

GENDER GAP IN LIFE EXPECTANCY BY AGE AND CAUSES OF DEATH

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Abstract

The gender gap in life expectancy is well known as a result of male excess mortality. Women tend to live longer than men. In recent years, the gender difference in life expectancy is decreasing in most countries. In Czechia, the life expectancy of males and females has a tendency to be closer to each other beginning in 1990, as the year of most socio-economic changes in society. In 1994, the gender gap was calculated at 7.1 years then it started to decline up to 5.8 years in 2018. To study this phenomenon, we use a decomposition method that allows us to describe the differences in life expectancy among males and females by age groups. The decomposition analysis extended by causes of death brings further understanding of the context of the differences in life expectancy by sex. We estimated the impact of age- and cause-specific mortality on the increase in male and female life expectancy at birth in the period of 1994–2018, and the gender gap in life expectancy in 1994 and 2018.

Key words: life expectancy, gender gap, decomposition method, cause of death, mortality

JEL Code: J11, J16, I10

Introduction

In relation to the length of human life, it is well known that women tend to live longer than men. This gender difference is both of biological and non-biological origin (Sundberg et al., 2018). Biological differences between the sexes do exist and include differences in genetic and physiological factors and these factors may account for at least a part of the female advantage in human life expectancy (Seifarth et al., 2012). Women live longer than men, but older men have fewer disabilities than older women (Newman & Brach, 2001). This mortality-morbidity paradox has been reported in connection with the longer life expectancy of women (Austad & Fisher, 2016). Gender equality policies are still necessary and will have an effect on women's as well as men's health (Kolip & Lange, 2018). Life expectancy in men and women and gender equality are correlated: the higher the gender equality, the higher the life expectancy in both sexes (Kolip & Lange, 2018).

In studying mortality, life expectancy is a widely used indicator due to its independence of age structure of the current population based on the model of stationary population. The indicator comes from the computing of life tables as a number which is comparative over time and between territorial units. Decomposing a difference in life expectancies is useful in estimating what mortality differences in a specific age group contribute to the total difference in life expectancy at birth (Preston et al., 2001). There are two main approaches in decomposing a difference in life expectancy, a continuous one according to Pollard (1982) and a discrete approach using the formula by Arriaga (1984). It is demonstrable that these two procedures formally lead to the same results nevertheless the discrete approach is easier to apply to traditional life tables (Preston et al., 2001). According to Arriaga's proposal (Arriaga, 1984; Arriaga, 1989), the decomposition method can be used to study the phenomenon of male excess mortality (Sundberg et al., 2018), where in the first step the difference between life expectancies is decomposed by the contribution from each age group and in the second step, the contributions from each separate age group were divided into the contributions from each specific cause of death.

1 Data and methodology

For the purpose of this contribution, we used the data coming from the life tables and the Demographic Yearbook produced by the Czech Statistical Office. We selected the period from 1994 to 2018 for comparability of data over time since the introduction of the revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-10) in the Czech Republic. We decomposed the difference in life expectancy at birth by age groups and by selected causes of death (in accordance with ICD-10) for males and females for the period 1994–2018. To measure the gender difference, we decomposed the difference in life expectancy at birth between males and females by age groups and by selected causes of death in 1994 and 2018. In order to decompose the total change in life expectancy at birth by age groups, (Ponnappalli, 2005) listed formulas in life table terms of l_x and e_x with regards to Arriaga's original proposal as follows:

$$(e_x^2 - e_x^1) - l_{x+n}^1(e_{x+n}^2 - e_{x+n}^1). \quad (1)$$

For the open-ended age group, Arriaga suggested (Ponnappalli, 2005):

$$l_x^1(e_x^2 - e_x^1). \quad (2)$$

According to the (Arriaga, 1989), for calculating age-cause-specific decomposition, we observe in the first step the proportion of change in the cause-specific mortality rates as a share of the total mortality change in the specific age interval. In the second step, we distribute the calculated total effect into specific cause contributions according to the proportions calculated in the first step. In formulas (Auger et al., 2014) as follows:

