The sterner sex, the weaker sex. Two patterns of excess male mortality.

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Abstract

The phenomenon of the excess male mortality takes place in populations all over the world. The life expectancy gap (LEG) between men and women has been observed not only in our times, but also in the past. Not always, however, has the LEG been determined by the same epidemiologic factors. The aim of this paper is to present the decomposition of the LEG by age and cause of death in longitudinal perspective, which allows to identify the most important epidemiologic factors disadvantageous for men. The analysis refers to England and Wales 1848-2003, as well as three other West-European countries. It presents the transition from the LEG caused by infant male mortality due to developmental and wasting diseases to the LEG driven by middle-age male mortality due to cardiovascular diseases and tumours. As much as the first pattern, observed till the 1950s, was biologic in origin, the second pattern, observed in the second half of the 20th century, results from biologic and behavioral factors.

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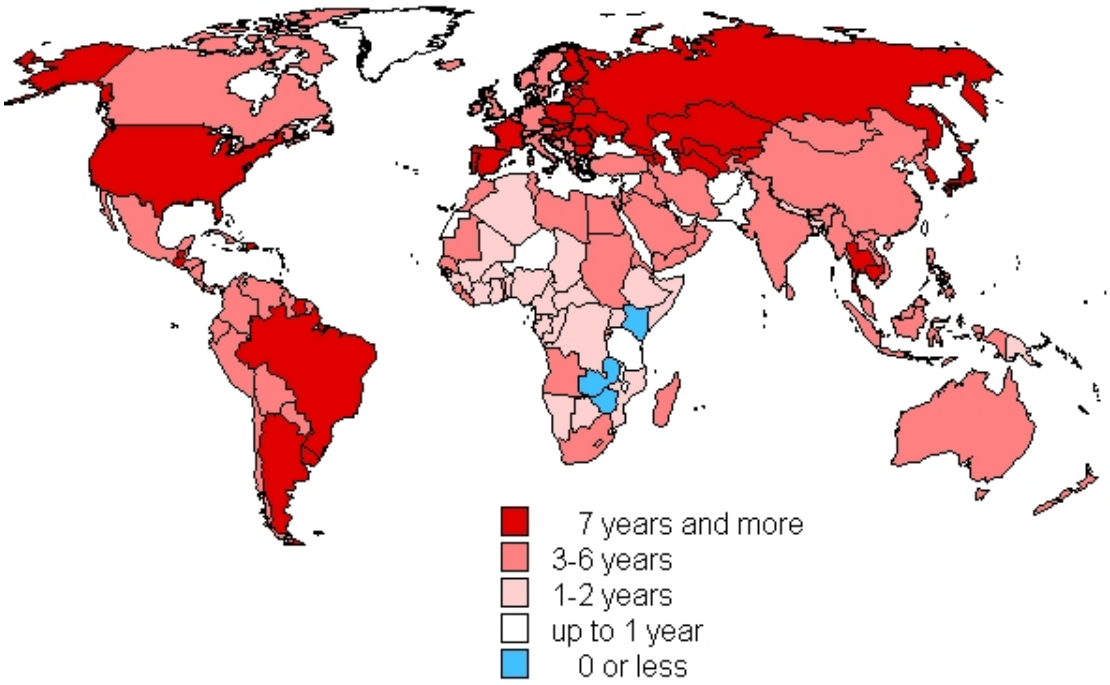
1 Introduction

The life expectancy gap (LEG) between males and females is the characteristic feature of populations all over the world. At present in most countries women live longer than men on average by 4-5 years[2]. While the female advantage in life expectancy in the most developed countries is approximately 5-6 years, in the post-communist countries, especially in the former Soviet Republics it is much higher: from 7 to 13 years (Fig.1). This results from the health crisis that began in the 1960s and affected mostly men at economically active age (Meslé, Vallin 1998; Shkolnikov, Meslé, Vallin 1996).

Fig.1. Female advantage in life expectancy at birth (*eF(0)-eM(0)*) in years, 2000-2005



Source: based on the UN (2005).

