PUBLIC HEALTH

A global assessment of the impact of violence on lifetime uncertainty

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Uncertainty around age at death, or lifetime uncertainty, is a key public health indicator and a marker of inequality in survival. How does the extent of violence affect lifetime uncertainty? We address this question by quantifying the impact of violence on dispersion in the ages at death, the metric most used to measure lifetime uncertainty. Using mortality data from the Global Burden of Disease Study and the Internal Peace Index between 2008 and 2017, we find that the most violent countries are also those with the highest lifetime uncertainty. In the Middle East, conflict-related deaths are the largest contributor to lifetime uncertainty. In Latin America, a similar pattern is attributable to homicides. The effects are larger in magnitude for men, but the consequences remain considerable for women. Our study points to a double burden of violence on longevity: Not only does violence shorten individual lives, but it also makes the length of life less predictable.

INTRODUCTION

Uncertainty about the future, particularly survival, is a fundamental feature of human life, influencing behavior and long-term decision-making. Investments in education and savings (*1–6*), whether to adopt or adhere to healthy lifestyles (*7*), and even whether and when to engage in childbearing (*8*) have all been linked to perceptions about uncertainty of survival. At the population level, lifetime uncertainty can be measured as the spread, or inequality, in age at death within the population. Despite its centrality in key life course decisions, lifetime uncertainty is less well known than life expectancy, as a metric of population health.

We hypothesize that violence is a key predictor of lifetime uncertainty cross-nationally. Exposure to violence entails a fundamental state of vulnerability with important social and psychological implications. Among these is a high risk of premature death, causing higher lifetime uncertainty (*9, 10*). At the same time, higher levels of uncertainty make individuals more likely to engage in violent behavior, creating a vicious cycle that is difficult to break (*11*). Although substantial effort has been directed to studying the interplay of individuals' perceptions of uncertainty and violence, an empirical link between prevailing levels of violence and lifetime uncertainty has not been comprehensively established worldwide.

Globally, levels of lifetime uncertainty have declined over time but vary considerably between countries (*12–15*). Most of this decline resulted from reductions in premature deaths (*16*), especially infant and maternal mortality, as well as mortality from infectious diseases (*17*). More recently, reduced cancer mortality has helped to reduce lifetime uncertainty within high-income countries (*17*). The role of violence in perpetuating lifetime uncertainty has so far been overlooked from an international perspective. We address this gap by estimating the contribution of violent deaths to the observed differences in lifetime uncertainty between violent and peaceful countries, for both sexes, in all regions of the world.

Violence and lifetime uncertainty around the globe

Defining violence is a key challenge for investigating violence-related phenomena at the global level. Here, we construct an indicator of internal peace using information from the Global Peace Index (GPI). The GPI accounts for the multifaceted nature of violence while considering country-specific conditions (*18*). It ranks the peacefulness of 163 (99.7% of the global population) countries based on three domains: (i) ongoing domestic and international conflict, (ii) societal safety and security, and (iii) militarization. Because our interest rests on how violence affects domestic mortality, we defined the GPI internal peace indicator as the weighted average of the internal peace components of the GPI (e.g., access to arms, deaths from internal conflict, homicide rate, and incarceration rate; see Materials and Methods) to avoid any potential bias due to external military commitments and particular foreign affairs policies.

Lifetime uncertainty is measured using a summary index of the dissimilarity in ages at death based on life tables (see Materials and Methods). Multiple indicators exist for this purpose, and they are highly correlated when measured from young ages (*19*). We use the SD conditioned on surviving to age 10. We conditioned on survival to age 10 because infant and child deaths are strongly weighted in the SD calculated from birth, so much so that they mask differences in lifetime uncertainty over adulthood between populations (*20*). Age 10 is young enough to capture the onset of violent deaths but old enough to capture important midlife mortality differences.

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RESULTS

For the two decades before the Russian invasion of Ukraine, Europe was the most peaceful region in the world. Whether it will continue to be remains to be assessed as the conflict in Ukraine unfolds. Lifetime uncertainty is low in most countries of Northern and Southern Europe, where we also observe minimal to low levels of violence (Fig. 1). The United States stands out among the G7 nations both for its higher levels of violence and its high lifetime uncertainty.

This is in line with the higher rate of gun violence in the United States compared with other high-income nations (21).

