**Title:** Violence and lifetime uncertainty on a global scale

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**Abstract [150]:**

**Anyone that want to jump in?**

**Main text [3500]:**

Uncertainty about the future, and about mortality in particular, is a fundamental condition of human life and key in shaping people’s behaviour. Any individual making choices over her/his lifetime must do so, somehow, subject to uncertainty about when death will happen. Most research on uncertain lifetimes, or lifespan inequality, has focused on how this unpredictability affects individual consumption and distribution of wealth.1-5 More recently, research on how social determinants, such as socioeconomic status, education or income, affect lifespan inequality has found that socially disadvantaged groups tend to experience higher uncertainty about their age at death.6-11Violence, as a social determinant of health, can too affect lifetime uncertainty with important social implications.12 However, this perspective has not yet been studied. This perspective matters because greater uncertainty in life suggests ineffectiveness of policies to protect individuals and implies a failure of social protection through which violence is spread in a population. At the societal level, greater uncertainty indicates that health improvements are not evenly distributed. Our hypothesis is that violence is fundamentally responsible for increases in lifetime uncertainty in countries with ongoing conflict or high levels of violence.

Globally, uncertainty around life expectancy varies considerably between countries.13-19 Greater uncertainty usually corresponds to those countries with lower life expectancy.17-19 Since the 18th century, major decreases in this uncertainty came about from reducing premature mortality. This mainly as a result of mortality improvements in infancy, and decreasing infectious diseases and maternal mortality.20 More recently, reduced cancer mortality has helped to make length of lives more equal in developed countries.20,21 However, detailed knowledge is lacking about whether and how violence – a fundamental state of vulnerability – makes human lives uncertain. Studies on how violence affects the quality of life often rely on subjective measures.22 Fear of crime, for example, depends on how individuals perceive their environment and, therefore, might lead to a mismatch between the real uncertainty and how it is perceived:23 Females are more likely to report significant levels of vulnerability, while experiencing lower levels of victimization in periods when violence is increasing.24 Certainly, this has an immediate effect on quality of life,25 causing higher levels of stress, anxiety and other mental health issues for individuals,26 while promoting segregation at the population level.24,27 Therefore, a more comprehensive understanding of the burden of violence on lifetime uncertainty holds potential insights for the consequences it poses on individuals and societies, their behaviour in violent environments, and the future of longevity.