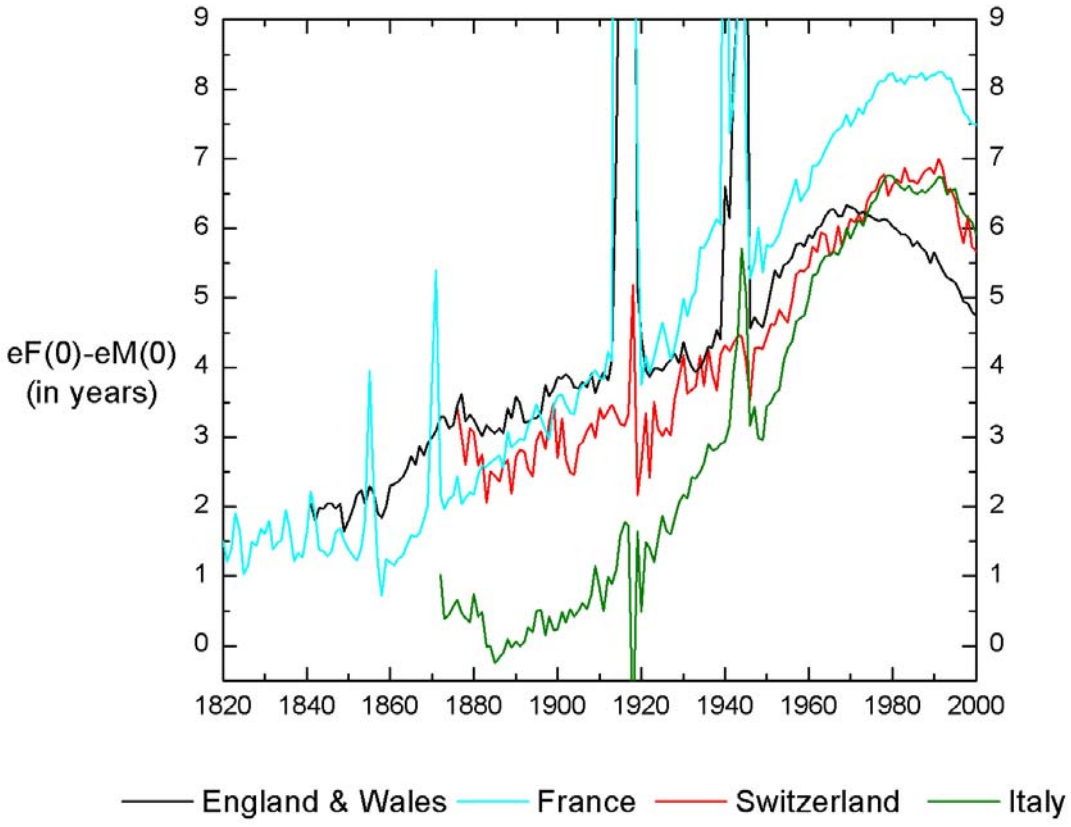
However, the female advantage has not been historically predominant, which is supported by the data referring to populations living in Western Europe in the 18th and 19th centuries. To quote just two examples, reconstitutions of French parish registers for the period 1740-1789 (Blayo 1975) and of household registers for Belgium, Italy and Sweden for the 19th century (Campbell et al. 2004) do not indicate that female sex was in all periods of analyses favoured as far as the length of life is concerned. By contrast, the French life tables reconstructed recently by Jacques Vallin and France Meslé (2001) indicate that since the beginning of the 19th century the life expectancy of women exceeded that of men but the LEG did not remain constant. At the begining of the 19th century the female life expectancy at birth was merely by 3-5% longer than the male life expectancy. In the mid 19th century this disproportion started to increase gradually[3] and reached the maximum of 11% (over 8 years) in the 1980s. Since then the drop in LEG was registered. The same pattern could be observed in other West

[2] This global predominance of female advantage in LEG is not contradicted by the case of three African and one Asian country (Kenya, Maldives, Zambia and Zimbabwe) where the situation is reverse.

[3] I exclude the years of wars when the difference between female and male life expectancy was abnormally high. For instance, in France due to French-German war of 1871 the LEG promptly increased from 2 years in 1870 to 5.4 years one year later, due to the WW1 the LEG rose from 4 years in 1913 to 25 years in 1915, due to WW2 from 6 years in 1939 to 16.4 years in 1940. Similar impact of the WW1 and WW2 was observed in other European countries.

European countries, such as England and Wales (for which the available life tables date back to 1841), Italy (1872) and Switzerland (1876) (see Fig.2).

Fig. 2. The difference between female and male life expectancy at birth (*eF(0)-eM(0)*) in years in four European countries: England and Wales, France, Italy and Switzerland.



Source: based on *Human Mortality Database* (2005); Vallin, Meslé (2001).

The following analysis consists of decomposition of the LEG with regard to the age and cause of death, which leads to identifying the most important epidemiologic factors contributing to the disadvantage of men.

2 The analysis of life expectancy gap by age

The analysis refers to the four West-European countries: England and Wales, France, Italy and Switzerland. Applying the method of decomposition of the LEG developed in the 1980s (Andreev 1982; Arriaga 1984; Pressat 1985), I distinguished the age groups that mainly contributed to the difference between life expectancy of men and women. The data used in the decomposition of life expectancies by age was derived from the French cohort life tables 1806-1996, English period life tables 1841-2003, Italian period life tables 1872-2004 and Swiss period life tables 1876-2006. French life tables were prepared by Jacques Vallin and France Meslé (2001), whereas the life tables of other countries were reconstructed in the *Human Mortality Database* project.

The decomposition of the difference between female and male life expectancy at birth according to age indicates the existence of two patterns of the LEG (Fig.3). The first pattern took place in the first half of the 19th century and consisted mostly of the excess male

