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Gender Differences in Life Expectancy with Chronic Disease at Old Age in Bulgaria

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Summary

Life expectancy at all ages, including old age, is increasing. The increase in old age life expectancy is quite often accompanied by an increase in the years lived in bad health, mainly due to chronic diseases. The present article aims at measuring the gender differences in the life expectancy with chronic disease at the age of 65 and over in Bulgaria. Data from the latest European Health Interview Survey carried out in Bulgaria have been used. In order to measure the differences between men and women, the life expectancy for people with and without chronic disease is calculated, while to measure the gender differences and the age differences in life expectancy with chronic disease the decomposition method is used. Through the decomposition method, gender differences are decomposed to ones due to differences in mortality and others due to health status. The results show that the differences in life expectancy between men and women with chronic disease are significant and, on the one hand, are due to the lower mortality rate among females and, on the other hand – to their worse health status.

Key words: life expectancy, gender differences in life expectancy, chronic diseases, gender differences in health, life expectancy with chronic diseases

JEL Classification: I10, I12, I14, J10, J14

Introduction

Life expectancy in almost all countries around the world is increasing. The reasons for this are mainly the decrease in child mortality, the improvement of socio-economic conditions and the advances in medicine. Since 1960, a decrease in mortality of the population at age 65 and over has been observed in the developed countries, which, too, contributes to the increase in life expectancy (Vallin and Meslè 2009). The increase in old age life expectancy, though, is often accompanied by an increase in the number of years lived in bad health. In all developed countries life expectancy is higher for females than for males. In comparison to males, though, females live longer (especially at old age) in bad health (Mutafova et al., 1997, Leveille et al., 2000; Perenboom et al., 2005; Oksuzyan et al., 2008, 2009; Mourgova, M., 2016, Yong et al., 2011; Minicici et al., 2011 and Engeler et al., 2013). Oksuzyan et al., 2008 called this difference “the female-male health survival paradox”.

The most important issue is the quality of life of elderly people, health status being one of the indicators for quality. One of the main health status indicators of the population is the chronic disease morbidity. Chronic diseases are the main causes for morbidity and mortality among the population and their significance increases when the age advances, while it is the elderly that remain most affected. The list

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of the major and chronic diseases includes: cardiovascular disorders (atherosclerosis and heart attack); malignant neoplasms (cancer); chronic respiratory diseases (incl. asthma and chronic obstructive pulmonary disease); neurodegenerative diseases; epilepsy; mental disorders (depression, schizophrenia); autistic disorders; musculoskeletal disorders; metabolic disorders; renal disorders; high blood pressure; visual and hearing impairment. They affect approximately 50 out of 100 thousand people and are responsible for 87% of deaths in the European Union (European Commission, 2017). In 2014, in Bulgaria mortality among the entire population due to neoplasms and cardiovascular diseases alone reached 83.13% of all deaths and 86.37% at age 65 and over. The proportion of deaths caused by these diseases among people at old age is higher in females (87.51%) compared to males (85.09%).

Due to the higher chronic disease morbidity among old age population and the increase of life expectancy at high age the proportion of these diseases in the overall life expectancy is high. To measure their influence, the indicator "life expectancy with or without chronic disease" is used. It is calculated on the basis of data about the mortality and morbidity due to chronic disease and measures the years a person at a given age is expected to live with or without chronic diseases in the presence of the existing mortality and morbidity prevalence among the population. Together with other measures of the health status of the population, such as "healthy life expectancy", "life expectancy without disability" (also called "healthy life years"), life expectancy without limitations, the indicator "Life Expectancy without Chronic Disease" is important for shaping the public health policies.

The impact of chronic diseases on life expectancy in Bulgaria at all ages and most specifically on advanced age population has been little studied[2]. The gender differences in life expectancy with or without chronic disease have not been fully explored either. They have a specific significance for the shaping of policies related to the prevention of chronic disease morbidity, chronic disease being a leading cause for morbidity and mortality.

The present study aims at measuring and comparing the life expectancy with chronic disease at old age in Bulgaria in 2014 by gender.

Data and method

The source of data on chronic disease morbidity in 2014 is the latest European Health Interview Survey in Bulgaria – second wave, carried out by the National Statistical Institute (NSI) between October 2014 and January 2015. The survey is part of European Health Survey System in the framework of the European Statistical System (ESS). The present article uses individual data from the "Health Status" module of the survey.

