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Women, men and COVID-19

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1. Introduction

From discrimination against medical school female applicants in Japan to female genital mutilation in Egypt, inequality between women and men takes different forms. One of the forms of gender inequality prevalent almost in all societies is the difference in men’s and women’s access to resources and healthcare. In the U.S. women are more likely than men to postpone or skip recommended treatment, not fill prescriptions or skip doses of medications because of high healthcare costs (Saganicoff et al., 2014). Women also have lower access to health services due to their assumed roles at homes, restrictive social norms and gender stereotypes (Saganicoff et al., 2014; Heise et al., 2019). Social norms attribute to prioritizing boys’ welfare over that of girls in lean times (Pandey et al., 2002; United Nations Department of Economic and Social Affairs, 1998). There is also an association between a family’s financial strength and the likelihood of the daughter’s dropout (Pandey et al., 2002). Norms and pro-male bias may affect other types of parental investment in children (Kingdon, 2005). In some parts of the world, boys are less likely to be malnourished (Pande, 2003; Choudhury et al., 2000), more likely to be vaccinated (Pande and Yazeck, 2003) and more likely to be taken to health facilities when sick (Chen et al., 1981). Unfortunately, male child preferences affect not only outcomes during childhood, but throughout a woman’s life (Sen and Ostlin, 2008), leaving her in a vulnerable condition.

Pandemics and recessions have the potential to exacerbate health inequalities. In almost all societies, women are responsible for the care of family members when they fall ill. During the 2014–2016 West African outbreak of Ebola, women were more likely to be infected due to their predominant roles as caregivers within families and as front-line healthcare workers (Davies and Bennett, 2016). Unfortunately, women are less likely than men to have power in decision-making during pandemics, and their healthcare needs are largely unmet (Harman, 2016). For instance, during the Zika virus outbreak, women did not have control over their sexual and reproductive lives (Wenham et al., 2019), which was compounded by their inadequate access to health care and insufficient financial resources (United Nations, 2020).

Today, in the light of COVID-19 pandemic, it is important to understand the factors that affect the disparities in men’s and women’s access to healthcare and health outcomes. First reports from China in 2020 pointed to sex imbalance in detected case and death rates of COVID-19, with men dying more from the virus (Guan et al., 2020). As more data became available, later studies painted a different picture. A study of 21 industrialized countries showed that relative increase in...
deaths due to COVID-19 were similar between men and women, with the balance of excess deaths changing from male dominated early in the pandemic to being equal or female dominated later on (Kontis et al., 2020). Despite this, the data discussed in this paper shows considerable imbalance in some parts of the world with men reportedly having higher shares of cases and deaths from COVID-19 than women. This study aims to investigate the factors influencing such disparities in 133 countries.

2. Methods

We use country-level COVID-19 sex-disaggregated data published by Global Health 50/50. The database utilized in this study contains 164 107 735 total cases of COVID-19 infections across 133 countries with mean number of total cases being 1 143 091. Of 133 countries only 102 report sex-disaggregated death rates with mean number of total deaths being 35 510. Due to concerns regarding representation and generalization, countries that reported less than 100 deaths were excluded from the sample.

While most countries, especially developed ones, report roughly equal infection and death rates between men and women, there are some that report higher share of men in total cases and deaths. Bahrain reports 88%, Qatar 85%, Saudi Arabia and South Sudan 75%, Pakistan 74% and Bangladesh 71% of COVID-19 confirmed cases being men. Chad, Malawi, Qatar and Pakistan report 74–80% of COVID-19 related deaths being men. On the contrary, countries as Ukraine, Moldova, Poland, Latvia, Jamaica, Georgia and Armenia report 55–60% share of female cases.

Factors both biological and social should be considered to explain differences in male and female COVID-19 confirmed case and death rates. Biological factors play a crucial role in susceptibility and response to viral infections, leading to sex differences in incidence and disease severity (Klein et al., 2009; Tsay et al., 2009). For instance, the prevalence of hepatitis B virus (HBV) and development of hepatocellular carcinoma is higher in males than females (Chen et al., 2006). In contrast, although exposure to influenza A viruses is often higher in males, fatality following exposure is reportedly higher in females (Chen et al., 2006). We use gender gap in healthy life expectancy to account for biological factors. Healthy life expectancy estimates the number of years that women and men can expect to live in good health accounting for years lost to violence, disease, malnutrition, or other relevant factors.

In some analyses, we substitute male and female healthy life expectancy with death rates from communicable and non-communicable diseases. Death rates from non-communicable diseases refer to the share of all deaths by underlying causes, such as cancer, diabetes mellitus, cardiovascular diseases, digestive diseases, skin diseases, musculoskeletal diseases, and congenital anomalies. Meanwhile, death rates from communicable diseases refer to those from infectious and parasitic diseases, respiratory infections, and nutritional deficiencies.