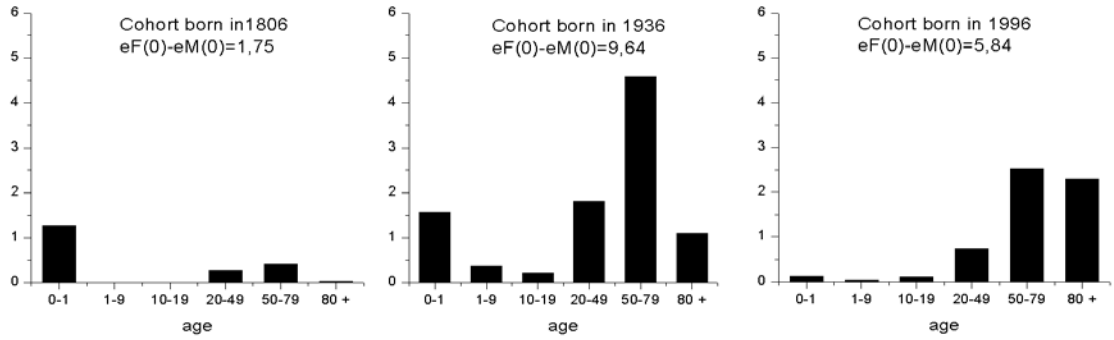
mortality in the infancy. According to the data for England and Wales, in the middle of the 19th century 65% of the whole difference between female and male life expectancy was caused by excess male mortality under one year. In France this percentage was as high as 73% in 1806 and 42% in 1856.

In the subsequent decades the excess male mortality at adult age, especially at age 50-79, started to contribute to the LEG. Since the 1950s the infant mortality has been significantly reduced and almost eliminated, mostly due to inventory of sulfonamides and antibiotics. Consequently, despite higher risk of death among male infants, the mortality within the first year of life stopped to make a relevant contribution into the LEG. In the second half of the 20th century the second pattern of the difference between female and male life expectancy appeared: it resulted almost exclusively from the excess male mortality in the adulthood and old age. Male mortality after 50th year of life was responsible for 78% of the whole difference between female and male life expectancy in England and Wales (2003) and 82% in France (1996). This transition from the LEG caused by infant male mortality to the LEG driven by middle-age male mortality was accompanied by unprecendented rise in the overall LEG.

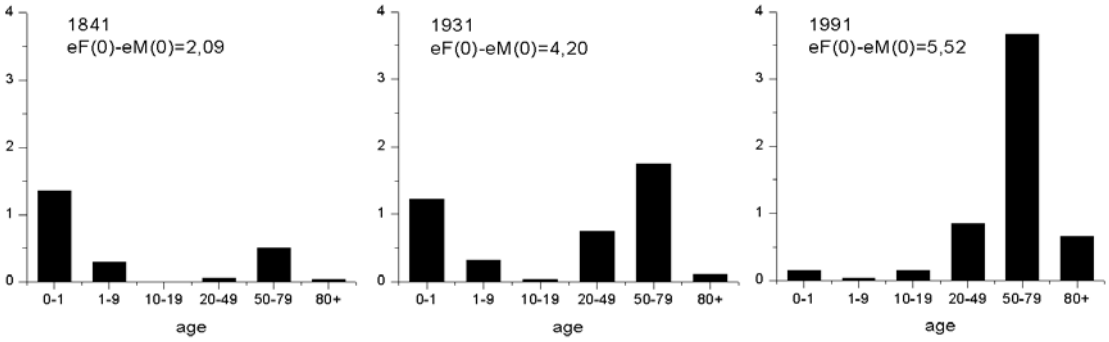
Fig. 3 a,b. The difference between female and male life expectancy at birth decomposed according to age, selected cohorts/years[1]

The premodern pattern of LEG	Transitional stage	The modern pattern of LEG

a) France, cohort analysis



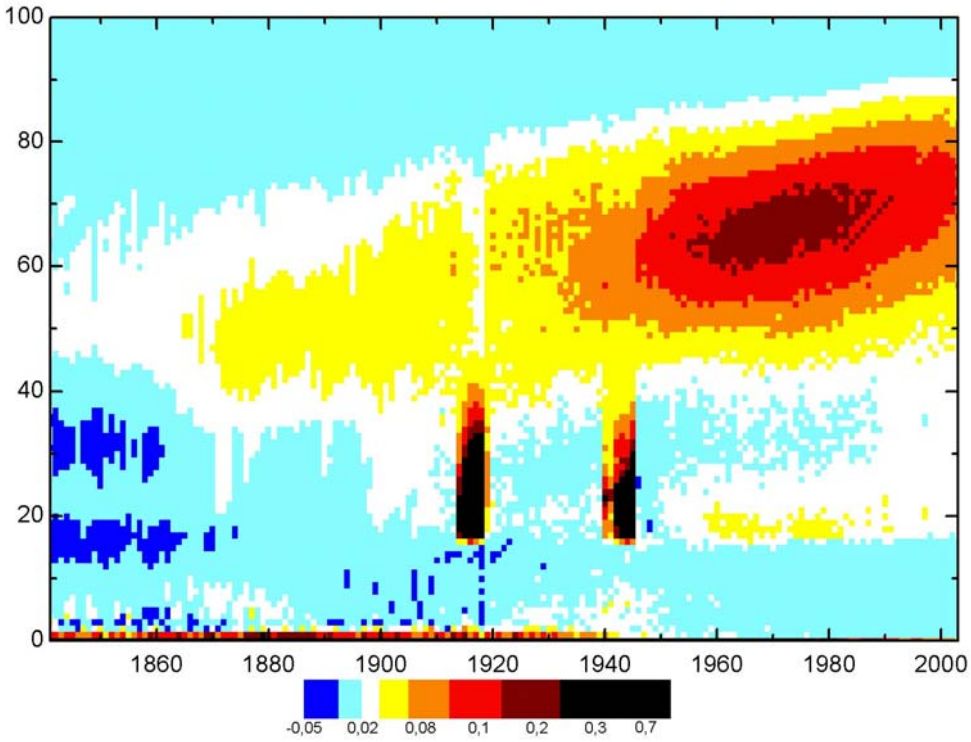
b) England and Wales, period analysis



[1]Results presented in the paper constitute only a sample of all calculations.
Source: own calculation based on *Human Mortality Database* (2005), Vallin, Meslé (2001).