To measure the life expectancy with chronic disease, data about the age-specific prevalence (proportion) of the population with chronic disease and age-specific mortality rates in Bulgaria for 2014 are used.

The proportion of the population aged 65 and over with or without chronic disease is calculated on the basis of the responses given to the question: "Do you have any longstanding illness or have you had health problems in the past 12 months?", the possible answers being "Yes" or "No". The self-reported chronic morbidity is a subjective indicator based on the person's perceived and/or diagnosed state of health. Its subjective nature reflects a person's knowledge about his/her health

[2] European Health and Life Expectancy Information System (EHLEIS) and Eurostat calculate life expectancies with and without chronic disease for Bulgaria based on Social Inclusion and Living Conditions (SILC) Survey. See EHLEIS (2017) and Eurostat (2017)

status. This is the main limitation of self-reported data because they depend on the individual's cultural, educational, and social background.

Both the source of data on the population number by age and the number of deaths also by age are provided by the NSI.

Life expectancy with chronic disease is calculated using the Sullivan's method (1971). This method is recommended by the World Health Organization (WHO) and Euro - Reves (Réseau Espérance de Vie en Santé) for measuring life expectancy in different health conditions (health status). The formula for measuring the proportion of the person's years lived with chronic diseases in the age interval x+n is:

$$ {}_nL'_x = {}_n\pi_x \cdot {}_nL_x, \quad (1) $$

where ${}_nL_x$ is the person-years lived for the population in the age interval x to x+n years obtained from the life table, and ${}_n\pi_x$ is the proportion of the people in the age interval x to x+n years who have responded that they suffer from chronic diseases. The life expectancy with chronic diseases is calculated with the following formula:

$$ e'_x = \frac{1}{l_x}\sum_{i=x}^{\varpi} {}_nL'_i, \quad (2) $$

where l_x is the number of persons who have lived to age x obtained from the life tables.

In this paper abridged life tables were constructed by the author.

Because the data for age-specific prevalence of different health statuses are derived from a survey, they are subject to sampling variation. The proportion of the population in the sample with or without chronic diseases by age is an estimation of the actual proportions and is associated with the respective variation and standard error. When comparing the life expectancy with or without chronic disease of two subgroups of the population (for example, males and females) standard errors can be measured (Jagger, 1999; Molla et al., 2003). The authors suggest the following formulae for their calculation: 1) as the distribution of the proportion of the population in the respective health status by age is binomial, the following formula is used to calculate the variance:

$$ S^2({}_n\pi_x) = [{}_n\pi_x.(1 - {}_n\pi_x)]/{}_nN_x, \quad (3) $$

where ${}_nN_x$ is the number of individuals in the sample in the age interval (x, x+n) years from which the proportions in different health statuses are computed;

2) the overall variation in life expectancy according to the health status at age x is calculated by the following formula:

$$ \mathrm{VAR}\,(e'_x) = \frac{1}{l_x^2}\sum_{i=x}^{w} {}_xL_i^2 \,.\, S^2\,{}_n\pi_x \quad (4) $$

The z-score test is used to compare the life expectancy in the different health statuses of two groups of the population (for example, by gender). The z-statistics is calculated by the formula

$$ z = \frac{e'_{x,1} - e'_{x,2}}{S(e'_{x,1}) + S(e'_{x,2})}, \quad (5) $$

where $e'_{(x,1)}$ and $e'_{(x,2)}$ are the life expectancies in the respective health status of population "1" and "2" (for example, "males" and "females"), while and are the respective standard errors (Molla et al., 2003).

The decomposition method proposed by E. Andreev, V. Shkolnikov, A. Begun (2002)[3] was used to measure gender differences in life expectancy with chronic disease. This method allows to measure the contribution of each of the two components, namely, the one due to mortality and the other due to health status (with or without chronic disease), to the difference in the life expectancy with chronic disease by gender.

