Algerian elders are living longer lives, but shorter lives free of chronic diseases: An analysis of the 2006-2019 period

Farid Flici[1], Meryem Chinoune[2]

AFFILIATION
1 Research Center in Applied Economics for Development (CREAD), Bouzareah, Algeria
2 Stochastic Phenomena Modelling Lab (LAMOPS), National Higher School of Statistics and Applied Economics (ENSSEA), Koléa, Algeria

CORRESPONDENCE TO
Farid Flici. Research Center in Applied Economics for Development (CREAD), Rue Djamel Eddine El-Afghani, BP.197, Rostomia, Bouzaréah Algiers, Algeria. E-mail: farid.flici@gmail.com ORCID iD: https://orcid.org/0000-0002-1954-2120

KEYWORDS
elderly, Algeria, chronic disease, survey, population studies

Received: 3 April 2023, **Revised:** 22 June 2024, **Accepted:** 1 November 2024

Popul. Med. 2024;6(November):31 https://doi.org/10.18332/popmed/196709

ABSTRACT

INTRODUCTION Population aging in Algeria dictates that the health conditions in which the elderly are expected to spend their remaining life years are examined. Chronic diseases account for a significant proportion of lost healthy years. This study aims to estimate the chronic disease-free life expectancy for Algerian elderly, analyze its evolution from 2006 to 2019, and examine disease-specific contributions to the years with chronic diseases.

METHODS Chronic diseases data, from the multiple indicator cluster surveys of 2006 and 2018–2019 and national life tables, allowed us to estimate chronic disease-free life expectancy using Sullivan's method. Disease-specific contributions to the unhealthy years were estimated using the cause-deleted healthy life expectancy approach.

RESULTS Although life expectancy at the age of 60 years increased by roughly a year between 2006 and 2018–2019, chronic disease-free life expectancy fell from 12.1 to 10.5 years in men and from 8.8 to 6.8 years in women. The main contributors to the unhealthy years are hypertension and diabetes. From 2006 to 2018–2019, the contribution of hypertension declined marginally, from 49.4% to 46.9% in men and from 58% to 53.8% in women. The contribution of diabetes increased dramatically, from 16.1% to 26.4% in men and from 12.3% to 22.4% in women.

CONCLUSIONS As the number of unhealthy life years expands faster than life expectancy at the age of 60 years, it will be imperative to plan for an augmentation of social and healthcare expenses for the elderly. Furthermore, chronic disease risk factors must be managed so that healthy years increase faster than life expectancy, while prioritizing hypertension and diabetes.

INTRODUCTION

During the last half-century, the Algerian population went through a demographic transition cycle characterized primarily by an increase in life expectancy at birth and a significant drop in fertility[1]. As a result, the number of elderly people and their life expectancy have increased. For a long time, Algeria was thought to have a young population. In 1977, just 5.8% of Algeria's population was 60 years or older. By 1998, the proportion had increased to 6.7%. It reached 7.7% in 2010 and 9.5% in 2019[2]. According to projections[3], the elderly will account for 12.5% of the country's population in 2030, 20% in 2050, and 20.5% in 2070.

The implications of longevity improvement on health expenditures depend on the quality of the life years gained in terms of health conditions[4,5]. There are three possible scenarios for the relative evolution of life expectancy and healthy life expectancy (HLE): morbidity compression[6], morbidity expansion[7], and dynamic equilibrium[8]. When HLE increases faster than life expectancy, we refer to morbidity compression, which results in reducing disability prevalence and concentrating the unhealthy years near the end of life. Morbidity expansion is defined as an increase in unhealthy years in absolute terms or relative to life expectancy. A dynamic equilibrium, also known as a morbidity-mortality balance, occurs when life expectancy and HLE improve at the same rate[9].

Longevity improvement increases the duration of pension benefit payments in comparison to contribution payments.

If not accompanied by a postponed retirement age, it is quite likely to result in higher retirement costs relative to contributions. However, postponing retirement age is not always possible because the increased life expectancy does not always imply good health, particularly in a morbidity expansion context. Advances in medical science and healthcare enabled individuals to live longer with their diseases without necessarily delaying their onset age[10]. This type of situation will result in increased healthcare and social security expenses without corresponding increases in working years. Only in circumstances of morbidity compression or mortality-morbidity balance is it possible to postpone retirement while keeping working and retirement ages balanced.

On the other hand, chronic disease prevalence increases with age, and the elderly are more likely to have a chronic disease than younger persons[11,12]. Thus, for the same population size, chronic disease cases should be higher in populations with a higher proportion of the elderly, and aging populations may result in higher healthcare and social security costs.

