

INTRODUCTION

Gender equality is defined as the equal rights, responsibilities and opportunities of women and men, and girls and boys (European Institute for Gender Equality, 2019). This definition explicitly acknowledges that the interests, needs and priorities of both women and men should be taken into consideration, and recognises the diversity of different groups of women and men (European Institute for Gender Equality, 2019). Gender equality is seen as critical to the enactment of the sustainable development goals, central to which is the importance of greater equality of welfare resources, roles and lifestyles between women and men (United Nations, 2015). Hence, the World Bank, along with other international organisations (such as the United Nations Development Programme) have been tracking the progress in achieving gender equality in economics, political life, educational attainment and health since the 1990s.

Aside from its importance as a social goal, there is growing recognition that gender equality has impacts on population level health (King et al., 2020), but there has been little examination of how gender equality is associated with suicide outcomes.

Suicidal behaviours in most parts of the world are patterned by gender. In most countries, a 'gender paradox' is observed, whereby women and girls exhibit higher rates of suicidal ideation and behaviour, but have lower suicide mortality than boys and men (Canetto and Sakinofsky, 1998). Some cross-sectional research has demonstrated a relationship between gender equality and suicide (Chang et al., 2019; Mayer, 2000). Mayer and colleagues (Mayer, 2000) found that gender equality (as measured using the GEM) was associated with increased suicide rates for both women and men, while Shah et al. (2008) found that gender equality

(measured using the Gender Development Index; GDI, and the GEM) had no effect on suicide rates. A more recent cross-sectional study by Chang and colleagues (Chang et al., 2019) reported lower ratios of male to female suicide in countries with greater gender inequality (lower gender equality). The authors suggested a reduction in gender inequality may result in better general well-being for women in particular, but argued that it is particularly important to pay attention to both suicide and gender equality as they are socially patterned within countries. This emphasises the importance of controlling for a wider range of country-specific factors in analyses to more accurately capture the relationship between gender equality and suicide.

Several theoretical frameworks have been deployed to explain associations between gender equality and health outcomes. According to role expansion theory, gender equality should particularly benefit women because holding multiple life roles or identities is associated with better health outcomes than holding fewer roles (Backhans et al., 2007; Nordenmark, 2004). The convergence theory posits that as gender equality increases in a society, there is a convergence in gender roles as well as behaviours and exposures, and these in turn lead to a convergence in health outcomes (Backhans et al., 2007). It is theorised that women may benefit from the positive effects of role-expansion but may experience the detrimental effects of poor working conditions, while men may benefit from the adoption of less masculinized beliefs and behaviours (Backhans et al., 2007).

Previous research has been cross-sectional and is thus unable to provide insight regarding within-country changes in gender equality in relation to suicide rates. In light of this, the current study drew on 11 years of gender equality and suicide data from 87 countries, and carried out the first study of within-country changes in suicide rates in relation to within-

country gender equality. Importantly, this approach enabled us to hold potentially important time-invariant country-specific factors stable. Applying the convergence theory, and given that males are more likely to die by suicide in most parts of the world, we hypothesised, that increasing gender equality would be associated with: a) an increase in female suicide rates, and; b) a decrease in male suicide rates.

METHODS

Data sources:

We used publicly available data collected by the World Health Organization and electronically extracted annual suicide rates for males and females across the world (World Health Organization, 2018). Information on the Gender Gap Index (GGI) was drawn from the World Economic Forum, via the World Bank (World Bank, 2019a). Information on confounders used to adjust analytic models were drawn from the World Bank, World Development Indicators (World Bank, 2019b), and the United Nations, Department of Economic and Social Affairs, Population division (United Nations, 2019).

Outcome:

The outcome was annual suicide rates per 100,000 for males and females (separately). We extracted all available information from 2006 – 2016 (to be consistent with the available GGI data).

Exposure:

The World Economic Forum introduced the Gender Gap Index (GGI) in 2006 as a means of measuring and tracking gender disparities across a range of dimensions. The GGI comprises

14 measures across four major domains: economic participation and opportunity; education attainment; health and survival; and political empowerment (World Economic Forum, 2014). Scores for each domain, as well as an overall score, are produced. The GGI has previously been used in studies on reproductive health, alcohol use and physical activity (Grittner et al., 2012; Van Tuyckom et al., 2012; Witvliet et al., 2014). We chose this measure over other gender equality indices (e.g., GEM, GDI, Gender Inequality Index; GII) as it is the most recently developed instrument to measure gender equality and provided the most recent data (2006 – 2016).