The formulae for calculating the differences in the life expectancy with chronic disease by gender due to the differences in

[3] In 2004 a similar method was proposed by Nusselder and Looman (2004)

$$\lambda_x = \frac{1}{4}(l_x^1 + l_x^2)({}_1P_x^2 - {}_1P_x^1)(\pi_x^1 + \pi_x^2) + \frac{1}{2}(h_{x+1}^1 l_x^1 + h_{x+1}^2 l_x^1)({}_1q_x^1 - {}_1q_x^2)$$
$$\gamma_x = \frac{1}{4}(l_x^1 + l_x^2)({}_1P_x^1 + {}_1P_x^2)(\pi_x^2 - \pi_x^1), \quad (6)$$

the health status (γ) and the ones due to the differences in mortality (λ) are:

where: $${}_1P_x^i = \frac{{}_1L_x^i}{l_x^i},$$

q_x – probability of dying at age x; and

h_x – life expectancy with chronic disease at age x.

The designations "1"and "2" refer to the indicators from the life tables for the two subgroups of the population (in this case those of males and females).

The decomposition method is applied to abridged life tables.

Results

1. Life expectancy with chronic disease

Data based on the European Health Interview Survey shows that in 2014, as much as 86.85% of the population in Bulgaria at age 65 and over suffered from chronic diseases. The proportion of males in comparison with females is lower – 83.55% compared to 89.03%.

Life expectancy within the age interval 65-69 is 14.02 years for males and 17.53 years for females, with a difference of 3.51 years (Table 1.). For all ages up to 85 and over life expectancy is lower for males than for females and the difference decreases with the increase in age. Life expectancy for females with chronic disease in the 65-69 age group, though, is higher – 15.72 years in females compared to 11.75 years in males[4]. It decreases with age for both sexes due to the increase in chronic disease morbidity. At all ages the life expectancy with chronic disease is higher for females in comparison with males and the differences between the two population groups decrease with the increase in age.

Table 1. *Life expectancy and life expectancy with chronic disease of the population at age 65 and over in Bulgaria in 2014 by age groups (in years)*

Age group	Life expectancy		Life expectancy with chronic disease	
	Males	Females	Males	Females
65-69	14.02	17.53	11.75	15.72
70-74	11.28	13.69	9.91	12.76
75-79	8.65	10.21	7.62	9.58
80-84	6.37	7.25	5.53	6.84
85 and over	4.61	5.13	3.86	4.70

[4] The hypotheses testing about the differences by gender in life expectancy with chronic diseases at age 65 and over, and 5-year age intervals show statistically significant differences in all ages except at age 85 and over only at level of significance α=0.01. The variation, the standard errors, the values of z-statistics, and the p-values are presented in the Appendix.

2. Proportion of remaining life spent with and without chronic disease by gender

Figures 1 and 2 present the percentage of remaining life spent with and without chronic diseases at age 65 and over for male and female population in Bulgaria.

The percentage of life expectancy with chronic disease of the overall life expectancy is higher in females than in males. At age 65 males are expected to spend 83.84% of their life with chronic disease, while for females this percentage is 89.72% or almost 6% higher. Due to an increase in morbidity with the increase of age, the proportion of remaining life spent with chronic disease is expected to increase. Males at the age of 70 and over are expected to live more than 87,8% of their overall life expectancy with chronic disease while for females the percentage is above 93%. Both sexes, though, in the last age group (85 and over), are expected to live less years with chronic disease in comparison with the younger age groups (except females at age 65-69).

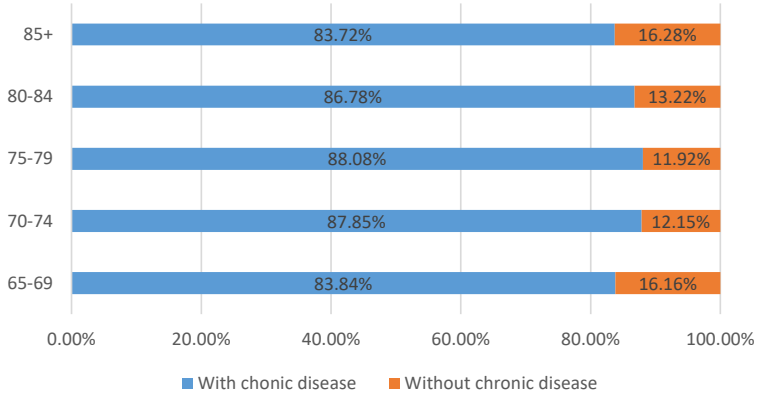

Fig. 1. *Proportion of remaining life at age 65 and over with chronic disease by age groups, males, Bulgaria 2014 (in %)*

