Article

How are the domains of women’s inclusion, justice, and security associated with maternal and infant mortality across countries? Insights from the Women, Peace, and Security Index

Jeni Klugman a,*, Li Li b, Kathryn M. Barker c, Jennifer Parsons a, Kelly Dale a

a Institute for Women, Peace and Security, Georgetown University, 1412 36th Street, N.W., Washington, DC, 20057, United States
b Hutchinson Institute for Cancer Outcomes Research, Fred Hutchinson Cancer Research Center, 1100 Fairview Ave. N., Seattle, WA, 98109, United States
c Center on Gender Equity and Health, Division of Infectious Diseases and Global Public Health, University of California San Diego, 9500 Gilman Drive, La Jolla, CA, 92093, United States

ARTICLE INFO

Keywords:
Inclusion
Index
Justice
Infant mortality
Maternal mortality
Women’s health

ABSTRACT

Women’s autonomy and empowerment in their homes, communities, and societies at large have been shown, through many direct and indirect pathways, to be associated with maternal and infant health. A novel global measure—the Women, Peace, and Security (WPS) Index—that bridges insights from gender and development indices with those from peace and security has recently been developed to capture the constructs of women’s inclusion, justice, and security, using indicators and targets in the Sustainable Development Goals. This paper adds to the growing literature about the importance of gender inequality to key mortality outcomes for women and children by investigating the associations between nations’ WPS Index scores and maternal mortality ratios and infant mortality rates. We use a range of international databases to obtain country-level data from 144 nations on health, demographic, income, and gender equality indicators. The aim is to highlight the role of women’s inclusion, justice, and security in explaining national rates of maternal and infant mortality. Fully adjusted Poisson regression models indicate that a one point (0.01) increase on the WPS Index score is associated with a 2.0% reduction in the number of maternal deaths and a 2.3% reduction in the number of infant deaths. For a country such as Sierra Leone, with a maternal mortality ratio of 1360 maternal deaths per 100,000 live births, a one point improvement in the WPS Index would correspond to a maternal mortality ratio of 1,332, or 28 fewer deaths per 100,000 births. These associations are ecological and apply to the average level of mortality at the country level rather than the likelihood of a specific death at the individual level. Although we cannot claim causality for the observed relations in the cross-country regressions, the findings and recurring patterns are both suggestive and encouraging about the potential contributions of women’s inclusion, justice, and security to maternal and infant mortality.

1. Introduction

Although global trends in key health outcomes over recent decades are encouraging, there is growing recognition of the deep-seated structural barriers to their improvement, including in gender inequality. The targets and indicators agreed upon by the 193 countries in the Sustainable Development Goals (SDGs) illustrate that health equity (SDG 3) is not a stand-alone goal and underlie the synergies between health outcomes and gender equality (SDG 5), economic opportunities (SDG 8), and ensuring peaceful societies (SDG 16), among others (WHO, 2017).

The targets to reduce maternal and infant mortality and the goal to achieve gender equality and empower all women and girls provide further impetus to investigate the connections between these important agendas.

This paper focuses on two key health outcomes used to measure progress against SDG 3—maternal mortality ratio (MMR) and infant mortality rate (IMR). These health metrics are widely used as measures of country progress and are important indicators of population health and socioeconomic development generally (Gruber, Hendren, & Townsend, 2014, Reidpath & Allotey, 2003). The global maternal mortality ratio has declined by 37% since 2000, yet in 2015, 303,000 women around the world died because of complications during pregnancy or

* Corresponding author.
E-mail address: jk2008@georgetown.edu (J. Klugman).

https://doi.org/10.1016/j.ssmph.2019.100486
Received 21 August 2018; Received in revised form 17 July 2019; Accepted 16 September 2019
Available online 20 November 2019
2352-8273/© 2020 Published by Elsevier Ltd. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/).
childbirth, largely from preventable causes, the vast majority in developing countries (Alkema et al., 2016). Infant mortality has also been declining, but still totaled 4.2 million infant deaths in 2016 (WHO, 2018a).

A number of studies have investigated the correlates of maternal and infant mortality outcomes. These correlates range from distal factors, such as the level of national income, to more proximate factors, such as the presence of skilled birth attendants during labor. Although a detailed review of these studies is beyond the scope of this article, a brief review is presented here.

Empirical studies suggest that per capita income is an important determinant of child and maternal mortalities globally (Grepin & Klugman, 2013) and regionally, in sub-Saharan Africa (Ashiabi et al., 2016), and the capability of governments to finance access to quality services (Ashiabi et al., 2016). Poverty is a risk factor for maternal mortality (Bonsman & Graham, 2006; Shiffman, 2000; Victora et al., 2010) and infant mortality (Filmer & Pritchett, 1997; Houweling, Kunst, Looman, & Mackenbach, 2005). Much of the effect appears to be due to poverty’s role in limiting access to care (Girum & Wasie, 2017; Grepin & Klugman, 2013; Muldoon et al., 2011), which is compounded by living a longer distance to the nearest health clinic (WHO, 2016; Montgomery, Ram, Kumar, & Jha, 2014). Women who live in poverty may face higher mortality risks related to nutrition and to communicable and noncommunicable diseases directly related to lack of resources (United Nations, 2009). Studies have also examined how government health expenditures are associated with MMR, including the World Health Organization (WHO) systematic review of maternal mortality and morbidity (Bertran et al., 2005), which found increased health expenditures per capita were a statistically significant factor in countries with lower maternal mortality ratios. In 44 sub-Saharan African countries, public and private healthcare spending was associated with lower infant mortality (Novignon, Olakoji & Nonvignon, 2012).

While money clearly matters, the evidence also points to a broader range of social factors driving maternal and infant health outcomes. For example, Schell, Reilly, Rosling, Peterson, and Mia Ekstrom (2007) found that in low-income countries, female literacy was more important than income per capita for infant mortality. A 2011 global study found that, compared with women with more than 12 years of education, women with between one and six years of education had twice the risk of maternal mortality, while those with no education had nearly triple the risk (Karlson et al., 2011).

Adolescent fertility is positively correlated with higher maternal (Blanc, Winfrey, & Ross, 2013) and infant mortality rates (Chen et al., 2007; Hajizadeh, Nando, & Heymann, 2014), although estimates of the size of the increased risk vary greatly (Nove, Matthews, Neal, & Cama, 2014). The WHO identified the presence of a skilled birth attendant as a significant factor in reducing maternal mortality (Betran, Wojdyla, Posner, & Gülmezoglu, 2005). A 2018 study of 47 Muslim-majority countries found that skilled birth attendants had a significant positive impact on rates of infant mortality (Akseer et al., 2018).