Covariates:

We identified a set of plausible confounders of the relationship between gender equality and suicide rates over time, based on their likelihood of being prior common causes of the relationship between the exposure (gender equality) and outcome (suicide). The selected variables included as confounders were: Gross Domestic Product per capita, total population number, the ratio of population living in urban/rural areas of a country, number of children per person, percentage of the population who were unemployed, and year. Year was modelled as a categorical variable, to account for annual fluctuations in suicide rates and capture trends over three-year periods (2006 to 2009, 2010 to 2013, and 2014 to 2016).

Analytic approach:

All analysis was conducted in Stata SE version 15.0 (StataCorp, 2017). We first conducted descriptive analyses (mean for each year period, overall mean) for GGI and male and female suicide rate, for each country. Secondly, fixed and random-effects unbalanced panel regression models were estimated. Fixed-effects (FE) models allow for both country and time-

related effects, as they hold time-invariant country effects stable, focusing on deviations away from the mean within a country. These models can thus provide a within-country assessment of the effect of changes in male and female suicide rates in relation to changes in gender equality, effectively controlling for unmeasured time-invariant factors such as social norms and country-specific cultural characteristics (which we acknowledge do change, but typically over a period of time that extends beyond the duration of the study period encapsulated here). Coefficients in the fixed effects models represent changes in suicide rates in relation to gender equality, within a country over time.

The coefficients produced from random effects (RE) models represent a weighted average of the estimates due to the within and between country effects. In our case, the RE coefficients for the effects of gender equality on suicide rates represent a combination of the relationship observed across (or between) different countries and the relationship occurring within countries (e.g., changes in both gender equality and suicide rates within the same country over time). When all unobserved effects (e.g., individual specific effects not already controlled for) are independent of all explanatory variables in all time periods (Wooldridge, 2009) both the between- and within-effects from the random effects models will be approximately equal and the combined random effects estimates provide causally-robust estimates. However, if this does not hold, then the between person relationship observed will be biased by these unobserved person specific effects, which will in turn bias the random effects estimates. In this case the within-country fixed-effects relationship by itself is likely to provide a more causally-robust estimate of the relationship.

We conducted both fixed and random effects models for male and female suicide rates separately. Our models included the total GGI as an exposure both before and after adjustment for confounders (resulting in eight separate models). Random effects models make a strong assumption of independence between the exposure (in this case gender equality) and unobserved country specific factors (Gardiner et al., 2009; Leyland, 1979). If this assumption is violated, and gender equality is correlated with certain unobserved country factors (such as religion), then bias in the parameter estimates will arise (Leyland, 1979). We therefore conducted the Hausman test to determine the most appropriate analytical model (Hausman, 1978), using the Hausman specification test in Stata. The null hypothesis, that the random effects and fixed effects are consistent estimators, would indicate that the random effects models are more efficient (because the standard error of the random effects is less than that of the fixed effects) (Hausman, 1978). Results of the Hausman test did not support the null hypothesis, indicating that the fixed-effects should be used for male ($p < .001$) and female suicide models ($p < .001$).

RESULTS

The highest average suicide rates between 2006-2016 for men were in Lithuania, Guyana, and Suriname, and for women in South Korea, Suriname, and Guyana. The lowest rates for men were in Egypt, Oman, and the Maldives, and for women in Oman, Egypt, and Barbados. These results by individual country can be seen in Figure 1. Figure 2 presents GGI score by country. The Gender Gap Index for the period between 2006-2016 was highest in Iceland, Norway, and Finland, and lowest in Iran, Egypt, and Oman. (See Supplementary File 1 for average male and female suicide rate and GGI scores, by country.)

