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ORIGINAL ARTICLE

Estimating life expectancy free of anxiety/depression in Argentina: trends and decomposition of demographic change, 2005-2018

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This study presents estimates of life expectancy free of anxiety/depression (a health expectancy) for the adult population in Argentina and observes its evolution during the 2005-2018 period. Given that life expectancy and health expectancy are strongly correlated indicators, we decomposed the change of the latter over time to establish not only which component causes its variation, but also which age groups contributed the most to this change. We analyzed cross-sectional data of the presence of anxiety/depression symptoms using multiple waves (2005, 2009, 2013 and 2018) of the Argentine National Risk Factor Survey (ENFR) and computed a series of anxiety/depression free life expectancies (conditional on those who reached age 20), by using the Sullivan method. Later we applied a stepwise algorithm decomposition technique to determine if the change in the health expectancy was due to a mortality change or a morbidity change. We obtained that the health expectancies increased between 2005 and 2013, and decreased for 2013-2018. This variation was larger for females, where a change in morbidity was responsible for almost all improvements before 2013. The decomposition also suggested that the net impact on morbidity would be larger if not for an increase in overall life expectancy between 2013-2018, with a one-year decline in health expectancy for males and 1.7 years for females, driven mainly by the younger age groups. It is not clear yet if such negative change is transitory or the beginning of a new trend in mental health for the Argentinian population.

Keywords: Health expectancy. Mathematical concepts. Aging. Mental health. Argentina.

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Introduction

Throughout the twentieth century, we observed a linear increase in life expectancy at birth (OEPPEN; VAUPEL, 2002). Along with this increase in longevity, greater attention has been paid to the quality of life across populations. Simply put, living longer does not necessarily mean living healthier. A series of theories have been postulated to this day to establish whether healthy/unhealthy lifespans are increasing or not. The most optimistic of these positions, known as compression of morbidity, suggests that with the increase in longevity, the age of onset of morbidities increases as well; therefore people not only live longer but also spend fewer years of their lives with diseases, limitations, or chronic conditions (FRIES, 1984). Its counterpart is the expansion of morbidity theory, in which people live a greater amount of time but the age of onset of those morbidities does not change, resulting in larger but unhealthier lifespans (GRUENBERG, 2005). An intermediate position is known as the dynamic equilibrium (MANTON, 1982; MYERS; MANTON, 1984). In this framework, there is a balance between lifespans and the presence of morbidities in a population: the age of onset on limitations/conditions is similar as in the expansion of morbidity theory, but with a lesser intensity in terms of affecting the quality of life of the affected population. A good review of these perspectives can be found in Beltrán-Sánchez *et al.* (2015).

These theories were formulated based mainly on physical limitations/chronic conditions/morbidities, and as a result, many studies monitoring population health and the burden of diseases tend to focus on that type of ailments (CAMBOIS *et al.*, 2020). However, the role of mental diseases is not clear when addressing this compression *versus* expansion debate about the quality of life of populations. Mental and behavioral disorders are becoming increasingly important when assessing the health of populations, and it is estimated that about 1 in 4 people in the world will at some point suffer from one of these conditions, being by 2030 the leading cause of disability in the world (FERRARI *et al.*, 2013; WHO, 2017). Just as the relationship between longer and healthier lifespans is unclear to this day, the same could be said about the role of psychic/mood disorders in those healthy lifespans.

Mood disorders (in this paper we will broadly consider those as depressive disorders and/or anxiety disorders) are diseases of psychic origin. While they were/are considered a non-lethal condition, they are associated with multiple negative health outcomes affecting the quality of life of those who have them (and the people close to them), including mortality (ANNEQUIN *et al.*, 2015; BLAZER; HYBELS, 2005; LLORENTE *et al.*, 2018; NEPOMUCENO *et al.*, 2020; STRINE *et al.*, 2008) antidepressant consumption, and the consultation of psychiatrists. It is for all these reasons that more and more attention has been paid lately to mental health as an indicator of the overall health of a population. Investigating, measuring, and monitoring trends and inequalities in population health (and its differentials by sex, age, and other characteristics) is critical to elaborate policies that different agents of

society can adopt to prevent or mitigate those risks. In particular, depression and anxiety are conditions that affect females more than males (AZIZ; STEFFENS, 2013; BLAZER; HYBELS, 2005; STAGNARO *et al.*, 2018). Therefore, the interest between the time lived with a good/poor mental health status acquires a special significance in this case, given that life expectancy at birth is also higher for females than for males. This implies that not only do they present these conditions more frequently, but they also carry the burden of these conditions for a longer time.

In Argentina, the prevalence of depressive-type disorders is close to 10% and anxiety disorders hovers around 16%, according to an epidemiological mental health study conducted by Stagnaro *et al.* (2018). However, prevalence by itself does not express the relationship between the presence of a condition in a population and the time experiencing it. Moreover, Argentina, to this day, does not have any given estimation of the overall burden of mental disorders from a demographic perspective.