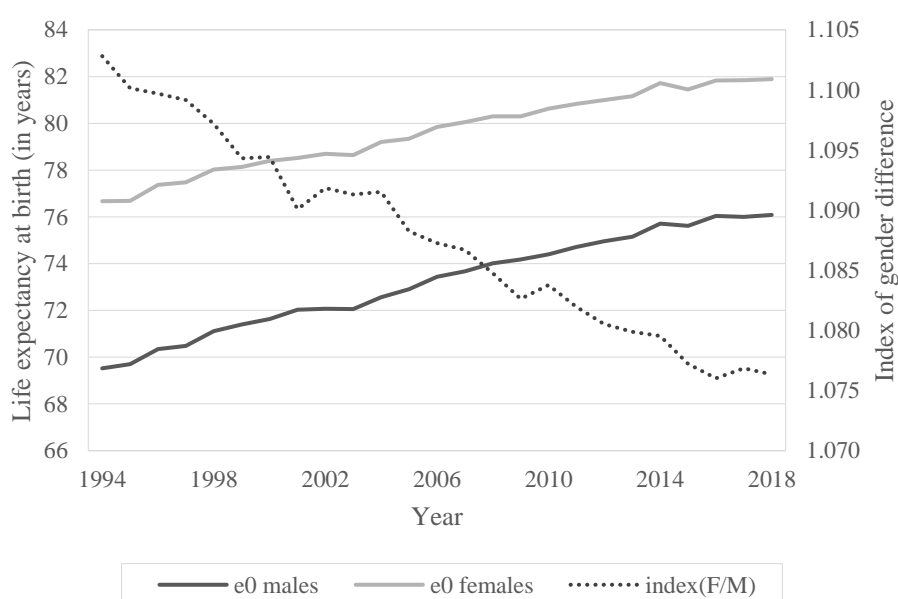
$${}_n C_x^{(i)} = {}_n C_x \times \left[\frac{{}_n R_x^{(i,2)} \times {}_n m_x^{(2)} - {}_n R_x^{(i,1)} \times {}_n m_x^{(1)}}{{}_n m_x^{(2)} \times {}_n m_x^{(1)}} \right], \quad (3)$$

where ${}_n R_x^{(i)}$ is the proportion of deaths between ages x and $x + n$ due to cause i , and ${}_n m_x$ is the all-cause mortality rate between ages x and $x + n$.

2 Life Expectancy

Life expectancy at birth for males and females tends to increase over time as it is shown in Fig. 1 for Czechia in the period of 1994–2018. Male life expectancy at birth rose by 6.6 to 76.1 years in 2018. Female life expectancy increased less than male, by 5.2 to 81.9 years. To measure the gender gap in life expectancy, we computed index of gender difference as the female life expectancy divided by male life expectancy. The gender gap is decreasing compared to the year 1994 (index = 1.103) with 2018 (index = 1.076). In 1994, the gender difference was calculated at 7.1 years then it started to decline up to 5.8 years in 2018.

Fig. 1: Life Expectancy at Birth, Males and Females, Czechia, 1994–2018



Source: Czech Statistical Office, author's calculations.

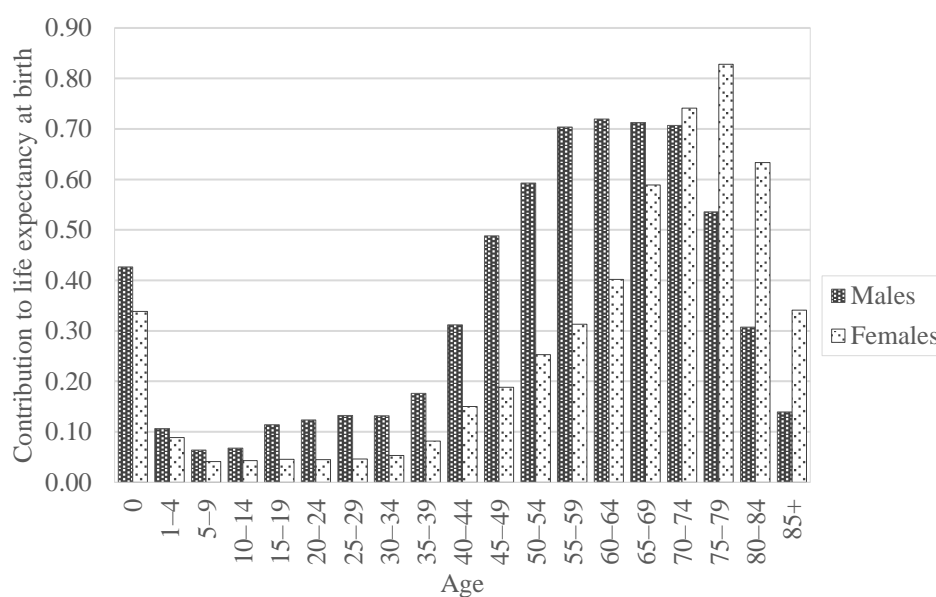
3 Main results

We estimated the impact of age- and cause-specific mortality on the increase in male and female life expectancy at birth in the period of 1994–2018, and the gender gap in life expectancy in 1994 and 2018.