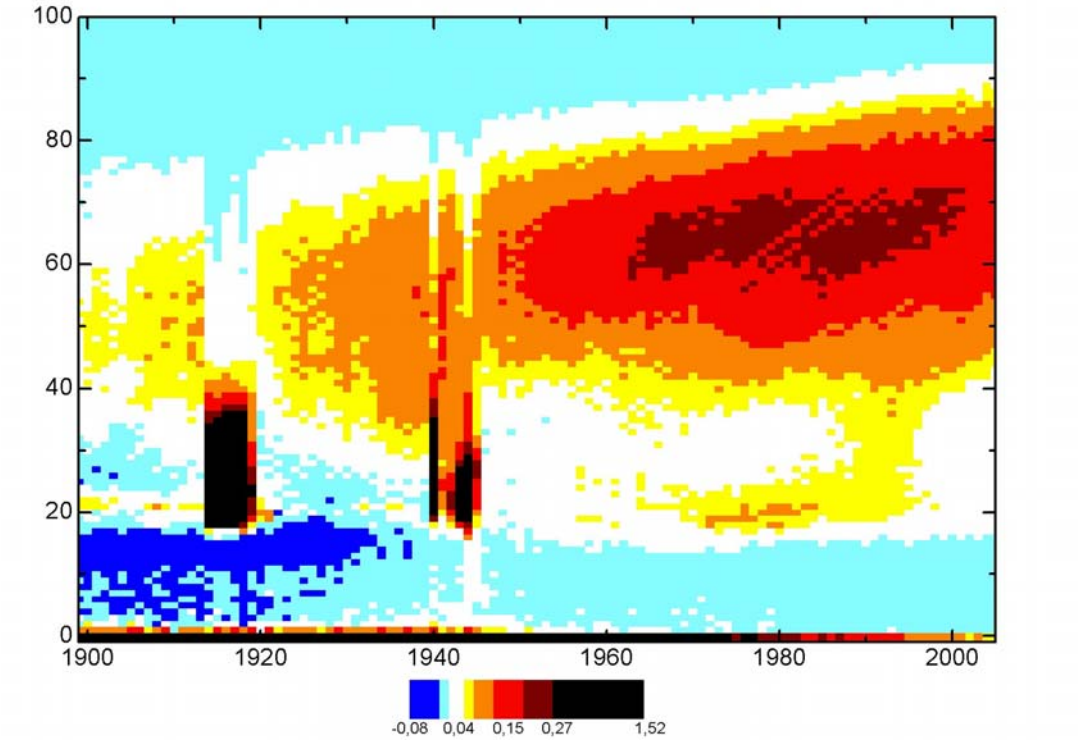
This transition can be also illustrated by the Lexis diagrams (Fig.4.1-4.4) drawn for the four countries of analysis. The second pattern of the LEG, resulting from the excess male mortality in the middle age, is illustrated by the orange, red and bronze patch starting in the 1960s, widening till the 1980s or 1990s and narrowing at the end of the 20th century. The first pattern of the LEG, resulting from the excess male mortality in the infancy, is marked with a black line at the bottom, which is hardly visible as one year in life fills very little space in the Lexis diagrams. The excess male mortality of English and French soldiers of the WW1 and WW2 is depicted with black patches in the adequate periods: 1914-1918 and 1939-1945.

Fig.4.1. The contribution of excess male mortality in the total difference between female and male life expectancy at birth in years, by year of birth and age, England and Wales, 1841-2003