Demography has a summary indicator known as healthy life expectancy (or broadly known in English as "*health expectancy*"), which allows an approximation of the time that a given condition affects the overall health of a population during a particular period. There are several methods for making such estimates. The simplest and most widespread one is known as the Sullivan method and is used to compute healthy life expectancies (HLE) or disease-free life expectancies (DFLE) by taking advantage of cross-sectional prevalence data (SULLIVAN, 1971). This method requires both mortality and population data to make a life table, along with the prevalence data of the condition being estimated (in this case, anxiety/depression disorders). Given its flexibility and ease of application, the Sullivan method has been used, not only to estimate health expectancies based on morbidity data (being the prevalence of a condition or permanent limitation for instance), but also other kinds of indicators such as life satisfaction (SOLÉ-AURÓ; LOZANO, 2019), perceived based health status (CAMARGOS *et al.*, 2008) or even active sex life on a given population (LINDAU; GAVRILOVA, 2010) 1995-6.

However, a higher value of a healthy life expectancy obtained via this method does not necessarily indicate a health improvement when compared to a different population (or in the same population in a different timeframe). As mentioned previously, the fact that a population lives longer does not mean that it lives healthier. And procedures like Sullivan's method for calculating healthy life expectancies have inherent limitations: one of them is that since this indicator is derived from a life table, both life expectancy and healthy life expectancy will be strongly correlated (VAN RAALTE; NEPOMUCENO, 2020). Therefore, it is possible that a healthy life expectancy at a moment n+1 presents a higher value when compared to a previous moment n, but such increase could be potentially due to an improvement in overall life expectancy, and not necessarily because of the health burden of the analyzed condition diminished over time (VAN OYEN *et al.*, 2013).

Fortunately, there are a series of mathematical decomposition techniques that allow us to disentangle the "net" impact of the change in the healthy life expectancy/disease-free

life expectancy (that is, the change attributed to the evolution of the morbidity of the given condition), separating it from the change that could be attributable to improvements in mortality (life expectancy). Furthermore, it is not only possible to identify whether the difference in a health expectancy between two populations is explained by the morbidity or mortality component, but also the contribution of each age group to the total outcome of the difference (ANDREEV *et al.*, 2002; NUSSELDER; LOOMAN, 2004; NEPOMUCENO *et al.*, 2021; VAN RAALTE; NEPOMUCENO, 2020. In this way, it is possible to have a clearer picture of the relationship between the change of the overall lived time and the change of time living with the presence of a condition in a population.

Some studies have been done previously to decompose the HLE difference in this way, using data from Europe or the United States as a reference (ANDREEV *et al.*, 2002; NUSSELDER *et al.*, 2005; NUSSELDER; LOOMAN, 2004; SAUERBERG, 2021; VAN RAALTE; NEPOMUCENO, 2020; VOIGT *et al.*, 2020 among others). However, none of these decomposition analyses has focused specifically on mental disorders, opting to calculate healthy life expectancies based on physical limitations (as the ones analyzed by the GALI index) of arbitrary major groups of chronic diseases (regardless of its origin, whether physical or mental). The work of Steensma *et al.* (2016), however, presented estimates of depression-free life expectancy and its change by using the decomposition procedure of Nusselder and Looman (2004). They have done so by comparing the results of two health surveys in Canada, concluding that despite a higher prevalence, depression-free life expectancy for women was higher than for men, along with lower overall mortality for those individuals without depression. In Latin America, the work of Andrade *et al.* (2016) previously estimated depression-free life expectancy for older adults in Brazil and found an increase in the indicator during the 2000 and 2010 period. Alves and Pereira (2018) also produced a set of depression-free life expectancy trends for Brazil, separately by race, but those works did not decompose the overall increase in life expectancy from the increase in depression free-life expectancy.

As previously mentioned, in Argentina there are no demographic estimations of any kind about the overall burden of mental health conditions. Based on this, it is also natural that there are no studies considering compositional change in life expectancy free of these conditions.

Objective

This paper seeks to describe and compute estimates of life expectancy free of anxiety/depression, but also intends to decompose the change in those health expectancies over time to see, not only the contribution of each component in the overall change, but also which age groups are responsible for such change. We believe this allows to quantify appropriately the health burden of the condition in Argentina and its evolution in recent years.

Data and methods

Data sources

For this study, cross-sectional data on the presence of anxiety/depression symptoms, mortality data, and population data were needed to calculate life expectancies and life expectancies free of anxiety/depression disorders (and the subsequent decomposition procedures). Prevalence data is obtained from the National Survey of Risk Factors (or ENFR, based on the Spanish acronym, Encuesta Nacional de Factores de Riesgo) of Argentina, taking advantage of its four available editions: 2005, 2009, 2013, and 2018. The ENFR is a cross-sectional survey that analyzes determinants of health, risk factors, and basic sociodemographic information of the adult population (aged 18 and above) in 31 urban agglomerations or Argentina (that represent roughly more than 90% of the overall adult population). Each survey was conducted with multiple layers: with a probabilistic selection of census areas, households and individuals, respectively. The response rate on these health surveys was around 70%, and correction factors (already included on the surveys) were used for each level to tackle non-response and possible underreporting/overreporting biases. The four ENFRs have 41392, 34732, 32365, and 29224 individual cases, respectively.