In contrast, the Middle East and North Africa (MENA) and Latin America regions have the lowest internal peace. These regions experience the highest levels of violence and the largest lifetime uncertainty (Fig. 1). Syria was the most violent country in the world in 2013–2017. Within Latin America, Colombia, Venezuela, and Mexico were the countries with the highest levels of violence. Venezuela and Mexico have undergone an unprecedented rise in
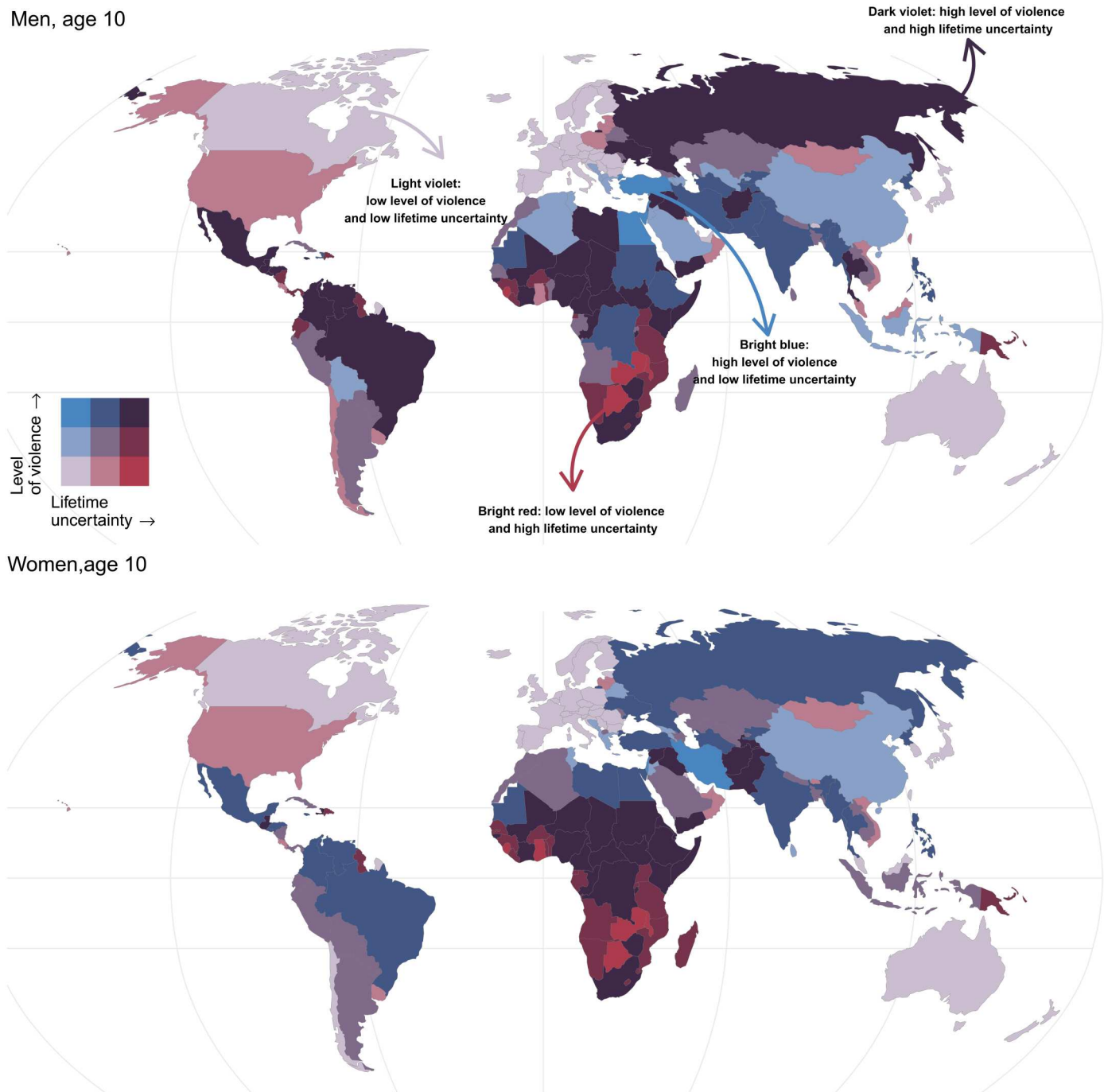
Fig. 1. Global lifetime uncertainty (SD) and level of violence (GPI internal peace) for men and women conditional on surviving to age 10 in 2017.

homicides over the past decades (10, 22). El Salvador had the second highest homicide rate (23, 24) and the third highest lifetime uncertainty. Colombia has had high homicide rates since the 1960s, although they have been declining since 1996 (24, 25). Some of these populations have endured armed conflicts, which have inflicted a disproportionate toll on civilians (26–29).

Pooling across 162 countries there is a moderately strong association between violence and lifetime uncertainty in 2017 with correlation coefficients of 0.56 and 0.63 for women and men, respectively (P < 0.001) (Fig. 2). Pooling across 162 countries and years 2008–2017, the coefficients are 0.50 and 0.60, for women and men respectively. The correlation has remained positive and statistically significant in each year over 2008–2017 (see fig. S1). The correlation also varies between regions. Grouping countries into the seven World Bank regions, we found strong correlations in Europe and Central Asia (correlation coefficients of 0.74 and 0.63 for females and males, respectively), East Asia and Pacific (0.66 and 0.67), Americas (0.45 and 0.72), MENA (0.65, 0.76), and South Asia (0.78, 0.97). However, in sub-Saharan Africa, the correlation was weak (0.017 and 0.08).

Violence, however, may be one of the many factors driving lifetime uncertainty, and lower lifetime uncertainty may reflect lower levels of socioeconomic development more broadly. To more directly assess the link between violence and lifetime uncertainty, we estimate a series of linear regressions including both violence (the GPI) and a widely used measure of development, the Human Development Index (HDI). The GPI is an indicator that resembles the HDI in that it has a similar weighting scheme and is a composite indicator. The GPI focuses on aspects linked to violence, while the HDI captures social and economic development in the domains of health, education, and the economy. Table 1 presents standardized coefficients from regression models predicting lifetime uncertainty

as a function of GPI, year (2008–2017), sex, and the HDI. Descriptive statistics of the sample by region are provided in table S1. Controlling for the linear decline in lifetime uncertainty over time, model 1 in Table 1 indicates that an increase in 1 SD in the GPI corresponds to an increase in 1.17 SDs in lifetime uncertainty. The size of this association diminishes once we control for socioeconomic development as proxied by the HDI. However, across all models, the positive and statistically significant association between GPI and lifetime uncertainty persists even after controlling for HDI and including region fixed effects (model 3, Table 1). Model 3 in Table 1 indicates that 1 SD increase in GPI corresponds to a 0.45 SD increase in lifetime uncertainty.

