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**Mortality differences between Western and Eastern  
Germany before and after Reunification**  
**A macro and micro level analysis of developments  
and responsible factors**

## 1. INTRODUCTION

Demographic changes and developments in Eastern and Western Germany offer an unique possibility to understand the interaction between societal, social respective economic conditions and population processes. Almost identical demographic composition and behaviour until 1945 were followed by 45 years of life under different political and socio-economic structures resulting in completely different demographic conditions (Dinkel, 1992, 1994, 1999; Gjonca *et al.*, 2000). With Reunification in 1990 the population in Eastern Germany returned to the Western societal and economic system that caused sudden changes in the development of all its demographic parameters. These special preconditions – leading some scholars to describe the Eastern German population as a kind of “natural experiment” (Dinkel, 1999; Vaupel *et al.*, 2003) – generated a large number of researches about changes in Eastern German demography.

The aim of this paper is to analyse mortality differences between Western and Eastern Germany before and after Reunification, focusing especially on the rapid convergence of survival conditions since 1990 following roughly two decades of continuous divergence. In recent years several other studies on mortality differences between Western and Eastern Germany have been performed. Trends in mortality in both parts of Germany were analysed focusing on the more intensive improvements in Eastern Germany since 1990. In contrast with this procedure, this study examines directly mortality differences between Western and Eastern Germany instead of an indirect examination via the separate developments of the two parts of Germany. This was similar to that done by Nolte *et al.* (2000c, 2002) using data for two single years in the 1990s. However, analysing all single calendar years since the 1960s as a complete time series leads to somewhat different results, especially regarding the meaning of some age-specific developments as will be shown in this paper.

On the basis of the hypothesis already stated regarding the former divergence in survival conditions, the first step is to describe East German

excess mortality at a macro level using official population statistics to locate the causes for the survival differences in the age- and cause of death-structures of the East and West German populations. In the next step, an analysis of behavioural differences at micro level is undertaken using the German Life Expectancy Survey which was carried out to examine developments in health-related behaviour and their influence on mortality and morbidity in both parts of Germany. Finally, we look at changes in medical and nursing care and their possible impact on the closing of the survival gap between Western and Eastern Germany leading to a new hypothesis to explain observed trends in mortality.

## 2. TRENDS IN EASTERN GERMAN EXCESS MORTALITY AND POSSIBLE EXPLANATIONS

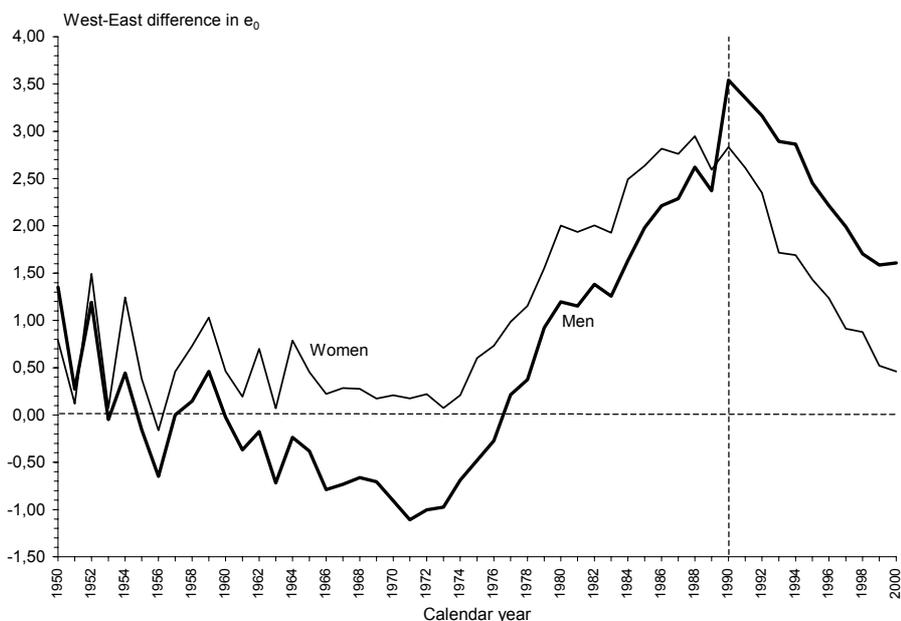
Figure 1 shows the West-East difference in period life expectancy at birth  $e_0$  for women and men for each single calendar year from 1950 to 2000. The irregular fluctuations before 1965 correspond with the waves of influenza in East and West Germany. In West Germany months with exceptional high influenza mortality occurred in the years 1953 (February), 1957 (October), 1960 (February), and 1963 (February), in East Germany in the years 1952 (April), 1954 (January and February), 1957 (October), and in the March of 1962 (Meyer and Rückert, 1975; Mammey and Rein, 1977). From then on, the development of West-East mortality differences became clearer, with a slightly higher mortality for East German women. In contrast, East German men had a higher life expectancy than their West German counterparts. This difference increased until 1971. Then, a continuous divergence occurred for both sexes in the development of survival conditions in favour of West Germany<sup>1</sup>. This was caused by the fact that East German life expectancy at birth increased with a lower gradient for both sexes, while life expectancy in West Germany rose more rapidly (Höhn and Pollard, 1990; Scholz, 1996; Gjonça *et al.*, 2000; Nolte *et al.* 2000b). The differences peaked in 1988 for women (2.95 years) and in 1990 for men (3.54 years). These peaks – virtually concurring with German Reunification – were followed by a continuous closing of the gap in West-East German mortality differences until 1999, where the difference in  $e_0$  was 0.52 years for women and 1.59 years for men. This convergence of mortality levels is