To better prepare for the upcoming era, which will be essentially characterized by accelerated population aging, in terms of elderly healthcare, it is necessary to examine recent trends in life expectancy and chronic disease-free life expectancy (CDFLE) among Algeria's elderly population. For a long time, the lack of consistent data series on chronic diseases in Algeria made it difficult to conduct such studies. Starting with edition 3 in 2006, the multiple indicator cluster survey (MICS) enabled the collection of data on the prevalence of chronic diseases in the Algerian population. Unfortunately, such a valuable source of data remains under-exploited, especially in regard to elderly health. Despite the considerable number of studies dedicated to the study of elderly living conditions in Algeria[13] and their health quality[14], it remains important to push the investigation further into estimating the proportion of healthy years that the elderly population is expected to still have to live after the age of 60 years, as well as determining the most contributing diseases to years with chronic diseases (YCDs) in the elderly population. Estimating and comparing disease-specific contributions to YCDs might help determine which chronic diseases should be targeted in preventive and healthcare programs for the elderly[15]. Only one previous study[16] analyzed the recent evolution of the CDFLE in the Algerian global population, but it did not take into account disease-specific contributions to YCDs. Furthermore, a focus on the elderly population is required, as morbidity patterns at advanced ages may differ from those reported at adult and younger ages.

In this study, we aim at estimating the CDFLE for Algerian men and women aged ≥60 years, analyzing its evolution from 2006 to 2018–2019, and examining the gender gap in terms of survival and health. We also estimate the disease-specific contribution to YCDs, including a temporal evolution analysis and gender-based comparison.

METHODS

Data sources

This study uses secondary data from two sources: chronic diseases data from waves 3 and 6 of the multiple indicator cluster survey (MICS)[17], which were conducted in 2006 (started on 25 March and continued for 2.5 months) and 2018–2019 (from 25 December 2018 to 22 April 2019), respectively, and mortality data from Algeria's official national life tables, which were published by the Office of National Statistics (ONS) for 2006, 2018, and 2019.

The MICS[18] is a program developed and funded by the United Nations Fund for Children (UNICEF) to produce data on various health and living conditions of households in developing countries. The program began in the mid-1990s, with surveys scheduled every five years. Algeria participated in the survey in 1995 (MICS 1), 2000 (MICS 2), 2006 (MICS 3), 2012–2013 (MICS 4) and 2018–2019 (MICS 6). Beginning with wave 3, MICS introduced questions about chronic diseases.

Concerning mortality data, the ONS publishes national life tables for Algerian men and women on an annual basis using civil registration data. These life tables were initially published in 1977 and include, among other indicators, mortality rates by abbreviated age intervals, i.e. 0, 1–4, 5–9, 10–14, and so on until the open age interval, which has shifted from ≥70 years to ≥85 years over time. Also, the life tables provide the remaining life expectancy at different ages.

For our study, we use the five-age mortality rates for ages ≥60 years, by sex, as published by the ONS for the year 2006[19] and we calculate average mortality rates, by five-age intervals and sex, based on the life tables of the years 2018[20] and 2019[21].

Sampling procedures in MICSs

The sampling of MICSs was carried out with the assistance of the ONS, with the goal of making the survey results representative at national and regional levels, by taking into account four regions in MICS 3 (Center, East, West, and South) and seven regions in MICS 6 (North-Center, North-East, North-West, High Plains-Center, High Plains-East, High Plains-West, and South). In both waves, the sample was determined using a two-stage stratified sampling method. In the first stage, a sample of clusters is randomly picked within each region, taking into account the urban–rural distribution of clusters in each region. In the second stage, a set of households is randomly selected to participate in the survey based on the households listed in the most recent population and housing census available (Censuses of 1998 and 2008, respectively for MICS 3 and MICS 6), and after some adjustments. To ensure that the survey population reflects the characteristics of the national population, specific weights are assigned to households in the survey sample. Additionally, correction factors are used to adjust survey results for non-responses.

In MICS 3[22], the four regions were further divided into 17

sub-regions (5 in the Center and East regions, 4 in the West, and 3 in the South regions), and 34 clusters were randomly picked in each sub-region, yielding a total of 578 clusters distributed at the national level. Subsequently, 51 households were randomly picked from each cluster, for a total of 29478 households to be surveyed. Out of this theoretical sample, 29008 households were interviewed, resulting in a 98.4% response rate.

For MICS 6[23], the first round of sampling resulted in the selection of 179 clusters in each of the seven regions, based on the urban–rural distribution of households in each region, for a total of 1252 clusters. Following that, a random selection of 25 households was carried out in each cluster, resulting in a total of 31325 households to be interviewed; 29919 households were successfully interviewed, resulting in a response rate of 96.7%.

Variables of interest

Respondents to the MICSs were asked if they or any other household member suffered from any of the chronic diseases, and if so, what type. The question is repeated for a second probable chronic disease. It was also asked if the chronic disease had been diagnosed by a health specialist. MICS 6 saw the introduction of a new question about the age at which the chronic disease was diagnosed. In MICS 3, questions about chronic diseases were asked of all household members of all ages, but only those aged ≥15 years in MICS 6.