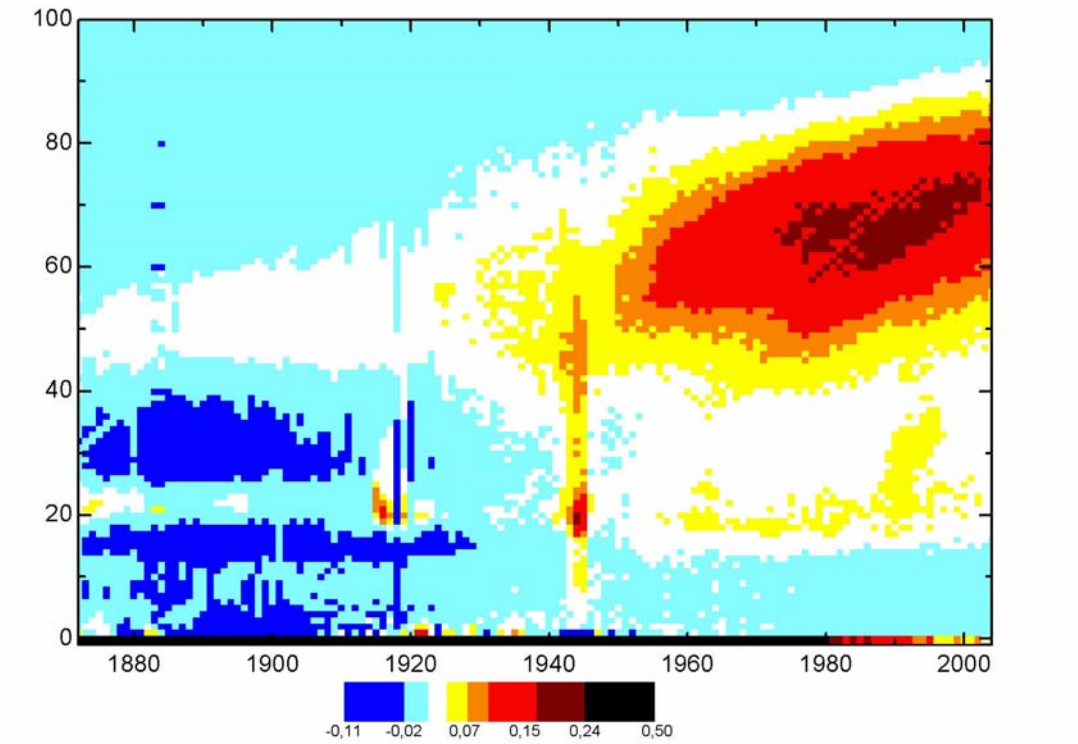
Source: own calculation based on *Human Mortality Database* (2005).

Fig.4.2. The contribution of excess male mortality in the total difference between female and male life expectancy at birth in years, by year of birth and age, France, 1899-2005



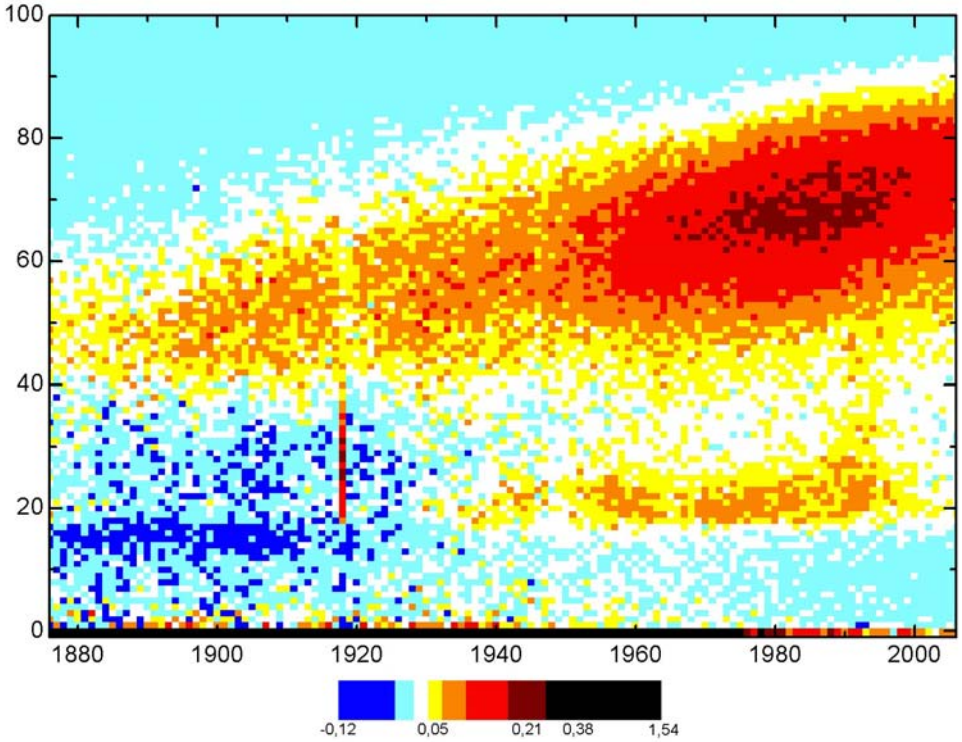
Source: own calculation based on *Human Mortality Database* (2005).

Fig.4.3. The contribution of excess male mortality in the total difference between female and male life expectancy at birth in years, by year of birth and age, Italy 1872-2004



Source: own calculation based on *Human Mortality Database* (2005).

Fig.4.4. The contribution of excess male mortality in the total difference between female and male life expectancy at birth in years, by year of birth and age, Switzerland, 1876-2006



Source: own calculation based on *Human Mortality Database* (2005).

3 The analysis of life expectancy gap by age and cause of death

The decomposition of the LEG by age and cause of death refers to England and Wales only, due to lack of the 19th century records on reasons of deaths in other countries of the former analysis. The analysis is based on the method developed by John H. Pollard (1982, 1987). The data on causes of death in England and Wales was collected and published by Logan (1950) for the following periods/years: 1848-1872, 1901-1910, 1921, 1931, 1939, 1947. For 2003 the data published by the Office for National Statistics (2005) was used. Both sets of data refer to civilian deaths only.