Although first reports pointed to sex imbalance in detected case and death rates from COVID-19, with men dying more from the virus (Guan et al., 2020), later studies painted a different picture (Kontis et al., 2020). We account for the timing of the reported data by dividing it into groups of before and after August 2020 reports, when countries in our sample had a sufficiently large number of cases and deaths by gender to generalize. We also control for differences in male and female shares in the total population.

Smoking have been argued to be associated with negative progression and adverse outcomes of COVID-19 (Vardavas and Nikitara, 2020). We control for smoking using the prevalence of current tobacco use among men and women. It indicates the percentage of the male (female) population who use any tobacco product on a daily or non-daily basis.

One of the roots of COVID-19 spread is through employment, making some groups at higher risks of contracting the disease than others. The study controls for differences in male and female employment rates.

To avoid the issues related to reverse causality and endogeneity, 2018–2019 data was used for the control variables. 2020–2021 COVID-19 case or death rates could not affect 2018–2019 health and gender related outcomes. However, 2018–2019 health and gender-related factors, that do not change drastically from year to year, can affect the reported outcomes of COVID-19.

Countries located in Eastern, Western and Middle Africa, Southern and South-Eastern Asia report considerably more male COVID-19 infection and death rates than others. Such trends cannot be explained by biological differences alone. Biological differences are often responsible for a more consistent pattern from place to place than gender differences. Therefore, non-biological factors related to social environment and norms also need to be examined to understand gender differences in health outcomes during a widespread pandemic. Indices, such as Women, Peace and Security Index, restricted access to resources and assets, discrimination in the family, women’s financial inclusion, and gender gap in education were used to account for gender norms.

Women, Peace and Security Index is a composite index that measures women’s achievements in the dimensions of inclusion, justice, and security. The index ranges from 0 to 1. The higher the index, the more empowered women are.

Women’s financial inclusion shows the percentage of women with accounts at financial institutions or with mobile money service providers.

Restricted access to resources and assets accounts for discriminatory social institutions (formal and informal) that limit women’s ownership and decision-making power over assets and financial tools and undervalue their status at work. Meanwhile, discrimination in the family provides information on formal and informal laws, social norms and practices that limit women’s decision-making power and undervalue their status in the household, covering areas such as child marriage, household responsibilities, parental authority, divorce, and inheritance. Both restricted access to resources and discrimination in the family indices range from 0 to 100, with 0 indicating no discrimination and 100 indicating absolute discrimination or absolute restriction.

2.1. Tests

After investigating the distribution of the data, conducting tests for heteroskedasticity, search for ladder transformation 1 and examining other characteristics of the data, heteroscedastic linear regression model was determined to be the best fit for our cross-sectional analysis. Due to further concerns related to heteroscedasticity, bootstrapped standard errors for predicted means were used. The bootstrap is a statistical procedure that resamples the dataset to create many simulated samples (Deb et al., 2017) and estimates from those samples are used to approximate the distribution.

Researchers usually address missing data by including in the analysis only complete (non-missing) cases. However, the results of such analyses can be biased. We use the imputation method to handle missing data (Sterne et al., 2009). Particularly, we use imputation method to calculate the approximate values of missing data for the difference in the male and female rates of tobacco use, women’s restricted access to resources and assets, and discrimination in the family. Finally, robustness check analyses were conducted by substituting healthy life expectancy variable with male and female deaths rates from communicable and non-communicable diseases.

2.2. Model specification

The dependent variables used in this study are difference in COVID-19 case and difference in death rates between men and women by countries. The equation of interest is the following:

1. Search for ladder transformation (Tukey, 1977) investigates the distribution of the data and informs how variables can be converted to achieve normal or nearly normal distribution.
DiffCases = α + β DiffHealthyLife + λ DiffSmoking + δ DiffPop + μ Timing + φ DiffEmp + ν GenderIndex

where:
DiffHealthyLife is the difference in male and female healthy life expectancy.
DiffSmoking is the difference in the male and female rates of tobacco use.
DiffPop is the difference in shares of men and women in the total population.
Timing determines whether the data was reported before or after August 2020.
DiffEmp is the difference in male and female employment rates.
GenderIndex includes Women Peace and Security Index, restricted access to resources and assets, discrimination in the family, women’s financial inclusion, and gender gap in education.

3. Results

In the analyses presented below the fixed effects include the difference in male and female healthy life expectancy, smoking and employment rates, share of men and women in the total population and the timing of the data. The results are displayed using 95% confidence intervals.

Culture and women’s perceived place in society seem to be important contributors to reported differences in male and female case and death rates from COVID-19 when analyzing country-level data. Particularly, 1 unit increase in the index of discrimination in family is associated with 0.33% (p < 0.01) increase in reported case and 0.23% (p < 0.01) increase in reported death rate difference from COVID-19 between men and women, everything else constant (See Fig. 1). Perhaps, the more discriminated women are in families, the less likely they are to make independent decisions about accessing medicine and testing for COVID-19, leading to lower reported rates of female cases and deaths. As has been noted in the literature, women are less likely to have power in decision-making during pandemics, and their healthcare needs are largely unmet (Harman, 2016; United Nations, 2020).