For our study, we used the answers to the first reported chronic disease for household members aged ≥60 years at the time of the interview, with a distinction made between men and women, in both waves. This enabled us to determine the distribution of patients with chronic diseases by age, gender, and chronic disease type. We notice that the disease type grouping has changed from MICS 3 to MICS 6. MICS 3 had six categories: hypertension, diabetes, cardiovascular disease, asthma, joint disease, and other diseases. In MICS 6, asthma was replaced with 'respiratory diseases' and four new categories were added: cancer, neuropsychiatric disorders, kidney diseases, and hereditary disease. For our study, we use a common classification that includes hypertension, diabetes, cardiovascular disease, respiratory disease, joint disease, and other diseases.

On the other hand, the listing of the household members allowed us to deduce the distribution of the population exposed to the risk of chronic diseases, by age and sex.

Statistical analysis

We used R Software, version 4.2.2 (R Foundation, Vienna, Austria), for all stages of this study, including data cleaning, data manipulation, mortality and health indicator estimations, and result visualization. The Method of Sullivan[24] was used to estimate the CDFLE at age 60 years for Algerian men and women in 2006 and 2018–2019. Sullivan's method involves incorporating morbidity prevalence information into life tables, allowing to split the years lived by a given population in each age interval into two parts: disease-free years and morbidity-affected years.

We use the abridged life tables of 2006 and 2018–2019, by sex and for the five age groups 60–64, 65–69, 70–74, 75–79, and ≥80 years. In addition to the mortality rates (or probabilities of death) between age x and $x+n$, denoted ${}_nQ_x$, the life tables provide other information, including: l_x, the surviving population at age x; ${}_nD_x$, the number of deaths occurred between age x and $x+n$; ${}_nL_x$, the total number of person-years lived by the population between age x and $x+n$; T_x, the total number of person-years lived by the population from age x until the last age interval; and E_x, the life expectancy at age x.

The evolution of the surviving population from one age to the next is determined using the probability of death, which may be written as follows: $l_{x+n} = l_x \times (1 - {}_nQ_x)$ while the difference in survivors' numbers between two ages represents the deaths that occurred in between. ${}_nL_x$ is calculated by considering the individuals who died between age x and $x+n$ to have lived half of the age interval, and the survivors to have lived n years each.

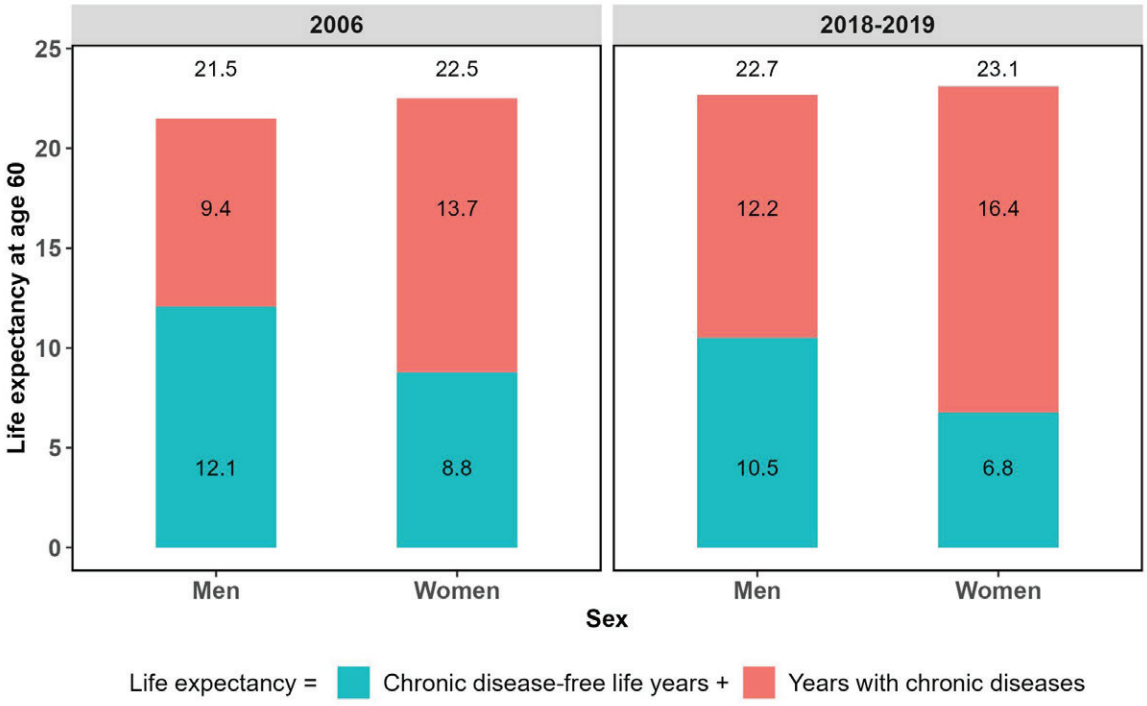
The idea behind Sullivan's method is to deduce the number of person-years lived without morbidity – without chronic diseases in our case – in each age interval starting from ${}_nL_x$ and the prevalence rate of morbidity (chronic diseases) in the age interval x to $x+n$ denoted by ${}_n\pi_x$. To this purpose, ${}_nL_x$ is multiplied by the probability of not having a chronic disease $(1 - {}_n\pi_x)$[25]. The CDFLE is then calculated following the same procedure as life expectancy.