We further estimate regression models separately by region, including controls for HDI and year (Table 2). The region-specific models show that, even after controlling for HDI, the association between GPI and lifetime uncertainty remains positive and statistically significant across all regions, with the exception of sub-Saharan Africa (extended models with and without HDI are included in table S2). This suggests that, in sub-Saharan Africa, violence is less predictive of lifetime uncertainty. Other factors contributing to high young- and middle-adult mortality rates in the region, such as communicable diseases including HIV, are likely more important drivers of lifetime uncertainty (30, 31). As indicated by the interaction term (GPI × year) in Table 2, the association between GPI and lifetime uncertainty remains similar across years, with the exception of the MENA. In this region, the association between GPI and lifetime uncertainty has become stronger over time.

Because lower life expectancy is typically associated with higher lifetime uncertainty (13–15) and because high levels of violence are related to greater lifetime uncertainty, there is reason to believe that violence could lead to lower life expectancy. We estimate a gap of around 14 years in remaining life expectancy at age 10 between the
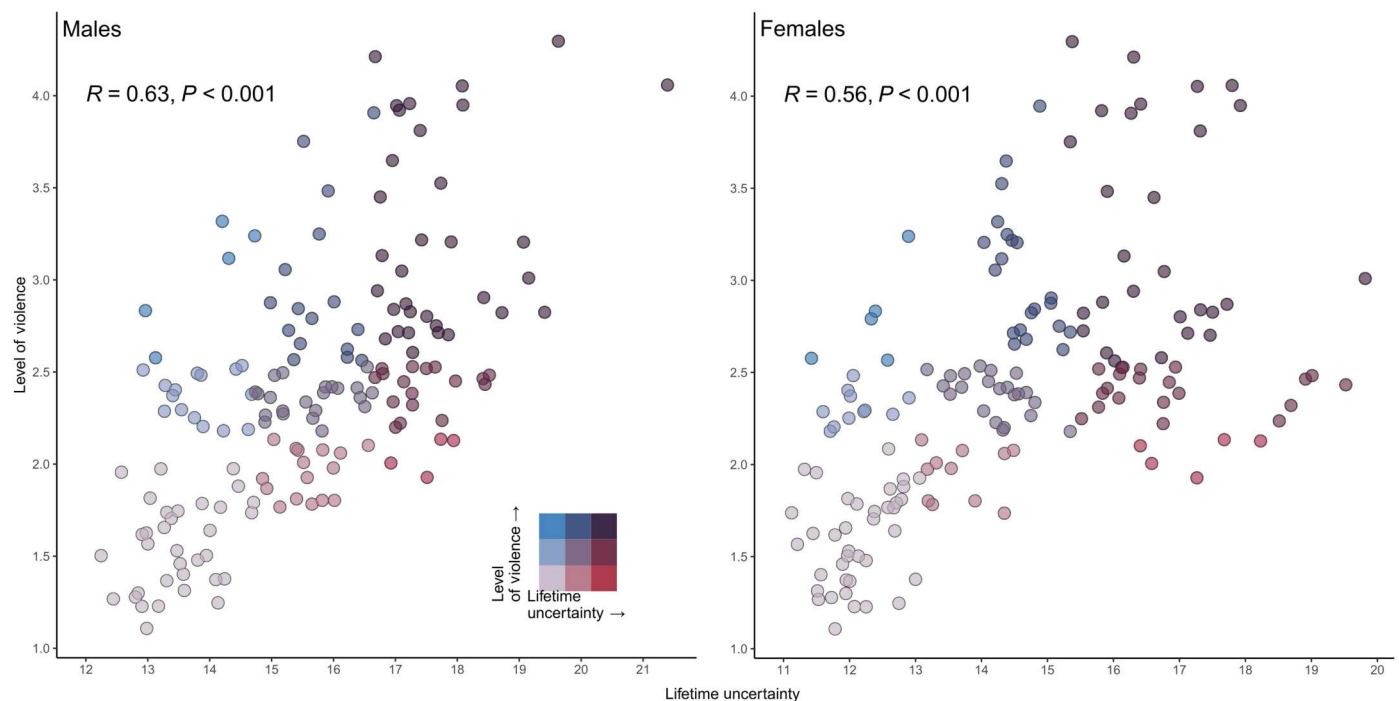
Fig. 2. Association between lifetime uncertainty and violence in 2017.

Table 1. Multivariate regression models, pooled sample across all countries over 2008–2017. *P < 0.05, **P < 0.01, and ***P < 0.001. Note that model predictors are centered and standardized for comparison. R^2, coefficient of determination.

