Life expectancy and lifespan variation by educational attainment in Mexico:
How large is the gap?

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Extended Abstract

Introduction

During the second half of the 20th century, as most Latin American countries, Mexico experienced rapid increases in life expectancy. These gains in life expectancy were mostly related to major improvements in health standards, urbanization and a decline in mortality (1). This period was characterized by major public health interventions such as the foundation, in 1943, of the Institute of Social Security and the Ministry of Health. Despite these efforts, ever since the beginning of the new century, the country has witnessed an outbreak of violence (4). During the so-called "War on drugs", homicide rates substantially increased (5). This led to a reversal in life expectancy for males and stagnation for females (5, 6, 7), in spite of the implementation of the Universal Health Coverage program, in the beginning of the 21th century, called *Seguro Popular*, which provided primary and secondary healthcare to the uninsured population (2, 3).

Life expectancy represents the average number of additional years that a person is expected to live given the current death rates at a given time (9). It is a well-known summary measure of the health status of a population. However, life expectancy does not give any information about the variability in age at death or lifespan variation. Lifespan variation gives additional insights into how spread ages at death are, and it is a useful indicator that relates to the increase interest in health inequalities, as it expresses heterogeneity in mortality at the population level. Large values of lifespan variation,

indeed, indicate that there is remarkable social vulnerability and that social policies are not properly protecting the more exposed groups.

Despite the fact that social and economic inequalities in Mexico have decreased since the second half of the 20th century, they are still severe and substantial (8). Inequalities in Mexico are spread across several dimensions, such as educational opportunities, income disparities and labour market conditions (8). Therefore, it is useful to consider not just life expectancy as marker of inequalities in health, but also lifespan variation to disclose persistent inequalities within subgroups. In terms of the variability in age at death, Mexico has high levels of lifespan variation in comparison with other Latin American Countries such as Argentina, Chile and Brazil (10, 11). Moreover, Aburto and Beltrán-Sánchez (2018) showed that in Mexico the increase in life expectancy for males aged 15 years slowed down in the last decade compared to the period from 1995 to 2005. Lifespan variation, instead, decreased by more than half a year from 1995 to 2005 and remained at a level of 13.77 years from 2005 to 2015 (the decline was just equal to 0.15). If improvements in other causes of death, such as accidents and cirrhosis, led to a decrease in lifespan variation, homicides had a remarkably large effect in slowing down these improvements (6).

It is accepted in the literature that socioeconomic status, has an important role in influencing health and mortality. This influence mainly operates through material, behavioural, and psychosocial factors (12, 16). Due to the strong interrelation between the measures that account for socioeconomic status, the disadvantaged group always experience a lower life expectancy and greater lifespan variation. Thus, less educated individuals not only have shorter life expectancies but also face greater uncertainty about the age at which they will die (12, 13, 14, 15, 16, 17).

We consider educational attainment as an indicator of socioeconomic status. In addition, Mexico has experienced important gains in educational attainment since the 50s (19). Due to the increase of urbanization and, consequently, to the growth of investment in public education, these gains raised extraordinarily the literacy level of the country: the percentage of the population without education decreased from 32% to 7% between 1970 and 2010 (19). The importance of educational level was also underlined by van Raalte et al. (2011), who asserted that educational inequalities lead to differences in mortality and

health, are perhaps it is the most unfair source of variation. They further explain that reducing premature mortality (i.e. avoidable mortality) is even more crucial for reducing lifespan inequalities across educational groups than it is for equalizing average lifespans, pointing to the differences between the two measures and, therefore, the need to consider both.

Other studies, which compared different countries with respect to their average lifespan, as well as lifespan variation, suggest that the advantage of the higher educated groups is less dependent on country specific context than the disadvantage of the lower educated groups (18). In other words, variability in health and mortality experienced by the most disadvantaged is better explained by the geographical and political context than that of more fortunate strata of the population. This also suggests that some countries have weaker social policies, failing to properly protect lower socioeconomic groups from premature mortality (11).