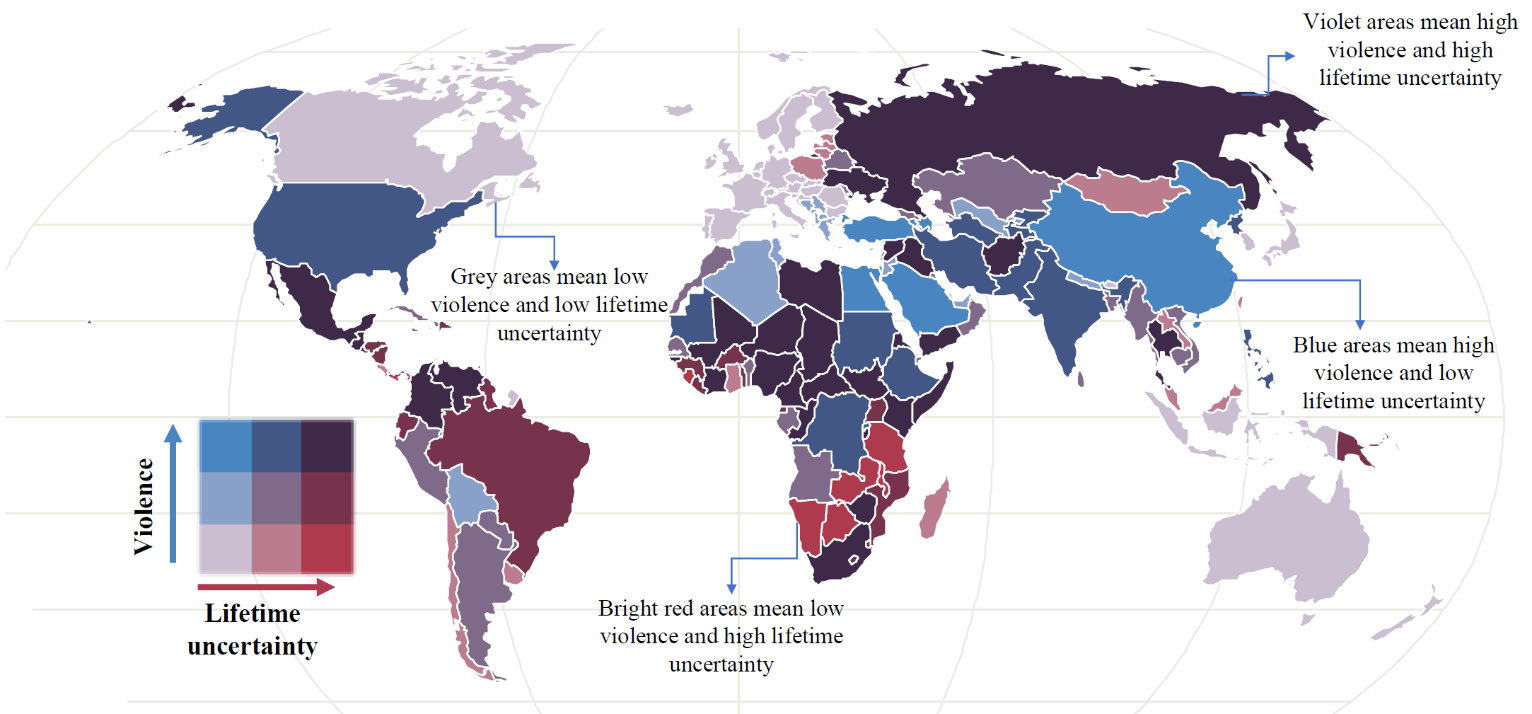
Here we study the relationship between lifetime uncertainty, also known as lifespan inequality, and violence. We pose four questions aimed at filling this knowledge gap: How does lifespan inequality manifest in violent countries, how does it compare with peaceful nations, how does it compare among males and females, and what is the contribution of violent deaths to the observed differences? To answer these questions, we use mortality data from 163 countries from the Global Burden of Disease Study (GBD) by sex (3072 life tables),28 and information on levels of violence from the Global Peace Index (GPI) for the period 2008-2017.

**Lifetime uncertainty and violence around the globe**

The level of violence in a country is determined by the Global Peace Index (GPI).29 This index ranks the peacefulness of 163 (99.7% of the global population) countries based on three domains: 1) Ongoing domestic and international conflict, 2) Societal safety and security, and 3) Militarization. It is constructed with 23 indicators of violence, such as number and duration of internal conflicts, level of perceived criminality, and homicide rates.29 Europe has consistently been the most peaceful region in the world over the last decade. By 2017, the most peaceful nations were Iceland, New Zealand, Portugal, Austria and Denmark. Conversely, the Middle East and North Africa (MENA) are in the other side of the spectrum as the most violent regions,29 and Latin America with highest homicide rates in the world (***Figure 1***).30 Syria, Afghanistan, Iraq, South Sudan and Yemen, in particular, were ranked as the most dangerous countries. These countries have all been embroiled in bitter and multifaceted civil wars, inflicting a disproportionate toll on civilians.31-33 In Latin America, Colombia, Venezuela and Mexico were the countries with the highest levels of violence. Venezuela and Mexico have undergone an unprecedented rise in homicides in the last decade due to political conflict and the war on drugs, respectively.12,30,34 Colombia has historically been a country with high homicide rates, even though homicides have declined since 1996.30