After grouping the population surveyed ${}_nN_x$ in MICS 3 and 6 as well as the population with chronic diseases ${}_nC_x$ following the same age structure in the life tables, we calculated ${}_n\pi_x$ for men and women, for age groups 60–64 years to ≥80 years, in 2006 and 2018–2019, using the following equation: ${}_n\pi_x = {}_nC_x / {}_nN_x$. We used the calculated prevalence rates to calculate the total number of person-years lived without chronic disease for all age groups (60–64, 65–69, … to ≥80 years). By summing and dividing the latter by the population at age 60 years, we were able to estimate the remaining life expectancy at age 60 years without chronic disease. The estimation formula, as suggested by Sullivan[24], can be written as follows:

$$CDFLE_{60} = \frac{1}{l_{60}} \sum_{x=60,65,\ldots}^{80+} (1 - {}_n\pi_x)\,{}_nL_x$$

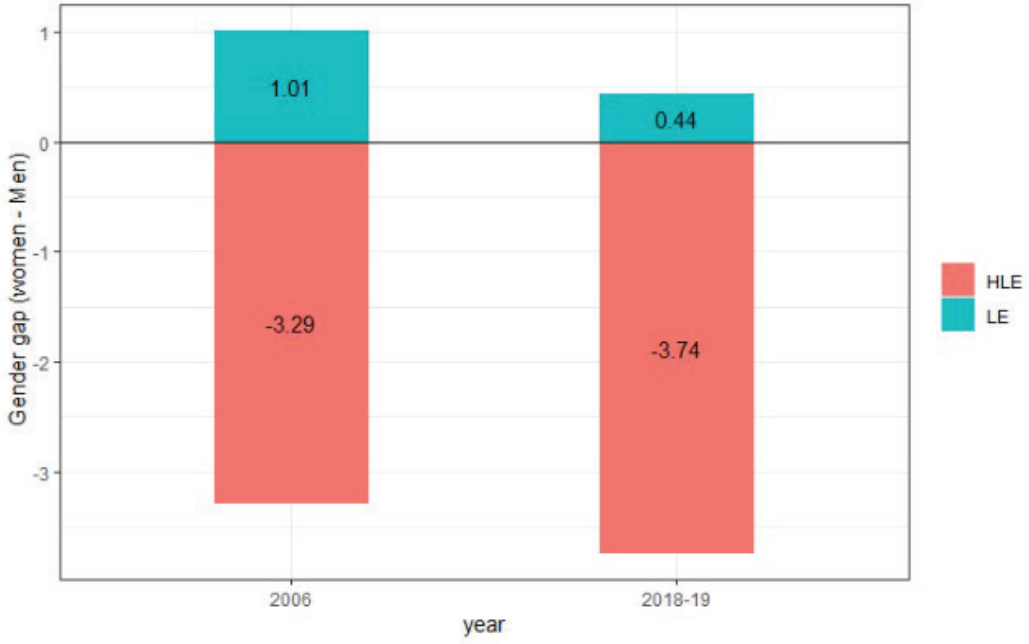
where n is the length age interval. After estimating the remaining CDFLE at age 60 years for men and women in 2006 and 2018–2019, we conducted a descriptive analysis of the evolution of CDFLE and YCDs in relation to life expectancy, followed by an examination of the gender gap in CDFLE and life expectancy. Next, we calculated disease-specific contributions to YCDs. The disease-specific contribution to YCDs was calculated

Figure 1. Life expectancy, healthy years, and years with chronic diseases at the age of 60 years, among Algerian elders in 2006 versus 2018–2019



Analysis based on combined data for chronic diseases data from waves 3 and 6 of the multiple indicator cluster survey (MICS) and mortality data from Algeria's official national life tables.

Figure 2. The gender gap in life expectancy and chronic disease-free life expectancy at the age of 60 years, among Algerian elders