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<sup>1</sup> This development corresponds to the general divergence in mortality trends between all Western and Eastern European countries (see e.g. Caselli and Egidi, 1980; Bourgeois-Pichat, 1985; Bobak and Marmot, 1996a, 1996b; Hertzman *et al.*, 1996; Meslé and Hertrich, 1997; Vallin and Meslé, 2001; Meslé and Vallin, 2002).

due to the fact that life expectancy rises faster in Eastern Germany since the beginning of the 1990s. Almost surprisingly, the data for the year 2000 shows a slight increase in the West-East difference in  $e_0$  among men to 1.61 years and a deceleration in the process of survival convergence among women. However, these changes must not necessarily be interpreted as the start of a new trend since the decline was similarly interrupted in 1994. If the general (approximately) linear trend would continue, the mortality gap between West and East Germany might be expected to close around 2003 for women and around 2006 for men.

Figure 1 – *Absolute difference in life expectancy at birth  $e_0$  between East and West Germany according to complete life tables for single calendar years, 1950-2000*



Source: own calculations.

Figure 1 clearly shows that political Reunification neither constituted nor contributed to a newly-emerged East German mortality crises, as was described in some articles, due to observations in several age groups (Eberstadt, 1994; Riphahn, 1999; Nolte *et al.*, 2000c). The long-term trends in survivorship completely contradict Eberstadt's (1994) description of a "demographic shock" and, rather, call for an explanation of the rapid closing

of the gap. There is good reason to assume that those conditions which were responsible for the increase of West-East German mortality differences before reunification could also have been responsible for or contributed to their later decrease. But since the true nature of the divergence between East and West German mortality has yet to be detected, it might even be that the reasons responsible for the previous widening of the gap have nothing to do with those factors now contributing to its reversal. In the late 1980s, some speculations were formulated about the potential nature of the widening West-East differential in mortality already visible at that time. Taking into account the developments after 1990, these speculations can be used as a starting point in seeking the factor(s) responsible for West-East German mortality differences. In principle, eight possibilities were discussed (for an extensive discussion see Dinkel, 1992, 1994, 1999; Heinemann *et al.* 1996)<sup>2</sup>:

1. deteriorating environmental conditions in East Germany,
2. health consequences of uranium mining and storage,
3. selective East-West migration,
4. ongoing immigration of a healthy foreign population to West Germany,
5. unfavourable working conditions in East Germany,
6. psychological reactions to the overall political suppression,
7. differences in cardiovascular risk factors and lifestyles, and
8. lack of medical technology in East Germany.

Since after Reunification former East Germany immediately left the former Eastern European mortality pattern, the prime candidates for an explanation are expected to be those where conditions now are different from what was experienced around and before 1990. The second rapid reversal of trends in the New German States within such a short period of time also indicates that the explanations cannot belong to the group of factors causing long-term effects. Typical long-term arguments include deteriorating environmental conditions and the health consequences of uranium mining and storage in East Germany. The latter had to be superseded or at least doubted, even without knowledge of the time prior to 1990. The regions with intensive uranium mining (the southern parts of Thuringia and Saxony) experienced the lowest overall mortality already in the 1960s, when mining was still in full swing. But in spite of this additional burden, the Southern regions experienced a lower overall mortality than the Northern parts of the GDR (Zimmermann, 1987). This north-south regional disparity in survivorship continues until today. Even in most recent years the coastal areas (Mecklenburg-Western Pomerania) show a relatively low life

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<sup>2</sup> The most discussed factors are the same as those that are assumed to be responsible for the general mortality gap between Western and Eastern European countries (e.g. Bobak and Marmot, 1996a, 1996b; Hertzman *et al.*, 1996).

expectancy at birth compared to the other new German states, the two southern states Saxony and Thuringia belong of the group of regions with the highest life expectancy (Sommer, 1998, 2002; Luy and Caselli, 2004).

Other factors, too, have to be rejected as being mainly responsible for West-East German mortality differences given developments after 1990, for example, the direct effects of differential East-West migration. The net migration from the East to the West was close to zero between 1961 and 1988, but was very high after the opening of borders in 1989. Irrespective of the hypothesis regarding the time before 1961, a so-called “healthy migrant phenomenon” was expected to be mainly responsible for the high mortality of Eastern German men in the years around Reunification, especially in 1990 (Dorbritz and Gärtner, 1995; Riphahn, 1999; Nolte *et al.*, 2000c). Younger researches support the hypothesis that East German’s survival conditions are influenced by a migration selection effect (Luy and Caselli, 2004). But despite continuing, albeit declining, East-West migration until the present day, differences in overall mortality did not increase further, but instead declined after 1990. Thus, the obviously existing migration effect must be more than balanced out by other factors. The same holds regarding ongoing immigration of a selected healthy foreign population to West Germany as, also after Reunification, foreign immigration is still focused on Western Germany. Moreover, something similar must be concluded concerning the influence of working conditions (see also Nolte *et al.*, 2000c). The influence of labour market conditions on health and mortality cannot have been more negative in the past than in today’s post-unification Eastern Germany since an increasing proportion of involuntary unemployment – completely unknown in the GDR – is certainly the least favourable working condition.