Mortality data was provided by the Directorate of Statistics and Information in Health (DEIS, by its Spanish acronym, for Dirección de Estadísticas e Información en Salud), a statistical office belonging to the Ministry of Health of Argentina (as we used the four ENFRs, we used mortality data for the years 2004, 2005, 2006, 2008, 2009, 2010, 2012, 2013, 2014, 2017, 2018 and 2019). Since mortality is a phenomenon that can present variations in a given year (and particularly in South American countries where mortality estimates usually rely on census and not on administrative records to complement such data), we computed life tables considering the three years (not only the year in which the ENFRs took place but also the previous and the following ones), to obtain a more robust indicator (thus, the mortality in 2005 is an average of mortality in the triennium 2004-06, for instance). Furthermore, we are considering mortality data (as provided by the statistical reports), at national level data and without considering cause of death. While there might certainly be some issues with assigning mortality by cause of death (RIBOTTA, 2016), overall death registration coverage and age-distribution does not seem to be an issue in the country, with a value very close to 100% for the analyzed periods (RIBOTTA, 2016; SACCO, 2016; WHO, 2014).

Population projections made by CELADE (the Population Division of the Economic Commission of Latin America and the Caribbean – ECLAC) were used for population exposures in the corresponding years, given that the latest revision of such projections is more recent (2019) than the one done by the Argentinian National Statistical Bureau (INDEC, which published its population projections in the year 2013 without any further revision). The classic procedure mentioned by Preston *et al.* (2001) was used to compute

life expectancies, considering the age group of 80 years and above as the final group for estimates (mainly because public mortality data in Argentina are provided this way, and also because health expectancies are rarely computed beyond ages 80 and above or 85 and above). We also considered age 20 as the bottom truncation for life expectancies (and health expectancies), since the ENFR does not present an estimation for individuals younger than 18 years old.

One of the questions in the survey refers to the daily situation of the respondent regarding anxiety/depression (coded as CISG06/BISG06 in the ENFR database for users, although the wording was similar for all four surveys), in a direct adaptation for Argentina of the EuroQol5D (EQ-5D-3L) scale, which is used to measure the quality of life of a given population. The question asks whether the interviewee does not feel anxious or depressed (level 1), whether they feel moderately anxious or depressed (level 2), or severely anxious or depressed (level 3). Based on this question, we considered both levels 2 and 3 as a proxy of the presence of anxiety/depression symptoms, as the result variable to compute health expectancies (or, in this case, remaining life expectancy free of anxiety/depression – ADFLE). This method certainly has its limitations: it does not rely on a physician's diagnosis nor on a complete psychiatric scale to monitor the mental health situation (ENFR does not have a separate mental health module). However, the performance of the EQ-5D-3L scale to broadly monitor the presence of anxiety/depressive disorders at a community level was deemed acceptable when compared to other international scales (such as the Patient Health Questionnaire - PHQ-9) that have greater detail (AUGUSTOVSKI *et al.*, 2013; SHORT *et al.*, 2021; SUPINA *et al.*, 2007). Furthermore, in the case of those with severe symptoms of anxiety/depression (level 3 of the question), the values obtained were on par with those calculated in the well-known Global Burden of Disease estimates (VOS *et al.*, 2015) prevalence, and years lived with disability (YLDs). While it is certainly possible to only focus on level 3 for the scope of our research, we also wanted to address an ampler health burden, given that the definition used in this study is ad-hoc (as that considers both the presence of one condition or another, which may not be necessarily exclusive) and does not exactly match other definitions that address psychological disorders. Therefore, despite such limitations, we consider the indicator defined in this way is valuable enough as a starting point to visualize general trends over time.

Among other limitations that we can point out in the ENFR (which are therefore limitations of this paper), is that they do not gather institutionalized population, and are only limited to urban areas (rural areas represent approximately 8% of the total population, but we do not have a strong reason to believe that among the excluded groups the presence of anxiety/depression symptoms should vary greatly when compared to the surveyed population). Having said that, we trust that the ENFRs are reliable enough to compute reasonable estimates of ADFLE20 (Anxiety/Depression Free remaining Life Expectancy at age 20).

Methods and technique

Before producing those indicators, we presented a small exploratory analysis of key variables (sex, age, presence of anxiety/depression), considering the mean values and the standard deviation, which was necessary to compute confidence intervals with 95%, with the classic mean value ± 1.96 standard errors (which in turn was obtained by dividing the standard deviation by the square root of the size of the distribution of the given variable). It should be noted that, in the surveys, age was expressed in integer values. In the sex category, value 0 represented males and 1 represented females, whereas regarding the presence of anxiety/depression, 0 represented absence and 1 represented the reported presence of the condition. We also graphically described the prevalence of anxiety/depression by age for each wave. The prevalence (percentage of population reporting anxiety/depression) was smoothed with the local regression method (also known as LOESS regression), taking advantage of the functionalities of the ggplot2 package in R software (WICKHAM, 2016).

We previously mentioned that the most direct and easy method to compute such indicators is via the method known as the Sullivan method (SULLIVAN, 1971). A good summary of the most important aspects of this technique can be found in Jagger *et al.* (2006), but also the critical steps of the method can be found at the end of this section. We calculated 95% confidence intervals for the ADFLE20 using the procedure described in the aforementioned document (and available at the end of this section as well). For computing the corresponding life expectancies (LE20) this was not necessary, because given the size of the population (more than 15 million observations for each group), variation in LE20 would be minimal.

With both LE20 and ADFLE20, we can also obtain both the time lived with anxiety/depression in absolute terms (expressed in years), as the difference between LE20 and ADFLE20, along with the proportion (expressed in percentage) of remaining lifespan with AD, as the quotient between such difference and LE20. This was done as an alternative way to see the evolution of the health burden of the condition in the population.