It must be underlined that the quality of data pertaining to causes of deaths in the past is very uncertain due to limited medical knowledge on diseases at the time. One century ago, without present diagnostic skills, it was impossible to diagnose many illnesses, i.e. infectious diseases, diseases of circulatory system or tumours. Without advanced examination it was impossible to distinguish diseases that give similar symptoms or to indicate the main reason of death when various complaints coexist. Due to the lack of correct diagnosis, historical registers are full of inaccurate notions such as old age, convultions, dropsy, natural causes of death. The proportion of death certified as “from unknown reason” was in England and Wales as high as 20% in 1848-1872. However, it does not mean that the past data is absolutely of no use. Due to classyfing diseases into larger groups, such as group of infectious diseases, the problem of misclassification (i.e. registering scarlet fever as diphtheria) can be partially omitted.

The results of the decomposition of LEG by age and causes of death (Fig.5) indicate that the first pattern of male disadvantage in the length of life, resulting from infant mortality, was due to developmental and wasting diseases, diseases of nervous, respiratory and digestive

system[4]. In the period 1848-1872 the excess male mortality under 1 year from those causes was responsible for 83% of male disadvantage under 1 year and 48% of total LEG, in the period 1901-1910, respectively, for 88 and 36%. In the 20th century the above-mentioned causes of death became less important, except for developmental and wasting diseases that remained to make a significant contribution into the LEG until 1947.

For the whole period of analysis the contribution of age groups from the 1st to 44th year of life into the LEG was low. The level of mortality at the age 1-14 was almost equal for women and men[5], while in the age group 15-44 two opposing tendencies took place: men could be characterized by higher risk of violent death[6] and women – higher risk of death due to pregnancy and puerperal complications. As long as the mortality level due to violent deaths remained low and constant for men, mortality of women due to childbearing has been declining[7] and was finally eliminated after the WW2. The influence of infectious and parasitic diseases on the LEG has been ambiguous: the mortality level from those diseases was higher for women at the age of 1-14, while at older age the situation was opposite. In the second half of the 20th century infectious and parasitic diseases were mostly eliminated as causes of deaths[8].

The contribution of excess male mortality at age 45-64 into the LEG increased from 0.64 year in the 19th century to almost 2 years in 1947, and afterwards declined to 1.1 year at the beginning of the 21st century. Mortality was higher for men than for women in the case of infectious and parasitic diseases, diseases of circulatory system and violent deaths. Till 1931 the most significant causes of death contributing to LEG were infectious diseases and diseases of respiratory system, while since 1939 diseases of circulatory system have played the most important role. At this time the contribution of excess male mortality after 65th year of life became significant. It resulted mainly from diseases of circulatory system (in 1947) and tumours (in 2003). In 2003 the excess male mortality due to diseases of circulatory system and tumours at the age over 65 increased the LEG by 1.8 years (46% of total LEG).

Those findings are similar to the results derived by Vallin, Meslé (1988) for the period 1925-1978 in France: in the period 1925-1929 the main constribution into the LEG was made by the infant mortality (40% of total disadvantage) due to infectious and congenital diseases, whereas in the period 1974-1978 the LEG resulted from the excess male mortality after 45th year of life (77% of the LEG) due to degenerative diseases and tumours. The role of those two groups of diseases increased at the end of the 20th century. According to Meslé (1995), in 1990 the main contribution into the LEG was made by the excess male mortality after 60th of life due to tumours (35% of total difference), diseases of circulatory system (23%) and violent deaths (19%).

[4] Many infant deaths registered in the 19th century as consequences of diseases of nervous, respiratory and digestive system were in fact complications after infectious diseases.