3.1 Age-Specific Decomposition

The contributions to difference in life expectancy at birth by age group and sex in Czechia 1994–2018 are shown in Fig. 2. Life expectancy at birth increased as a result of improving mortality among infants and among older age groups between years 1994 and 2018. The majority of the increase in male life expectancy at birth is due to the positive contributions of age groups 50–79 years. Male mortality has improved more compared to females at ages up to 70 years. Mortality of children and adults increased faster among men between 1994 and 2018. The contributions of the age groups of males from 40 to 69 years to the difference in the overall life expectancy at birth significantly exceeded the contributions of females. The contributions of the age groups of females over the age of 70 exceeded the contributions of men in these ages.

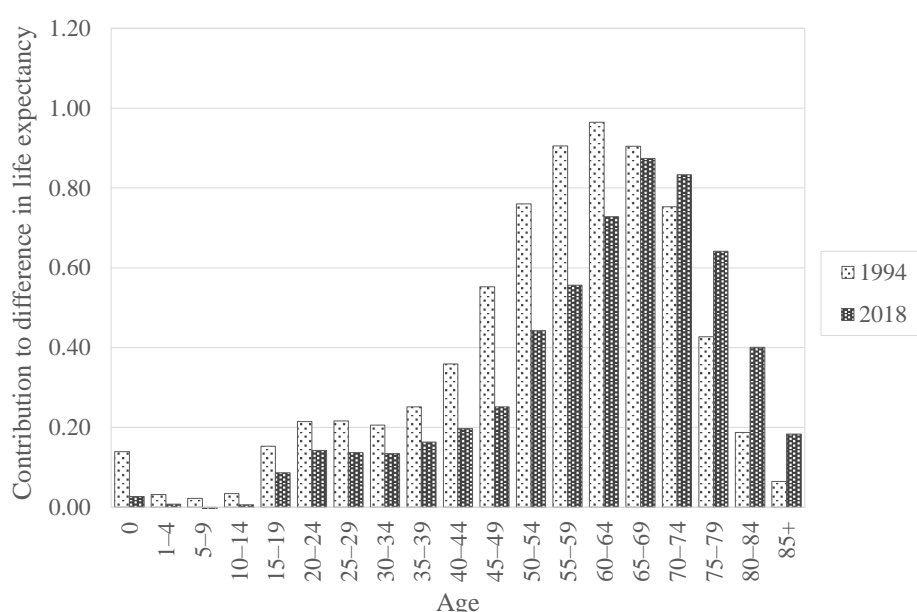
Fig. 2: Contributions to Difference in Life Expectancy at Birth by Age Group and Sex, Czechia 1994–2018



Source: Czech Statistical Office, author's calculations.

We computed the gender gap between the sexes as the contributions to difference in life expectancy at birth between males and females by age group for Czechia in 1994 and 2018 (Fig. 3). The differences in mortality between children and adults decreased among men and women. After improving mortality of males in the age group 50–69 years, the differences in mortality between the sexes decreased. In 2018, the gender gap in mortality over the age of 70 increased significantly compared to 1994 due to a greater mortality improvement among females compared to males in these ages.

Fig. 3: Contributions to Gender Difference in Life Expectancy at Birth by Age Group, Czechia in 1994 and 2018