Unlike the above, psychological reactions to the overall political suppression and differences in cardiovascular risk factors and lifestyles are factors working at the individual level. The argument relating to the potential effects of political suppression on mortality was supported by the fact that the East German population seemed to become increasingly adapted to the Communist regime in the 1970s, when the gap in mortality started to occur. Suicide statistics were suppressed by GDR officials for many years (Casper, 1990), reinforcing the impression that some unfavourable change must have taken place. But when the data became available after Reunification, differences between East and West suicide mortality turned out to exist, but only for a few cohorts with surprisingly small extents (Dinkel and Görtler, 1994).

In contrary to findings for other Eastern European countries (Bobak, 1996), German population surveys indicated that the distribution of major cardiovascular risk factors (such as smoking, alcohol intake, nutrition, serum

cholesterol, Body Mass Index, *etc.*) have indeed been different to the disadvantage of East German men and women (Bormann *et al.*, 1991; Heinemann and Greiser, 1993). It was concluded that cardiovascular risk factors are probable determinants of health inequalities between the former East and West Germany and markers of differences in lifestyles and socio-economic status between the two areas (see also Gjonça *et al.*, 2000)<sup>3</sup>. This hypothesis is strongly supported by the fact that the former GDR showed significantly higher cardiovascular mortality than the FRG. However, until now there is no evidence as to whether the distribution of risk factors could have changed so quickly as to be able to explain the rapid reversal of past trends.

In the absence of other explanations, one argument gains increasing support. Immediately after Reunification, considerable financial support was given to modernise equipment used by private physicians and especially hospitals in East Germany (Nolte *et al.*, 2002). The medical support system reached the newest and most effective standards within a few years. East Germans now enjoy unlimited access to effective up-to-date diagnostic and treatment technologies, medical information, as well as efficient drugs. This factor is widely accepted to be mainly responsible for the observed mortality trends in East and West Germany before and after Reunification (Chruszcz, 1992; Dinkel, 1994, 1999; Schott *et al.*, 1994; Becker and Boyle, 1997; Gjonça *et al.*, 2000) as well as for the general West-East mortality gap in Europe (Boys *et al.*, 1991; Mackenbach *et al.*, 1996; Velkova *et al.*, 1997; McKee and Nolte, 2004). Irrespective of other potential contributors, one should certainly conclude that today's progress in survival gains in East Germany would probably not have been possible without the contribution of a high-technology medical support system. The progress in medical care and possible changes in lifestyles and cardiovascular risk factors of East German women and men are the only two of all the given explanations for East German excess mortality that are consistent with rapidly changing trends after Reunification. Consequently, the following analyses are focused on testing the impact of these factors on observed mortality trends.

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<sup>3</sup> Somewhat contrary to this hypothesis is the finding that in the first years after Reunification self-reported health among East German men was considerably better compared to that of West German men (Lüschen *et al.*, 1997; Martin *et al.*, 2000). However, this seemed to change by the late 1990s (Mueller and Heinzl-Gutenbrunner, 2001).

### 3. DATA AND METHODS

Macro level East/West mortality differences in Germany are analysed using official population statistics, *i.e.* numbers of the living population and deaths for each calendar year and single age groups. As was already used in figure 1, the life table is favoured as the standardisation method over direct standardisation. There are several reasons for not using official life tables of East and West Germany, the construction of new period life tables for each single calendar year was preferred. Firstly, no complete time series of life tables for the entire observation period are available in either West nor East Germany. Secondly, East and West German life tables were constructed using different methods. While in the former GDR, life tables were generally constructed using the Becker/Zeuner method (also called “birth year” method), West German statisticians changed the methods used during the observation period. Finally, official West German life tables are constructed for three-year periods, life tables for the GDR were constructed for two successive calendar years. Consequently, to compare West and East German mortality it is impossible to use official life tables as standardisation instruments for single calendar years.

The life table accentuates older age groups less strongly than does the official German standard population (average population of total Germany in 1995). Thus, the results in the parameter life expectancy at birth  $e_0$  indicate lower differences between East and West German mortality than direct standardised death rates would do. The reason for choosing life tables is that this method offers much greater possibilities for analysis and interpretation. The parameter  $e_0$  provides values which have a distinct meaning. A difference in the life expectancy at birth of 1.5 years between West and East German men in 1999, for example, is much easier to assess than the corresponding difference in standardised death rates of 0.0016. The same holds for showing the effects of specific age groups or causes of death on the overall mortality, which will also be done in the following sections. For both kinds of analysis the decomposition method proposed by Arriaga (1984) is used to decompose differences in life expectancy between West and East Germany into the contributions of the different age-groups' respective causes of death (see also the description for extending Arriaga's decomposition method by Preston *et al.* 2001).

The use of German data on causes of death data poses some technical difficulties that have to be taken into account in the analysis and interpretation. Firstly, the number of deaths broken down into causes of death is only available for five year age groups (except age 0 and age group 1-4). Consequently, analysing causes of death requires the construction of

abridged life tables. For this, the standard life table technique as described by Chiang (1984) was used, estimating the necessary values for the fraction of last age interval of life from the complete life tables for each calendar year. The second problem is the world-wide change from the ICD 9 to the ICD 10 coding scheme in 1998. Since these systems are not perfectly compatible, it is impossible to create a time series for identical causes of death categories<sup>4</sup>. An additional, insoluble problem lies in the distortion of the cause of death data, especially in 1998, due to the difficulties experienced by physicians in applying the new ICD 10 system. Finally, there is an exclusively German problem. Until 1997, data relating to the living population and demographic events were divided into the former FRG including West Berlin (West Germany), and the former GDR including East Berlin (East Germany). From 1998 on, Berlin's cause of death data was no longer divided into the East and West of the city, but only for the city as a whole, allocated to West Germany. The living population, however, is still divided according to the old system. To gain the same population at risk for numerator and denominator of the cause of death-specific death rates after 1997, the living population was corrected to West Germany including Berlin and East Germany without Berlin, using data on the living population for East and West Berlin. Consequently, the time series for the causes of death describe West Germany, including West Berlin, (former FRG) and East Germany, including East Berlin (former GDR) until 1997 and, since 1998, West Germany including Berlin, and East Germany without Berlin.