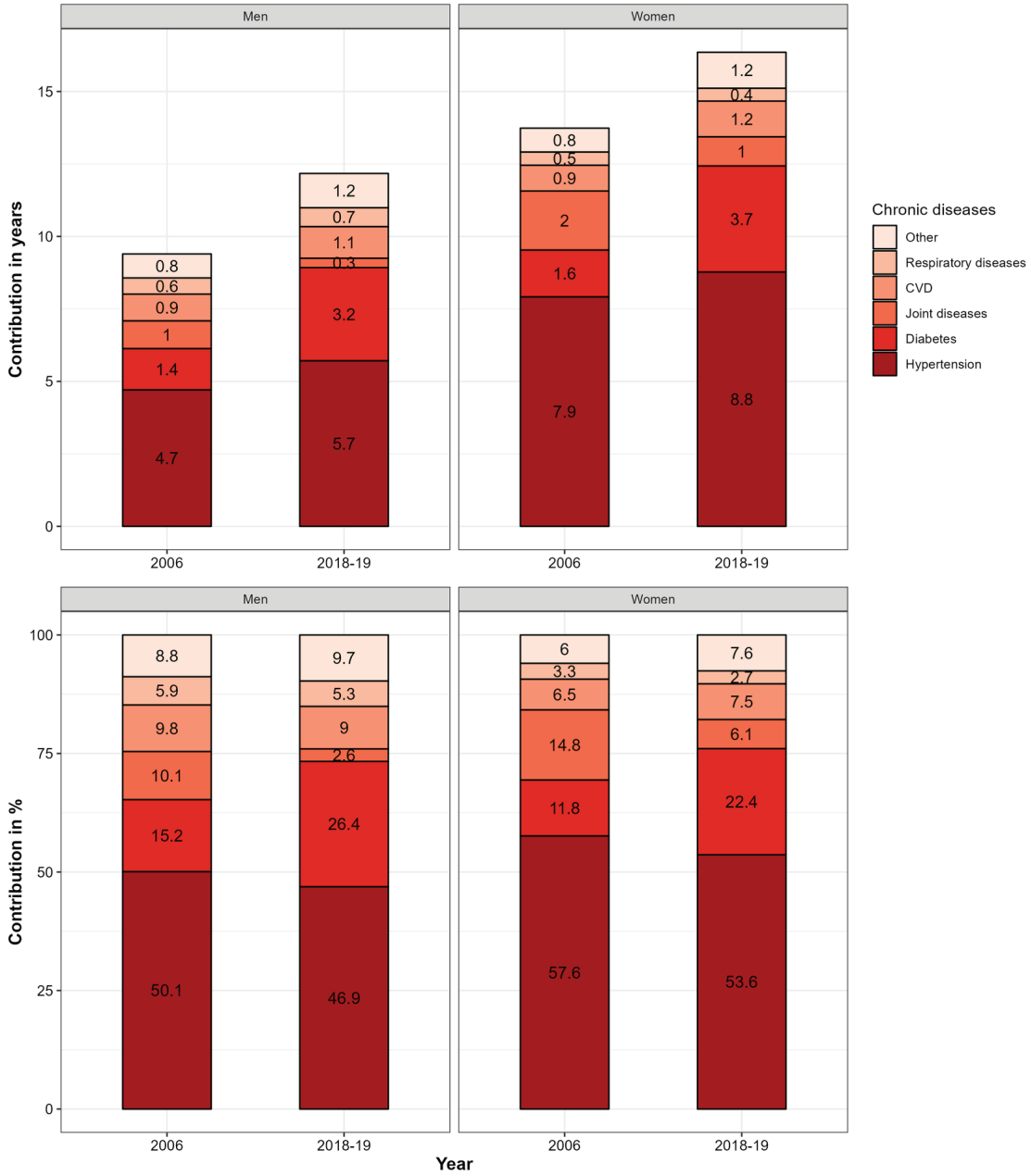
Analysis based on combined data for chronic diseases data from waves 3 and 6 of the multiple indicator cluster survey (MICS) and mortality data from Algeria's official national life tables.

using the cause-deleted health expectancy approach[26]. It is defined as the gain that could be obtained in CDFLE if a given disease is completely eradicated. To assess the contribution of a specific disease to the YCDs, we exclude the cases that were reported to have the disease from the calculation of ${}_n\pi_x$ and re-estimate the CDFLE, which we termed CDFLE(d), where d refers to a specific type of chronic disease. The difference between CDFLE(d) and CDFLE is imputed to disease d. The sum of the contributions of the various chronic diseases should equal the difference between life expectancy and CDFLE, or simply the total YCDs. We must point out that our analysis only considers the first reported disease, therefore comorbidity was not taken into account. Finally, we examined the trend of absolute and relative disease-specific contributions to YCDs from 2006 to 2018–2019, as well as by sex.

RESULTS

Our analyses indicate that Algerians' life expectancy at birth

Figure 3. Disease-specific contribution to years with chronic diseases at the age of 60 years and older, among Algerian elders



The upper subplot shows the disease-specific contributions in absolute values for men and women in 2006 and 2018-2019 while the lower subplot shows disease-specific contributions as a proportion of total YCDs.

increased from 53.6 years in 1970 to 77.7 years in 2018[27]. Even though the decrease in mortality rates at high ages was less significant than at lower ages, the remaining life expectancy at 60 years increased from 22.0 years in 2006 to 22.9 years in 2018–2019.

In contrast to the rise in life expectancy at 60 years, which increased from 21.5 to 22.7 years for men and from 22.5 to 23.1 years for women between 2006 and 2018–2019, the corresponding CDFLE declined from 12.1 to 10.5 years for men and 8.8 to 6.8 years for women during the same period. Otherwise, men aged 60 years in 2006 were expected to spend 56% of their remaining life years free of chronic diseases, compared to 39% for women. In 2018–2019, the proportion of years without chronic diseases among Algerians aged 60 years dropped to 46% for men and 29% for women. Figure 1 shows the evolution of life expectancy and CDFLE for Algerian men and women aged 60 years old in 2006 and 2018–2019.