Water and sanitation are also important correlates of MMR and IMR. In a study of 193 countries, Cheng, Schuster-Wallace, Watt, Newbold, and Mente (2012) show that access to water and improved sanitation are correlated with lower infant mortality. Improved handwashing and sanitation practices during childbirth have been shown to reduce the risk of infections, sepsis, and death for infants and mothers by up to 25% (Blencowe et al., 2011).

Recognizing the breadth and multiple levels of factors that influence maternal and infant mortality, a number of researchers have utilized composite measures to test the association between the multiple factors of influence and health outcomes across countries. These studies employ an ecological study design, with the country as the unit of analysis, to assess the association between female empowerment indices and a range of factors, such as income per capita and health service provision. One composite measure is the United Nations (UN) Development Programme Gender Inequality Index (GII), which aggregates gaps between men and women in labor force participation and empowerment (secondary education and parliamentary seats), as well as MMR and adolescent fertility.

Using the 2010 GII, Brinda, Rajkumar, and Enemark (2015) found a positive association between gender inequality and infant mortality rates, in an analysis covering 135 countries. Lan and Tavrow (2017) used two other composite measures, the Gender Equity Index (GEI), which measures the gaps between women and men in education, the economy, and political representation, and the Social Institutions and Gender Index (SIGI), which measures discrimination against women in social institutions (formal and informal laws, social norms, and practices), and found that both were significantly correlated with maternal mortality in 44 low-income countries, although none of the indices were consistently significant.

The present study builds upon the existing empirical evidence by undertaking an ecological analysis using a novel global composite measure: the Women, Peace, and Security (WPS) Index. In addition to being the first gender index framed explicitly by the Sustainable Development Agenda, and selecting indicators agreed upon in the Sustainable Development Goals, the WPS Index is also the first to bring together women’s inclusion, justice, and security into a single number and ranking (Klugman, 2019). The WPS Index aggregates measures of women’s inclusion (economic, social, political), justice (formal laws and informal discrimination), and security (family, community, and societal levels). Existing gender indices—such as the World Economic Forum’s Gender Gap Index—are typically limited to such aspects as whether women have completed secondary school or are engaged in paid work (Klugman, 2019). These aspects of inclusion are undoubtedly important but are incomplete in the absence of aspects of justice and security. The WPS Index responds to this gap by incorporating several indicators that have never been used in other prominent gender indices: women’s perceptions of safety in the community and organized violence; whether women’s paid work is deemed acceptable by men in the society; cell phone use; a bias for sons; and intimate partner violence (Klugman, 2019). The WPS Index provides a useful summary measure of aspects of both women’s status (e.g., whether they are legally discriminated against in the society and whether they are in positions of political leadership), as well as aspects of their well-being (safety in their own homes and community, engagement in paid work, and their educational attainment). The WPS Index does not, however, directly capture gaps in women’s achievements compared with men; it is not a measure of gender equality or inequality.

The WPS Index has several advantages for the present purposes, including that it is not endogenous (i.e., it does not include MMR and IMR). It is based on internationally comparable data from published sources rather than expert assessment of achievement, which is the case for elements of the SIGI and World Economic Forum measures, and the construct is easy to understand. Further attractions include its policy relevance, as the components are generally actionable (e.g., expanding

---

1 We are grateful to Gary Darmstadt, Stanford University, for highlighting these benefits.

2 The WPS Index has the most in common with the SIGI Index and the Economist Intelligence Unit’s Women’s Economic Opportunity Index. However, those two indices rely extensively on expert judgment to measure various concepts or to address missing data and have many more indicators than the WPS Index. And the SIGI Index does not include economic dimensions, such as employment and cellphone use, or indicators of organized violence. The number of indicators in other gender indices currently available ranges from five (the GII, which includes maternal mortality) to 33 (SIGI Index) and averages around 16 indicators.
access to education for girls and eliminating legal discrimination) and the fact that the index is recently available for a large number of countries (n 153) and that nations’ scores will be updated every two years (Georgetown Institute for Women, Peace and Security and Peace Research Institute Oslo, 2017, p. 10).

To advance our knowledge, we undertake ecological investigations using the WPS Index and average level of maternal and infant mortality at the country level rather than the “risk” faced at the individual level. Although we cannot claim causality for the observed relations in the cross-country regressions, the findings and recurring patterns are both suggestive and encouraging about the potential role of women’s status.

2. Methods

2.1. Data

A range of data sources are used to obtain the country-level variables used in analysis. These data sources include national Demographic and Health Surveys (DHS), Gallup Polls, and surveys from the World Bank and UN Member Organizations and their partners (e.g., the International Labor Organization [ILO], the United Nations Educational, Scientific, and Cultural Organization [UNESCO], the United Nations Children’s Fund [UNICEF], and the United Nations Entity for Gender Equality and the Empowerment of Women [UN Women]). The list of variables, associated definitions, sources, and years are summarized in Table 1. As shown, the World Development Indicators dataset—compiled by the World Bank using the most currently accurate national, regional, and global estimates available (World Bank, 2018)—was used for the health-dependent variables (MMR and IMR) as well as national income and health expenditure per capita, improved sanitation and water source, rural population share, poverty headcount at $1.90 per day, adolescent fertility rate, and HIV prevalence. The World Governance Indicators database was used for political stability and government effectiveness variables, and WHO data was used for private health expenditure and physician data. Antenatal care (at least one visit) and skilled birth attendance are from Demographic and Health Surveys (DHS) Multiple Indicator Cluster Survey (MICS), and other nationally representative sources.

We recognize at the outset that the data are not perfect. Although gender-disaggregated data are more available in the health sphere (relative to the environment sector, for example), gaps in availability and quality affect the indicators used for cross-country analysis. This study draws on the best available estimates from internationally comparable sources, bearing these caveats in mind.

2.2. Measures

Study outcome measures are MMR and IMR. MMR measures the number of women who die during pregnancy, childbirth, or the six weeks after delivery per 100,000 live births in a given region (WHO, 2018b). IMR measures the number of deaths per 1000 live births of children under one year of age (WHO, 2018b).