Decomposing the change in healthy life expectancies is possible in many ways. A popular technique relies in an extension of Arriaga's method (NUSSELDER; LOOMAN, 2004), which is traditionally used when decomposing the change of life expectancies (ARRIAGA, 1984). However, as noted by some authors (SHKOLNIKOV; ANDREEV, 2017; VAN RAALTE; NEPOMUCENO, 2020), some additional calculations have to be added to this specific procedure to produce a correct form. A more general decomposition method is the stepwise replacement method, as suggested by Andreev *et al.* (2002). In this method, the difference between two healthy life expectancies (or another aggregate indicator) at two given periods is the sum of the components attributable to mortality and morbidity/health/disability instead. The mortality component would explain how much of the change in the ADFLE20 is due to an increase in life expectancy (LE) in a population and the change

in morbidity component would be due to the effect of the analyzed condition. Additional details can be found at the end of this section.

This decomposition technique is integrated into the *DemoDecomp* package and is freely available in R software (RIFFE, 2018), as the stepwise decomposition command. We calculated the differences between 2005-2009, 2009-2013, and 2013-2018, separately by component (mortality and morbidity) and by five age groups. As is usual in these types of papers, we only decomposed the mean values in a difference (NUSSELDER; LOOMAN, 2004; STEENSMA *et al.*, 2016; VAN RAALTE; NEPOMUCENO, 2020).

On computing health expectancies with the Sullivan method

The Sullivan method is arguably the most straightforward way to compute a health expectancy (in this case ADFLE20). As previously mentioned, it requires a life table (either single or abridged) and cross-sectional prevalence data of a given population. We follow the Jagger *et al.* (2006) procedure to present this technique.

First, we need to compute the amount of time lived without the chosen condition (π). If π represents the proportion of a given age group that presents such condition, (1- π) should represent the proportion of individuals who do not have it. By multiplying such quantity by the L_x function in a life table (which represents the person years lived in an age interval), we can have an approximation of the person years lived without the condition in a given interval n or L'_x, as shown in equation 1:

$$ {}_nL'_x = (1-\pi)^*{}_nL_x \tag{1}$$

To compute the total number of years lived in an interval n without the condition π (T'_x), we simply do the reverse cumulative sum of the respective L'_x, in analogous fashion as in the life table, as presented in equation 2:

$$ {}_nT'_x = \sum_x {}_nL'_x \tag{2}$$

Finally, to obtain the ADFLE20 (or e'_x), simply divide T'_x by the number of survivors at a given age or l_x, just as in a mortality life table, just as equation 3 shows:

$$ ADFLE20'^x = \frac{nT'_x}{nl_x} \tag{3}$$

On computing standard errors with the Sullivan method

To obtain standard errors using this method, we also need to take into account the survey size (N) for each age group. As a result, the larger the number of observations, the smaller the range of possible values. Following Jagger *et al.* (2006) once again, we need to obtain the variance (S^2) of the prevalence rates π with a general formula, present in equation 4:

$$ nS^2x = \frac{\pi x^*(1-\pi x)}{N} \tag{4}$$

The next step requires us to compute the square of L_x by S^2, as equation 5 indicates:

$$ {}_nSL_x = {}_nL_x^{2*} {}_nS_x^2 \quad (5) $$

And just like in the life table, before obtaining the variance of the health expectancy, we need to obtain the cumulative sum of the respective SL, following equation 6:

$$ {}_nST_x = \sum {}_nSL_x \quad (6) $$

To obtain the variance of the health expectancy, we simply divide ST_x by square l_x, as equation 7 indicates:

$$ SADFLE20'^x = \frac{nST_x}{nl_x^2} \quad (7) $$

Equation 8 presents the formula for standard error, which is simply the square root of SADFLE20 (SEADFLE20). To obtain a 95% confidence interval, simply sum ADFLE20 – 1.96* SEADFLE20:

$$ ADFLE20 \pm 1.96^* SEADFLE20 \quad (8) $$

On a general method to decompose health expectancies: the stepwise replacement

The stepwise replacement algorithm procedure (ANDREEV *et al.*, 2002) allows us to do an age-specific decomposition for aggregate demographic measures (health expectancy, life expectancy, parity-to-progression ratio, total fertility rate). In this case, decomposing the health expectancy into mortality and morbidity.

In this scenario, the change of the number of person-years lived without anxiety/depression between populations 1 and 2 (or ADFLE20-2 – ADFLE20-1), implies the sum of mortality/age components (MOR) and disability/morbidity (DIS) components, which relies on a series of operations of life table components. For a full mathematical proof we recommend following Andreev *et al.* (2002), and also Shkolnikov and Andreev (2017) which provides a correct form of the Nusselder and Looman (2004) decomposition technique. For practical reasons, we only present the final form of the procedure, which is an average of a weighted replacement of indicators for each population. Each value of the formulas in equation 9 and 10 represents the same concepts in a life table as previously indicated, except for qx which is the probability of death in a life table (in this case an abridged life table). It is also worth mentioning that $(ADFLE20^i_{x+5})$ is not the final indicator but the corresponding one for the next age interval:

$$ MOR = \frac{1}{4}(l_x^1 + l_x^2)\left(\frac{L_x^2}{l_x^2} - \frac{L_x^1}{l_x^1}\right) * \left(\pi_x^1 + \pi_x^2\right) + \frac{1}{2}(ADFLE20^1_{x+5} * l_x^2 + ADFLE\,20^2_{x+5} * l_x^1) * (q_x^2 - q_x^1) \quad (9) $$

$$ DIS = \frac{1}{4}(l_x^1 + l_x^2) * \left(\frac{L_x^1}{l_x^1} + \frac{L_x^2}{l_x^2}\right) * \left(\pi_x^2 + \pi_x^1\right) \quad (10) $$