	Lifetime uncertainty		
	Model I	Model II	Model III
Predictors		Estimates	
(Intercept)			
GPI	1.17***	0.35***	0.45***
	(1.11–1.23)	(0.29–0.41)	(0.39–0.51)
HDI		−1.36***	−0.68***
		(−1.42–−1.30)	(−0.77–−0.59)
Region			
Europe and Central Asia	Reference		
East Asia and Pacific			0.69***
			(0.53–0.85)
Americas			1.61***
			(1.46–1.75)
Middle East and North Africa			0.24**
			(0.08–0.39)
South Asia			0.40**
			(0.15–0.64)
Sub-Saharan Africa			2.18***
			(2.00–2.37)
Sex			
Female	Reference		
Male	1.08***	1.08***	1.08***
	(0.95–1.20)	(0.98–1.17)	(0.99–1.16)
Year	−0.19***	−0.05	−0.11***
	(−0.25–−0.13)	(−0.10–0.00)	(−0.15–−0.06)
Observations	3154	3154	3154
R^2/R^2 adjusted	0.349/0.348	0.591/0.590	0.683/0.682

least and most violent countries in our dataset for 2017. In El Salvador, Honduras, Guatemala, and Colombia, the gap in life expectancy with the high-income countries is predominantly explained by excess mortality due to homicides (*23*).

Notable, however, is how violence is even more strongly correlated with levels of lifetime uncertainty than with life expectancy (see fig. S2). This indicates that the impact of violence is strongly captured by its impact on the inequalities in ages at death and is further evidence that life expectancy and lifetime uncertainty do not always move together. Important changes in mortality patterns can thus be overlooked when only life expectancy is monitored. In Mexico, life expectancy stagnated after 2005 due to the rise in homicides (*9*). During this period, lifetime uncertainty increased within the most violent regions of the country. In Venezuela, male life expectancy stagnated between 1996 and 2013, while

lifetime uncertainty actually increased in the same period due to the rise in violence (*10*).

Lifetime uncertainty is consistently higher for men than for women, because of higher male mortality at young adult ages. These ages are referred to as the "young-adult mortality hump" and are an important explanatory factor of sex differences in mortality (*32*). For example, war-related deaths are five times higher for men than that for women (*33*), and homicide rates in Latin America are 10 times higher for men than that for women (*34*).

Figure 3 shows lifetime uncertainty by sex predicted from the region-specific models in Table 2 for the most violent and most peaceful countries. Within each group of violent/peaceful, the countries are ordered from the lowest to highest predicted levels of lifetime uncertainty. The figure shows a clear gap in lifetime uncertainty levels, or, in other words, excess lifetime uncertainty, between the most violent and peaceful countries, controlling for differences in HDI between countries within a region. The average predicted value of lifetime uncertainty across the top 10 most violent countries is 16.48 [95% confidence interval (CI):16.18, 16.78], being 32% higher than the average of the most peaceful countries at 12.54 (95% CI: 12.36, 12.72). The overall largest gaps in predicted lifetime uncertainty among the most violent countries and peaceful ones are found in the countries of the MENA region for both sexes, followed by males in Latin America and females in Africa, and Russia and Ukraine. Males in Yemen (MENA region) experience the highest lifetime uncertainty 18.59 (95% CI: 18.14, 19.02), followed closely by their MENA male counterparts in Syria [18.01 (95% CI: 17.61, 18.42)].

Sex differences in lifetime uncertainty are found across all regions, with males experiencing higher lifetime uncertainty when compared to females. This is particularly the case in the Americas, driven mainly by Latin American countries. Predicted lifetime uncertainty is highest for men compared to that for women in Colombia [males: 17.48 (95% CI: 17.24, 17.72); females: 15.16 (95% CI: 14.92, 15.40)], followed closely by El Salvador [males: 17.59 (95% CI: 17.39, 17.79); females: 15.27 (95% CI: 15.08, 15.47)], Venezuela [males: 17.62 (95% CI: 17.39, 17.85); females: 15.30 (95% CI: 15.07, 15.54)], and Mexico [males: 17.82 (95% CI: 17.52, 18.11); females: 15.50 (95% CI: 15.21, 15.79)]. Notably, countries in the sub-Saharan region have an inverse relationship, with females experiencing higher lifetime uncertainty relative to males {as shown in Fig. 3 in the case of Niger [males: 16.59 (95% CI: 16.38, 16.81); females: 16.99 (95% CI: 16.77, 17.20)], South Sudan [males: 16.63 (95% CI: 16.35, 16.91); females: 17.02 (95% CI: 16.74, 17.30)], and Central African Republic [males: 16.57 (95% CI: 16.30, 16.85); females: 16.96 (95% CI: 16.69, 17.24)]}.

Given the different forms that violence can take, we decompose excess lifetime uncertainty between the most violent countries and composite of the 10 most peaceful ones into the proportion attributable to homicides and war-related deaths versus other remaining causes of death leveraging formal demographic methods (see Materials and Methods). In violent regions, deaths attributed to homicide and war represent a lower bound because violent deaths are often underestimated and underreported, especially in highly violent settings. In Latin America, misclassification, underreported murders, and the increasing number of missing individuals have made it difficult for researchers to estimate the current level of homicide (*10*, *22*, *23*). Similarly, there is considerable uncertainty surrounding the cause-of-death attribution in besieged and remote

Table 2. Multivariate regression models, World Bank regions, over 2008–2017. *$P < 0.05$, **$P < 0.01$, and ***$P < 0.001$. Note that model predictors are centered and standardized for comparison.