The primary exposure of interest is the WPS Index, with a theoretical range from 0 to 1, with a ranking of 1 indicating a perfect national score on inclusion, justice, and security. Formative research, and the selection of final indicators included in the index was based on extensive review of the academic literature and reports by the United Nations. All indicators included in the index are explicit aspects of the SDGs. Development of the index and final indicator selection criteria has been described in-depth elsewhere (Georgetown Institute for Women, Peace and Security and Peace Research Institute Oslo, 2017; Klugman, 2019). The index and scores for 153 countries were published for the first time in October 2017 (Georgetown Institute for Women, Peace and Security and Peace Research Institute Oslo, 2017; Klugman, 2019).

| Variable                      | Definition                                                                 | Source                                      | Year(s) |
|-------------------------------|-----------------------------------------------------------------------------|---------------------------------------------|---------|
| MMR                           | Maternal mortality ratio (modeled estimate, per 100,000 live births)       | World Bank World Development Indicators     | 2015    |
| IMR                           | Infant mortality rate (per 1000 live births)                               | World Bank World Development Indicators     | 2015    |
| Women, Peace, and Security (WPS) Index and Sub-indices | A composite index measuring women’s achievements for the three dimensions of inclusion, justice, and security | WPS Index                                   | 2017    |
| WPS Inclusion Sub-index       | Education Average number of years of education completed by women aged 25 years | UNESCO Institute for Statistics             |         |
|                              | Financial inclusion The percentage of women aged 15 years who reported having an account alone or jointly at a bank or other type of financial institution or personally using a mobile money service | World Bank Global Findex Database          |         |
|                              | Employment The percentage of a country’s female population aged 25 years that is employed | ILOSTAT database                            |         |
|                              | Cell phone use The percentage of women aged 15 years responding “Yes” to the Gallup World Poll question: “Do you have a mobile phone that you use to make and receive personal calls?” | Gallup World Poll 2016                     |         |
|                              | Parliamentary seats The percentage of seats held by women in lower and upper houses of national parliaments. | Inter-Parliamentary Union                   |         |
| WPS Justice Sub-index         | Legal discrimination Aggregate score of laws and regulations that limit women’s ability to participate in the society or economy or that discriminate between men and women, as measured by Women, Business, and the Law | World Bank, Women, Business, and the Law database |         |
|                              | Son bias Sex ratio at birth (ratio of male births to female births). An excess number of births of boys over girls relative to demographic norms (ratio of 1.05 boys to 1.00 girls) reflects discrimination against girls and women | United Nations Department of Economic and Social Affairs, 2016. 2015 Revision of the World Population Prospects |         |
|                              | Discriminatory norms Percentage of men aged 15 years who responded ‘No’ to the Gallup World Poll question: “Is it | Gallup, Inc., and International Labour Organization 2017. Towards a Better Future for Women and Work: Voices of Women and Men. |         |

(continued on next page)
Table 1 (continued)

| Variable | Definition | Source | Year(s) |
|----------|------------|--------|---------|
| WPS Security Sub-index | The percentage of women who have experienced physical or sexual violence committed by their intimate partner | UN Women Global Database on Violence against Women; DHS (Demographic and Health Surveys) Program STATcompiler database 2016 and United Nations Population Fund (UNFPA) Asia-Pacific. | 2010–2016 |
| Lifetime intimate partner violence | Percentage of women aged 15 years who responded “yes” to the Gallup World Poll question: “Do you feel safe walking alone at night in the city or area where you live?” | Gallup World Poll 2016 | |
| Perception of community safety | Total number of battle deaths from state-based, non-state based, or one-sided conflicts per 100,000 people | UCDP (Uppsala Conflict Database), UCDP Georeferenced Event Dataset | |
| Organized violence | | | |
| National Income/Health Expenditure | GDP per capita (constant, 2010 US$) | World Bank World Development Indicators | 2010–2016 |
| Real gross domestic product (GDP) per capita | | | |
| Real health expenditure per capita | Health expenditure per capita, PPP (constant 2011 international $) | World Bank World Development Indicators | 2014 |
| Out of pocket expenditure per capita in PPP international $ | Out-of-pocket spending per capita | World Health Organization data repository | 2011–2015 |
| Health expenditure GDP share | Health expenditure, total (% of GDP) | World Bank World Development Indicators | 2014 |
| Government | Political stability | Political stability and absence of violence/terrorism measures perceptions of the likelihood of political instability and/or politically motivated violence | Worldwide Governance Indicators | 2013–2016 |
| Political stability | | | |
| Government effectiveness | Perceptions of the quality of public services, quality of the civil service and the degree of its independence from political pressures, and quality of policy formulation and implementation and the credibility of government commitment to such policies | Worldwide Governance Indicators | 2013–2016 |
| Water/Sanitation | Improved water source | Improved water source (% of population with access) | World Bank World Development Indicators | 2011–2015 |
| Improved water source | | | |
| Improved sanitation facilities | Improved sanitation facilities (% of population with access) | World Bank World Development Indicators | 2011–2015 |
| Access to Health Care | Physicians density (per 1000 population) | | 1997–2016 |

Table 1 (continued)

| Variable | Definition | Source | Year(s) |
|----------|------------|--------|---------|
| Antenatal care (%) | Percentage of women (aged 15–49 years) attending at least once during pregnancy by skilled health personnel (doctor, nurse, or midwife) and the percentage attended by any provider at least once | UNICEF of the World’s Children: DHS, MICS and other nationally representative sources. | 2011–2016 |
| Skilled birth attendant (%) | Percentage of births attended by skilled health personnel (doctor, nurse, or midwife) | UNICEF of the World’s Children: Joint UNICEF/WHO SBA database, November 2017 update, based on DHS, MICS and other nationally representative sources. | 2013–2016 |
| Population/Poverty Line | | | |
| Rural Population Share | Rural population (% of total population) | World Bank World Development Indicators | 2011–2016 |
| Poverty head count ratio at $1.90 per day | Poverty headcount ratio at $1.90 per day (2011 PPP) (% of population) | World Bank World Development Indicators | 2008–2015 |
| Family | Adolescent fertility rate | Adolescent fertility rate (births per 1000 women, aged 15–19 years) | World Bank World Development Indicators | 2015 |
| Disease | HIV prevalence | Prevalence of HIV, total (% of population aged 15–49 years) | World Bank World Development Indicators | 2015 |

Research Institute Oslo, 2017; Klugman, 2019). The 153 countries represent more than 98% of the world’s population across all levels of income and development.3 Scores for the present analysis use the 2017 country rankings (provided in Appendix A). The index contains three sub-indices: inclusion (economic, social, and political spheres); justice (formal laws and informal discrimination); and security (at the individual, community, and societal levels). The WPS Index scores are generated using the variables listed below in Table 1. In addition to the WPS Index and sub-indices, a range of covariates shown in empirical literature to be correlated with both maternal and infant mortality are examined for inclusion in final analyses.

