower suicide rates (Table 1).

## Discussion

In the present study, we demonstrated, controlling for relevant covariates, that countries with higher LGB acceptance show lower suicide rates. Using different predictor selection methods, we were able to identify a sparse model with high predictive power about suicide rates, which also comprised LGB acceptance as a significant predictor.

A strength of our study is that we could establish a link between representatively recorded discrimination of LGB individuals (presence of a negative attitude towards homosexuality in the general population) and an objective marker of deteriorated mental health (suicide rates). Our results thereby complement emerging evidence, which identifies the lack of acceptance of minorities as a risk factor for suicides. They are a further empirical underpinning of the minority stress framework that explains mental health disparities along sexual

**Table 1** Statistics and coefficients of the full and the selected model

| | | Beta | T | Sig. |
|---|---|---|---|---|
| **Full model** | | | | |
| $R^2 = 0.576$, | Constant | | 3.684 | 0.001 |
| $R^2$ adj. $= 0.440$, | LGB acceptance | $-0.656$ | $-3.100$ | 0.005 |
| $P = 0.003$ | Unemployment rate | $-0.299$ | $-1.902$ | 0.069 |
| | Fertility rate | $-0.271$ | $-1.706$ | 0.100 |
| | Religiosity | $-0.352$ | $-1.650$ | 0.111 |
| | Health expenditure per capita | 0.380 | 1.384 | 0.179 |
| | Female labor participation | 0.187 | 0.946 | 0.353 |
| | Gini coefficient | $-0.177$ | $-0.894$ | 0.380 |
| | GDP per capita | $-0.195$ | $-0.790$ | 0.437 |
| **Selected model** | | | | |
| $R^2 = 0.510$, | Constant | | 8.027 | $< 0.001$ |
| $R^2$ adj. $= 0.442$, | Unemployment rate | $-0.402$ | $-2.774$ | 0.010 |
| $P < 0.001$ | Religiosity | $-0.450$ | $-2.766$ | 0.010 |
| | Fertility rate | $-0.367$ | $-2.701$ | 0.011 |
| | LGB acceptance | $-0.398$ | $-2.602$ | 0.014 |

*GDP* gross domestic product, *LGB* lesbian, gay, bisexual

orientation with additional stress to which stigmatized groups are exposed. In concrete terms, it is conceivable that a generally negative attitude towards homosexuality would make it difficult to recruit support in the close social environment, which was identified as crucial for the mental health of LGB people (Postuvan et al., 2019). Socially widespread homophobia could similarly complicate the emergence of perceptible LGB communities, which are a relevant protective factor for mental health (Kertzner, Meyer, Frost, & Stirratt, 2009; Puckett, Levitt, Horne, & Hayes-Skelton, 2015). Finally, it can be assumed that being continuously confronted with societal homophobia makes it difficult to accept one's own sexual orientation and thus leads to an internalized homophobia that is associated with poorer mental health status (Newcomb & Mustanski, 2010). This could have significant implications for a suicide prevention public health policy: Destigmatizing measures to reduce minority stress implemented on different social scales might help to reduce mental distress and suicidality in vulnerable communities. For instance, it has been shown that the legalization of same-sex marriages led to a reduction of suicide attempts among adolescents (Raifman, Moscoe, Austin, & McConnell, 2017), possibly in parts through increasing LGB acceptance in the general population (Hooghe & Meeusen, 2013). Similarly, anti-discrimination campaigns to prevent bullying in schools can also effectively prevent suicidality in sexual minority youth (Hatzenbuehler, Birkett, Van Wagenen, & Meyer, 2014; Hatzenbuehler & Keyes, 2013). These are evidence-based measures that can be part of a joint strategy to reduce health disparities involving clinicians, public health researchers, and policy makers (Mayer et al., 2008).

A limitation of our study is the cross-sectional design, which impedes direct causal interpretations of study results. In the case of the associations investigated by us "reverse causation" (which would mean that high suicide rates cause low LGB acceptance) is unlikely and we tried our best to rule out other possible confounders, but nevertheless, longitudinal studies would be needed to make reliable claims about causality.

A second limitation concerns the validity of the used LGB acceptance index, which relies on a single question, because it is derived from international surveys aimed at measuring a variety of attitudes (and not LGB acceptance only). However, in our view, there are several reasons to trust in the validity of the measure: it represents the official measure of LGB acceptance published by the OECD and is, according to the OECD publication, closely related to different items aiming to capture the same construct (e.g., the question whether the respondent would be comfortable with homosexuals as neighbors). Moreover, as can be seen from the OECD report, it shows the expected associations with age, gender, and education, and e.g., the legality of same-sex marriages or support for gender equality, which speaks for construct validity.

It can be debated, whether the relationship reported in this study can be fully attributed to variance in the LGB population (which, depending on definition criteria, constitute 2–12% of the adult population) (Valfort, 2017). Given the well-established association between homophobia and negative attitudes towards other marginalized groups (Akrami, Ekehammar, & Bergh, 2011), it seems plausible that the association between low LGB acceptance and suicide rates observed in the present study is partly related to discrimination against other vulnerable groups as well. For instance, it has

been shown that higher stigmatization of mentally ill individuals is associated with higher suicide rates on a country level (Schomerus et al., 2015). Thus, societies characterized by low LGB acceptance may also show rejecting attitudes towards mentally ill individuals which may contribute to increased suicide rates also among mentally ill non-LGB individuals.

## Conclusions

Worsened mental health in LGB individuals, culminating in an increased risk of suicide, has hitherto been documented by numerous studies. The minority stress framework explains these findings with additional stress to which sexual minorities are exposed due to discrimination and rejection at different social levels. In our work, we show that a generalized negative attitude towards homosexuality as revealed by large international surveys is statistically associated with increased suicide rates at the country level. Based on these findings (and on previous research with empirical validation of the minority stress framework), it might be suggested that a public policy targeting stigmatization of sexual minorities could impact positively on national suicide levels.

**Data Availability** All data sources are publicly accessible. The corresponding author can provide the Table with merged data as well as the Matlab scripts used for statistical analysis upon request.

## Compliance with Ethical Standards

**Conflict of Interest** The authors declare that they have no conflict of interest.

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