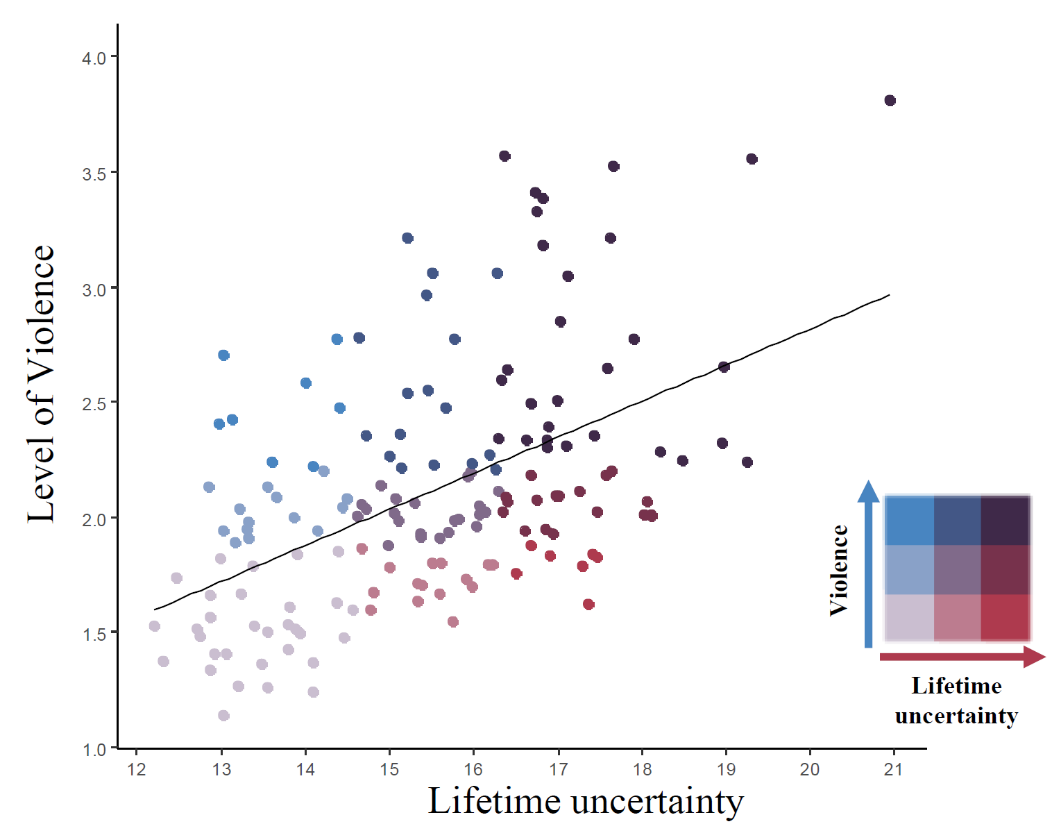
Lifetime uncertainty can be measured with a summary indicator of how similar ages at death are. Multiple indicators exist for this purpose.35 These include the standard deviation or the Gini coefficient of the age-at-death distribution. We chose the standard deviation conditioned on surviving to age 10 to determine how spread ages at death are. The high correlation between these indices suggests that our results would not change significantly with the use of another index.14,35

**Figure 1 Global level of violence and lifetime uncertainty for males in 2017**



In Syria, Iraq, El Salvador, South Africa and Venezuela, lifetime uncertainty is extraordinarily high for males and females (***Figure 1***, see Supplementary Material [SM] for females). This set of countries also shares the highest levels of violence. Syria has been for the past five years the most violent country in the world, while El Salvador has presently the second highest homicide rate. In contrast, lifetime uncertainty is remarkably low in most countries of Northern and Southern Europe, where we also observe minimal to low levels violence. The only slightly more peculiar cases are those of Italy, the United Kingdom and Tunisia, where lifespan uncertainty is low, but violence ranges to moderate to middle levels, allegedly due to more regionalised episodes of violence.

Peaceful countries all enjoy low lifetime uncertainty (***Figure 2***). The most violent instead tend to have higher lifetime uncertainty. Between 2008 and 2017, males and females living in the most dangerous countries showed a positive association with higher uncertainty in lifetime (correlation between level of violence and life uncertainty is 0.52 and 0.44 for males and females, respectively). Moreover, the strong relationship between uncertainty about life and life expectancy suggests that those countries with high levels of violence experience lower levels of life expectancy than the peaceful ones.14 For example, life expectancy in Mexico, after six decades of improvements in longevity, stagnated in the first decade of the 20th century as a result of the rise in homicides after 2005.34 During this period, lifespan inequality increased for the most violent regions of the country.12 In Venezuela, life expectancy at birth stagnated between 1996 and 2013, while lifetime uncertainty increased due to the rise in violence for males.36 As of 2017, our results show that males in Syria and Afghanistan had a life expectancy at age 10 of x and y years respectively, while the expected lifespan for males aged 10 in Iceland and New Zealand was of z years, a gap of almost 14 years. [something about inequality or disparities?] This is important because life uncertainty is a measure of how the length of life varies and the GPI measures the level of violence in a country. Although, in principle, the two indicators could be unrelated to each other –a peaceful country could suffer high lifetime uncertainty, as is the case of southern countries in Africa, while a violent country could show lower mortality and uncertainty in life – but consistently the most violent countries in the world show the highest levels of lifetime uncertainty. This means that violent countries tend to have a double burden in terms of life expectancy and lifetime uncertainty: on average they live less, and their life is less predictable. [more sociology here?] The only country which displays a different behaviour is Israel. Here, although measures of violence are relatively high, life uncertainty is low.