2.3. Analysis

The process for final model selection follows four steps. We begin by examining bivariate correlations between the variables that the literature suggests are significant determinants of infant and maternal mortality and our outcome measures (MMR and IMR), using the threshold of

3 To be included in the WPS Index, a country must have data available for at least 8 of the 11 indicators. Of the 153 countries included in the WPS Index, 15 lacked data for 1 indicator, 8 lacked data for 2 indicators, and 82 lacked data for 3 indicators. Missing data were generally addressed by imputing the regional average for that score. In a few cases, the estimate for the country’s nearest neighbor that shared common characteristics, such as level of development, was imputed. All these cases are footnoted in Statistical Table 1: https://jglwp.ssm. georgetown.edu/wp-content/uploads/2017/10/WPS-Index-Report-2017-18.pdf.
a correlation of 0.60 (i.e., moderate to high correlation) to determine inclusion (Table 2) (Hinkle, Wiersma, & Jurs, 2009). For both MMR and IMR, the following variables emerged as having moderate to high correlation and are retained for subsequent analysis: real GDP per capita, real health expenditure per capita, out-of-pocket expenditure per capita, government effectiveness, improved water source, improved sanitation facilities, physician density, antenatal care, presence of a skilled birth attendant, rural population share, poverty headcount ratio, and adolescent fertility rate. HIV prevalence was included for MMR but not for IMR (Spearman’s correlation of p = 0.607 and 0.536, respectively).

We next examine the correlation between these remaining variables and the WPS Index (Table 3). Given our exposure of interest is the WPS Index, any covariates with high correlation (0.80) with the WPS Index are removed. Only government effectiveness had a high correlation with the WPS Index and was subsequently removed.

Stepwise Poisson regression is conducted with the remaining covariates. Given the high collinearity between variables, when included in models together, the direction of the relationships between some of the covariates and the outcome variables changes (real health expenditure per capita, out-of-pocket expenditure per capita, rural population, and antenatal care). In the third step, we look for high correlation (0.80) between the remaining twelve covariates. Through this process, we find that the log of real health expenditure per capita and log of gross domestic product (GDP) per capita are highly correlated (r = 0.96); poverty headcount and total sanitation are highly correlated (p = 0.82). Therefore, we exclude real health expenditure per capita and poverty head count from subsequent analyses.

In the final step, we conduct stepwise Poisson regression with MMR and IMR as outcome variables. Final covariates included in MMR models are GDP per capita, physician density, presence of a skilled birth attendant, adolescent fertility rate, and HIV prevalence. Final covariates in IMR models are GDP per capita, improved water source, access to improved sanitation facilities, physician density, and adolescent fertility rate.

The final number of country observations in the full models is 105 countries for maternal mortality and 144 countries for infant mortality. All analyses are conducted in Stata/SE 15.1.

3. Results

Table 4 shows the summary statistics of the two dependent variables and seven independent variables. There is large variation across countries. MMRs range from 3 (Finland, Greece, Iceland, and Poland) to 1360 (Sierra Leone) per 100,000 live births, while IMRs range from 1.5 (Luxembourg) to 96 (Angola) per 1000 live births.

Large differences in maternal and infant mortality are seen across regions (Table 5). In Europe and Central Asia, MMR (13.5) and IMR (7.3) are 36 times and 7 times, respectively, lower than in sub-Saharan Africa, where MMR is 481.1 per 100,000 live births and IMR is 52.7 per 1000 live births.

There is a similarly wide range in national achievements by region and by GDP per capita, access to improved water and sanitation facilities, physician density, skilled birth attendant, adolescent fertility rate, and HIV prevalence (Table 5). Europe, Central Asia, and North America

Table 2
Bivariate Spearman correlations with MMR and IMR.

|                         | (1)      | (2)      | (3)      | (4)      |
|------------------------|----------|----------|----------|----------|
| National Income and Health Expenditure |                       |          |          |          |
| Real GDP per capita    | 0.857    | 0.870    | 189      |
| (p < 0.001)            | (p < 0.001) |          |          |
| Real health expenditure per capita | 0.861    | 0.885    | 190      |
| (p < 0.001)            | (p < 0.001) |          |          |
| Out-of-pocket expenditure per capita | 0.790    | 0.776    | 190      |
| (p < 0.001)            | (p < 0.001) |          |          |
| Health expenditure share GDP | 0.343    | 0.361    | 190      |
| (p < 0.001)            | (p < 0.001) |          |          |
| Government             |                       |          |          |          |
| Political stability    | 0.539    | 0.564    | 191      |
| (p < 0.001)            | (p < 0.001) |          |          |
| Government effectiveness | 0.782    | 0.815    | 191      |
| (p < 0.001)            | (p < 0.001) |          |          |
| Water/Sanitation       |                       |          |          |          |
| Improved water source  | 0.846    | 0.870    | 187      |
| (p < 0.001)            | (p < 0.001) |          |          |
| Improved sanitation     | 0.895    | 0.872    | 185      |
| facilities             | (p < 0.001) |          |          |
| Access to Health Care  |                       |          |          |          |
| Physician density, per 1000 population | 0.876    | 0.846    | 185      |
| (p < 0.001)            | (p < 0.001) |          |          |
| Antenatal care (%), at least one visit | 0.646    | 0.677    | 161      |
| (p < 0.001)            | (p < 0.001) |          |          |
| Skilled birth attendant (%) | 0.848    | 0.797    | 164      |
| (p < 0.001)            | (p < 0.001) |          |          |
| Population/Poverty Line |                   |          |          |          |
| Rural population share | 0.647    | 0.636    | 192      |
| (p < 0.001)            | (p < 0.001) |          |          |
| Poverty headcount ratio at $1.90/day | 0.883    | 0.857    | 145      |
| (p < 0.001)            | (p < 0.001) |          |          |
| Family                 |                       |          |          |          |
| Adolescent fertility rate | 0.827    | 0.803    | 183      |
| (p < 0.001)            | (p < 0.001) |          |          |
| Disease                |                       |          |          |          |
| HIV prevalence         | 0.607    | 0.536    | 132      |
| (p < 0.001)            | (p < 0.001) |          |          |
| WPS                    |                       |          |          |          |
| WPS Index              | 0.795    | 0.820    | 153      |
| (p < 0.001)            | (p < 0.001) |          |          |
| WPS Inclusion Sub-index | 0.792    | 0.826    | 153      |
| (p < 0.001)            | (p < 0.001) |          |          |
| WPS Justice Sub-index  | 0.517    | 0.597    | 153      |
| (p < 0.001)            | (p < 0.001) |          |          |
| WPS Security Sub-index | 0.6374   | 0.592    | 153      |
| (p < 0.001)            | (p < 0.001) |          |          |

Abbreviations: GDP, gross domestic product; IMR, infant mortality rate; MMR, maternal mortality ratio; WPS, Women, Peace, and Security Index.

NB: Sample sizes reflect existing data for each variable.