In examining the development of West-East German differences in individual behaviour the German Life Expectancy Survey (*LES*) is used. The *LES* is a panel that until now consists of two waves of interviews (a third wave is planned). It is based on the National Health Survey, which was a major element of the "German Heart Circulation Study". The first National Health Survey was carried out between 1984 and 1986. In the following years, there were more surveys on this group of topics, which included the New Federal States for the first time in 1991/92. All these surveys were cross-sectional, each based on a new representative random sample, and also including medical examinations in some cases. In 1998, the Federal Institute for Population Research (BiB) carried out a follow-up survey of the individuals interviewed in an earlier survey. For West Germany, the basis used was the 1984/86 survey, since the number of respondents was the largest and, due to the relatively long time interval, it was also possible to gain sufficient information regarding the already deceased. For East

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<sup>4</sup> To create at least almost identical cause of death categories, the ICD9-ICD10 DIMDI (Deutsches Institut für Medizinische Dokumentation und Information) re-coding key was used.

Germany, the 1991/92 survey was used as the basis for the second interview. In the second survey, the initial questionnaires were slightly modified because of the specific research questions of the BiB. Purely medical details were removed and replaced by questions on general living conditions and family situations. Furthermore, the number of respondents was restricted to those born in 1952 and earlier (for a more detailed description of the life expectancy survey see Gärtner, 2000 and 2001).

Altogether, the *LES* contains 10,020 individuals, 8,474 from West (surveyed in the years 1984 to 1986) and 1,546 from East Germany (surveyed in the years 1991 and 1992). Of these, 1,081 died until the follow-up survey in 1998, 957 of the Western and 124 of the Eastern German sample. Due to a number of additional losses because of other reasons (emigration or refusal) the number of people interviewed the second time round decreased to 3,939 individuals from the Western and 904 individuals from the Eastern German sample. Despite the relatively high number of censored cases, the age composition of the 1998 follow-up sample is quite similar to the age composition of the total German population, with slight deviations among the oldest cohorts (see Gärtner, in press). However, the 1998 sample must be expected to contain a selected sub-population of the first survey sample. Nevertheless, the main results presented in this paper are not seriously affected by these aspects of the *LES*, since (at least almost) all deaths of individuals included in the first spate of interviews are known by the exact date, and only information from the first survey was used for the survival analysis with Cox-Regression models on the impact of different lifestyles on mortality.

#### 4. RESULTS

##### *4.1 Age-specific mortality differences between West and East Germany*

Figures 2 and 3 show the absolute contribution (in years) of the different age groups to difference in  $e_0$  between West and East German women and men from 1965 to 2000. For each calendar year, the sum of the values for all age groups, negative and positive, represents the total West-East difference in  $e_0$  shown in figure 1. White-coloured areas represent age groups with lower East German mortality, grey-coloured areas represent age groups with lower West German mortality. The darker the colour the greater the difference is. To facilitate a direct comparison for women and men, the same scale is chosen in both figures. It can be seen that, until the end of the 1970s, there were huge West German disadvantages in infant mortality for

both males and females. This effect is probably due to different definitions of live birth in East and West Germany which caused lower infant mortality rates in the former GDR for purely statistical reasons<sup>5</sup>. It is remarkable that despite these different definitions of live birth, West Germany was able to reach the same statistical level of infant mortality at the end of the 1970s<sup>6</sup>.