**Figure 2 The relationship between lifetime uncertainty and the level of violence in a country by in 2017 for males.**

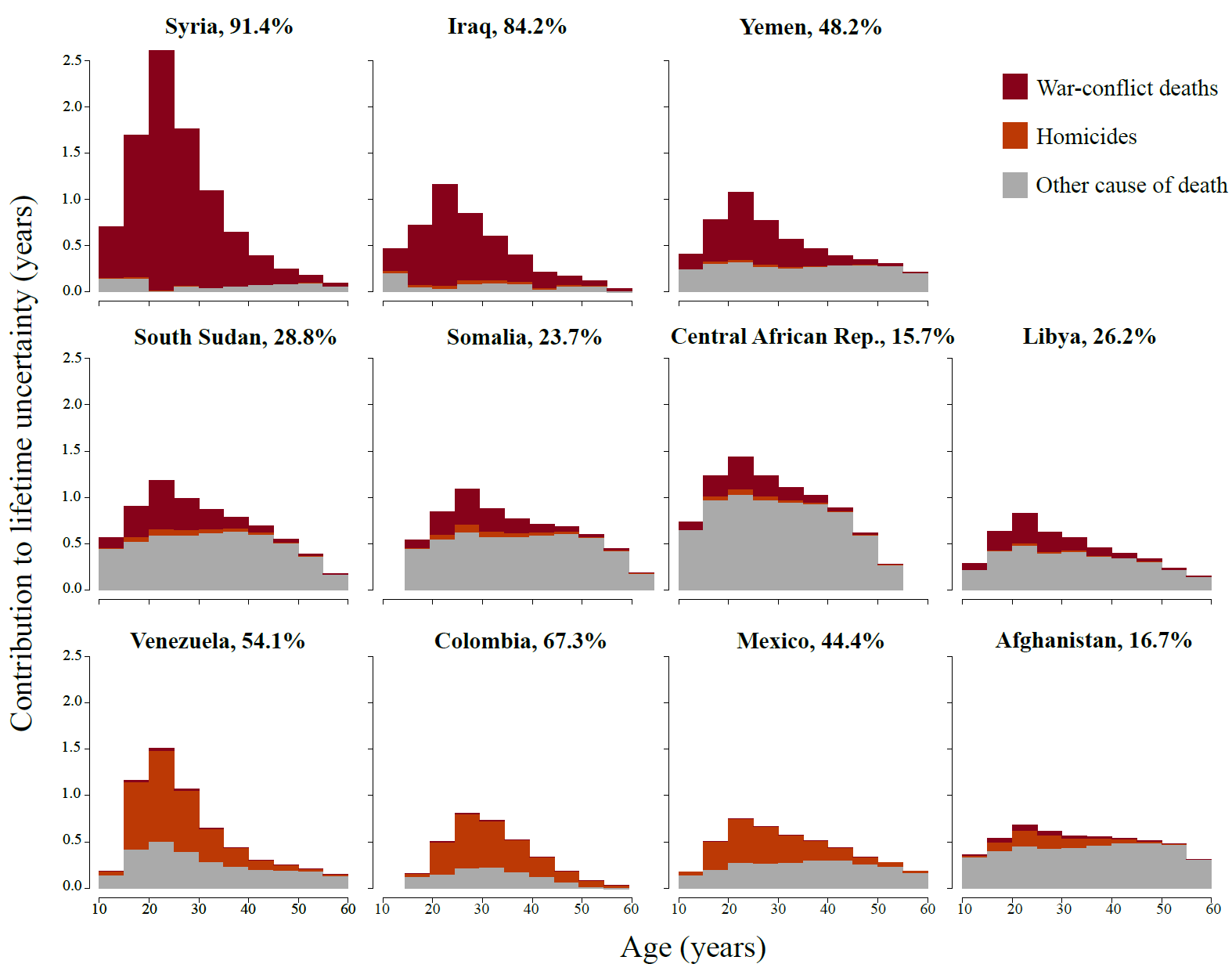
As for gender differences, lifetime uncertainty is lower for females than for males. This advantage, however, is less associated with levels of violence (correlation of 0.44). We hypothesize that this difference results from higher mortality at young and working ages for males. This is usually referred to as the ‘young-mortality’ hump and it is an important explanatory factor of sex differences in mortality.37 For example, war related deaths are five times higher for men than for women, and homicide rates in Latin America are 10 times higher for men than for women.38 This highlights the importance of premature mortality on lifetime uncertainty in contexts of high violence. [more on this, see also outlook section Ridhi?]

