Supplemental material for the paper Homicides in Mexico increased inequality of lifespans and slowed down life expectancy gains in 2005-2015

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Abstract
Background Mexico experienced an unprecedented rise of violence after 2005. The net effect of this rise on lifespan inequality and life expectancy for the young population in the last decade is unknown. We quantify the effect of rising homicides on lifespan inequality and average lifespan from 2005 to 2015.
Methods Life expectancy and lifespan inequality conditional on surviving to age 15, as measured by years of life lost, with age- and cause-specific contributions to the changes between 1995 and 2015 were calculated. We analysed medically amenable conditions, diabetes, ischemic heart diseases, traffic accidents and homicides by state and sex.
Results Mexican male life expectancy at age 15 increased more than twice in 1995-2005 (1.17 years) than in 2005-2015 (0.55 years). Lifespan inequality decreased by more than half a year for males in 1995-2005 (from 14.31 to 13.77), while in 2005-2015, the reduction was about four times smaller. Homicides between ages 15-49 had the largest effect on slowing down male life expectancy and lifespan inequality in 2005-2015. At the state level, some states experienced reductions in life expectancy in 2005-2015 particularly in the North. In the same period five states showed a large increase in lifespan inequality.
Conclusions After ten years of the unexpected increase of violence in Mexico, the country has not been able to reduce the levels homicides to those prior to 2005. Thus, life expectancy slowed down and inequality of lifespans increased among young Mexican males.

Lifespan inequality indicator

In lifetable notation, $e^{\dagger}_{15}$ is defined as:

$$e^{\dagger}_{15} = \frac{\int_{15}^{\omega} \ell(\mathrm{x})\mu(\mathrm{x})e(\mathrm{x})\mathrm{dx}}{\ell(15)} = \frac{\int_{15}^{\omega} d(\mathrm{x})e(\mathrm{x})\mathrm{dx}}{\ell(15)}, \tag{1}$$

where $\ell(\mathrm{x})$, $\mu(\mathrm{x})$, $e(\mathrm{x})$, $d(\mathrm{x})$ and ω are the survival function, the force of mortality, life expectancy, the age at death distribution at age x, and the open-aged interval, respectively.

Decomposition method summary

The decomposition method used in this paper is based on the line integral model (Horiuchi et al 2008). Suppose f (e.g. $e^{\dagger}$ or life expectancy) is a differentiable function of n covariates (e.g. each age-cause specific mortality rate) denoted by the vector $\boldsymbol{A} = [x_1, x_2, \dots, x_n]^T$. Assume that f and $\boldsymbol{A}$ depend on the underlying dimension t, which is time in this case, and that we have observations available in two time points t_1 and t_2. Assuming that $\boldsymbol{A}$ is a differentiable function of t between t_1 and t_2, the difference in f between t_1 and $t_2$can be expressed as follows:

$$f_2 - f_1 = \sum_{i=1}^{n} \int_{x_i(t_1)}^{x_i(t_2)} \frac{\partial f}{\partial x_i} dx_i = \sum_{i=1}^{n} c_i, \tag{2}$$

where c_i is the total change in f (e.g. $e^{\dagger}$ or life expectancy) produced by changes in the i-th covariate, x_i. The c_i's in equation (2) were computed with numerical integration following the algorithm suggested by Horiuchi et al (2008). This method has the advantage of assuming that covariates change gradually along the time dimension

Code and data to reproduce results

Available at https://goo.gl/tQV6fL.

Shinny app for sensitivity and state specific analysis

Results with starting age 0, available at https://goo.gl/n9XuDy

Results with starting age 15, available at https://demographs.shinyapps.io/LVMx_15_App/

Supplemental figures. All figures are own calculations based on CONAPO (2017) and INEGI (2017) data.

Figure S1. Age-cause specific contributions to the changes in national life expectancy at age 15 for females. Panel A refers to 1995-2005 and panel B to 2005-2015. Note: Numbers in boxes are age-specific contributions.