	Lifetime uncertainty					
	Europe and Central Asia	Americas	East Asia and Pacific	Middle East and North Africa	South Asia	Sub-Saharan Africa
Predictors	Estimates					
(Intercept)	12.66***	14.67***	13.99***	13.79***	15.13***	17.68***
	(12.58–12.74)	(14.55–14.79)	(13.85–14.12)	(13.59–13.98)	(15.00–15.26)	(17.57–17.80)
GPI	0.58***	0.51***	0.46***	0.59***	0.66***	−0.02
	(0.49–0.68)	(0.41–0.61)	(0.32–0.60)	(0.43–0.74)	(0.55–0.76)	(−0.11–0.07)
GPI:year	0.03	−0.06	−0.03	0.21**	−0.03	0.07
	(−0.03–0.08)	(−0.15–0.03)	(−0.12–0.07)	(0.07–0.35)	(−0.12–0.06)	(−0.01–0.15)
HDI	−0.20***	−0.54***	−0.83***	−0.94***	−0.45***	0.15***
	(−0.29–−0.11)	(−0.65–−0.44)	(−0.97–−0.69)	(−1.09–−0.79)	(−0.55–−0.34)	(0.06–0.24)
Year	−0.07*	−0.09*	−0.03	−0.03	−0.08	−0.31***
	(−0.13–−0.02)	(−0.18–−0.01)	(−0.13–0.07)	(−0.17–0.11)	(−0.18–0.01)	(−0.40–−0.23)
Sex						
Female	Reference					
Male	1.58***	2.31***	1.33***	1.41***	0.74***	−0.39***
	(1.47–1.69)	(2.14–2.49)	(1.13–1.52)	(1.14–1.68)	(0.56–0.93)	(−0.55–−0.23)
Observations	936	500	340	384	140	854
R^2/R^2 adjusted	0.629/0.627	0.696/0.693	0.701/0.697	0.565/0.559	0.776/0.767	0.093/0.087

areas of Syria and Yemen, where data collection is particularly complex (*35*). In addition, we note as a limitation that all of our estimates from high mortality countries are based on modeled mortality schedules because vital registration systems are affected by poor coverage, migration, underregistration, and age misstatement (*36*).

Of the violent countries, among males in MENA (Syria, Iraq, and Yemen) and Latin America (El Salvador, Venezuela, and Colombia), violent deaths account for over half of the difference in lifetime uncertainty with peaceful countries (Fig. 4). The largest burden of homicides is in Latin American countries, a region where one-third of global homicides are concentrated (*34*). In Colombia and Mexico, lifetime uncertainty due to homicides is particularly visible among men aged 20 to 35 years. In Venezuela, the contribution of homicides is manifested even at younger ages, with homicides for men aged 15 to 20 years contributing more than 1 year to the difference in SD of ages at death with peaceful countries. The impact of homicides is substantially more visible among men than women. Nevertheless, women in these countries experience an excess lifetime uncertainty of around 20% compared to peaceful countries, with 16% of this excess due to violence. Among the MENA countries, war-related mortality explains much of the gap in lifetime uncertainty to the peaceful nations, and, in some countries of Africa affected by conflicts, war-related mortality is also a substantial contributor. In Russia and Ukraine, mortality from nonviolent causes around mid- to late-working ages accounts for most of the difference in lifetime uncertainty with peaceful countries for both men and women, although about 10% of the gap was attributed to homicide. These data stem from before the Russian invasion of Ukraine in 2022, which is expected to unleash a major health crisis (*37*).

Our results show that violent deaths are responsible for a high proportion of the difference in lifetime uncertainty between violent and peaceful countries, even if there is uncertainty in our point estimates due to data quality. This underscores the sizable public health burden of violence. These measures, moreover, do not capture the indirect ways, in which violence may affect other causes of death by triggering other forms of vulnerability. For example, in certain African countries, the greater excess lifetime uncertainty observed among women compared to those in peaceful countries likely reflects a heightened vulnerability of adolescent women in contexts where violence may come in the form of gender-related sexual violence and higher maternal mortality due to limited access to obstetric care (*38–41*).