As mentioned before, the sum of both components is the variation of the ADFLE20 between periods 1 and 2, as shown in equation 11:

$$ADFLE\,20_x^2 - ADFLE\,20_x^1 = MOR + DIS \quad (11)$$

Furthermore, considering that both mortality and morbidity/disability components are the sum of the specific contributions by age group (and being w the final age group of an abridged life table, as equation 12 and 13 show, they could also be expressed in the following form, which makes them suitable for an age-specific decomposition:

$$MOR = \sum^{x,W} {}_5MOR_x \quad (12)$$

$$DIS = \sum^{x,W} {}_5DIS_x \quad (13)$$

Results

Table 1 presents the mean and standard deviation value for the basic general characteristics (age, sex, and presence of anxiety/depression or A/D) of the population analyzed in the different ENFRs (along with the values corresponding to the 95% confidence intervals). It is observed that the average age of respondents increased slightly during the 2005-2018 period (which is consistent with an aging population, as is the case of Argentina). The composition by sex in the four surveys remained similar, with a proportion of females between 56 and 57 percent. Regarding the prevalence of anxiety/depression disorders, it is observed that during the period 2005-2013 the average proportion of those who reported anxiety/depression dropped from 23 percent to 15 percent, and then increased slightly, reaching 18 percent.

TABLE 1
Basic sociodemographic characteristics of the population analyzed in the ENFR Argentina – 2005-2018

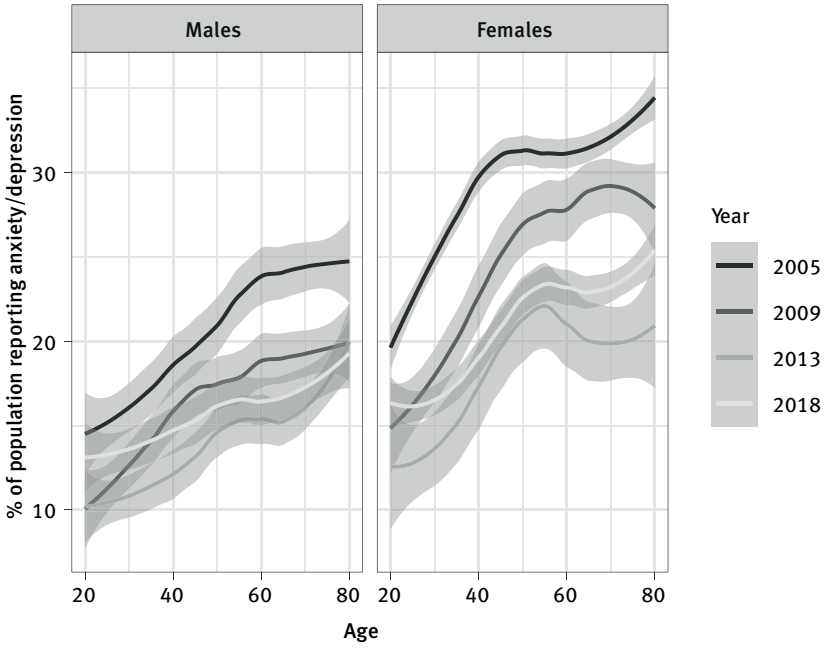
Measure	2005		2009		2013		2018	
	Mean (95% CI)	SD	Mean (95% CI)	SD	Mean (95% CI)	SD	Mean (95% CI)	SD
Age	43.92 (43.75/44.09)	17,66	44.57 (44.38/44.75)	17,85	44.60 (44.49/44.79)	17,85	46.49 (46.28/46.69)	18,05
Sex	0.57 (0.56/0.57)	0,5	0.57 (0.56/0.57)	0,5	0.56 (0.55/0.56)	0,5	0.57 (0.56/0.57)	0,5
A/D	0.23 (0.23/0.24)	0,43	0.19 (0.18/0.20)	0,39	0.15 (0.15/0.15)	0,36	0.18 (0.17/0.18)	0,38

Source: Author's calculations based on ENFR 2005, 2009, 2013, 2018.

Figure 1 illustrates the percentage of the population that report anxiety/depression (prevalence) in the Argentine population between 2005 (darkest line) and 2018 (clearest line). It is observed that the prevalence is higher for females than for males and that it tended to increase with age. However, while for males prevalence has increased linearly throughout the life course, in females there was a noticeable spike between ages 20 and 50, to present

a somewhat stable pattern afterwards. It is also observed that in 2005, values seemed to be the highest for all of the age groups, and the opposite occurred in 2013. In 2018, prevalence was higher when compared to 2013 for all of the age groups, but in particular, at the youngest age groups, the prevalence could be compared to the one presented for 2009.

FIGURE 1
Percentage of population reporting the presence of anxiety/depression by sex
Argentina – 2005-2018



Source: Author's calculations based on ENFR 2005, 2009, 2013, 2018.