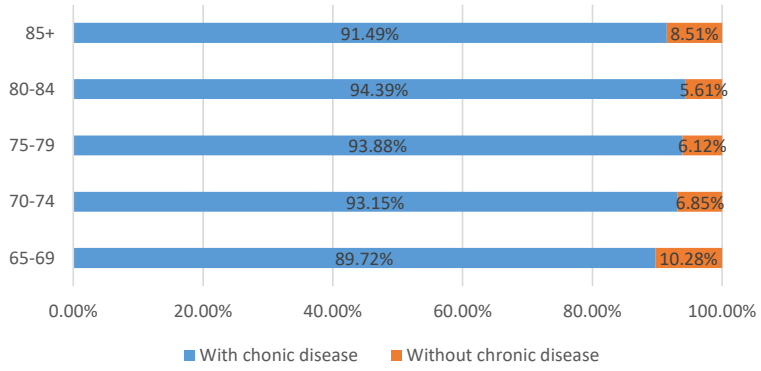

Fig. 2. *Proportion of remaining life at age 65 and over with chronic disease by age groups, females, Bulgaria 2014 (in %)*

The lower percentage of remaining life with chronic disease for age group 85 and over in males comparing to all other age groups and for the same age group comparing to ages between 70 and 84 years in females, could be explained either with the better health status of the population in those age groups or with the respondents' misunderstanding of the question related to chronic disease morbidity.

3. Decomposition of life expectancy with chronic disease

The method for decomposing the difference in the life expectancy with chronic disease at age 65 between males and females disaggregates into two components the overall difference of 3.97 years, which is in favour of females: one due to differences in the mortality and the other due to differences in chronic disease morbidity. The higher chronic disease morbidity in females contributes to the overall difference by 0.67 years, while the lower mortality in females contributes to the overall difference by 3.30 years.

The decomposition of differences in the life expectancy with chronic disease at age 65 and over between males and females and by 5-year age groups is presented in Figure 3. The 3.97-year overall difference in the life expectancy with chronic disease between males and females is due to the worse health status and the lower mortality of females in all age groups. The most significant difference between both sexes is observed in the age group 65-69 years. The 1.92-year higher life expectancy with chronic disease in females in this age group is due to the lower mortality, which explains their higher overall life expectancy (by 1.73 years, compared to the males in the same age group). At the same time, the higher chronic disease morbidity in females contributes by 0.19 years to the difference in life expectancy with chronic disease. The differences decrease when the age increases and are lowest in the last age group.

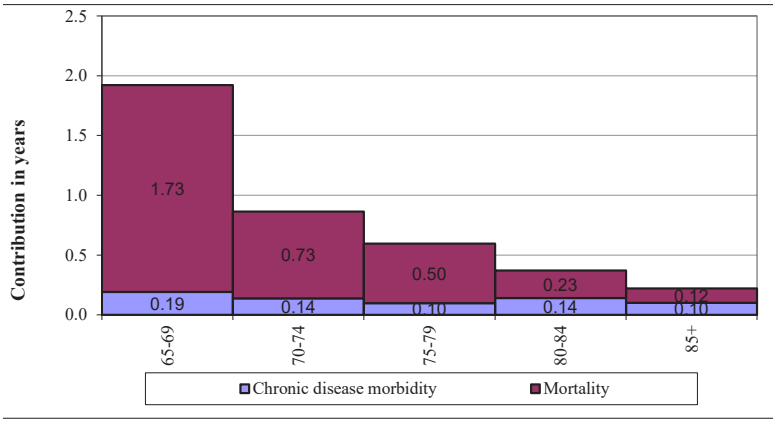

Fig. 3. *Contribution of mortality and chronic disease morbidity to the differences in the life expectancy with chronic disease at age 65 and over by gender in Bulgaria, 2014*

Discussion

The differences in life expectancy for males and females are mainly due to their different lifestyles (Waldron, 1995, 2005; Valkonen and Van Poppel, 1997; Golemanov, 2001; Conti et al., 2003, Gjonca et al., 2005; Elo and Drevenstedt, 2005; Preston and Wong, 2006; Barford et al., 2006), although there are also hypotheses of biological

factors (Lopez, 1983, Horiuchi, 1997; Kramer, 2000; Christensen et al., 2000, 2001; Klotz and Staufer, 2003; Austad, 2006), that could also contribute to those differences.