[INSERT FIGURES 1 & 2]

Table 1 shows the results of the fixed and random effects regression models for male and female suicide rates. As noted above, the results of the Hausman test suggested that the estimator arising from the fixed effects model was more consistent and preferred over the estimator from the random effects model. Hence, we will focus discussion of the results on the adjusted fixed-effects models. Increasing scores of the GGI over time was associated with a reduction in male suicide rates, however the wide confidence intervals crossing zero indicate that this was only a weak relationship (β -Coef -5.76, 95% CI -19.40 to 7.86, $p= 0.403$). For women, the same direction of effects was observed, however a significant reduction in suicide was seen in relation to increasing gender equality (β -Coef -7.08, 95% CI -12.35 to -1.82, $p= 0.009$).

[INSERT TABLE 1]

Results for the covariates indicated that for men, more children per capita was associated with reduced rates of suicide (-5.94, 95%CI -10.57 to -1.31, $p=0.012$). Period of time was also negatively associated with suicide – that is, suicide rates decreased over time (-0.87, 95%CI -1.67 to -0.77, $p=0.032$ for 2010-2013; -1.91, 95%CI -3.08 to -0.75, $p< 0.001$ for 2014-2016). Higher population level unemployment was associated with increased rates of suicide (0.19, 95%CI 0.11 to 0.27, $p<0.001$). For women, higher population unemployment was associated with increased suicide rates (0.03, 95%CI 0.00 to 0.05, $p=0.021$). As for men, time was also associated with reduced suicide rates, although this was weaker for the years 2014-2016 (-

0.24, 95%CI -0.39 to -0.96, $p=0.002$ for years 2010-2013; and -0.27, 95%CI -0.55 to 0.14, $p=0.062$ for years 2014-2016).

Associations between many of the covariates and suicide were similar across the fixed and random effects models, however the estimates for gender equality were different. Reasons for these differences are explored in the discussion.

DISCUSSION

Our results demonstrate that increasing gender equality, as measured by the GGI, is associated with a significant reduction in within-country suicide rates for women. We hypothesised that increasing gender equality would also be significantly associated with a reduction in the suicide rate for males: while increasing gender equality did appear to be associated with a reduction in the suicide rates for men, this did not reach statistical significance and there was insufficient evidence to support this hypothesis.

Our findings differ to previous cross-sectional work by Mayer (2000), who found that higher levels of gender equality was associated with increased suicide rates for both women and men. Our results are aligned with those of Chang and colleagues (2019), who reported that countries with greater gender equality (as measured using the GII) had higher ratios of male to female suicide rates (Chang et al, 2019), this being largely driven by reduced suicide rates among women.

According to the convergence theory which underpinned our stated hypothesis, it follows that increasing gender equality will be associated with reduced suicide rates among males, and increased suicide rates among females. While the association between gender equality and suicide for men appeared to be in the expected direction, the wide confidence intervals

indicate low precision in the measurement of the estimate and provide no support for the hypothesis that increasing gender equality within a country is associated with reduced male suicide rates.

Our results provide some support for the role expansion theory which contends that individuals benefit from multiple social roles (Nordenmark, 2004; Thoits, 1983). This is predicated on the work of Thoits (1983) on multiple identities and social isolation. Thoits (1983) argued that identity is intrinsically linked to social roles, and importantly, social identities give meaning and guidance to behavior. The accumulation of multiple identities is thought to lead to a more meaningful existence and sense of purpose and value, and contribute to improved psychological well-being (Thoits, 1983). Having multiple social roles also develops and consolidates economic and social resources that provide satisfaction and can be drawn on in adversity (Nordenmark, 2004). These multiple roles also enable engagement and connection across different contexts that anchor and support individuals, and according to Sieber (1974), they can be leveraged and transacted to gain further benefits. Applying this theory to our results for women; as gender equality within a country increases, the suicide risk of women is reduced through their ability to acquire and accumulate multiple social roles. This may operate through various specific mechanisms such as labour force participation: as women enter the labour force (or remain in the labour force), they acquire (or retain) an identity tied to their role as an employee, which, in addition to their identities associated with other roles (such as mother, friend, volunteer), provides them with an accumulated set of rewards and resources that positively impacts on their mental health and lowers their suicide risk.

Given that the mental health of boys and men has been observed to benefit from gender equality (King et al., 2020) and gender egalitarian attitudes (King et al., 2019), we expected that the suicide risk for men may have reduced as gender equality within a country increased. There was however, no clear evidence that within country changes in gender equality is associated with within country changes in suicide rates.