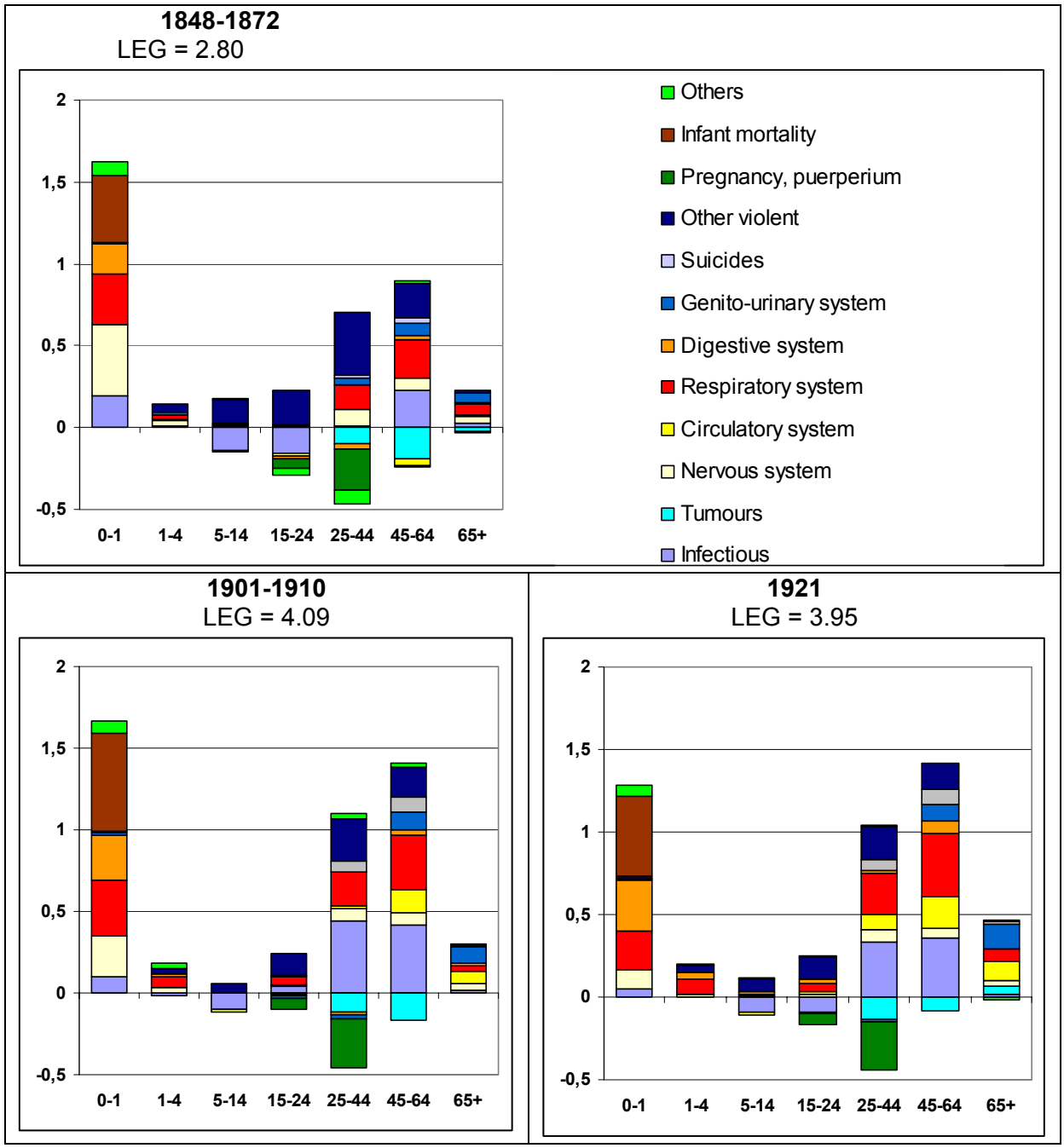
[5] Although different causes of death applied to boys and girls. The excess male mortality the age 1-4 years was caused mainly by violent deaths, diseases of nervous, respiratory and digestive system. In the age group 5-14 the male disadvantage was caused mostly by violent deaths but to some extent it was smoothed away by female excess mortality due to infectious and parasitic diseases and diseases of circulatory system. In the period 1901-1910 the level of mortality was even higher for girls than boys.

[6] The excess male mortality due to violent deaths remained during the whole period of analysis at a low level. In the period 1848-1872 its contributon (at all ages) into the LEG was 1 year, while in the 20th century it fluctuated from 0.62 to 0.86, and decreased to 0.41 in 2003. Therefore, while the LEG has been increasing, the role of violent deaths has become less and less important.

[7] In the whole period of analysis, the contribution of female excess mortality due to pregnancy and puerperal state into the LEG did not exceeded -0.4 year.

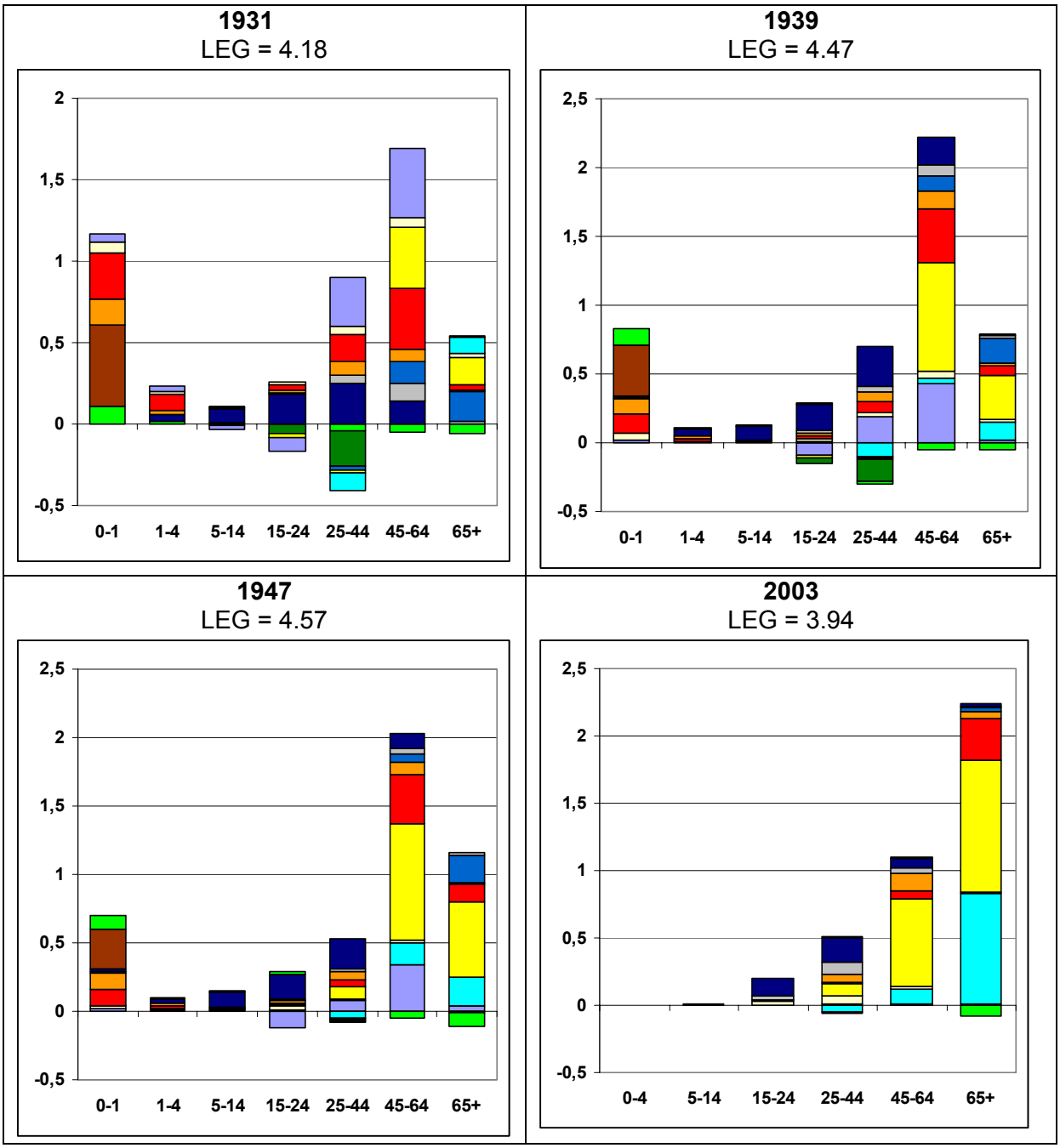
[8] At all ages the most important role played tuberculosis that in the period 1901-1910 caused 30% of deaths of men and 25% of women, in 1939, respectively, 23% and 20%.