DISCUSSION

Violence increases uncertainty in when we will die. This central finding of our study shows that the impact of violence on mortality goes beyond cutting lives short. When lives are routinely lost to violence, those left behind face uncertainty as to who will be next. In these cases, individuals might rationally decide to forego investments in human and physical capital that only pay off in the long run. In Los Angeles, male youth exposed to urban violence engaged in behavior counterproductive for school completion but protective from short-run victimization (*42*). Existential uncertainty about survival may itself generate further uncertainties in the life course. In these settings, key life course decisions, such as family
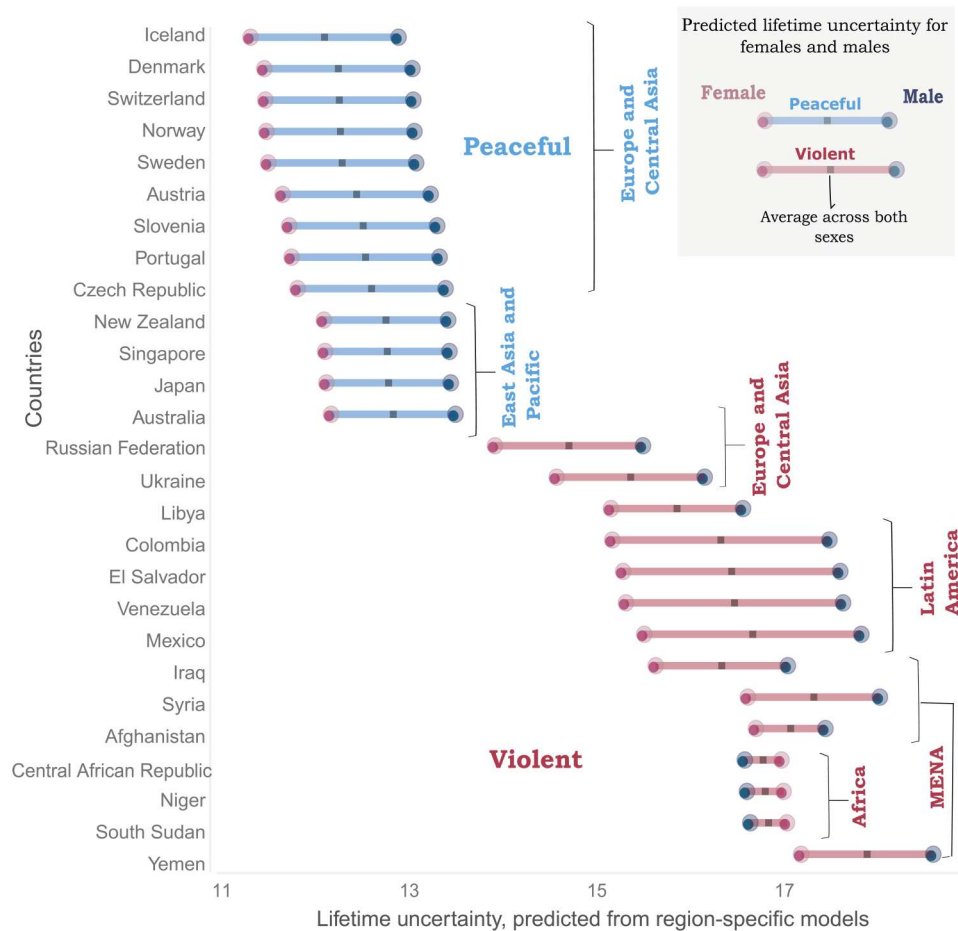
Fig. 3. Predicted lifetime uncertainty by sex, ranked from highest to lowest lifetime uncertainty across the most violent and peaceful countries. Predictions generated from region-specific regression models (Table 2), adjusting for HDI, year, and sex.

formation, are strategically made by seizing a series of opportune chances rather than fulfilling prior intentions (43).

One plausible channel through which a violence and lifetime uncertainty relationship might operate is if violence directly affects the distribution of psychological time perspectives (44), the time horizon typically guiding actions and goals, across a population. Individuals with fatalistic or strongly present-oriented time perspectives routinely engage in higher-risk health behaviors (45, 46) and adhere less to preventive-health programs such as cancer screenings compared to forward-oriented individuals (47).

Although our analysis was conducted at the macro level, French survey data have shown that subjective lifetime uncertainty broadly maps on to the real variability in ages at death (48). Less is known about how individuals perceive aggregate mortality risk in violent settings. However, our psychological tendencies to widely share reports of unusual death patterns across social networks (49) might even lead to an overestimation of subjective lifetime uncertainty, further exacerbating the societal consequences of actual lifetime uncertainty in violent settings.

The most violent countries in the world tend to have the highest lifetime uncertainty. The population-level impacts of violence on lifetime uncertainty are most notable in MENA and Latin America. In these regions, a high proportion of the differential in lifetime uncertainty with peaceful countries is driven by violent causes of death, predominantly homicides and conflict-related deaths. While widespread violence has long been known to exert a heavy toll on life expectancy (9, 10, 22, 23, 35), we show here that its association with lifetime uncertainty was even greater.

The relationship between violence and lifetime uncertainty, as well as the direct impacts of violent causes of death on excess lifetime uncertainty, was generally more pronounced among men than among women. Most combatants in armed conflicts and members of drug-cartels are men, so it is expected that men are the major direct victims of military and paramilitary operations. However, women are affected indirectly in violent contexts too. In MENA, peace and social order have sharply deteriorated from years of civil violence (50, 51), exacerbating poverty, displacement, and restrictions on livelihoods and increasing food insecurity (52). Poverty-insecurity-violence cycles magnify preexisting structural patterns of disadvantage for women and fundamental imbalances in gender relations at young ages (53). In some Latin American countries, female homicides have increased over the past decades (24) and exposure to violent environments brings health and social burdens, particularly for children and women (54).