Around the world, men are at substantially greater risk of suicide than females (World Health Organization, 2014). Men are also known to be less likely to seek help in times of distress (Rasmussen et al., 2018; Seidler et al., 2018). Masculine norms and ideologies have been implicated as key factors linked to mental health literacy (Milner et al., 2019) and to suicide behaviours (Cleary, 2012; King et al., 2019; Pirkis et al., 2017). While it is logically assumed that gender equality is associated with an erosion of traditional masculine norms, it is possible that this process is somewhat out of step. Some masculine norms may remain inveterate and immutable, and the process of dismantling such norms may lag behind the process of increasing gender equality. It is also important to note that countries with increased gender equality also make for a more competitive labour market where men may find it more difficult to be the main provider. Economic conditions where being a provider is more difficult has important consequences for their suicide risk. While it is feasible that some pressures on men may be relieved by initiatives and policies designed to progress gender equality, the pressure (and associated suicide risk) may be higher for men who are particularly attached to the male breadwinner role.

In the results, we highlighted some differences between the fixed and random effects results. These differences are likely driven by two possibilities. First, it is possible that we

have not captured a time-varying confounder of the relationship between gender equality and suicide. Such an effect might arise if cultural norms that are prior causes of both gender equality and suicide changed over the course of the study. We contend however, that country level cultural change is generally not a rapid process. While not impossible, given the likely lag between change in cultural norms and effects on both of these constructs, we consider an effect of this kind unlikely in the space of 10 years. Second, it is possible that the differences between fixed and random effects reflects the influence of country-specific factors on the relationship between gender equality and suicide. The fixed effects approach controls for time-invariant within country factors such as religion, social norms regarding suicide, collectivist vs individualist culture, and it is likely that the random effects models are evincing the influence of these unobserved factors, and the violation of the random effects assumption.

We note some important strengths and limitations of this analyses. In terms of strengths, this is the first study that we are aware of to examine within-country changes in suicide rates for males and females in relation to within-country changes in gender equality. We have used statistical methods (fixed-effects) appropriate for the examination of within-country changes in suicide rates in relation to within-country changes in gender equality.

In terms of limitations, suicide is known to be highly culturally specific. Different cultural contexts perpetuate different ideologies and varying cultural scripts in relation to suicide (Canetto, 2008). In some cultures, suicide is considered to be a highly feminine act, whereas in others it is considered to be a masculine act (Canetto, 2008). While the fixed-effects methods we used in this analysis account for such cultural variations if they remain stable

within a country, it is possible that shifting cultural norms and attitudes, particularly if associated with gender equality, underpin the associations observed in this analysis.

It is important to acknowledge the limitations of population data on suicide mortality. The way that suicide is defined and measured varies considerably (Turecki and Brent, 2016), and it is known that suicide can be substantially under-reported in many countries (Nock et al., 2008; Tøllefsen et al., 2012). Therefore, our results are likely conservative and underestimate associations. We also note that the composition of indices such as the GGI is at least partly driven by the availability of comparable statistics (Dijkstra, 2006). This means that as the heterogeneity of the countries assessed by the indicator increases (as in this study), the fewer relevant measures will be available to enable empirical comparison across all of the countries (Bericat, 2012). This means that such indicators, while useful in comparing countries and contexts, may be insufficiently nuanced to assess change within countries with relatively high gender equality (Plantenga et al., 2009). It is also important to acknowledge that the aggregated nature of the GGI means that it is unclear what specific dimensions of gender equality are driving the observed associations. Furthermore, gender equality within the GGI is assessed in the public domain – it is well recognized that improvements in gender equality within the public sphere do not always occur concomitantly with improvements in gender equality in the private sphere (Esping-Andersen, 2009). Thus, the extent to which the associations observed between the GGI and suicide rates for women is reflective of within-country shifts in gender equality enacted within the private sphere is unclear. This indicates a need for additional investigation linking our country-level results to individual-level longitudinal data.

In conclusion, we find that within-country improvements in gender equality are associated with reduced within-country suicide rates for women. There was insufficient evidence that gender equality is associated with reduced suicide rates for men. There is a need for further research to understand the potential influence of unmeasured time-varying confounders, and examine the specific components of gender equality that are driving these associations.

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