With regard to the gender gap in survival and health, women typically outlive men, with the gender gap in life expectancy at birth ranging between one and two years in Algeria from 2000 to present, according to national statistics[27]. The gap in life expectancy at age 60 years narrowed marginally, from one year in favor of women in 2006 to five months in 2018–2019. When comparing CDFLEs of men and women, the advantage women have in terms of life expectancy is reversed. Figure 2 shows that men lived 3.3 years longer without chronic disease than women in 2006. This difference widened to 3.7 years in 2018–2019. Women aged 60 years are expected to live with chronic diseases for more than four years longer than men.

Assessing which diseases contribute the most to the years with chronic diseases, we note that hypertension is the leading cause of YCDs among the elderly in Algeria. In 2006, hypertension contributed 49.4% and 58%, respectively, for men and women; in 2018–2019, it had marginally decreased to 46.9% and 53.6%, respectively (Figure 3). Women lost 8.8 healthy years in 2018–2019 due to hypertension, compared to 7.9 healthy years in 2006. Men were less affected than women, with 4.7 and 5.7 lost healthy years in 2006 and 2018–2019, respectively.

Diabetes is the second leading cause of YCDs; however, its prevalence has increased dramatically between 2006 and 2018–2019. Diabetes-related contributions have nearly doubled throughout the indicated period, increasing from 1.4 to 3.2 years for men and 1.6 to 3.7 years for women. In 2006, diabetes accounted for 15.2% of all YCDs in men and 11.8% in women. In 2018–2019, these proportions increased to 26.4% for men and 22.4% for women.

Contrary to diabetes, joint diseases, the third largest cause of YCDs, contribute less and less over time. Between 2006 and 2018–2019, the contribution of joint diseases in men decreased from 10.1% to 2.6%, and in women from 14.8% to 6.1%. In 2006, men and women lost one and two healthy years, respectively, due to joint diseases. In 2018–2019, men and women lost 0.3 and one year, respectively. Cardiovascular and respiratory diseases, on the other hand, accounted together for 15.7% and 9.8% of YCDs in men and women, respectively, in 2006, and remained at comparable levels in 2018–2019, at 14.3% and 10.2% for men and women, respectively.

DISCUSSION

The observed trend in chronic disease-free life expectancy at age 60 years in Algeria from 2006 to 2018–2019 shows a drop in healthy years and a rise in the number of years with chronic diseases for both men and women. In 2006, men aged 60 years were expected to spend 44% of their remaining life years with a chronic condition, compared to 61% for their female counterparts. Because of the huge rise in chronic disease prevalence, these numbers grew to 54% and 71% for men and women in 2018–2019, respectively. Such a situation is more likely to correspond to a 'absolute morbidity expansion', which indicates that the gained years in life expectancy are more likely to be spent with chronic diseases, resulting in an increase in unhealthy life years both in absolute terms and as a percentage of life expectancy[28]. Similar evolution patterns were observed in many countries around the world[29], with the impact being attributed to advances in medicine and healthcare systems, which helped to reduce the fatal effects of chronic diseases and allowed people to live longer in illness[30] without necessarily postponing the disease's onset age[10,31]. However, in our case, the situation is even worse, with the number of years spent with chronic diseases increasing while the number of healthy years decreasing. Despite the possibility that advances in disease screening from 2006 to 2018–2019 influenced the evolution of CDFLE and that the prevalence of chronic diseases was under-reported in 2006 compared to 2018–2019, the huge increase in YCDs prompts the search for alternative explanations. As in various countries, unhealthy diets and lack of physical activity are the key causes of the rise in chronic illness prevalence[31].

Another element that needs to be considered when reading our results is the intensity of morbidity expansion depends on the adopted definition of 'morbidity'. In other words, it is less likely to observe a morbidity expansion when disability is considered compared to when chronic diseases – independently of their disabling effect – are considered[32]. In our case, morbidity expansion might be less strong if we considered disability-free life expectancy as a health indicator instead of CDFLE.

On the other hand, our findings add to the evidence for the 'female survival-health paradox', which argues that women live longer but less healthy lives than men[33,34]. Although Algerian women outlive men, their chronic disease-free life expectancy at the age of 60 years is more than three years shorter. This paradox can be explained by women having a higher exposure to chronic disease risk factors than men, as well as the fact that men are more likely to develop life-

threatening diseases such as cancer and cardiovascular disease, while women are exposed to less life-threatening diseases such as joint disease and diabetes[35].

When it comes to the diseases contributing the most to the YCDs in the population of elderly in Algeria, it turns out that hypertension and diabetes are the leading causes of YCDs in Algeria's older population, accounting for around two-thirds in 2006 and three-quarters in 2018–2019. Despite the fact that hypertension contributes more, the contribution of diabetes has increased dramatically from 2006 to 2018–2019. As a result, an effective strategy for improving the health of Algeria's elderly and increasing their life years without chronic diseases must prioritize hypertension and diabetes. In other words, hypertension and diabetes should be emphasized for prevention and treatment in Algeria's elderly population to help them live longer, disease-free lives while lowering public health and social security expenses.