Table 3
Bivariate Spearman correlations with WPS index.

|                         | WPS Index | N      |
|------------------------|-----------|--------|
| National Income and Health Expenditure | 0.785 (p < 0.001) | 150    |
| Real GDP per capita    | 0.785 (p < 0.001) | 152    |
| Health expenditure share GDP | 0.702 (p < 0.001) | 152    |
| Government             |                       |        |
| Government effectiveness | 0.810 (p < 0.001) | 153    |
| Sanitary/Environmental |                       |        |
| Improved water source  | 0.734 (p < 0.001) | 152    |
| Improved sanitation facilities | 0.720 (p < 0.001) | 151    |
| Access to Health Care  |                       |        |
| Physician density, per 1000 population | 0.732 (p < 0.001) | 149    |
| Antenatal care (%), at least one visit | 0.617 (p < 0.001) | 127    |
| Skilled birth attendant (%) | 0.703 (p < 0.001) | 130    |
| Population/Poverty Line |                   |        |
| Rural population share | 0.544 (p < 0.001) | 153    |
| Poverty headcount ratio at $1.90/day | 0.704 (p < 0.001) | 131    |
| Family                 |                       |        |
| Adolescent fertility rate | 0.689 (p < 0.001) | 153    |
| Disease                |                       |        |
| HIV prevalence* | 0.266 (p < 0.001) | 118    |

Abbreviations: GDP, gross domestic product; WPS, Women, Peace, and Security Index.

NB: Sample sizes reflect existing data for each variable.

*Reached correlation threshold only with MMR.
### Table 4
Descriptive statistics for dependent and independent variables.

| N   | Mean | SD  | Min | Max  |
|-----|------|-----|-----|------|
| Maternal mortality ratio | 144 | 168.76 | 236.06 | 3.00 | 1360.00 |
| Infant mortality rate | 144 | 23.67 | 22.69 | 1.50 | 96.00 |
| Women, Peace, and Security Index | 144 | 0.69 | 0.11 | 0.38 | 0.89 |

| N   | Mean | SD  | Min | Max  |
|-----|------|-----|-----|------|
| Real gross domestic product per capita | 144 | 1435.80 | 20270.22 | 218.28 | 108600.90 |
| Improved water source | 144 | 88.90 | 14.29 | 49.00 | 100.00 |
| Improved sanitation facilities | 144 | 72.91 | 29.31 | 11.60 | 100.00 |

| N   | Mean | SD  | Min | Max  |
|-----|------|-----|-----|------|
| Physician density | 144 | 1.74 | 1.49 | 0.02 | 6.26 |
| Skilled birth attendant | 122 | 84.35 | 20.10 | 20.20 | 100.00 |
| Adolescent fertility rate | 144 | 47.03 | 40.24 | 2.84 | 173.74 |
| HIV prevalence | 114 | 2.13 | 4.86 | 0.10 | 27.20 |

*Data availability is different for the skilled birth attendant and HIV prevalence variables.

perform the best across these indicators, while sub-Saharan Africa performs the worst.

### 3.1. Multivariate analysis

We proceed to investigate the statistical relationships between the WPS Index and MMR and IMR using Poisson regression. The first set of models (Table 5) examines null models with the WPS Index and each of the sub-indices. These models indicate that the WPS Index and each sub-index (inclusion, justice, and security) are significantly and negatively associated with mortality rates. For the overall index, the associated incidence rate ratio (IRR) for MMR is 0.9306, indicating that a one point (0.01) increase in a nation’s WPS Index score is associated with a 7.0% reduction in the number of maternal deaths. The associated IRR for IMR for the WPS Index is 0.9433, indicating that a one point increase in a nation’s WPS Index score is associated with a 5.7% reduction in the number of infant deaths. Among the three sub-indices, the inclusion sub-index has the greatest magnitude for both MMR and IMR.

The next set of models (Table 7) examine the relationship between GDP per capita, the WPS Index, and mortality rates. Increases in GDP per capita are often used to explain reductions in maternal and infant mortality. We find that when included in models separately, the IRRs for the WPS Index exceed those for log GDP per capita. When both variables are modeled together, both remain significant and negatively associated with infant and maternal mortality ratios, indicating that as WPS Index scores and GDP increase, mortality decreases. The coefficient sizes of GDP per capita decline once we include the WPS Index (Table 7, columns 2 to 3 and 5 to 6), suggesting that it is important to account for women’s inclusion, justice, and security in understanding determinants of mortality.

In the final set of models, we include the remaining covariates. In the model examining maternal mortality (Table 8), we account for GDP per capita, improved sanitation, physician density, presence of a skilled birth attendant, adolescent fertility rate, and HIV prevalence (covariate selection process detailed above in the methods section). For infant mortality (Table 9), we account for GDP per capita, improved water and sanitation facilities, physician density, and adolescent fertility rate.

The inclusion of the known covariates attenuates the magnitude of the coefficients for the WPS Index, but the index remains statistically significant and negatively associated with both infant and maternal mortality. With respect to the covariates included in models, all associated coefficients are statistically significant, but the IRRs are very small. The largest IRR for the covariates is for physician density (MMR IRR 0.9952; IMR IRR 0.9980).

Fully adjusted Poisson regression models indicate that a one point (0.01) increase on the WPS Index score is associated with a 2.0% reduction in the number of maternal deaths (IRR 0.9796), and a 2.3% reduction in the number of infant deaths (IRR 0.9775). For a country such as Sierra Leone with a MMR of 1360 maternal deaths per 100,000 live births, a one point improvement in the WPS Index would correspond to an MMR of 1,332, or 28 fewer deaths per 100,000 births. For a country such as Angola with an IMR of 96 infant deaths per 1000 live births, a one point improvement in the WPS Index would correspond to an IMR of 93.8 infant deaths per 1000 live births, or 2.2 fewer infant deaths per 1000 live births.

### 4. Discussion

Our analysis takes advantage of recent improvements in data and innovations in measurement that generated the WPS Index. The WPS Index echoes the widely cited Human Development Index, with a focus on women, justice, and security. Compared with other composite gender indices, the WPS Index has the specific attraction—in the context of understanding drivers of health—of not being endogenous. For example, unlike the Gender Inequality Index, the WPS Index does not include commonly used health outcome indicators: MMR and IMR. The WPS Index also includes actionable components (for example, repealing legal discrimination against women) and is available for a large number of countries.