**Contribution of violent deaths to life uncertainty**

To test our hypothesis of the young mortality hump, we compared the 25 countries with the highest levels of violence in 2017 with the set of countries that ranked in the top-10 of the most peaceful in the period 2008-2017. The former group includes countries like Syria, Iraq, Yemen, South Sudan, Somalia, Central African Republic, Libya, Venezuela, Colombia, Mexico and Afghanistan shown in ***Figure 3*** (results for women and rest of countries is shown in the SM). The latter includes, Iceland, New Zealand, Austria, Portugal and Denmark, among others. This strategy allowed us to identify the ages driving the difference in lifetime uncertainty between violent countries and more peaceful ones. Additionally, we were able to analyse the contribution of homicides, war-related, and other violent causes of death to lifetime uncertainty. These results, however, represent a lower bound as violent deaths are often underestimated and underreported, especially in high-level violent settings. For example, in Mexico and Venezuela, lack of data has made difficult for researchers to estimate the current level of homicides due to misclassification, underreported murders, and the increasing number of missing individuals.36,39 Equally, the collection of credible/accurate data is particularly difficult in besieged and remote areas in Syria and Yemen. Compared to peaceful countries, the difference in lifespan uncertainty resulting from violence is remarkably high in the MENA region for both genders. ***Figure 3*** shows the contribution of mortality by different causes to the difference in lifetime uncertainty between violent and peaceful countries between ages 10 and 60 years. For instance, violent deaths represent 91.4% and 55.7% of the difference for Syrian males and Iraqi females, respectively. In these countries, war-related violence contributes disproportionately to lifetime uncertainty as compared to homicides or other causes. This is especially true for men of young ages. For instance, lifetime uncertainty in Syria for men aged 20-25 contributes 2.5 years of life to the difference with the peaceful region, while in Iraq and Yemen it ranges between 1 and 1.3 years. Here, as well as in African settings like the Central African Republic, Somalia and South Sudan, the female advantage is visible across almost all age categories; yet, lifespan uncertainty due to war-related deaths is higher for women approaching the start of their reproductive ages as compared to their male counterparts (about 0.8 for females and 0.5 years for males in Syria, 0.25 and 0.1 years in Yemen and 0.3 and 0.25 in Iraq). This suggests heightened vulnerability of adolescent females in contexts where war-related violence may come in the form of gender-related sexual violence.40-42

The contribution of homicides to lifetime uncertainty dominates in violent contexts of Latin America. This region concentrates one third of global homicides.38 Yet, age and gender-related patterns are substantially similar to countries experiencing war-type of violence. In Colombia and Mexico, lifespan uncertainty due to homicides is particularly concentrated among men aged 20-35. In Venezuela, the contribution of homicides is manifested even at younger ages, with lifetime uncertainty due to homicides for men aged 15-20 approaching more than one year of the standard deviation of ages at death. The impact of homicides is substantially more visible among men, although these still account for about 21, 14 and 11 percent of the total causes of lifetime uncertainty among Colombian, Mexican and Venezuelan women, respectively.