The high gains in education attainment in the country raise questions about their effect on life expectancy and lifespan variation, and how this could have changed over time from 1990 to 2015.

Hypotheses

By analysing the gap in life expectancy and lifespan variation by educational attainment we can understand deeper the sources of inequalities in Mexico. We aim to contribute on the literature about inequality, health, mortality, life expectancy and lifespan inequality in the country by focusing in a period in which major public health interventions have happened together with the so-called war on drugs.

The wider hypothesis of this work is that the relations between educational attainment, life expectancy and lifespan variation, that are already well documented and studied for Europe and other countries, follow the same trends and rules in Mexico**.**

 For the trend of life expectancy by educational attainment, our hypothesis is that life expectancy will increase for all the different educational groups from 1990 to 2005. After this period, as previous studies already shown, we expect that life expectancy will

stagnate, or decrease from 2005 to 2015 (6). Furthermore, we expect that life expectancy will stagnate for those how have higher educational attainment and decrease for those who have it lower. Indeed, violence is strongly related with socioeconomic status; it is also concentrated in young ages of males and this can heavily affect lifespan variation (5).

For the trend in life span variation, our hypothesis is that it will increase for the lower educational attainment group in the period of 2005-2015, and will stagnate for the higher one.

Data and Methods

Data

We used data on vital statistics from the National Institute of Statistics, which contain information about year, sex, ages at death and educational attainments of the deceased. These data are available in the web page of the National Institute of Statistics and they are free access (www.inegi.org.mx/programas/mortalidad). We use four categories for grouping educational attainment, 0 for those who not have formal education at all; 1 for those who have 1 to 6 years old of formal education which in Mexico represents the elementary school, 2 for those with 7 to 12 years of formal education which represents middle school, and 3 for those white 13 years or more of formal education, which means bachelor or postgraduate education.

For the exposure we used the mid-year period populations, that come from the National Council of Population in Mexico. These mid-years period populations are estimation of the whole population for each single year from 1990 to 2015. The limitation of this dataset is that it does not provide any information about educational attainment. For this reason, we used census and mid period years to estimate the proportions for each age-group, with the information on educational attainments. Afterwards, for the non-census years, we will use the national employment survey to assess the proportion of exposures by educational attainment.

Methods

For estimating life expectancy, we first estimated age-specific mortality rates, by sex and stratified by educational attainment. The numerators are the count of deaths and the denominators are the person-years of exposures. Then, we constructed abridged life tables using Preston's methodology (2001), fixing the $_na_x$ (numbers of life years lived by those who die) for all educational attainment subgroups. For assessing lifespan variation in the preliminary results, we use life disparity $e^{\dagger}$ (20). This is a measure of the average remaining life expectancy at death and can be interpreted as the average life years lost at death.