As a social determinant, exposure to violent contexts increases the risk of depression, alcohol abuse, suicidal behavior,
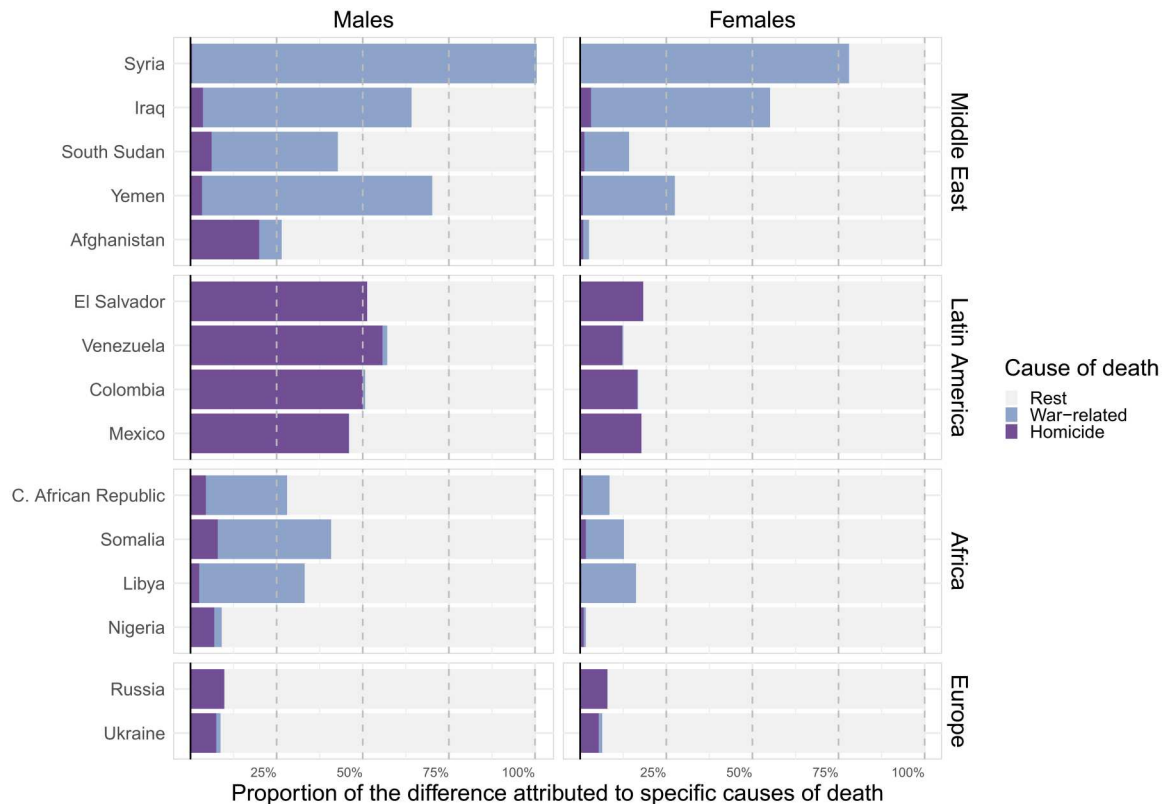
Fig. 4. Cause-specific mortality contribution to the difference in lifetime uncertainty between countries with high levels of violence and composite of 10 most peaceful countries in 2017.

posttraumatic stress disorder, and other long-term psychological problems (*55*). In addition, women are more likely to report vulnerability and experience nonfatal consequences than men in violent contexts, thus facing lingering effects throughout their life cycle (*56*). This raises questions about the nature and extent of differences in how individuals experience and survive violent conflicts as well as how they respond to socially mediated resources and risks in times of high levels of violence. Witnessing violence has an immediate and lasting effect on quality of life (*57*), causing higher levels of stress, anxiety, and other mental health issues for individuals (*58*) while promoting segregation at the population level (*59*).

Looking at the link between lifetime uncertainty and violence reveals the centrality of these two components in today's world. Our study shows that, in the contexts of high violence, lifetime uncertainty is linked to high premature mortality and that such early deaths are the driving factor behind the gap with peaceful nations. To live in a violent country is to experience a double burden: Lives are both shorter and less predictable. The magnitude of lifetime uncertainty attributed to violence in the form of armed conflicts and homicides highlights how it is a public health crisis in many parts of the world with tremendous implications on population health.

MATERIALS AND METHODS
Mortality data
We used mortality estimates for 162 countries from the Global Burden of Disease (GBD) Study (3072 life tables) (*33*). GBD is an observational epidemiological study widely used to analyze trends in mortality and morbidity from major diseases, injuries, and risk factors in a global perspective. These data are provided in 5-year age intervals with the highest interval concentrating deaths above age 85. We focus on three main causes of death related to violence: (i) homicide, (ii) other violence (mostly war, state, and terrorist), and (iii) all other causes. These data were used to estimate our main outcome of interest, lifetime uncertainty.

GPI internal peace indicator
To measure the levels of violence (or peacefulness), we use the GPI as reference. The GPI is the most comprehensive index at a global scale, ranking 163 countries according to the level of peacefulness (*18*). We excluded Kosovo from our analysis because there were no enough data on mortality estimates. In addition, the GPI scores available since 2008 varied as a couple of countries were included with time. There are 160 countries available between 2008 and 2010, 161 countries from 2010 until 2015, and then 162 countries from 2016 onward. The GPI is based on 23 qualitative and quantitative indicators that measure the state of peace using three domains: the level of societal safety and security, the extent of ongoing domestic and international conflict, and the degree of militarization. To avoid potential bias on the violence levels due to external conditions (e.g., weapon exports) that may not directly contribute to each country's lifetime uncertainty, we constructed the GPI internal peace indicator as the weighted average of the "internal peace" components of the GPI, which include violent

demonstrations, violent crime, terrorism impact, political terror scale, political instability, police rate, perceptions of criminality, internal conflict fought, intensity of internal conflict, incarceration rate, homicide rate, deaths from internal conflict, and access to arms. The R code to get the data is available at https://osf.io/degjy/?view_only=2ea76b5fa7ac4eac925707eedc27e291.