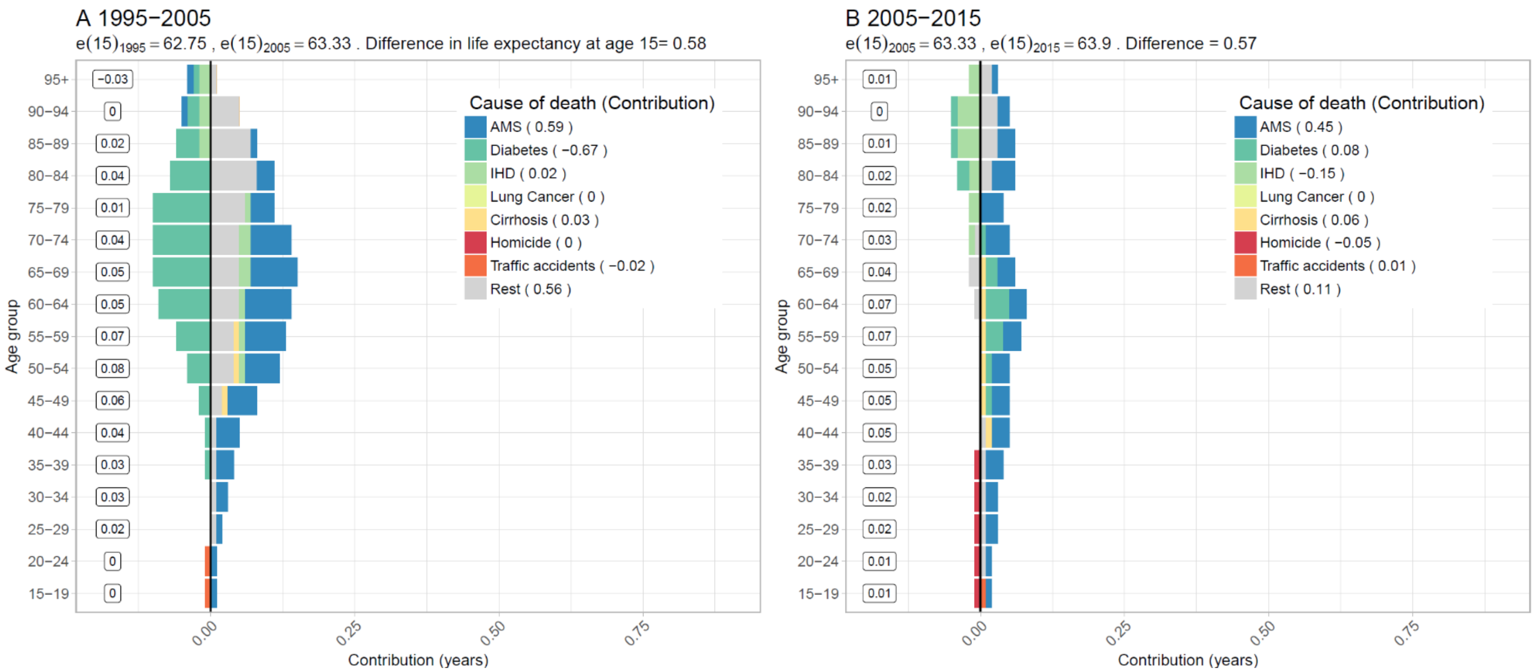


Figure S2. Age-cause specific contributions to the changes in national lifespan variation at age 15 ($e^{\dagger}$) for females. Panel A refers to 1995-2005 and panel B to 2005-2015. Note: Numbers in boxes are age-specific contributions