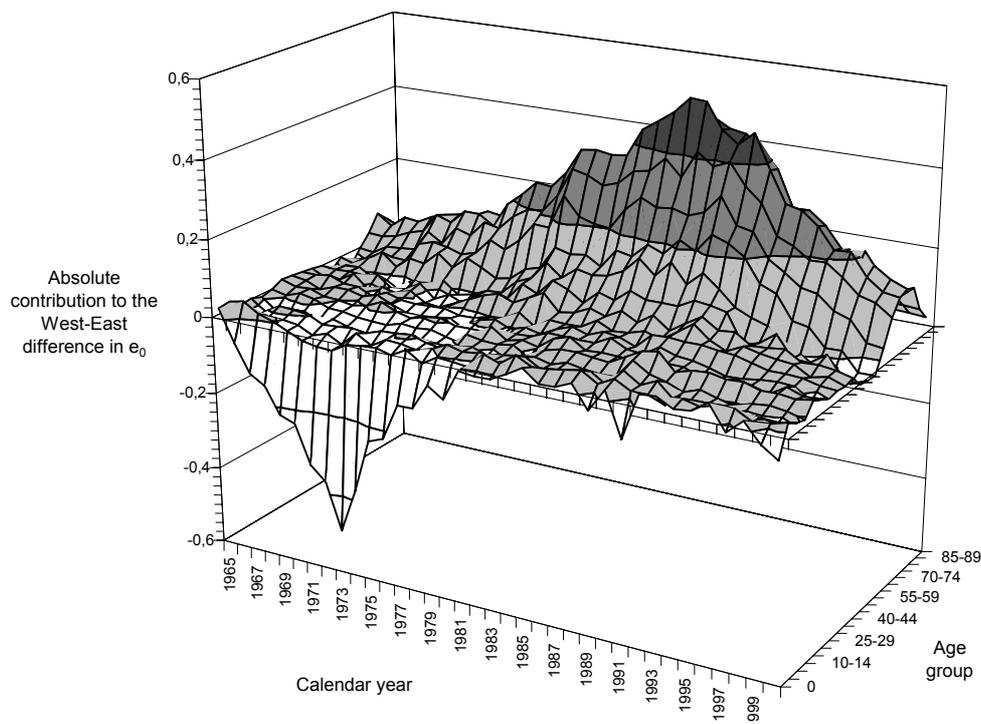
For the development in overall West-East mortality differences, the most important fact is that the differences in favour of West German women increased in higher adult ages, starting around age group 55-59 (figure 2). It is interesting to notice that the age groups responsible for the decline in total West-East mortality differences since the end of the 1980s are the same as those that were responsible for the preceding divergence. Figure 3 shows that the situation is only partly similar for men. Until the mid-1970s, East German men showed survival advantages up to age 69, resulting in a higher life expectancy at birth compared to West German men (see figure 1). From then on, the advantages of West German men increased more or less continuously until 1990. The comparison with figure 2 makes it clear that the maximum West-East differences in age-specific mortality are lower among men than among women. However, the differences between West and East German men show a considerably broader age distribution (see also Nolte *et al.*, 2000c, 2002). Unlike the women, the beginning of age groups mainly responsible for the overall excess East German mortality is found in younger adult ages (mid-30s). After Reunification in 1990, men also show a continuous decline in East German survival disadvantages from age 70 onwards. An important difference compared with women is that, among men, younger adult ages show an increased East German mortality after 1990. This development counteracts the declining trend in West-East mortality differences after age 70, and seems to be the reason why the mortality gap between Eastern and Western Germany is closing faster among women than men. Nolte *et al.*'s. (2000c) interpretation that improvements in younger and middle adult ages contributed most to the decline of mortality differences among men between 1992 and 1997 should be seen less positively when the overall development for the last decades is taken into account.

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<sup>5</sup> In West Germany, the result of a delivery is defined as a live birth if one of the three signs of life, namely heartbeat, natural respiration, or pulsating umbilical cord, is recognised. According to East German statistics, a live birth was defined only by the joint existence of heartbeat and natural respiration (Müller, 1976). Consequently, all deaths of new-borns showing only one of the three signs of life are registered as live births, and thus as infant deaths only in West Germany, while in East Germany such cases were registered as stillbirths, and did not enter infant mortality statistics.

<sup>6</sup> About recent trends in neonatal and post-neonatal mortality in Eastern and Western Germany see Nolte *et al.* (2000a).

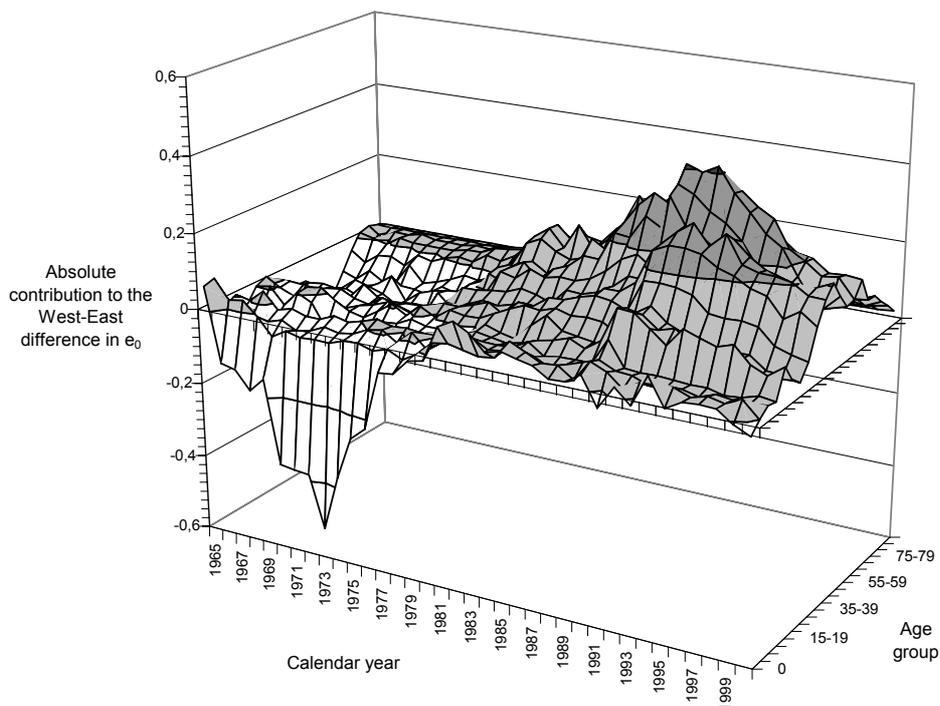
Figure 2 – *Age-specific contributions to the difference in  $e_0$  between women in Western and Eastern Germany, 1965-2000*



Source: own calculations.