Our findings confirm significant positive associations between women’s inclusion, justice, and security and maternal and infant mortality rates, after adjusting for the effects of major economic and health service variables. We find that a one point (0.1) increase on the WPS Index score is associated with a 2.0% reduction in the number of maternal deaths and a 2.3% reduction in the number of infant deaths. The WPS Index helps to explain more variation in MMR and IMR than

### Table 5
Descriptive statistics for dependent and independent variables' mean, by region and income group.

| Region            | N   | MMR | IMR | WPS Index | Real GDP Per Capita | Improved Water Source | Improved Sanitation Facilities | Physician Density | Skilled Birth Attendant | Adolescent Fertility Rate | HIV Prevalence * |
|-------------------|-----|-----|-----|-----------|---------------------|-----------------------|-------------------------------|---------------------|------------------------|-------------------------|-----------------|
| East Asia and Pacific | 13  | 69.9 | 14.8 | 0.7       | 15244.5 | 91.4 | 80.8 | 1.6 | 90.0 | 25.9 | 0.4 |
| Europe and Central Asia | 46  | 13.5 | 7.3  | 0.8       | 26766.1 | 97.8 | 95.4 | 3.3 | 99.3 | 15.7 | 0.3 |
| Latin America and Caribbean | 22  | 96.0 | 17.8 | 0.7       | 7155.2 | 91.9 | 79.7 | 1.4 | 91.9 | 62.9 | 0.7 |
| Middle East and North Africa | 15  | 61.9 | 13.8 | 0.6       | 18560.9 | 93.3 | 90.9 | 1.9 | 89.6 | 25.2 | 0.1 |
| North America | 2  | 10.5 | 5.0  | 0.8       | 5131.2 | 99.5 | 99.9 | 2.6 | 99.2 | 15.3 | 0.5 |
| South Asia | 8   | 178.5 | 34.1 | 0.6       | 2552.9 | 89.2 | 60.6 | 1.0 | 70.9 | 40.9 | 0.2 |
| Sub-Saharan Africa | 38  | 481.1 | 52.7 | 0.6       | 2062.2 | 72.2 | 33.1 | 0.2 | 67.3 | 94.6 | 5.8 |

Abbreviations: GDP, gross domestic product; IMR, infant mortality rate; MMR, maternal mortality ratio; WPS, Women, Peace, and Security Index.

* Data availability is slightly different for the skilled birth attendant and HIV prevalence variables.
Table 6
Women, peace, and security (WPS) Index and sub-indices on maternal mortality ratio and infant mortality rate.

| Variables                  | (1)          | (2)          | (3)          | (4)          | (5)          | (6)          | (7)          | (8)          |
|----------------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
|                            | Maternal Mortality Ratio |              |              |              | Infant Mortality Rate |              |              |              |
|                            | IRR (Coefficient) | SE       | IRR (Coefficient) | SE       | IRR (Coefficient) | SE       | IRR (Coefficient) | SE       | IRR (Coefficient) | SE       |
| WPS Index                  | 0.931 (7.192*** | 0.0524      |              |              | 0.943 (5.838*** | 0.141      |              |              |
| WPS Inclusion Sub-index    | 0.938 (6.362*** | 0.0466      |              |              | 0.952 (4.872*** | 0.118      |              |              |
| WPS Justice Sub-index      | 0.958 (4.259*** | 0.0623      |              |              | 0.959 (4.158*** | 0.166      |              |              |
| WPS Security Sub-index     | 0.958 (4.292*** | 0.0414      |              |              | 0.967 (3.358*** | 0.115      |              |              |
| Constant                   | 1.102 (9.742*** | 0.0317      | 1.086 (8.236*** | 0.0207      | 1.090 (8.575*** | 0.0495     | 1.084 (8.058*** | 0.0272     | 1.072 (6.974*** | 0.0877     | 1.058 (5.632*** | 0.0558     | 1.068 (5.543*** | 0.132      | 1.057 (5.498*** | 0.0799     |
| Observations               | 153          | 153          | 153          | 153          | 153          | 153          | 153          | 153          |

Standard errors in brackets.

***p < 0.01, **p < 0.05, *p < 0.1.

Table 7
Results for multivariate regression model: GDP per capita and WPS index, maternal mortality ratio and infant mortality rate.

| Variables                  | (1)          | (2)          | (3)          | (4)          | (5)          | (6)          |
|----------------------------|--------------|--------------|--------------|--------------|--------------|--------------|
|                            | Maternal Mortality Ratio |              |              | Infant Mortality Rate |              |              |
|                            | IRR (Coefficient) | SE       | IRR (Coefficient) | SE       | IRR (Coefficient) | SE       | IRR (Coefficient) | SE       |
| WPS Index                  | 0.925 (7.830*** | 0.0561      | 0.972 (2.874*** | 0.0805      | 0.939 (6.332*** | 0.150      | 0.971 (2.979*** | 0.218      |
| Log GDP per capita          | 0.992 (0.812*** | 0.00560     | 0.993 (0.676*** | 0.00689     | 0.995 (0.548*** | 0.0129     | 0.996 (0.399*** | 0.0172     |
| Constant                   | 1.107 (10.14*** | 0.0340      | 1.121 (11.42*** | 0.0402      | 1.130 (12.19*** | 0.0456     | 1.076 (7.295*** | 0.0937     | 1.078 (7.552*** | 0.0980     | 1.086 (8.292*** | 0.111       |
| Observations               | 150          | 150          | 150          | 150          | 150          | 150          |

Abbreviations: GDP, gross domestic product; WPS, Women, Peace, and Security Index.

Standard errors in parentheses.

***p < 0.01, **p < 0.05, *p < 0.1.

GDP alone. This underscores that addressing exclusion, injustice, and a lack of security at home, in the community, and in society at large is not only important in itself, as reflected in the Sustainable Development Goals, but carries additional instrumental value to improving the health of mothers and infants.

Exploring the relationships between maternal and infant mortality and the WPS Index, we found that the inclusion sub-index had the largest magnitude of effect. This is perhaps unsurprising, as this dimension includes women’s years of schooling, which has been shown in earlier studies to be influential (Gakidou, Cowling, Lozano, & Murray, 2010), as well as women’s access to finance (savings and credit) and mobile phones. Although these variables may be important proxies for women’s empowerment, it is also possible that access to finance can help women to cope with unexpected or catastrophic health events and thereby avert death. If a woman has her own financial account (as measured in the WPS Index), she may have more possibilities to access the health care needed for herself and her children. It is also possible that access to mobile technology—captured by the cell phone indicators in the inclusion dimension of the WPS Index—enables greater connectedness to information and services that can enable better health outcomes. A number of initiatives have sought to build on mobile subscriptions to pave the way for implementation of mobile health (mHealth) initiatives, especially among remote populations and in areas where women’s mobility is limited, such as in Afghanistan (Yamin, Kaewkungwal, Singhavison, & Lawpoolsri, 2018). Further analysis of these potential mechanisms, beyond the use of mHealth messaging, would cast further light.