The results of our study also show that in spite of the higher life expectancy in females at age 65 and over, they are expected to live more years in bad health due to the higher chronic disease morbidity.

The main but not the only causes for chronic disease morbidity are related to the unhealthy lifestyle – unhealthy diet, lack of exercise, smoking and alcohol consumption. Alcohol consumption and smoking are more common among males than among females. Obesity and lack of exercise though are more common among females. Strong correlations exist between obesity and high blood pressure and between the high cholesterol levels and diabetes (Lamon-Fava at al., 1996). Data from the European Health Interview Survey (2014) shows that 19.8 % of the females in Bulgaria at age 65 and over suffer from obesity[5], while for males the percentage is 16.8%. According to the same survey, males are more physically active than females. To the question "How many days in a regular week do you walk without a break for at least 10 minutes (going to or coming back from certain places)", 84.55% of the men responded that they had walked for 10 minutes in a single day while the proportion of women is 81.53%. Obesity and sedentary lifestyle, that are more common among females, are also pointed out as a cause for the difference in the health status and chronic disease morbidity by Leveille, S.G. et al. (2000).

According to Robine and Jagger, 2005 with regard to the gender gap in health at old ages, explanations may also include reporting bias, higher rates of disabling diseases (including depression and dementia, arthritis), possible physiologic differences, and behavioral factors (women having less social support and assistance), presence of more comorbidities or chronic health problems.

Conclusion

Health status at old age to a great extent depends on the lifestyle throughout the individual's entire life. Change in the lifestyle not only at old age but also during the active years is one of the most significant factors for decreasing the chronic morbidity and increasing the healthy life expectancy. The relation between the socio-economic factors and the health determinants: diet, alcohol consumption, smoking and physical activity, and the differences in life expectancy for males and females in Bulgaria has to be studied more profoundly.

In order to decrease the chronic disease morbidity in Bulgaria it is also necessary to conduct an effective policy for increasing the public awareness and mainly the awareness among the risk groups about the consequences of unhealthy living; improving the efficiency of the healthcare system; improving the quality of life of the elderly people and decreasing the inequality in accessing medical care and services. In relation to that, the policy of the European Union with respect to fighting chronic diseases is directed towards health promotion, prevention and early detection of diseases (European Commission, 2017). The battle against chronic diseases is part of the WHO Plan of Action for prevention and control of the main and the chronic diseases 2013-2020 (WHO, 2013). The main goal of this plan of action is to achieve a 25% decrease in the mortality rate from cardiovascular disorders, cancer, diabetes and chronic diseases by 2025.

The decrease in the chronic disease morbidity is a significant factor for the

[5] The levels of obesity are determined by the body mass index proposed by WHO

decrease of the overall mortality as well as for the decrease in the differences in the health status of both sexes.

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APPENDIX

Statistical test for difference in life expectancy with chronic disease at age groups 65 and over for males and females in Bulgaria, 2014

Age groups	Life expectancy with chronic disease		Variance of life expectancy with chronic disease		Standard error of life expectancy with chronic disease		Difference in life expectancy with chronic disease	z-statistics	p-value*
	Males	Females	Males	Females	Males	Females			
	$e'_{x,1}$	$e'_{x,2}$	Var ($e'_{x,1}$)	Var ($e'_{x,2}$)	S ($e'_{x,1}$)	S ($e'_{x,2}$)	$e'_{x,2} - e'_{x,1}$		
65-69	11,75	15,72	0,006099	0,006277	0,02716	0,02104	3,97	25,23	<0,00001
70-74	9,91	12,76	0,009552	0,005500	0,02339	0,01647	2,85	16,57	<0,00001
75-79	7,62	9,58	0,012316	0,006143	0,02772	0,01813	1,96	10,37	<0,00001
80-84	5,53	6,84	0,014836	0,003414	0,03348	0,01466	1,31	7,27	<0,00001
85+	3,86	4,70	0,056372	0,019974	0,05630	0,02878	0,84	2,21	<0,02710

*The p-values are calculated at levels of significance α=0.01, α=0.05, α=0.10, and two-tailed test