Overall, this analysis shows that violence in the form of armed conflicts and interpersonal deaths has manifest importance in variation in lifespans. This impact on the unpredictability of life is overwhelmingly concentrated in young ages and predominantly influences lifespan uncertainty of men, confirming our hypothesis that gender differences are shaped by higher male violence-related mortality. It follows that countries with the lowest levels of lifespan uncertainty succeeded not only because of lower general levels of mortality at all ages, but also because deaths due to war or interpersonal violence in these contexts for both genders are almost inexistent. [what else can we say here]



**Figure 1 Contribution to male lifetime uncertainty by war-conflict deaths, homicides and other causes of death by age in 2017**

**Outlook**

Conflict and non-conflict armed violence are a phenomenon plaguing many regions of the world, with many of the crises that erupted in the past decade remaining unresolved. This progressive fall in peacefulness is having impacts on individuals’ life chances and lifetime uncertainty and has yielded lifespans that are both shorter and less predictable. Indeed, those countries with high levels of violence did not benefit from the dramatic increases in both life expectancy and on the predictability of length of life that most peaceful countries experienced in the 21st century. To put this in perspective, in the period 2010-2014, males in Honduras, El Salvador, Colombia, Venezuela, and Guatemala lost over two years of life expectancy due to homicides when compared to developed countries.43 Similarly, the conflicts and crises in Egypt, Yemen, Libya, and Syria led to reductions in life expectancy. Life expectancy in Syria, for example, would have been 5 and 6 years higher for females and males respectively, had the crisis not occurred.44

The double burden of lower life expectancy and higher lifetime in contexts of high violence may be precursors for indirect consequences on quality of life. Lifetime uncertainty is generally more pronounced among men than among women. This male-female difference raises questions about the nature and extent of differences in how individuals survive violent conflicts and how they respond to socially mediated resources and risks in times of high levels of violence. Most combatants in armed conflicts and members of drug-cartels are men, so it is expected that men are the major direct victim of military operations. As a result life expectancy for women is less affected relative male in periods of crises.45,46 Nevertheless, the consequences and toll of violence on women extends mortality. In the MENA region, for example, peace and social order have been sharply deteriorated by years of civil violence.47,48 At the same time, the increasingly internationalization of these armed conflicts and the consequent external military support, peculiarly Syria and Yemen, have allowed warring factions to use highly sophisticated and more deadly weapons with huge collateral effects on women and civilians in general.31 Violence in the region has been further exacerbated by pre-existing widespread poverty, displacement and restrictions on livelihoods and increasing food insecurity.49 Such tremendous escalation in violence has substantially shaped lifetime uncertainty in these settings and contributed to the gap with more peaceful regions. Yet, from our analyses it also emerges that the breakdown of social stability due to conflict violence in this region influences also the lifespan uncertainty of adolescent women approaching their reproductive ages. This age-related differential vulnerability can be partly explained by pre-existing fundamental imbalances in gender relations at young ages in particular in the region.50 Structural patterns of disadvantage for women approaching their reproductive ages are likely to have been magnified in times and zones of conflict.

In some Latin American countries homicide rates increased disproportionately.51In Mexico, male homicide rates more than doubled between 2007 and 2012.52,53 As a result, male life expectancy was reduced between 2005-10.34,54 This epidemic of violence is related to specific policies trying to mitigate drug cartels operations and it has had unprecedented negative consequences in the last ten years of Mexico’s population health.55-58 Nonetheless, little attention has been paid to the public health impact on women. Over 31 thousand females have been victims of homicide in Mexico in the new century.52 Homicides are the ultimate form of violence, but living in violent environments or experiencing other types of violence also has health and social burdens, particularly for children and women.59 For example, victims of violence are at risk of depression, alcohol abuse, suicidal behavior, psychological problems, among other detrimental consequences over their life course.60-63 Even witnessing violence can affect the wellbeing of the population. Those who witness violence have higher rates of post-traumatic stress disorder, depression, and are more likely to externalize violent behaviors.64,65 In particular, women who witnessed violent acts are twice as likely to experience depressive and anxiety symptoms compared to those who did not witness violence.66 [we need a stronger link of this paragraph with lifetime uncertainty].