Fig.5 The difference between female and male life expectancy at birth (LEG) decomposed by cause of death and age, England and Wales, various periods/years



Note: Diseases of nervous system include diseases of sense organs; diseases of digestive system include diabetes and anaemia; data for 2003 refer only to England.

Fig.5-cont. The difference between female and male life expectancy at birth (LEG) decomposed by cause of death and age, England and Wales, various periods/years



Note: Diseases of nervous system include diseases of sense organs; diseases of digestive system include diabetes and anaemia; data for 2003 refer only to England.

Source: own calculation based on Logan (1950), Office for National Statistics (2005).

4 Two patterns of LEG. Discussion

To sum up, in this paper two patterns of LEG were identified.

Generally, the first pattern was observed in the 19th century and in the first half of the 20th century. The analysis done for England and Wales proved that the main contribution into the LEG was made by excess male mortality in the infancy due to developmental and wasting diseases, diseases of nervous, respiratory and digestive system. Since the 1950s the infant mortality was radically reduced and this age group ceased to determine the LEG. It must be underlined, however, that excess male mortality in the infancy has never been eliminated, neither in England and Wales, nor in other countries of the world (Preston, Keyfitz, Schoen 1972; UN 1998).

The reason for higher risk of death among male infants is biologic in origin. As Ingrid Waldron (1998) points out, the presence of both X chromosomes protects girls from X-linked genetic diseases, whereas boys are devoid of such protection. Moreover, the X chromosome determines the production of immune components and therefore, as it was proven for many populations[9], till the 6th month of life the level of antibodies is higher for girls than boys. Last, but not least, infant males have higher mortality for perinatal[10] and neonatal conditions. There are two factors contributing to this phenomenon. First, higher level of testosterone for boys delays the maturation of lungs (Waldron 1998), which leads to greater vulnerability to respiratory distress syndrome. Second, boys are more likely to be born prematurely, which results in worse adaptation of male organisms to independent life.

The 20th century recorded exorbitant mortality level due to cardiovascular diseases and tumours. At that century the second pattern of LEG came into existence: it was due to excess mortality of middle-aged men from cardiovascular diseases and tumours. For biologic and behavioural reasons those two groups of diseases disadvantaged men, as males to greater extent than women involve themselves in risky and unhealthy behaviours (see for instance the results of WHO MONICA project). Moreover, the biological response of male organisms to risk factors contributing to cardiovascular diseases is much more disadvantegeous in comparison to female organisms (Barrett-Connor 1997; Johnson 1977; Waldron 1995). The last two decades of the 20th century in the highly developed countries the rise in excess mortality of middle-aged men from cardiovascular diseases and tumours has been suppressed. The reason for this was the health transition, which resulted in the fact that, as Jacques Vallin points out, men “are modelling their behaviour on that of women and adopting what for them is a new health culture” (2007:335).

In spite of the fact that LEG has been noted not only in the 20th century, but also in the past, the reasons for the male disadvantage might be completely different. The above-presented decomposition of LEG proved the existence of two distinct patterns of excess male mortality, to which different age groups and causes of deaths contributed. In the 19th and 20th centuries the rise in the LEG was not a continuation of the previous mortality pattern but constituted a new epidemiological process, driven by the phenomenon of ageing and consequent widespread of degenerative diseases.

[9] See for instance Grundbacher (1972), Kanariou et al. (1995), Stoop et al. (1969), Wiedermann, Wiedermannova (1981).

[10] I.e. conditions originating in the perinatal period.

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