Strengths and limitations

The findings of this research are intended to contribute to the body of literature on the health of the elderly in Algeria. The study gives the first survey-based estimates of chronic disease-free life expectancy among Algeria's elderly population, as well as an analysis of its recent evolution. It also shed light on the most contributing chronic diseases to YCDs. Despite this, the findings presented here should be regarded with caution due to significant study limitations, primarily data availability and survey design. First, the data used are from a self-reported health survey, which may exclude some prevalent cases that have not yet been diagnosed, resulting in an underestimation of chronic disease prevalence. Second, the survey did not include older persons who live in institutions. Third, comorbidity is not considered in this study, and only the first declared disease was considered. This may not have an impact on the estimation of global prevalence rates, but it may have an impact on the estimation of the disease-specific contributions to YCDs. Finally, because causes-of-death data are unavailable, this analysis exclusively evaluated chronic diseases' contributions to YCDs, not their effects on years of life lost due to chronic diseases.

CONCLUSIONS

This study revealed that life expectancy free of chronic disease decreased in Algeria's old population over the last two decades, whereas life expectancy at the age of 60 years increased slightly. Such a 'morbidity expansion' increases the number of years that the Algerian old population is likely to spend with a chronic condition, both as a percentage of life expectancy and in absolute terms. Such an evolution may potentially result in rising healthcare and social security costs for the elderly in the future years, for which social and healthcare policies must be reshaped to accommodate such an evolution. These expectations indicate that it may be important to set up preventive health policies that target the risk factors that contribute to chronic illness prevalence, as well as curative programs that lessen their disabling consequences. In this regard, hypertension and diabetes, which are the leading causes of YCDs in our context, deserve more attention.

REFERENCES

1. Flici F, Kouaouci A. Population ageing in Algeria: Why should we start caring about? Research Center in Applied Economics for Development (CREAD); 2021. Accessed December 2, 2024. https://cread.dz/wp-content/uploads/2021/12/A202101.pdf
2. Mendil D. Les conséquences du vieillissement démographique sur le système de retraite en Algérie. Retraite et société. 2020;84(2):143-153. doi:10.3917/rs1.084.0144
3. Flici F. Multi-scenarios Population Projection for Algeria. Gitbook; 2020. Accessed December 2, 2024. https://farid-flici.gitbook.io/multi-scenarios-population-projection-for-algeria/
4. Dormont B, Oliveira Martins J, Pelegrin F, Suhrcke M. Health Expenditures, Longevity and Growth. 2007. Accessed December 2, 2024. https://www.frdb.org/wp-content/uploads/2020/07/IX-conf_Report-1_2007NEW1.pdf
5. World Health Organization. Living longer, but in better or worse health? WHO; 2020. Accessed December 2, 2024. https://iris.who.int/handle/10665/332075
6. Fries JF. Aging, natural death, and the compression of morbidity. N Engl J Med. 1980;303(3):130-135. doi:10.1056/NEJM198007173030304
7. Gruenberg EM. The Failures of Success. Milbank Q. 1977;55(1):3-24. doi:10.2307/3349592
8. Robine JM, Ritchie K. Healthy life expectancy: evaluation of global indicator of change in population health. BMJ. 1991;302(6774):457-460. doi:10.1136/bmj.302.6774.457
9. Manton KG. Changing concepts of morbidity and mortality in the elderly population. Milbank Q. 1982;60(2):183-244. doi:10.2307/3349767
10. Rosén M, Haglund B. From healthy survivors to sick survivors--implications for the twenty-first century. Scand J Public Health. 2005;33(2):151-155. doi:10.1080/14034940510032121
11. Atella V, Piano Mortari A, Kopinska J, et al. Trends in age-related disease burden and healthcare utilization. Aging Cell. 2019;18(1):e12861. doi:10.1111/acel.12861
12. Kennedy BK, Berger SL, Brunet A, et al. Geroscience: linking aging to chronic disease. Cell. 2014;159(4):709-713. doi:10.1016/j.cell.2014.10.039
13. Merah A, Hammouda NE. Retraite et niveau de vie des chefs de ménages âgés de 60 ans et plus. Rev Sci Econ Gest Sci Commer. 2018;11(2):406-420.
14. Bouaziz K. Conditions de vie et état de santé de la population âgée en Algérie. Rev Algérienne Étud Popul. 2020;3(1):76-95.
15. Robine JM, Jagger C; Euro-REVES Group. Creating a coherent set of indicators to monitor health across Europe: the Euro-REVES 2 project. Eur J Public Health. 2003;13(3 Suppl):6-14. doi:10.1093/eurpub/13.suppl_1.6