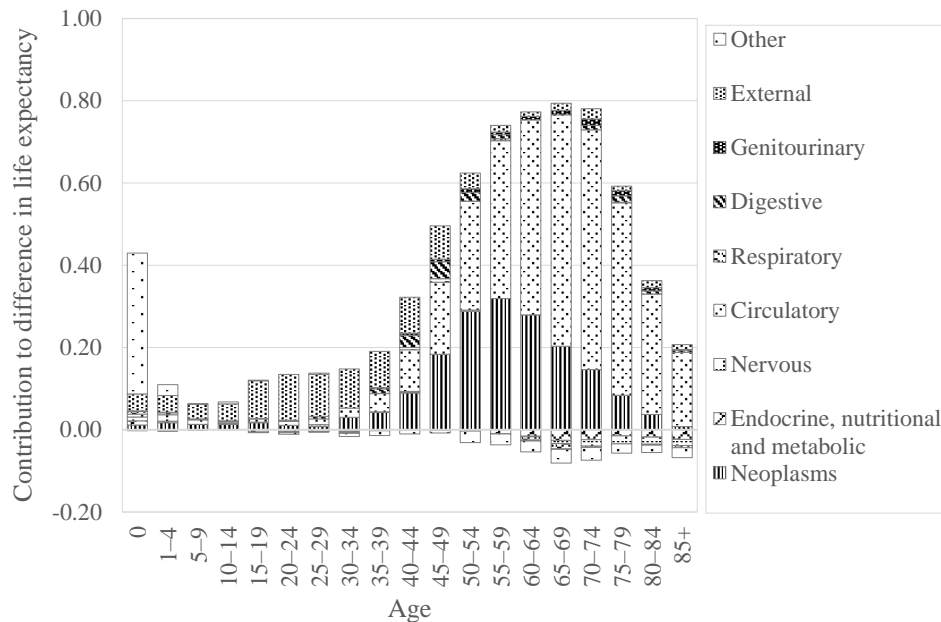
Source: Czech Statistical Office, author's calculations.

3.2 Age-Cause-Specific Decomposition

The Fig. 4 shows the contributions to difference in life expectancy at birth by age group and by selected cause of death for males in Czechia 1994–2018. A major part of the increase is due to improving mortality of circulatory diseases and neoplasms in age groups over 40 years. Improvements in mortality due to external causes of death can be seen among children and adolescents, which have contributed to an increase in life expectancy. The contributions of females (Fig. 5) showed improvements of mortality of circulatory diseases and neoplasms, mostly in older age groups compared to males. The reduction of death of external causes is most visible among females in old age above 70 years. A greater contribution to the

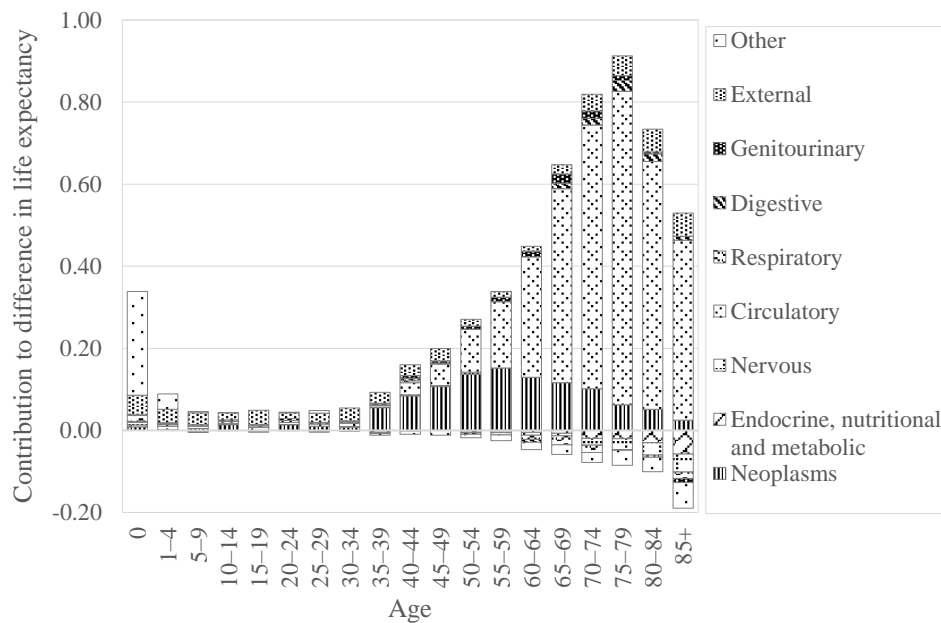
difference in life expectancy at birth due to neoplasms are visible among males, and the contribution due to circulatory diseases are more significant among females.

Fig. 4: Contributions to Difference in Life Expectancy at Birth by Age Group and by selected Cause of Death (ICD-10), Males, Czechia, 1994–2018



Source: Czech Statistical Office, author's calculations.