For later analyses we will use the Kulback-Leibler divergence (KLD) which is a useful method to provide insight about the effect of educational disparities on mortalityacross the entire age-at-death distribution. It can also illustrate the relative importance of the difference in means and the difference in variance for overall lifespan inequality changes (21).
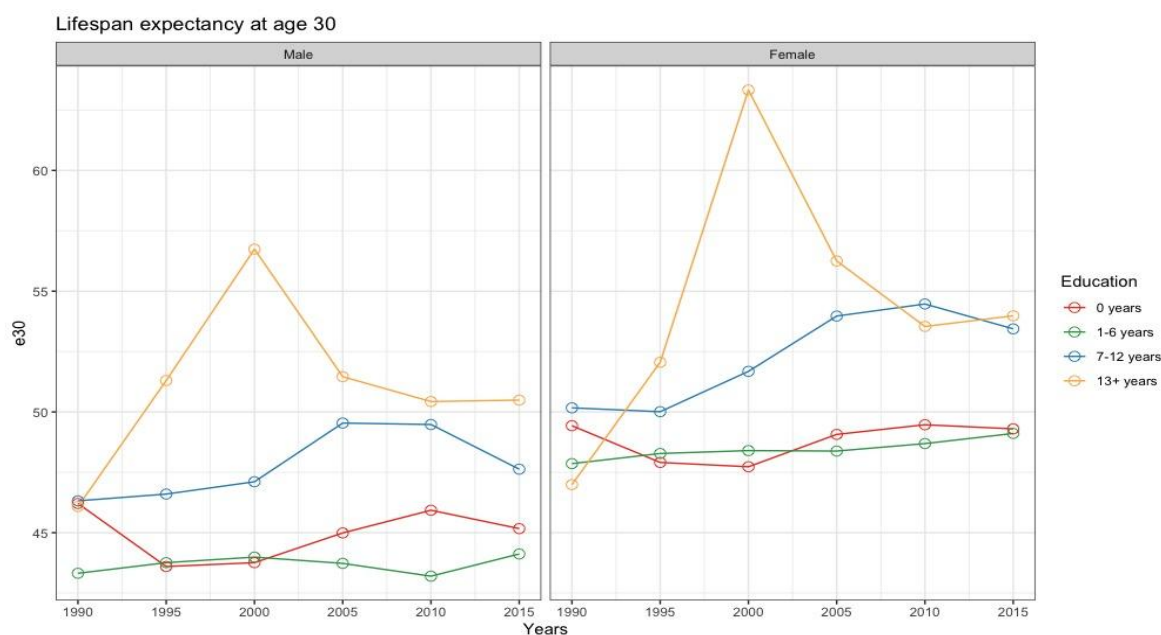
Preliminary results

Figure 1. Male and Female life expectancy at age 30, by educational attainment. From 1990 to 2015 in Mexico.
Figure 1 shows life expectancy at age 30 for Mexican males and females from 1990 to 2015, by educational attainment.

We see that life expectancy is always higher for females, for all educational groups. When looking more closely at each sex, we can notice that male life expectancy increased or remained stable until 2000, for those with at least 1 year of education. After 2010 it stagnated for the most educated, while it decreased for the least educated and for individuals with 7 to 12 years. Only those who had up to 6 years of education experienced a slight increase in life expectancy. Females followed the same trend, although the gaps between educational groups are generally smaller than for males. This is reversed, however, at the beginning of the period we analyze, where the differences between categories are most noticeable for females, the most educated females experienced the lowest life expectancy. On the contrary, no difference is noticeable between differently educated males in the same year, the only exception being individuals with 1 to 6 years of education, who display the lowest male life expectancy.