A large proportion of the total West-East differences in  $e_0$  is strongly affected by the above-mentioned different definitions of live births. Lower infant mortality causes a higher number of life table survivors at age 1. However, besides the number of survivors at age 1, this also affects the number of life table survivors at every subsequent age, and thus ultimately affects total life expectancy as the main indicator of mortality levels. Consequently, the use of the parameter  $e_0$  as an instrument for measuring West-East German mortality differences automatically contains this distortion and thus, similarly, the absolute contributions of the different age groups to the difference in  $e_0$  between West and East German women and men shown in figures 2 and 3. To solve this problem, Arriaga (1984) proposed a decomposition method to measure the pure direct mortality effect for each age group, excluding the so-called indirect and interaction effects which are additionally included in the crude difference in  $e_0$  as described briefly above (for a more detailed description see Arriaga, 1984). Analogous

Figure 3 – *Age-specific contributions to the difference in  $e_0$  between men in Western and Eastern Germany, 1965-2000*

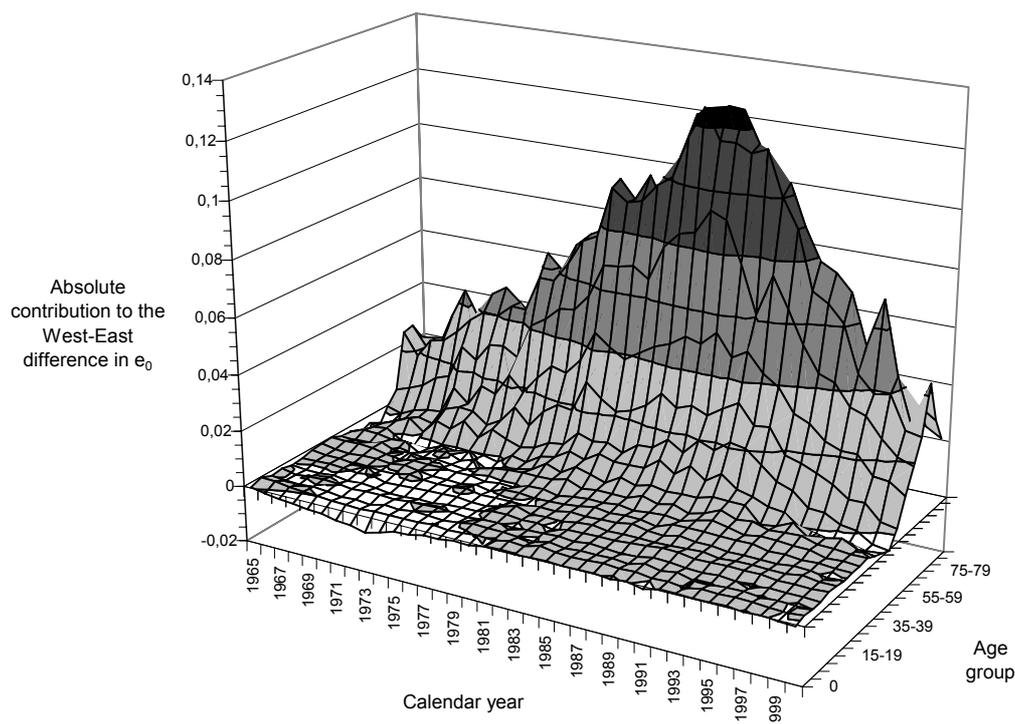


Source: own calculations.

to the earlier analysis, figures 4 and 5 show the number of years that the pure mortality effect in all age groups contributes to the West-East German mortality differences in life expectancy at birth of women and men from 1965 to 2000. Here, it becomes clear that, among women, the decisive ages for the differences observed begin around age 60, and that the mortality differences in younger age groups are more or less negligible (figure 4). The maximum lies at ages 75 to 84. It is interesting to notice that exactly the same age groups are also responsible for the interruption of the nearly linear decline after Reunification in the years 1994 and 2000. Besides this, these age groups also showed some irregular peaks in the years of political division. Figure 5 for men confirms what was revealed above, that is that the distribution of age groups responsible for overall East German excess mortality is much broader than among women, and that for younger adult ages an additional East German survival disadvantage occurred, beginning some years before Reunification. These differences between women and

men are significant despite the fact that the maximum amount of years contributed to the total  $e_0$  difference in the decisive age groups is lower among men.