Table 2 illustrates the remaining life expectancy at age 20 (LE20) and the remaining life expectancy free of anxiety/depression disorders at age 20 (ADFLE20). It can be seen that during 2005 and 2018 both the LE20 and the ADFLE20 have increased for males and females. Between 2005 and 2018, LE20 increased by 1.5 years for males and 0.7 years for females, while ADFLE20 increased by 3.6 years and 5.6 years respectively. It is noteworthy that, although improvements in LE20 could be considered modest for females, ADFLE20 presented a larger improvement, which is interesting since the presence of anxiety/depression disorders tends to be higher for females. It is also remarkable that in the period 2013-2018, the LE20 increased for both sexes, but the ADFLE20 decreased.

TABLE 2
Remaining life expectancy after 20 years (LE20) and remaining life expectancy free of anxiety/depression after 20 years (ADFLE20) by sex
Argentina – 2005-2018

Period	LE20		ADFLE20 (95%CI)	
	Males	Females	Males	Females
2004-2006 (2005)	53.4	60.3	42.8 (42.5/43.2)	42.8 (42.5/43.2)
2008-2010(2009)	53.7	60.6	45.3 (44.9/45.6)	46.1(45.8/46.5)
2012-2014(2013)	54.1	60.7	46.9 (46.5/47.2)	49.9 (49.5/50.2)
2017-2019 (2018)	54.9	61.0	46.4 (46.1/46.8)	48.4 (48.0/48.8)

Source: Own estimates based on DEIS, CELADE, and ENFR.

With the information provided in Table 2, we can also obtain both the time lived with anxiety/depression (AD) in absolute (in years) and relative terms (expressed in percentage), which are available in Table 3. We can observe how in absolute terms females live a longer lifespan with the presence of AD in all periods when compared with males, both in absolute and relative terms. In relative terms, the time lived with AD in females decreased from 17.5 percent in 2005 to 12.6 percent of their lives in 2018, while for males the reduction was more modest, from a 10.6 percent to an 8.5 percent.

TABLE 3
Remaining lifespan with AD (absolute and relative) by sex
Argentina – 2005-2018

Period	Time (in years) lived with AD (95% CI)		Time (in percentage) lived with AD (95% CI)	
	Males	Females	Males	Females
2004-2006 (2005)	10,6 (10,2/10,9)	17,5 (17,1/17,8)	10,6 (10,2/10,9)	17,5 (17,1/17,8)
2008-2010 (2009)	8,4 (8,1/8,8)	14,5 (14,1/14,8)	8,4 (8,1/8,8)	14,5 (14,1/14,8)
2012-2014 (2013)	7,2 (6,9/7,6)	10,8 (10,5/11,2)	7,2 (6,9/7,6)	10,8 (10,5/11,2)
2017-2019 (2018)	8,5 (8,1/8,8)	12,6 (12,2/13)	8,5 (8,1/8,8)	12,6 (12,2/13)

Source: Own estimates based on DEIS, CELADE, and ENFR.

Table 4 presents the overall results of the decomposition, indicating the contributions of each component (both in absolute and relative terms) to the total change in the ADFLE20 for each period. A positive value in each component means an improvement in the population health within the period relative to such component (in the same fashion that a higher life expectancy tends to indicate a decrease in mortality). As previously mentioned, during 2005-2018 the increase in ADFLE20 was larger for females than for males, and the decomposition results indicate that the relative contribution of the morbidity component to the change in the indicator has been greater as well: while for males approximately one-third of the total change in ADFLE20 was due to improvements in mortality, for females improvements in mortality explained only 11 percent of the total ADFLE change (in absolute terms, of the 5.6-year increase in

ADFLE20 for females, only 0.6 years were due to improvements in LE20). However, the decomposition also shows that the reduction in the morbidity component during the 2013-2018 period would have been even greater had there not been an improvement in mortality. In other words, the drop in ADFLE20 would have been 1 year for males and 1.7 years for females within those years, had there not been an increase in LE20.

TABLE 4
Results of the decomposition of ADFLE20 by sex
Argentina – 2005-2018

Period	Males			Females		
	Difference ADFLE20	Contribution mortality	Contribution morbidity	Difference ADFLE20	Contribution mortality	Contribution morbidity
2005-09	2.5	0. 3 (12%)	2. 2 (88%)	3.3	0.2 (6%)	3.1 (94%)
2009-13	1,6	0. 3 (19%)	1.3 (81%)	3,8	0. 2 (5%)	3. 6 (95%)
2013-18	-0,5	0. 6 (120%)	-1.1 (-220%)	-1,5	0. 2 (13%)	-1.7 (-113%)
2005-18	3,6	1.2 (33%)	2.4 (67%)	5,6	0. 6 (11%)	5 (89%)