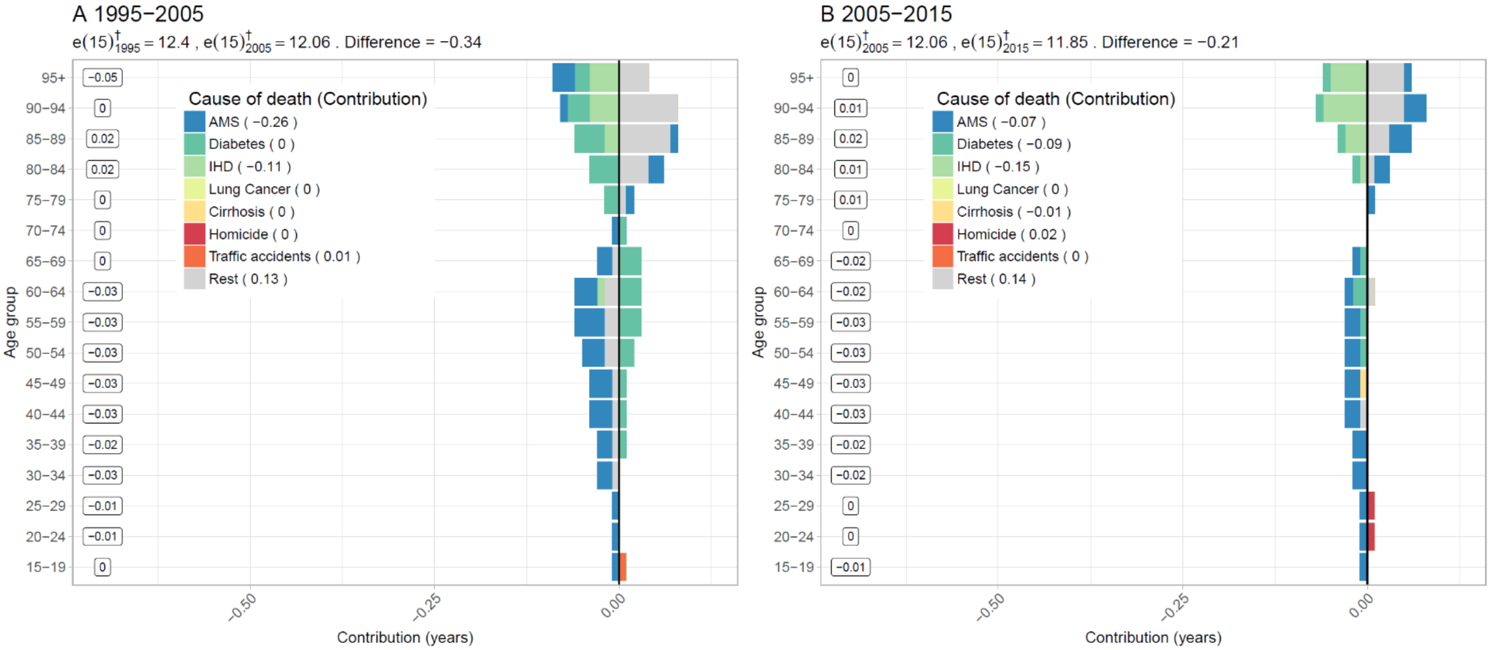


Figure S3. Changes in female life expectancy (e_{15}) (panel A) and female lifespan variation at age 15 ($e^{\dagger}$) (panel B) by state for the periods 1995-2005 and 2005-2015