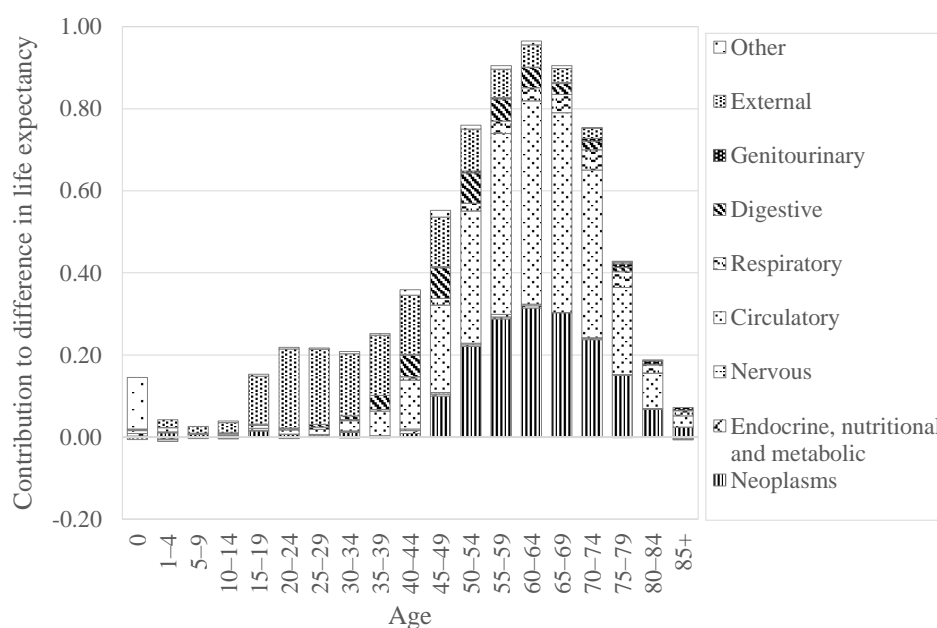
Fig. 5: Contributions to Difference in Life Expectancy at Birth by Age Group and by selected Cause of Death (ICD-10), Females, Czechia, 1994–2018



Source: Czech Statistical Office, author's calculations.

As seen in the Fig. 6, the contributions to gender difference in life expectancy at birth by age group and by selected cause of death in 1994 for Czechia prevailed due to circulatory diseases and neoplasms. It is evident that the differences between life expectancy at birth of men and women are partly due to the higher mortality of men due to external causes of death, mostly in younger age groups. The contributions to the difference in life expectancy at birth between males and females caused by digestive and respiratory diseases are visible mostly in older ages.

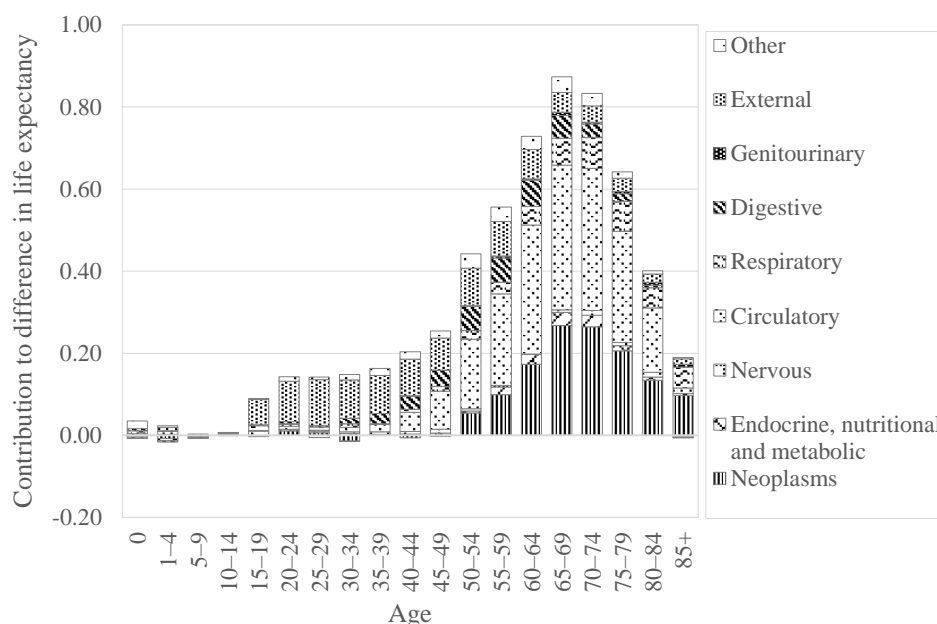
Fig. 6: Contributions to Gender Difference in Life Expectancy at Birth by Age Group and by selected Cause of Death (ICD-10), Czechia in 1994



Source: Czech Statistical Office, author's calculations.