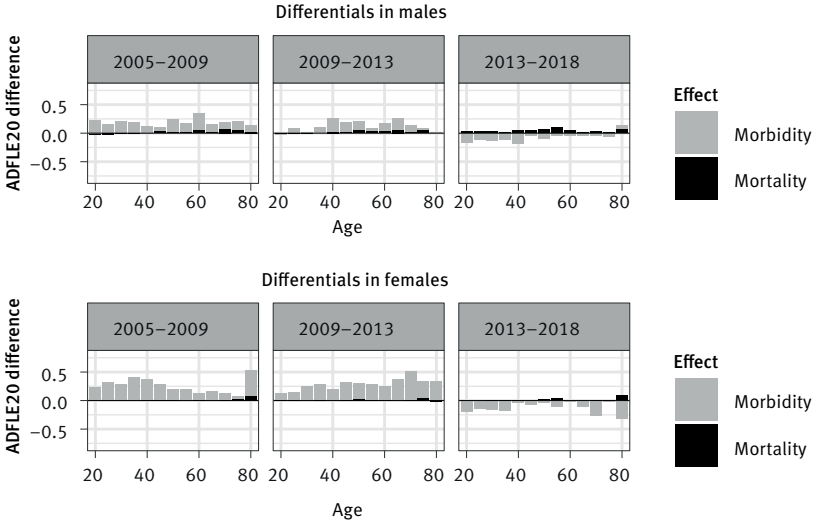
Source: Own estimates based on DEIS, CELADE, and ENFR.

Figure 2 presented the age-specific contribution to the total changes in ADFLE20. In black, we can see the change attributable to the mortality component (which can be interpreted as the change in life expectancy within periods) and in gray, we present the changes in the morbidity component (which is the change corresponding to the impact of the anxiety/depression condition on the population). As was the case for the previous table, positive values indicate an improvement within the period, and negative values indicate a decrease. For males, during the 2005-2009 period, improvements in the morbidity component have occurred in all age groups, while improvements in mortality mainly occurred in the population aged 40 and above. Between 2009 and 2013, improvements in ADFLE20 due to improvements in mortality had a similar distribution across age-groups (with a slight increase in the middle age groups); while in the morbidity component, the largest increases seemed to occur in the intermediate age groups, between ages 40 and 65 (and with a higher intensity than the mortality component). In the period 2013-2018, it is observed that the increases in mortality were compensated by a decline in the morbidity differences, mainly in the younger age groups, which are responsible for most of the negative contribution.

In females, we previously mentioned that the increase in LE20 between the 2005-2013 period was minimal. On the one hand, the age-specific decomposition indicates that improvements in the oldest age groups were responsible for the majority of such changes. On the other hand, the morbidity component improvements were large and distributed evenly across all age groups, indicating a better anxiety/depression health situation overall (although between 2005 and 2009 the morbidity contribution was slightly larger for the younger females and between 2009 and 2013 for the older age groups). Unlike males, between 2013 and 2018 improvements in life expectancy were minimal, and as a result, the reduction in ADFLE20 was barely mitigated by the mortality component, with

negative contributions in the morbidity component for practically all age groups. However, the majority of those negative contributions were found in the youngest and the oldest age groups (the mortality improvements were positive in the latter).

FIGURE 2
Age-specific contribution to ADFLE20 difference by sex
Argentina – 2005-2018



Source: Own estimates based on DEIS, CELADE, and ENFR.

Discussion

This study aimed to quantify the life expectancy free of anxiety/depression disorders (ADFLE) for adults in Argentina and to monitor its changes over the last years. Unsurprisingly, during 2005-2018 the increase in ADFLE was accompanied by an increase in overall life expectancy (LE), given that these indicators are strongly correlated to each other. However, we identified that during the five years between 2013 and 2018, life expectancy increased but ADFLE decreased for both sexes. Through the application of a mathematical decomposition procedure, it was observed that during the period 2005-2013, the increase in ADFLE was not only due to an improvement in mortality, but mainly due to a general improvement in the population health concerning the presence of anxiety/depression disorders. This means, not only that people lived longer, but also healthier during that time. This particularly was the case for females, where the morbidity component explained almost the entirety of the change in ADFLE (and the overall time lived with the presence of anxiety or depression decreased, both in absolute and relative terms). However, during 2013-2018 there was a generalized increase in prevalence, accompanied by a decrease in ADFLE, which would be even more impactful if not for an increase in overall LE during that period.

The causes of the contraction of ADFLE are not clear and cannot be inferred from the results of this study. However, it is plausible to think that the scenario of economic and social instability in which Argentina has been involved during the past decade could be related in some capacity. This scenario involves a prolonged recession, high inflation levels, currency depreciation, and deterioration of living conditions in general, which intensified during the last years, all of which could have taken its toll on the mental health of the population. Unfavorable economic situations have been associated with a higher proportion of the population presenting mood disorders such as depression or anxiety (EVANS-LACKO *et al.*, 2013; FRASQUILHO *et al.*, 2016; MONCHO *et al.*, 2018, among others) and this may not be the exception. It should be noted that a significant part of the negative contributions in the morbidity component during these five years occurred in the younger age groups, who are usually the ones exposed to the events of an economic downturn. Therefore, is also possible that once the economic situation stabilizes, the prevalence of this type of health conditions will decrease again. An alternative hypothesis would suggest that the aging process simply leads to a scenario of morbidity expansion once a certain point has been reached, where increases in longevity do not occur at the same rate as increases in the prevalence of a particular condition (SALOMON *et al.*, 2012). However, we believe that the definition in this article of the presence of anxiety/depressive disorders refers more to a temporary condition rather than to a chronic one, which would probably require a more select characterization of the chosen variables. Therefore, we cannot determine yet if this effect is temporary or part of a new trend. It should also be mentioned that the impossibility of having mortality data disaggregated by some individual characteristic (such as income level or educational attainment of the population) did not allow us to visualize whether there is any particular socioeconomic group that has contributed more or less to the change in the general trend of the ADFLE. However, further analyses of the different ENFR would potentially allow us to produce another type of indicators (REGIDOR, 2004a, 2004b) capable of monitoring socioeconomic inequalities in health in Argentina.