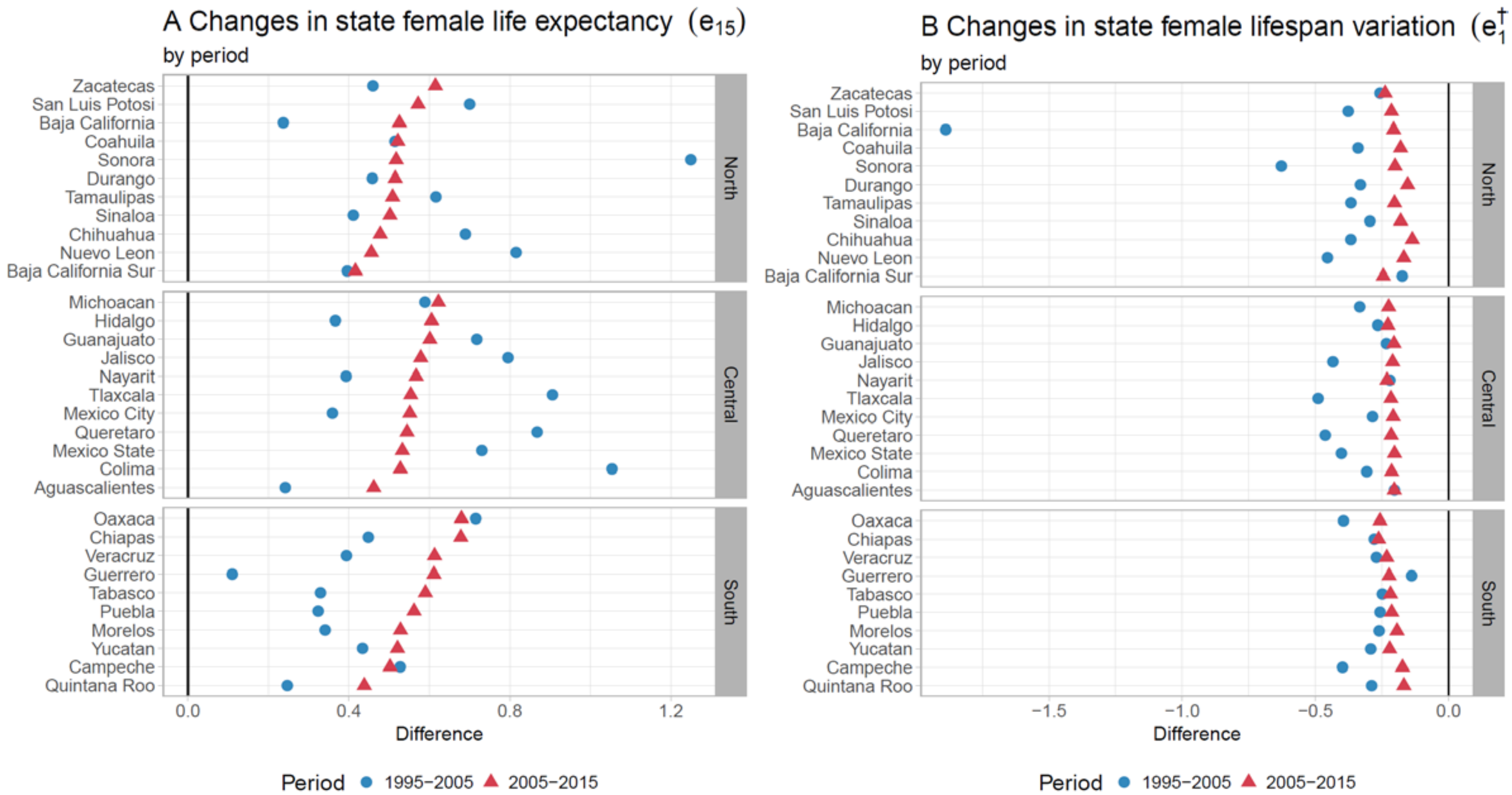


Figure S4. Cause-specific contributions to changes in female lifespan variation at age 15 ($e^{\dagger}$) by state for the periods 1995-2005 and 2005-2015.