Table 1 also indicates that 1% increase in women’s access to finance (Goetz and Gupta, 1996) and makes the decision about allocation of resources and medical care.

Epidemiologists and public health experts often believe that cultural determinants of health would be taken care of if the broader domain of social causations is addressed (Chaturvedi et al., 2011). Experience has shown otherwise. There is often a gender bias in access and provision of care. This study investigated the country-level disparities in male and female COVID-19 case and death rates. It showed that countries where women’s rights are less protected and women do not have access to personal finance and education, the associated gap between men’s and women’s recorded case and death rates from COVID-19 are larger than expected. When women have less power in decision-making and less financial independence in such extreme health-related emergencies, they cannot afford tests and hospital stays and need to rely on family members’ benevolence for help. Additionally, compared to “regular” recessions, the employment drop related to social distancing measures has a large impact on sectors with high female employment shares (Alon et al., 2020). Left with lower or no income, women will inevitably have lower access to healthcare and their cases of infection and deaths may largely go unreported.

It could be argued that lower rates of female cases and deaths could be due to lower employment rates and limited interactions with the outside world. However, as the experience from other pandemics has shown, women are more likely to be infected due to their assumed roles as caregivers within families and as front-line healthcare workers (Harman, 2016; United Nations, 2020). This study also showed that even after controlling for men’s and women’s employment status, gender norms and access to finance still have a large effect on recorded disparities. Additionally, women’s employment may not always translate into access to personal finance. Men may still control the household finance (Goze and Gupta, 1996) and make the decision about allocation of resources and medical care.

Overall, discrimination in the family, restricted access to resources, women’s empowerment, access to finance and education are significant factors explaining reported differences in case and death rates from COVID-19 between men and women. Hence, for current and future health crises we recommend:

- Initiating communication and programs with clear understanding of men’s and women’s needs, constraints, roles and responsibilities.
- Equal representation of women in all pandemic responses, gender analysis, planning and decision-making.
### Table 1
Main analyses.

| Difference in male and female COVID-19 case rates | (1) | (2)       | (3) | (4)       | (5)     | Num. of Obs. |
|-------------------------------------------------|-----|-----------|-----|-----------|---------|-------------|
| Restricted access to resources and assets       | 0.302*** (0.107) | 0.329*** (0.069) |       |           |         | 130         |
| Discrimination in the family                     | 0.071*** (0.031) | 0.163*** (0.057) |       |           |         | 130         |
| Women’s financial inclusion                      | 0.159*** (0.06)  | 0.159*** (0.06)  |       |           |         | 128         |
| Women, Peace, and Security index                 | 0.016*** (0.03)  | 0.016*** (0.03)  |       |           |         | 128         |
| Gender education gap                             | 0.208*** (0.107) | 0.208*** (0.107) | 0.208*** (0.107) |         |         | 128         |

### Table 2
Using death rates from communicable and non-communicable diseases.

| Difference in male and female COVID-19 death rates | (1) | (2)       | (3) | (4)       | (5)     | Num. of Obs. |
|--------------------------------------------------|-----|-----------|-----|-----------|---------|-------------|
| Restricted access to resources and assets         | 0.389*** (0.144) |       |       |           |         | 101         |
| Discrimination in the family                      | 0.229* (0.126)   |       |       |           |         | 101         |
| Women’s financial inclusion                       | -0.294*** (0.056) |       |       |           |         | 100         |
| Women, Peace, and Security index                  | -0.766*** (19.079) |       |       |           |         | 100         |
| Gender education gap                              | 2.919* (1.735)   |       |       |           |         | 101         |

Notes: Bootstrapped standard errors in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1.

- Taking serious steps towards young girls’ and women’s empowerment around the globe.

We acknowledge that the series of tests presented in the study have some limitations. Unfortunately, sex-disaggregated data are still not provided by all countries and the interaction of sex and age is not available in Global Health 50/50 or other country-level databases. Also, the data does not report or account for gender identity.

Efforts were made to add other health and gender-related data. Alas, such country-level data was not available. Generally, good and detailed data by gender is not readily available for many countries around the globe and compromises have to be made in the choice of control variables to include a large number of countries in the study. One shortcoming of the paper is that it does not directly control for differences in male and female access to care or related issues. While such country-level data is not available, controls used in the study indirectly capture the effect of access to care. The best study with regards to gendered norms, access to healthcare and exposure to the virus would be a controlled experiment, allowing more in-depth analysis and the study of causalities. Such studies, however, are not possible during widespread pandemics and we are left to rely on today's available data and draw conclusions from it.

### Authors’ contributions

Yeva Aleksanyan: Literature search, data collection, data analysis and visualization. Yeva Aleksanyan and Jason Weinman: Study design, methodology, data interpretation, writing, reviewing, editing. Jason Weinman: Supervision.

### Data sources

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