Despite these limitations and the lack of a clear explanation to the findings that were presented in this paper, this study has managed to produce estimates of life expectancies free of anxiety/depression disorders for adults in Argentina, showing that during 2005 and 2018 this indicator has tended to increase (despite a contraction in the recent years), that such increase was larger for females than for males, and that it occurred in all age groups. In addition, we believe that despite being unable to provide a satisfactorily definitive answer, the question of the expansion/compression of morbidity in mental disorders is worth introducing. Not only because, as mentioned previously, they are expected to be one of the main drivers of disability in the future, but also because in spite of that, they are usually overlooked when compared to other more general indicators of physical limitations such as GALI (BOGAERT *et al.*, 2018; JAGGER *et al.*, 2010; VAN OYEN *et al.*, 2018). The first approximation presented in this paper with

regard to the mental health burden of Argentina, from a population perspective, left us with more questions than answers, compared to the moment we started to write it, and we believe those questions are worth pursuing in future research.

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Resumo

Estimação da expectativa de vida remanescente livre de ansiedade/depressão na Argentina: tendências e decomposição da mudança demográfica, 2005-2018

Esta pesquisa apresentou estimativas de expectativa de vida livre de ansiedade/depressão para a população adulta (uma expectativa de saúde) na Argentina e observou sua evolução durante o período 2005-18. Dado que as expectativas de vida e de saúde estão fortemente correlacionadas, também se decompõem as mudanças destas últimas ao longo do tempo para estabelecer não apenas quais componentes causam sua variação, mas também quais faixas etárias contribuíram mais para estas mudanças. Foram analisados dados transversais da presença de sintomas de ansiedade/depressão utilizando ondas múltiplas (2005, 2009, 2013 e 2018) da Pesquisa Nacional de Fatores de Risco (ENFR) da Argentina e calculou-se uma série de expectativas de vida livres de ansiedade/depressão (condicionadas às pessoas que chegaram aos 20 anos), utilizando o método Sullivan. Em seguida, aplicamos uma técnica de decomposição do algoritmo *stepwise* para determinar se a mudança na expectativa de saúde decorreu de uma mudança em termos de mortalidade ou uma em termos de morbidade. Obteve-se que as expectativas de saúde aumentaram entre 2005 e 2013 e diminuíram de 2013 a 2018. Esta variação foi maior para o sexo feminino, em que a mudança na morbidade foi responsável por quase toda a melhoria antes de 2013. A decomposição também sugeriu que o impacto líquido sobre a morbidade seria ainda maior se não fosse por um aumento na expectativa de vida geral durante no período 2013-18, com declínio na expectativa de saúde de 1 ano para homens e 1,7 ano para mulheres, o qual foi impulsionado, principalmente, pelas faixas etárias mais jovens. Ainda não está claro se essa mudança negativa é transitória ou o início de uma nova tendência de saúde mental para a população da Argentina.

Palavras-chave: Expectativas de vida saudável. Conceitos matemáticos. Envelhecimento. Saúde mental. Argentina.

Resumen

Estimación de la esperanza de vida libre de ansiedad/depresión en Argentina: tendencias y descomposición del cambio demográfico, 2005-2018

Este estudio presentó estimaciones de la esperanza de vida libre de ansiedad o depresión (esperanza de vida saludable) para la población adulta de Argentina y observó su evolución durante el período 2005-2018. Debido a que la esperanza de vida y la esperanza de vida saludable son indicadores fuertemente correlacionados, también se descompuso el cambio de esta última en el tiempo para determinar no sólo qué componente causó su variación, sino también qué grupos etarios contribuyeron a dicho cambio. Se analizaron datos transversales de la presencia de trastornos de ansiedad o depresión utilizando ondas múltiples (2005, 2009, 2013 y 2018) de la Encuesta Nacional de Factores de Riesgo (ENFR) de Argentina, y se calculó una serie de esperanzas de vida libres de ansiedad o depresión (condicional a los veinte años de edad) usando el método

Sullivan. Luego se aplicó una técnica de descomposición algorítmica *stepwise*) para establecer si el cambio en la esperanza de vida saludable se debió a un cambio en la mortalidad o en la morbilidad. Se obtuvo que durante el período 2005-2013 la esperanza de vida saludable aumentó pero que se redujo en 2013-2018. Esta variación fue mayor para las mujeres, entre las que casi la totalidad de las mejoras en el período se debieron a cambios en la morbilidad. La descomposición sugirió que el impacto neto de la morbilidad hubiese sido aun mayor de no mediar un incremento en la esperanza de vida durante 2013 y 2018, con reducciones en la esperanza de vida saludable de un año para los hombres y 1,7 años para las mujeres, causadas principalmente por los grupos de edad más jóvenes. No está claro aún si este cambio negativo es un fenómeno transitorio o si es el comienzo de una tendencia negativa en la salud mental de la población Argentina.

Palabras clave: Esperanzas de vida saludable. Conceptos matemáticos. Envejecimiento. Salud mental. Argentina.

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