4.1. Limitations

First, this study presents cross-sectional analysis at the country level, and we cannot draw causal inferences from the results. Second, we need to avoid ecological fallacy, in which associations observed between variables on the aggregate level do not represent associations at the individual level. Third, the WPS Index is a new index and is currently only available for one point in time and is thus not able to be used to
We undertake analysis that generated ecological associations and apply it to the average level of mortality in a population rather than the “likelihood” or “risk” faced at the individual level. Although we cannot claim causality for the observed relations in the cross-country regressions, and there are inevitable limitations in the quality of the data, the findings and recurring patterns are suggestive of and encouraging about the potential role of women’s inclusion, justice, and security in advancing progress in maternal and infant mortality.

4.2. Conclusions

As underscored in the Sustainable Development Agenda, there are major synergies between health outcomes and gender equality. Our headline results underscore these synergies and the centrality of addressing gender inequality and women’s empowerment as part of the Sustainable Development Agenda. Countries that performed the worst in terms of women’s inclusion, justice, and security often have among the worst records in maternal and infant mortality. Our results point to the breadth of the Agenda and highlight specific levers that could be expected to accelerate future progress. Our results provide insights into the connections between the important international agendas called for in the SDGs, and maternal and infant mortality outcomes at a national level.

The SDGs include ambitious goals to reduce global maternal mortality and to end preventable deaths of newborns, alongside achieving gender equality and empowering all women and girls. To achieve these goals, it is imperative that the cross-cutting importance of women’s status in society to achievements in health and economic development be addressed. As stated by Dr. Tedros Adhanom Ghebreyesus, Director General of the WHO, “...when women and girls are socially, economically and politically empowered, they are … more likely to control their sexuality and fertility, and more likely to be healthy. When women and girls have access to quality and comprehensive health care, information about their health and bodies, and the financial protection to be able to access services, it contributes to gender equality” (Women Deliver, 2018). The Goals have accelerated momentum to address the structural inequalities that impede the expansion of peace and prosperity. This paper buttresses that momentum by using a novel and robust measure showing the importance of women’s wellbeing for the key health outcomes of maternal and infant mortality.

The breadth of the WPS Index and its significance to health outcomes illustrates the importance of a broad multipronged approach of policy and programmatic levers to advance women’s well-being and to reduce maternal and infant mortality. By investigating the country-level data included in the WPS Index, policy makers can consider the program and policy reforms needed to enhance women’s inclusion and security, and to address maternal and infant mortality.

Ethical statement

Institutional Review Board deemed the nature of the research exempt from review, because of its sole use of publicly available secondary data sources.

Acknowledgements

This work was supported by the Government of Norway’s Ministry of Foreign Affairs [grant number QZA-16/0019].

### Appendix A. Supplementary data

Supplementary data to this article can be found online at [https://doi.org/10.1016/j.ssmph.2019.100486](https://doi.org/10.1016/j.ssmph.2019.100486).
### Appendix B. Women, Peace, and Security (WPS) Index scores by country

| Country                        | 2017 WPS Index Value | Country                        | 2017 WPS Index Value |
|--------------------------------|----------------------|--------------------------------|----------------------|
| Afghanistan                    | 0.385                | Lesotho                        | 0.623                |
| Albania                        | 0.714                | Liberia                        | 0.588                |
| Algeria                        | 0.595                | Lithuania                      | 0.790                |
| Angola                         | 0.575                | Luxembourg                     | 0.841                |
| Argentina                      | 0.715                | Madagascar                     | 0.576                |
| Armenia                        | 0.654                | Malawi                         | 0.591                |
| Australia                      | 0.827                | Malaysia                       | 0.665                |
| Austria                        | 0.841                | Maldives                       | 0.605                |
| Azerbaijan                     | 0.623                | Mali                           | 0.505                |
| Bahrain                        | 0.709                | Malta                          | 0.795                |
| Bangladesh                     | 0.585                | Mauritania                     | 0.566                |
| Belarus                        | 0.767                | Mauritius                      | 0.705                |
| Belgium                        | 0.846                | Mexico                         | 0.686                |
| Belize                         | 0.682                | Mongolia                       | 0.761                |
| Benin                          | 0.582                | Montenegro                     | 0.770                |
| Bhutan                         | 0.628                | Morocco                        | 0.623                |
| Bolivia (Plurinational State of)| 0.707                | Mozambique                     | 0.628                |
| Bosnia and Herzegovina         | 0.734                | Myanmar                        | 0.606                |
| Botswana                       | 0.656                | Namibia                        | 0.735                |
| Brazil                         | 0.677                | Nepal                          | 0.672                |
| Bulgaria                       | 0.735                | Netherlands                    | 0.854                |
| Burkina Faso                   | 0.609                | New Zealand                    | 0.826                |
| Burundi                        | 0.603                | Nicaragua                      | 0.717                |
| Cambodia                       | 0.660                | Niger                          | 0.538                |
| Cameroon                       | 0.548                | Nigeria                        | 0.583                |
| Canada                         | 0.854                | North Macedonia                | 0.766                |
| Central African Republic       | 0.474                | Norway                         | 0.879                |
| Chad                           | 0.551                | Pakistan                       | 0.441                |
| Chile                          | 0.713                | Panama                         | 0.694                |
| China                          | 0.671                | Paraguay                       | 0.696                |
| Colombia                       | 0.659                | Peru                           | 0.693                |
| Comoros                        | 0.583                | Philippines                    | 0.702                |
| Congo                          | 0.559                | Poland                         | 0.799                |
| Costa Rica                     | 0.730                | Portugal                       | 0.822                |
| Cote d’Ivoire                  | 0.604                | Qatar                          | 0.707                |
| Croatia                        | 0.804                | Republic of Korea              | 0.800                |
| Cyprus                         | 0.802                | Republic of Moldova            | 0.671                |
| Czech Republic                 | 0.797                | Romania                        | 0.739                |
| Democratic Republic of the Congo| 0.486               | Russian Federation             | 0.721                |
| Denmark                        | 0.845                | Rwanda                         | 0.662                |
| Dominican Republic             | 0.707                | Saudi Arabia                   | 0.655                |
| Ecuador                        | 0.746                | Senegal                        | 0.616                |
| Egypt                          | 0.559                | Serbia                         | 0.804                |
| El Salvador                    | 0.685                | Sierra Leone                   | 0.563                |
| Estonia                        | 0.809                | Singapore                      | 0.846                |
| Eswatini                       | 0.575                | Slovakia                       | 0.776                |
| Ethiopia                       | 0.633                | Slovenia                       | 0.861                |
| Finland                        | 0.855                | Somalia                        | 0.555                |
| France                         | 0.817                | South Africa                   | 0.732                |
| Gabon                          | 0.592                | Spain                          | 0.860                |
| Georgia                        | 0.727                | Sri Lanka                      | 0.656                |
| Germany                        | 0.845                | Sudan                          | 0.521                |
| Ghana                          | 0.701                | Suriname                       | 0.718                |
| Greece                         | 0.760                | Sweden                         | 0.854                |
| Guatemala                      | 0.650                | Switzerland                    | 0.871                |
| Guinea                         | 0.573                | Syrian Arab Republic           | 0.385                |
| Haiti                          | 0.625                | Tajikistan                     | 0.687                |
| Honduras                       | 0.675                | Thailand                       | 0.670                |
| Hungary                        | 0.739                | Togo                           | 0.640                |
| Iceland                        | 0.886                | Trinidad and Tobago            | 0.743                |
| India                          | 0.580                | Tunisia                        | 0.663                |
| Indonesia                      | 0.669                | Turkey                         | 0.634                |
| Iran (Islamic Republic of)     | 0.619                | Turkmenistan                   | 0.679                |
| Iraq                           | 0.500                | Uganda                         | 0.654                |
| Ireland                        | 0.823                | Ukraine                        | 0.646                |
| Israel                         | 0.679                | United Arab Emirates           | 0.746                |
| Italy                          | 0.790                | United Kingdom                 | 0.845                |
| Jamaica                        | 0.755                | United Republic of Tanzania    | 0.672                |
| Japan                          | 0.798                | Uruguay                        | 0.714                |
| Jordan                         | 0.627                | USA                            | 0.810                |
| Kazakhstan                     | 0.741                | Uzbekistan                     | 0.720                |
| Kenya                          | 0.631                | Venezuela (Bolivarian Republic of)| 0.684            |
| Kuwait                         | 0.675                | Viet Nam                       | 0.665                |
| Kyrgyzstan                     | 0.690                | Yemen                          | 0.407                |