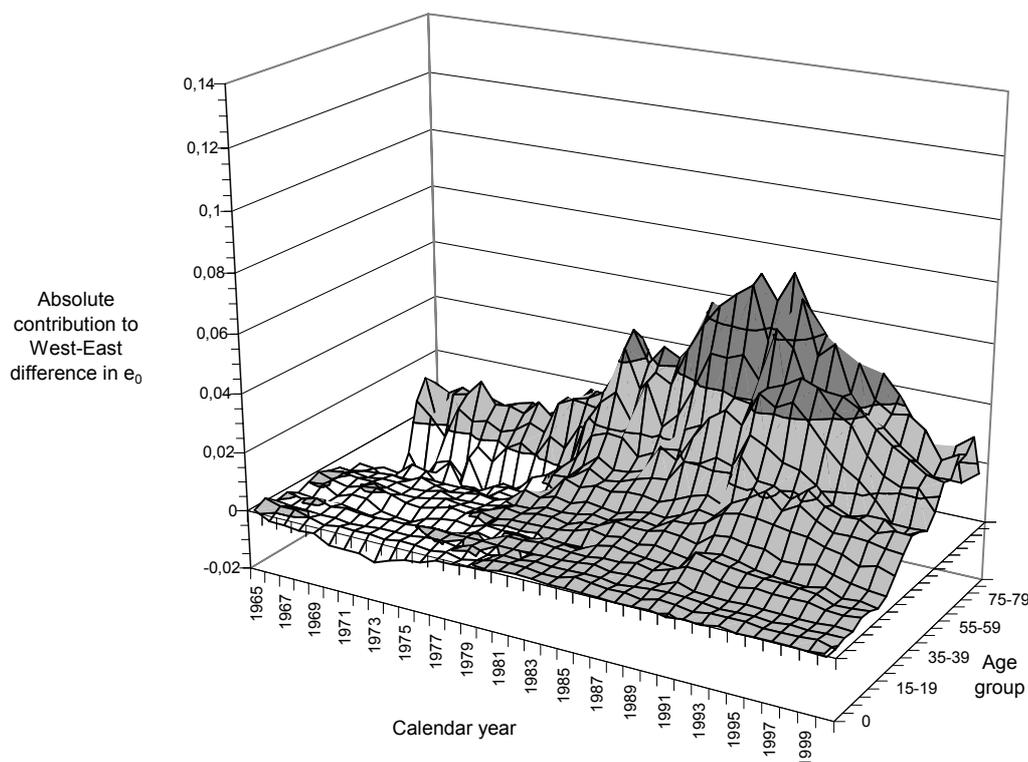
Figure 4 – *Direct effects of age-specific contributions to the difference in  $e_0$  between women in Western and Eastern Germany, 1965-2000*



Source: own calculations.

The next step is to examine if there are any cohort effects underlying these developments described with period measures. For this, the East/West ratios of age-specific death rates for each single age of women and men are calculated and shown graphically in the Lexis surface in figures 6 and 7. Dark colours represent ages with West German excess mortality, light colours East German excess mortality, as can be seen in the given legends. The figures make it clear that there are no cohort effects for either men or women. Among men, changes from Western excess mortality to Eastern excess mortality start at almost all ages at the end of the 1970s (figure 6). As was also shown in the figures above, there are no significant differences in

Figure 5 – *Direct effects of the age-specific contributions to the difference in  $e_0$  between men in Western and Eastern Germany, 1965-2000*



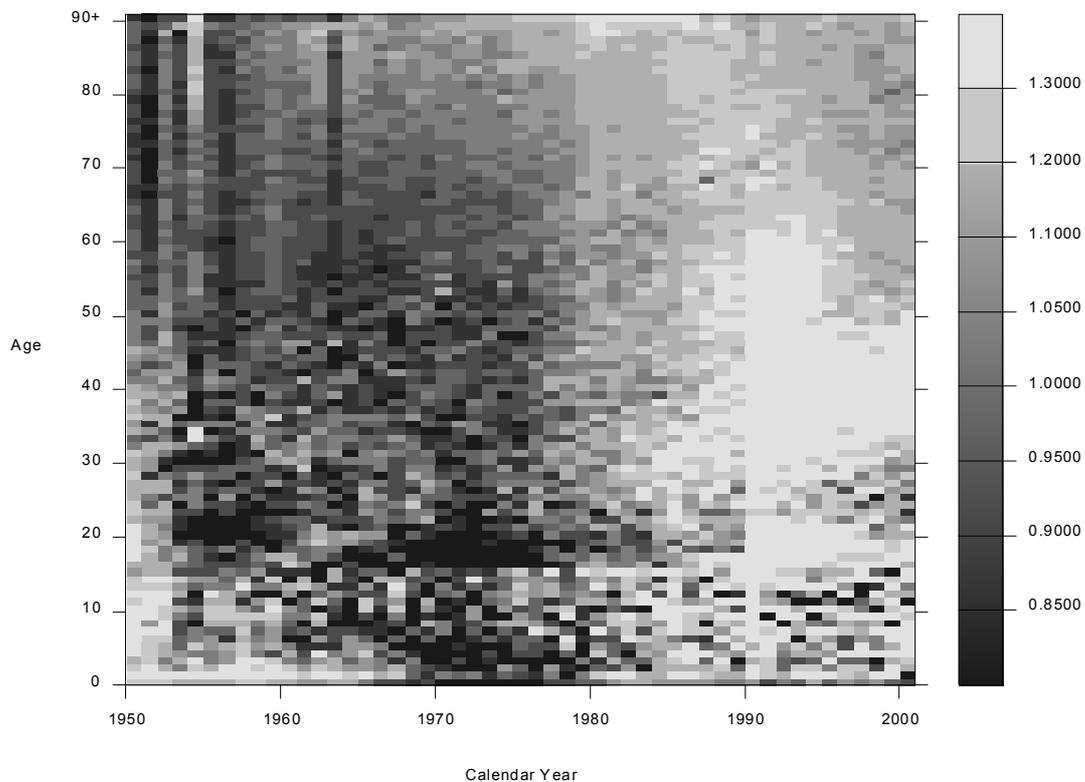
Source: own calculations.

childhood and young adult ages. Among women, developments responsible for the differences in  $e_0$  in favour of West Germany have their origin a few years earlier, and started first at the highest ages (figure 7). The visible development of East German excess mortality from the highest ages around 1970 to the lower ages in the 1980s completely contradicts what would be expected in the case of cohort effects. Consequently, for women and men, both developments in overall mortality – the increase of West-East differences in Germany before and the decrease after Reunification – are clearly due to pure period effects<sup>7</sup>. The first trend started a little earlier for women than for men. The following reverse trend also started a little earlier for women, and progressed faster than for men. Moreover, figures 6 and 7

<sup>7</sup> Dinkel (1992) came to the same result constructing cohort life tables for Eastern and Western Germany.

show that, among women, the biggest relative differences between East and West German mortality can be found in the highest age groups. Among men, the relative differences are most significant in the middle age groups, connected with a much broader distribution of age groups with Eastern German excess mortality, as has already been described above.