The contributions to gender difference in life expectancy at birth by age group and by selected cause of death in 2018 is shown in Fig. 7. The difference in life expectancy between men and women is mainly due to the higher mortality of men from diseases of the circulatory system and neoplasms over the age of 40 years. Younger age groups contributed to the difference between the life expectancy of men and women due to external causes of death. The greater contribution is visible due to respiratory diseases compared to the year 1994.

Fig. 7: Contributions to Gender Difference in Life Expectancy at Birth by Age Group and by selected Cause of Death (ICD-10), Czechia in 2018



Source: Czech Statistical Office, author's calculations.

Conclusion

We showed that the gender difference in life expectancy at birth is decreasing for Czechia in 1994–2018. The gender gap was calculated at 7.1 years in 1994 then it has started to decline up to 5.8 years in 2018. Life expectancy increased in the period of 1994–2018. Male life expectancy at birth rose by 6.6 to 76.1 years in 2018. Female life expectancy at birth increased less than male, by 5.2 to 81.9 years. Mortality among males improved more compared to females at ages up to 70 years. The contributions of the age groups of females over the age of 70 exceeded the contributions of men in these ages. Life expectancy at birth increased as a result of improving mortality among infants and among older age groups. After improving mortality of males in the age group of 50–69 years, between 1994 and 2018, the differences in mortality between the sexes decreased. In 2018, however, the gender gap in mortality over the age of 70 increased significantly compared to 1994 due to greater mortality improvement among females compared to males in these ages. The major part of the increase in life expectancy at birth between years 1994 and 2018 is due to improving mortality of circulatory diseases and neoplasms. We discussed that the differences between life expectancy at birth of men and women are partly due to the higher mortality of men due to external causes of death, nevertheless the mortality of males decreased.

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References

- Arriaga, E. (1984). Measuring and explaining the change in life expectancies. *Demography*, Springer, Population Association of America (PAA), 21(1), 83–96.
- Arriaga, E. (1989). Changing trends in mortality decline during the last decades. *Differential mortality: methodological issues and biological factors*. L. Ruzicka, G. Wunsch and P. Kane. Oxford, Clarendon Press: 105–129.
- Auger, N., Feuillet, P., Martel, S., Lo, E., Barry, A. D., & Harper, S. (2014). Mortality inequality in populations with equal life expectancy: Arriaga's decomposition method in SAS, Stata, and Excel. *Annals of epidemiology*, 24(8), 575–580.
- Austad, S. N., & Fischer, K. E. (2016). Sex differences in lifespan. *Cell metabolism*, 23(6), 1022–1033.
- Canudas-Romo, V. (2008). The modal age at death and the shifting mortality hypothesis. *Demographic Research*, 19, 1179–1204.
- Canudas-Romo, V. (2010). Three measures of longevity: Time trends and record values. *Demography*, 47(2), 299–312.
- Czech Statistical Office (CZSO). (1995) *Demographic Yearbook of the Czech Republic - 1994*. Czech Statistical Office, Prague. Retrieved from : https://www.czso.cz/csu/czso/casova_rada_demografie.
- Czech Statistical Office (CZSO). (2018). *Demographic Yearbook of the Czech Republic - 2018*. Czech Statistical Office, Prague. Retrieved from : <https://www.czso.cz/csu/czso/demographic-yearbook-of-the-czech-republic-p0juug02in>.
- Czech Statistical Office (CZSO). (2018). *Life tables for the Czech Republic*. Czech Statistical Office, Prague. Retrieved from : https://www.czso.cz/csu/czso/life_tables.
- Kolip, P., & Lange, C. (2018). Gender inequality and the gender gap in life expectancy in the European Union. *European journal of public health*, 28(5), 869–872.

Newman, A. B., & Brach, J. S. (2001). Gender gap in longevity and disability in older persons. *Epidemiologic reviews*, 23(2), 343–355.

Ponnappalli, M. K. (2005). A comparison of different methods for decomposition of changes in expectation of life at birth and differentials in life expectancy at birth, *Demographic Research*, 12, 141–172.

Preston, S. H., Heuveline, P., & Guillot, M. (2001). *Demography: Measuring and modeling population processes*. Oxford: Blackwell Publishers.

Seifarth, J. E., McGowan, C. L., & Milne, K. J. (2012). Sex and life expectancy. *Gender medicine*, 9(6), 390–401.

Sundberg, L., Agahi, N., Fritzell J. and Fors S. (2018) Why is the gender gap in life expectancy decreasing? The impact of age- and cause-specific mortality in Sweden 1997–2014. *International journal of public health*, 63(6), 673–681.

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