(continued on next page)
References

Akeer, N., Kamali, M., Bakhache, N., Mirza, M., Mehta, S., Al-Gashim, S., et al. (2018). Status and drivers of maternal, newborn, child and adolescent health in the Islamic world: A comparative analysis. The Lancet, 391, 1493–1512. https://doi.org/10.1016/S0140-6736(18)31831-1.

Akema, L., Chou, D., Hogan, D., Zhang, S., Moller, A. B., Gemmill, A., ... Say, L. (2016). Global, regional, and national levels and trends in maternal mortality between 1990 and 2015, with scenario-based projections to 2030: A systematic analysis by the UN maternal mortality estimation interagency group. Lancet, 387(10017), 462–474. https://doi.org/10.1016/S0140-6736(15)00838-7. Epub 2015 Nov 13.

Ashiahi, N., Nkentia-Amponsah, E., & Senadza, B. (2016). The effect of health expenditure on selected maternal and child health outcomes in sub-Saharan Africa. International Journal of Social Economics, 43(12), 1386–1399. https://doi.org/10.1108/IJSE-08-2015-0199.

Betran, A. P., Wojdyla, D., Posner, S. F., & Gülmezoglu, A. M. (2005). National estimates for maternal mortality: An analysis based on the WHO systematic review of maternal mortality and morbidity. BMC Public Health, 5, 131. https://doi.org/10.1186/1471-2458-5-131.

Blanc, A. K., Winfrey, W., & Ross, J. (2013). New findings for maternal mortality age patterns: Aggregated results for 38 countries. PLoS One, 8, e59864.

Blencowe, H., Cousens, S., Mullany, L. C., Kerber, K., Wall, S., Darmstadt, G. L., et al. (2011). Clean birth and postnatal care practices to reduce neonatal deaths from sepsis and tetanus: A systematic review and Delphi estimation of mortality effect. BMC Public Health, 11(Suppl 3), S11.

Brinda, E. M., Rajkumar, A. P., & Enemark, U. (2015). Association between gender inequality index and child mortality rate: A cross-national study of 136 countries. BMC Public Health, 15(97).

Buur, D., & Bream, K. (2004). An analysis of the determinants of maternal mortality in sub-Saharan Africa. Journal of Women’s Health, 13(8), 926–938.

Chen, J. J., Schuster-Wallace, C. J., Watt, S., Newbold, B. K., & Mente, A. (2012). An ecological quantification of the relationships between water, sanitation and infant, child, and maternal mortality. Environmental Health, 11(4).

Chen, X., Wen, S. W., Fleming, N., Demissie, K., Rhoads, G. G., Walker, M., et al. (2007). Teenage pregnancy and adverse birth outcomes: A large population based retrospective cohort study. International Journal of Epidemiology, 36(2), 368–373. https://doi.org/10.1093/ije/dyl284.

Cutter, D., Deaton, A., & Lleras-Muney, A. (2006). The determinants of mortality. The Journal of Economic Perspectives, 20(3), 97–120.

Women Deliver. (October 23, 2018). To deliver health for all we must prioritize gender equality: A Q&A with Dr. Tedros Adhanom Ghebreyesus. https://womenedeliver.org/2018/health-for-all-must-include-girls-and-women-a-q-a-with-dr-tedros/.

Filmer, D., & Pritchett, L. (1997). Child mortality and public spending on health: How much does money matter? Washington, DC: World Bank Publications.

Gakidou, E., Cowling, K., Lozano, R., & Murray, C. J. (2010). Increased educational attainment and its effect on child mortality in 175 countries between 1970 and 2009: A systematic analysis. The Lancet, 376, 959–974.

Georgetown Institute for Women, Peace and Security and Peace Research Institute Oslo. (2017). Women, peace and security index 2017/18: Tracking sustainable peace through inclusion, justice, and security for women. Washington, DC: GPWPS and PRIO.

Girum, T., & Wasie, A. (2017). Correlates of maternal mortality in developing countries: An ecological study in 82 countries. Maternal Health, Neonatology and Perinatology, 3, 19. https://doi.org/10.4074/S0748-01559-8.

Global Burden of Disease 2015 Eastern Mediterranean Region Maternal Mortality Collaborators. (2018). Maternal mortality and morbidity burden in the eastern Mediterranean region: Findings from the global burden of disease 2015 study. International Journal of Public Health, 63(Supplement 1), 47. https://doi.org/10.1007/s00291-018-1604-3.

Grepin, K., & Klugman, J. (2013). Maternal health: A missed opportunity for development. The Lancet, 381(9879), 1691–1693. https://doi.org/10.1016/S0140- 6736(13)60981-2.

Gruber, J., Hendren, N., & Townsend, R. M. (2014). The great equalizer: Health care access and infant mortality in Thailand. American Economic Journal: Applied Economics, 6(1), 91–107. https://doi.org/10.1257/app.6.19.1.