HDI indicator

The HDI is a composite measure of three key dimensions of human development: health, education, and standard of living. The health dimension is assessed by life expectancy at birth, and the education dimension is measured by means of years of schooling for adults aged 25 years and more and expected years of schooling for children of school entering age. The standard of living dimension is measured by gross national income per capita. Each dimension falls within a value between 0 and 1. The HDI uses the logarithm of income to reflect the diminishing importance of income with increasing gross national income. The scores for the three HDI dimension indices are then aggregated into a composite index using geometric mean. The range of values determines the levels of development, with values above 0.800 classified as very high, 0.700 to 0.799 classified as high, 0.550 to 0.699 classified as medium, and below 0.550 classified as low. The HDI is available for 191 nations and for the majority of countries from 1990 on, including the United Nations' member states, the State of Palestine, and Hong Kong SAR. However, The HDI is not available for North Korea, Monaco, Nauru, and Somalia. The indicator is calculated on a yearly basis. As only 162 countries are available for the GPI scores, we only combined information on HDI for those sets of countries. See table S1 for a descriptive summary of the HDI variable in this sample.

Demographic methods

To measure the age-at-death distributions more accurately for each country, we split the 5-year age intervals to single ages using the penalized composite link model (60). Mortality rates were extrapolated to age 110+ using the Gamma-Gompertz mortality pattern, which tends to fall between an exponential and logistic functional form (61). We constructed life tables for each country, sex, and year following standard demographic techniques (62). From these, the SD in age at death conditional on surviving to age 10 was calculated as our metric of lifetime uncertainty.

The impact of violent deaths on life expectancy and lifetime uncertainty was estimated following the cause-deleted life table methodology (62). In addition, we decomposed the difference in lifetime uncertainty between violent countries and a composite peaceful region using the linear integral model for decomposition (63). The results of this analysis are shown in Fig. 4. All procedures were done using the R software (64) and are fully reproducible from open data. Our code is posted in a public code repository (https://osf.io/degjy/?view_only=2ea76b5fa7ac4eac925707eedc27e291).

Lifetime uncertainty indicator

Several highly correlated indices of lifetime uncertainty are available (16, 19). We chose the SD of longevity conditional on surviving to age 10. This index has the advantages of being widely used as a dispersion indicator in statistics, is easy to interpret, can be decomposed into age- and cause-specific components, and is expressed in years.

Robustness check with life disparity

All figures were replicated using "life disparity" or average life (65). This indicator has been used in several lifetime uncertainty studies, including one focusing on homicide mortality (9). The indices differ in their sensitivity to changes in mortality at different ages. While some variations in the rankings of lifetime uncertainty were observed, the main results and conclusions of our study are supported.

Regression methods

To examine the association between GPI and lifetime uncertainty, we computed bivariate correlation coefficients between GPI and lifetime uncertainty. We further estimated multivariate regression models, both for the pooled sample across all countries over 2008–2017 (shown in Table 1) and separately for each region (shown in Table 2). The region groupings are based on World Bank classification of countries into regions. The multivariate regression models include controls for year, HDI, and sex, in addition to the main predictor of interest, the GPI. By including the HDI in these models, we are able to examine the net association between GPI and lifetime uncertainty across the pooled sample, and within each region, accounting for differences in human development between countries. The regressions in Tables 1 and 2 report standardized coefficients. Figure 3 reports predicted values from the region-specific regression models reported in Table 2 (holding year at 2017) grouped by the most violent and peaceful countries (by GPI). Within each group, the countries are ordered from the lowest to highest predicted levels of lifetime uncertainty.

Selection of violent countries and construction of the composite peaceful region

The demographic decomposition analysis comparing the contribution of violent deaths to lifetime uncertainty between violent and peaceful countries is shown in Fig. 4. The "best performers" category includes all countries that ranked in the top 10 over the period 2008–2017: Australia, Austria, Belgium, Canada, Switzerland, Czech Republic, Denmark, Finland, Ireland, Iceland, Japan, Norway, New Zealand, Portugal, Singapore, Slovenia, and Sweden. The "most violent" category includes the 25 worst performer countries that scored a low or very low level of GPI in 2017. To have more robust comparisons of lifetime uncertainty between violent countries and a peaceful environment, for each sex, we constructed peaceful-region lifetime uncertainty levels on the basis of the best performers of GPI. It was determined by the weighted mean of age-specific death rates of the best performers. The weights were constructed according to the instances each country appeared in the top 10.

Ethics approval

This research project does not require ethics approval as it only uses macro data that are freely available online.

Supplementary Materials

This PDF file includes:
Figs. S1 and S2
Tables S1 and S2

REFERENCES AND NOTES

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