16. Flici F, Chinoune M. Analysis of recent changes in chronic disease-free life expectancy in Algeria. East Mediterr Health J. 2022;28(12):872-878. doi:10.26719/emhj.22.091
17. Unicef. MICS 6 dataset. Accessed December 2, 2024. https://mics.unicef.org/surveys
18. Unicef. About MICS. Accessed December 2, 2024. https://mics.unicef.org/about
19. Office National des Statistiques. No.471 Démographie Algérienne 2006. 2007. Accessed December 2, 2024. https://www.ons.dz/IMG/pdf/DEMOGRAPHIE_2006_final.pdf
20. Office National des Statistiques. No.853 Démographie Algérienne 2018. 2019. Accessed December 2, 2024. https://www.ons.dz/IMG/pdf/demographie2018.pdf
21. Office National des Statistiques. No.890 Démographie Algérienne 2019. 2020. Accessed December 2, 2024. https://www.ons.dz/IMG/pdf/demographie2019.pdf
22. Unicef. Enquête nationale à indicateurs multiples: Rapport principal. 2008. Accessed December 2, 2024. https://mics-surveys-prod.s3.amazonaws.com/MICS3/Middle%20East%20and%20North%20Africa/Algeria/2006/Final/Algeria%202006%20MICS_French.pdf
23. Unicef. Enquête par grappes à indicateurs multiples [MICS] 2019: Rapport final des résultats. 2020. Accessed December 2, 2024. https://mics-surveys-prod.s3.amazonaws.com/MICS6/Middle%20East%20and%20North%20Africa/Algeria/2018-2019/Survey%20findings/Algeria%202018-19%20MICS_French.pdf
24. Sullivan DF. A single index of mortality and morbidity. HSMHA Health Rep. 1971;86(4):347-354. doi:10.2307/4594169
25. Jagger C, Van Oyen H, Robine JM. Health Expectancy Calculation by the Sullivan Method: A Practical Guide. 4th ed. 2014. Accessed December 2, 2024. https://reves.site.ined.fr/fichier/s_rubrique/20182/sullivan.guide.pre.final.oct2014.en.pdf
26. Colvez A, Blanchet M. Potential gains in life expectancy free of disability: a tool for health planning. Int J Epidemiol. 1983;12(2):224-229. doi:10.1093/ije/12.2.224
27. Flici F, Hammouda NE. Mortality evolution in Algeria: What can we learn about data quality? Vienna Yearbook of Population Research. 2021;19(1):169-190. doi:10.1553/populationyearbook2021.res1.3
28. Browne B. Relative compression or expansion of morbidity: further evidence from the Global Burden of Disease Study 2010. Actuarial Research Clearing House (ARCH). 2014;2(June 25):1-14.
29. GBD 2016 DALYs and HALE Collaborators. Global, regional, and national disability-adjusted life-years (DALYs) for 333 diseases and injuries and healthy life expectancy (HALE) for 195 countries and territories, 1990-2016: a systematic analysis for the Global Burden of Disease Study 2016. Lancet. 2017;390(10100):1260-1344. doi:10.1016/S0140-6736(17)32130-X
30. Mwangi J, Kulane A, Van Hoi L. Chronic diseases among the elderly in a rural Vietnam: prevalence, associated socio-demographic factors and healthcare expenditures. Int J Equity Health. 2015;14:134. doi:10.1186/s12939-015-0266-8
31. Zueras P, Rentería E. Trends in disease-free life expectancy at age 65 in Spain: diverging patterns by sex, region and disease. PLoS One. 2020;15(11):e0240923. doi:10.1371/journal.pone.0240923
32. Chatterji S, Byles J, Cutler D, Seeman T, Verdes E. Health, functioning, and disability in older adults--present status and future implications. Lancet. 2015;385(9967):563-575. doi:10.1016/S0140-6736(14)61462-8
33. Alberts SC, Archie EA, Gesquiere LR, Altmann J, Vaupel JW, Christensen K. The male-female health-survival paradox: a comparative perspective on sex differences in aging and mortality. In: Weinstein M, Lane MA, eds. Sociality, Hierarchy, Health: Comparative Biodemography: A Collection of Papers. National Academy Press; 2014:339-363.
34. Oksuzyan A, Petersen I, Stovring H, Bingley P, Vaupel JW, Christensen K. The male-female health-survival paradox: a survey and register study of the impact of sex-specific selection and information bias. Ann Epidemiol. 2009;19(7):504-511. doi:10.1016/j.annepidem.2009.03.014
35. Crimmins EM, Shim H, Zhang YS, Kim JK. Differences between men and women in mortality and the health dimensions of the morbidity process. Clin Chem. 2019;65(1):135-145. doi:10.1373/clinchem.2018.288332

CONFLICTS OF INTEREST
The authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest and none was reported. F. Flici reports that in the past 36 months he was an expert-member (unpaid) of the National Commitee for Population (Algerian Health Ministry) and the Algerian National Council of Statistics.

FUNDING
There was no source of funding for this research.

ETHICAL APPROVAL AND INFORMED CONSENT
Ethical approval and informed consent were not required for this secondary data analysis.

DATA AVAILABILITY
The data supporting this research are available from the following link: https://mics.unicef.org/surveys

AUTHORS' CONTRIBUTIONS
FF: study design and methodology, writing of the first draft, writing of the final version, checking calculation code, data visualization. CM: reading the first draft, writing the calculation code, data visualization. Both authors read and approved the final version of the manuscript.

PROVENANCE AND PEER REVIEW
Not commissioned; externally peer reviewed.