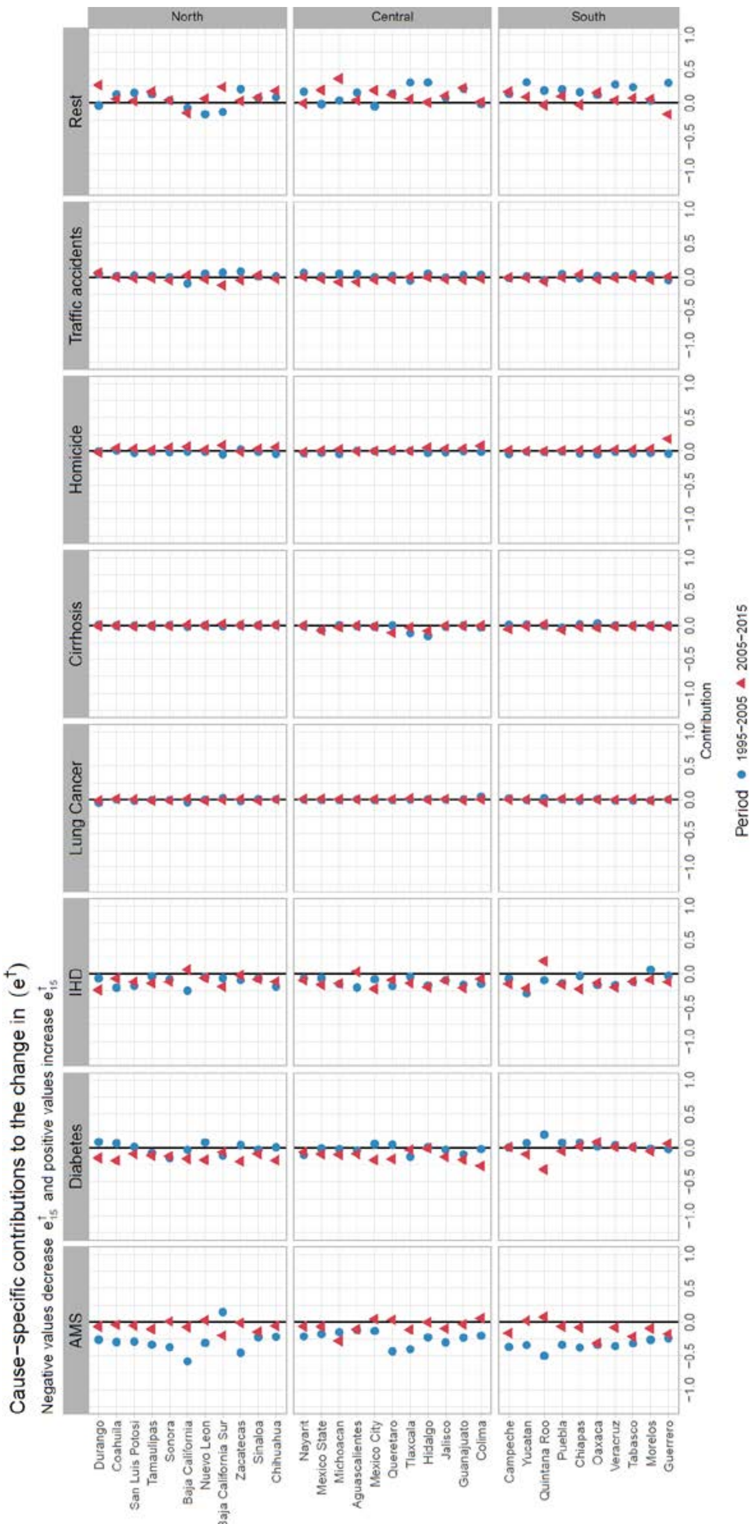


Figure S5. Cause-specific contributions to changes in female life expectancy at age 15 (e_{15}) by state for the periods 1995-2005 and 2005-2015.