Describing the landscape of lifetime uncertainty and violence enabled us to reveal the link between these two central components of one of today’s world challenges: increasing violence. This is the first study to find a positive association of lifetime uncertainty and violence in a global scale. High lifetime uncertainty is linked to high premature mortality.12,13,18 Our study revealed that in context of high violence mortality among young people drives the gap with peaceful nations and the relationship is stronger across countries with high levels of violence. We hypothesize that this is link is governed by fundamental psychological, sociological and biological features. Our results illustrate the power of analyzing the consequences of violence through the lens of lifetime uncertainty or lifespan inequality. This analytical strategy will yield further insights into the consequences of violence when applied to specific countries or subgroups within a population. In particular, our framework applied to the effect of violence by socioeconomic status, education, or other social determinants of violence may lead to new results. [what else can we about the relationship we find]

We might want to consider (From OT):

1. A study on Peru’ found strong positive effects of exposure to civil conflict violence, especially during a woman's late childhood and early teenage years, on the probability of experiencing domestic violence as a wife. Furthermore, they also found that exposure to the civil conflict affects women’s attitudes towards violence: women who were more exposed to civil conflict violence are more likely to report that it is justified for men to beat women for various reasons.  This suggests somehow a normalisation in the use of violence, even within the household, once under uncertain violent contexts.

See: **Gallegos, J. V., & Gutierrez, I. A. (2011). The effect of civil conflict on domestic violence: the case of Peru. SSRN Electronic Journal.**

1. Another paper on Rwanda finds a positive, large and robust effect of conflict on the likelihood of experiencing domestic violence for women who married after the mass killings (**La Mattina, G. (2013). Armed conflict and domestic violence: Evidence from Rwanda**). Similarly, another study on sub-Saharan Africa uses diff-in-diff approach and finds that men and women who were exposed to conflict in childhood appear to express more acceptance of domestic violence. Women who experienced conflict during these ages were also more likely to report being a victim of domestic violence (**La Mattina, G., & Shemyakina, O. (2018). Domestic Violence and Childhood Exposure to Armed Conflict: Attitudes and Experiences (No. 255). Households in Conflict Network**.)
2. On alcohol misuse, I am aware of a systematic review (predominantly of cross-sec studies) by Lo et al. who showed that research shows that men, people with higher cumulative trauma experiences, are significantly more likely to engage in harmful alcohol use compared to women when in conflict.

See**: Lo, J., Patel, P., Shultz, J. M., Ezard, N., & Roberts, B. (2017). A systematic review on harmful alcohol use among civilian populations affected by armed conflict in low-and middle-income countries. *Substance use & misuse*, *52*(11), 1494-1510.**

Some other good references which are also presented in this systematic review are:

**Roberts, B., Felix Ocaka, K., Browne, J., Oyok, T., & Sondorp, E. (2011). Alcohol disorder amongst forcibly displaced persons in northern Uganda. Addictive Behaviors, 36(8), 870–873.**

**Roberts, B., Murphy, A., Chikovani, I., Makhashvili, N., Patel, V., & McKee, M. (2014). Individual and community level risk-factors for alcohol use disorder among conflict-affected persons in Georgia. PLoS ONE, 9(5).**

1. A study on Sri Lanka analysed trends in alcohol misuse in non-conflict districts after the end of the conflict and found a rise in per capital alcohol consumption. They seem to suggest that the effect of conflict on negative health behaviours is influential even if one is not directly exposed, i.e. uncertainty matters even if you are not right on the conflict ground. Yet, note this study, as many of this kind is ecological, with all the fallacies that come with that.

See: **Nugawela, M. D., Lewis, S., Szatkowski, L., & Langley, T. (2017). Rapidly increasing trend of recorded alcohol consumption since the end of the armed conflict in Sri Lanka. Alcohol and Alcoholism, 52(5), 550-556**.

1. A similar systematic review is also available for tobacco consumption, although much less definitive in terms of results.

See: **Lo, J., Patel, P., & Roberts, B. (2016). A systematic review on tobacco use among civilian populations affected by armed conflict. Tobacco control, 25(2), 129-140.**

1. On tobacco, I know one paper on OPTs and Palestinians in general which showed that refugees in Syria and Palestine had higher odds of smoking as compared to refugees and non-ref in Jordan and Lebanon. They note that the former settings are much more prone to violent events than the others. Yet, the study is cross-sectional, so no prior info on prevalence before.