2000 seems to be a pivotal year. The difference in life expectancy between educational groups was at its highest: for males, the most educated group lived on average 57 years, while the least educated individuals could only expect to live 43 years. In 2015 this gap was much smaller, around 5 years. The corresponding gap for females was of 4 years. The year 2000 also witnessed a dramatic reversal in the trends of life expectancy for some of the groups. The most educated category, which had enjoyed constantly increasing lifespans until now, lived through a consistent drop to the values in 1995. On the contrary, life expectancy rose for the second most educated group at a faster pace than before in the case of males. Trends for the other two groups are less obvious, although life expectancy increased for the least educated and decrease or stagnated for those with 1 to 6 years of education.
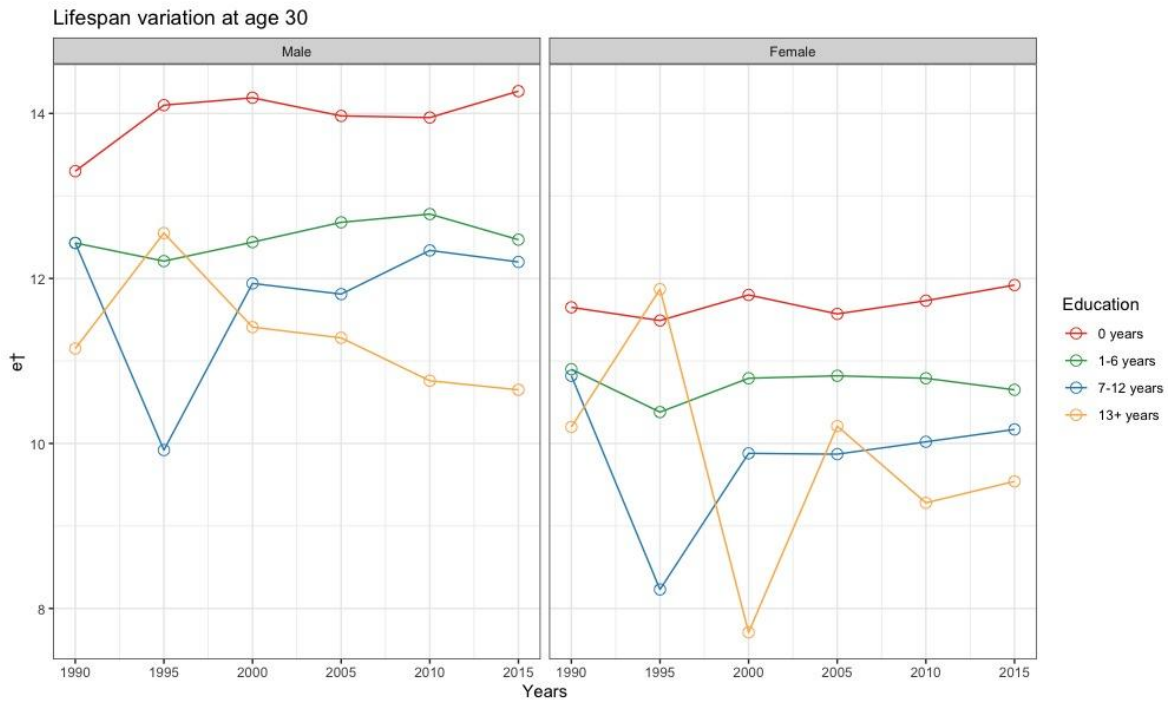
Figure 2. Male and Female lifespan variation, by educational attainment. From 1990 to 2015 in Mexico.

Figure 2 shows lifespan variation for Mexican males and females from 1990 to 2015, by educational attainment.

Just as in many other countries (12), in Mexico females experience less lifespan variation than males across educational categories. We also see that the highest lifespan variation was experienced by the least educated group, throughout the period (with the exception, for females of 1995, where the variation of the highest educated category was greatest). From 1990 to 1995 both life expectancy and lifespan variation increased for the most educated group for females and males, while during the next 5 years the relation between the two measures inverted. A similarly ambiguous relationship is noticeable for the other groups as well, although it is not as obvious. After 2000, there seems to be direct link between within-group lifespan variation and educational attainment: the less educated groups display higher levels of variation than the more educated ones. The only exception being the most educated females, who briefly experienced higher variation than the second most educated group around 2005. After 2010, we also see signs of a convergence in lifespan variation for the two middle categories, a convergence which seems to include the

highest educated females, as well. At the same time, however, lifespan variation increased for the least educated group and decreased for the highest educated males. Thus, in 2015, the gap between highest and lowest educated was of more than 2 and almost 4 years for females and males, respectively.

These preliminary results shed light on the trends in life expectancy and lifespan variation in Mexico during the last 25 years. We see that these trends generally confirm our expectations, for both life expectancy and lifespan variation, illustrating the importance of the so-called "war on drugs" for understanding recent mortality patterns in Mexico, even at a very aggregate level. It is interesting to underline that this relationship varies in magnitude and sense depending on the year and the educational group considered, urging a deeper analysis of these trends. The comparison of males and females also shows remarkable similarities between the two, but also consistent differences, namely for the highest educated group, which experienced more drastic variations in both life expectancy and lifespan variation in the female population. Further analyses are required to better understand these patterns.

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