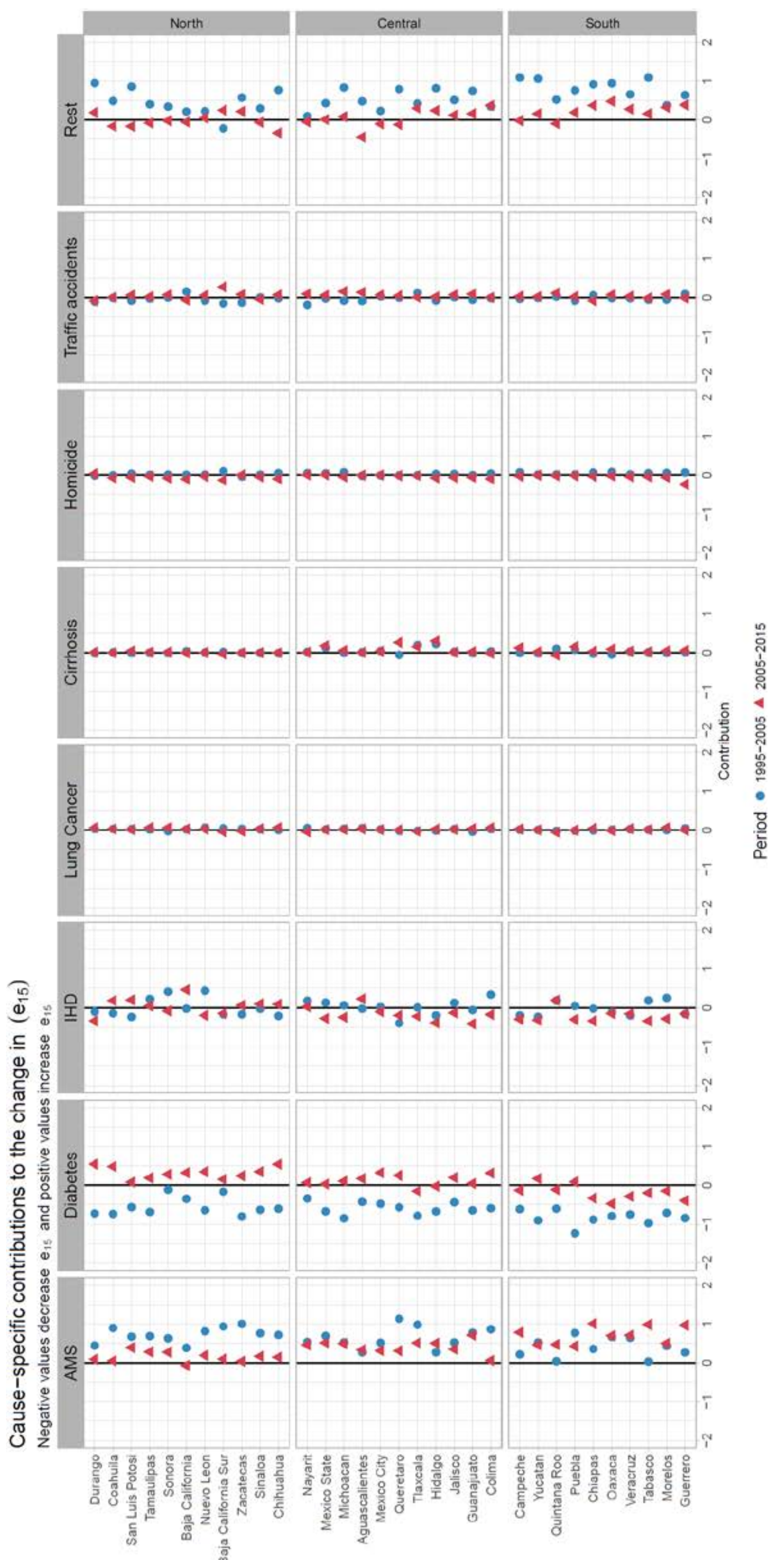


Figure S6. Cause-specific contributions to changes in male lifespan variation at age 15 ($e^{\dagger}$) by state for the periods 1995-2005 and 2005-2015.