**Jawad, M., Khader, A., & Millett, C. (2016). Differences in tobacco smoking prevalence and frequency between adolescent Palestine refugee and non-refugee populations in Jordan, Lebanon, Syria, and the West Bank: cross-sectional analysis of the Global Youth Tobacco Survey. Conflict and health, 10(1), 20.**

1. The study on contraception came out last week: [**https://onlinelibrary.wiley.com/doi/pdf/10.1111/sifp.12087**](https://onlinelibrary.wiley.com/doi/pdf/10.1111/sifp.12087) and you may also want to have a look at more discursive papers, e.g. **Cange, C. W. (2016). The life course model as a framework for post-conflict health analysis: reflections on the Gulf War critical period. Medicine, Conflict and Survival, 32(4), 282-294.**

**Methods & Data [3000]**

**Data.** We used mortality estimates for 163 countries from the Global Burden of Disease Study.28 GBD is an observational epidemiological study widely used to analyse 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 ***Table 1*** for code of the International Classification of Diseases [ICD10]): 1) homicide, 2) other violence (mostly war, state, and terrorist), and 3) all other causes.

To measure the levels of violence (or peacefulness) we use the Global Peace Index (GPI). GPI has been systematically calculated in the period that we study 2008-2017.29 It ranks the 163 countries according to the level of peacefulness. It 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. It is the most comprehensive index at a global scale and, therefore, a primary source of this study. The R-code to get the data is available at [URL].

**Demographic methods.** To more accurately measure the age-at-death distributions for each country we ungrouped the 5-year age intervals to single ages and distributed the deaths above age 85 with the penalized composite model assuming that deaths follow a Poisson distribution and calculated age-specific mortality rates.67 We constructed life tables for each country, sex, and year following standard demographic techniques.68 From these, lifespan uncertainty conditional on surviving to age 10 were calculated.

To disentangle the effect of violent deaths we calculated life expectancy and lifespan uncertainty in absence of these following the cause-deleted life table methodology.68 Additionally, we decomposed the difference in lifespan uncertainty between violent countries and RPR using the linear integral model for decomposition.69 All procedures were done using the R software,70 and are fully reproducible from the public repository [URL].

**Life span uncertainty indicator.** Several indices, highly correlated, to measure lifespan uncertainty exist.35,71 We chose the standard deviation of longevity conditional on surviving to age 10. This indicator has the advantages of being widely used as dispersion indicator in statistics, easy to interpret, decomposable into age- and cause-specific components, and is expressed in years. In life table notation the standard deviation () is given by

Where and denote the age-at-death density function, life expectancy at age 10, and the open-aged interval (110+ in our case), respectively. We condition to age 10 to capture the onset of violent deaths, which [x%, Tim?] occur over this age, and because infant mortality conceals mortality dynamics of adult ages.72

**Robustness check with life disparity.** All figures were replicated using “life disparity” or average life lost. This indicator has been used in several lifespan uncertainty studies, including one focusing on homicide mortality.12 The indices differ in their sensitivity to changes in mortality and in properties and is measured in years, allowing a direct comparison with the standard deviation. While some variations in the levels of lifetime uncertainty were observed, the main results and conclusions of our study are supported.

**Robustness check conditioning on surviving to different ages.**

**Selection of violent countries and construction of the robust peaceful region (RPR).** We focus on the worst and best performers of GPI to compare the burden of violence on lifespan uncertainty. The “Best Performers” category includes all countries that ranked in the top ten 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 performers countries that scored a low or very low level of GPI in 2017. [Let’s create a table with both the peaceful, violent and life uncertainty levels, gpi] To have more robust comparisons of lifetime uncertainty between violent countries and a peaceful environment, we constructed a “Robust Peaceful Region” based on the best performers of GPI. It was determined by the weighted mean of age-specific death rates by sex of the Best Performers. The weights were constructed according to the instances each country appeared in the top ten.

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**Author contributions:**

**Competing interests:** Non-declared.

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