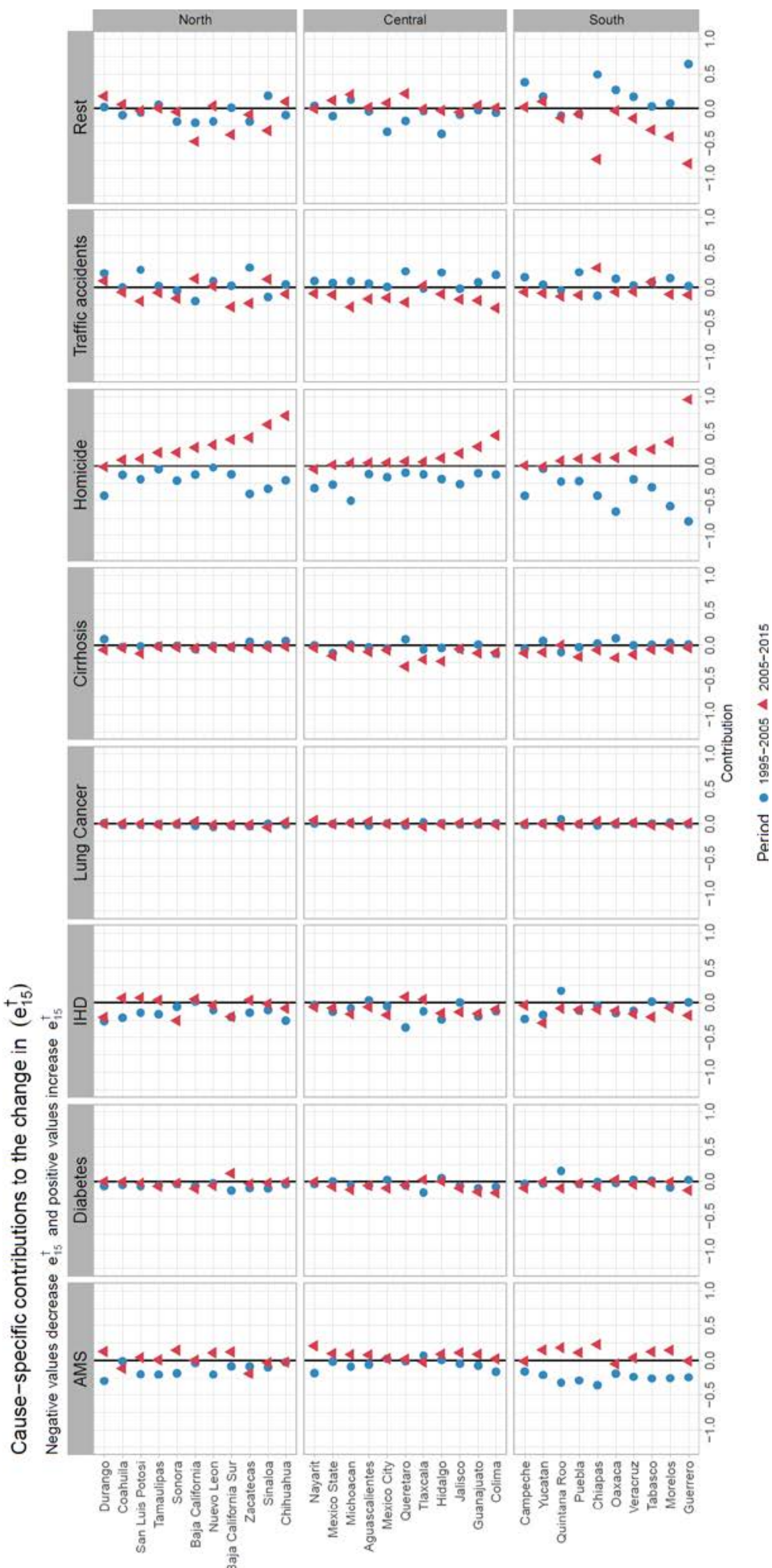
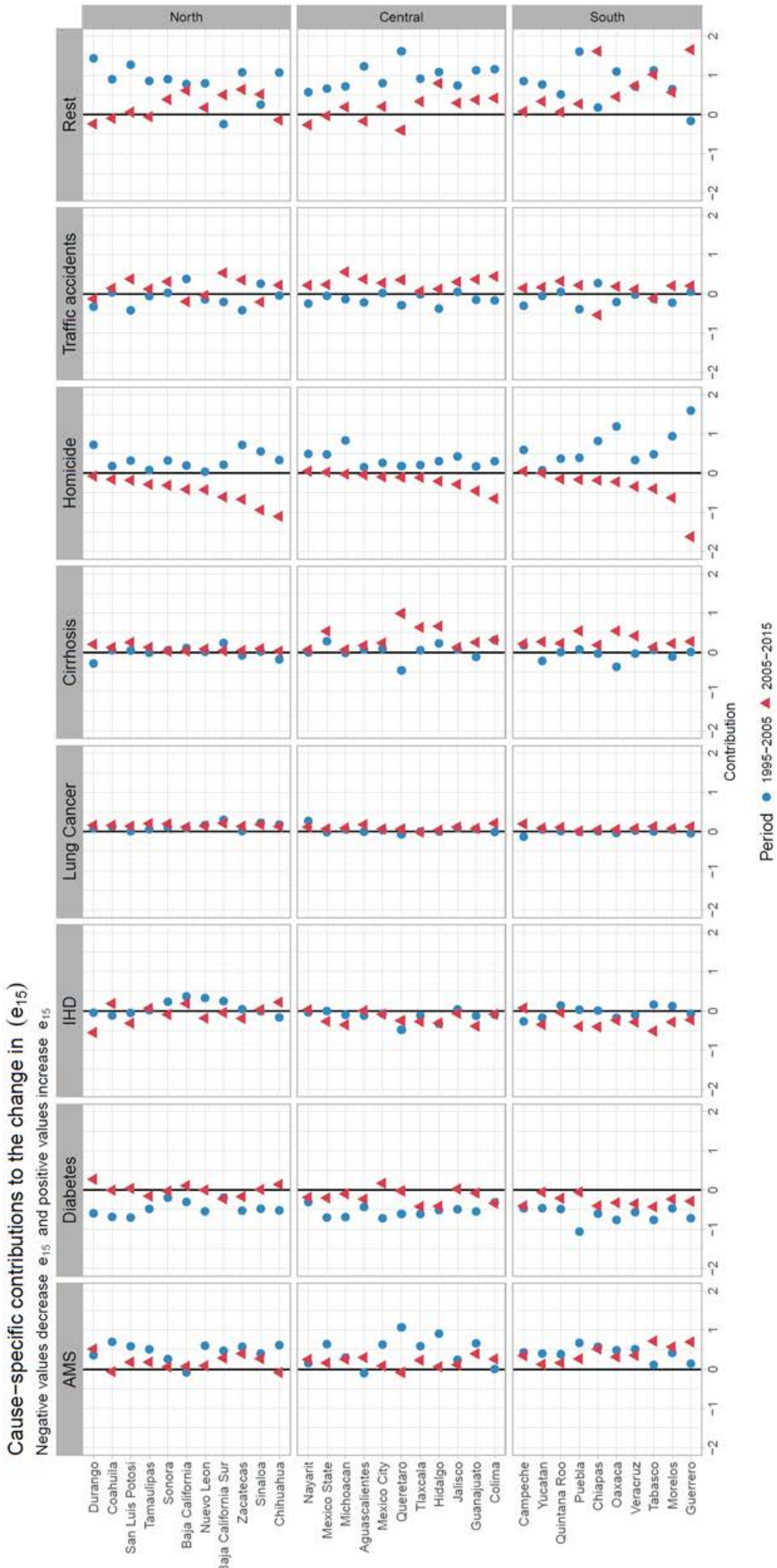


Figure S7. Cause-specific contributions to changes in male life expectancy at age 15 (e_{15}) by state for the periods 1995-2005 and 2005-2015.



References

CONAPO. (2017). Mexican Population Council: Population estimates. Retrieved from https://datos.gob.mx/busca/dataset/activity/proyecciones-de-la-poblacion-de-mexico

INEGI. (2017). National Institute of Statistics: Micro-data files on mortality data 1995-2015. Retrieved from http://www.beta.inegi.org.mx/proyectos/registros/vitales/mortalidad/default.html