Figure 6 – *East/West ratio of age-specific death rates for men in Germany, 1950-2000*

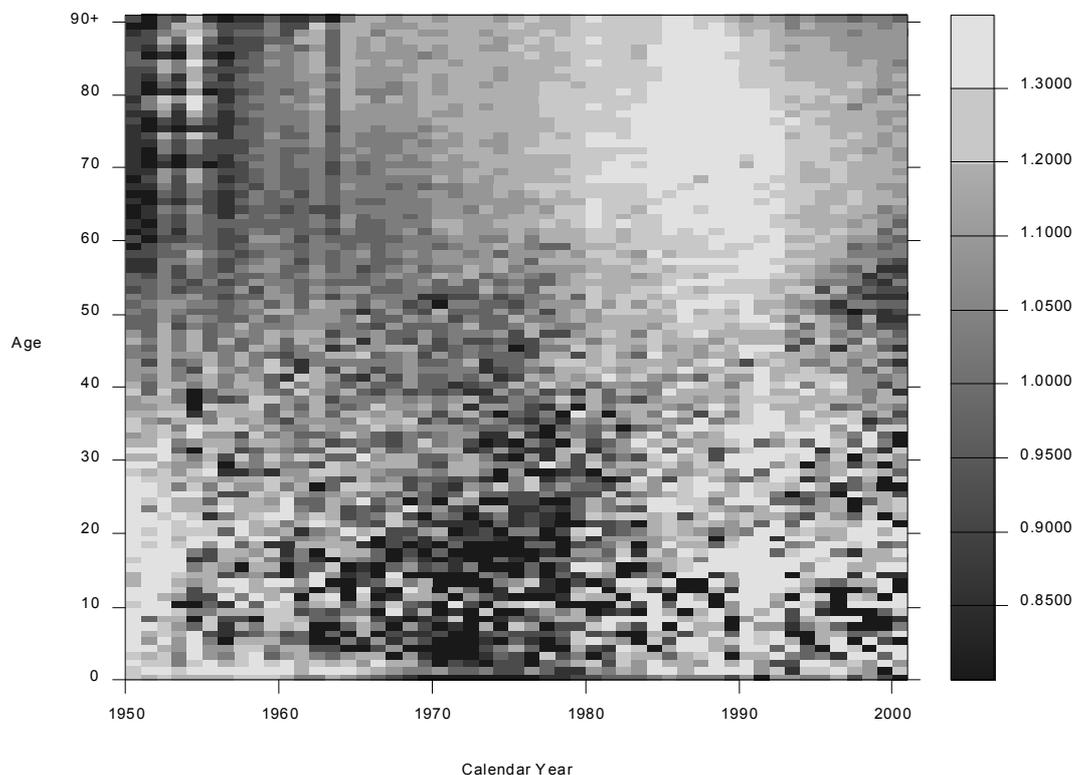


Source: own calculations.

#### 4.2 Cause of death-specific differences between Western and Eastern Germany

Cardiovascular diseases and cancer are still the leading causes of death all over Europe. Before Reunification, the two German states differed in their cause of death-structure and showed the so-called “East” (GDR) and “West European pattern” (FRG). The East European pattern generally shows

Figure 7 – East/West ratio of age-specific death rates for women in Germany, 1950-2000



Source: own calculations.

a lower probability of dying from cancer and a higher probability for persons to die from a cardiovascular disease than in the West European pattern. However, an analysis of these patterns before and after German unification discloses the danger of international comparisons among cause-of-death-statistics. Figure 8 shows the development of the direct standardised death rates for “neoplasms” (ICD 9: 140-239, ICD 10: C00-D48) for East and West German men from 1980 to 2000. It is well known that by their very nature cause of death statistics include a certain degree of uncertainty (Cameron and McGoogan, 1981; Eisenblätter *et al.*, 1981, 1994; Höhn and Pollard, 1990; Modelmog *et al.*, 1992), but it is unexpected that even the main cause of death groups are affected by significant distortions to such an extent. According to the cause of death statistics, two years after Reunification (and one year after applying the Western German coding rules) the former differences in cancer mortality completely disappeared and

reversed to a now excess neoplasm mortality in East Germany. Since the physiological nature of cancer rules out any very rapid change in cancer incidence or mortality within one or two years, the results shown in figure 8 can have only one explanation. In the cause of death statistics, out of potentially many causes contributing to death only the “leading cause” is selected. The detailed coding is performed by specifically-trained personnel at the Statistical Offices of the German States, after reviewing the death certificates completed by medical doctors. Since 1991, the West German instructions for coding the leading cause of death have also applied to the New States, while in the GDR-system the doctors themselves provided the cause of death information that then directly entered the official statistics (Brückner, 1993). The strong effect of these different coding procedures is the only convincing explanation for the immediate change in the cause of death structure (see also Bertz *et al.*, 1991; Dinkel, 1999)<sup>8</sup>. As a consequence, the following comparison of East and West German cause of death-specific mortality is restricted to the years 1991-2000, and thus concentrates only on the closing of the survival gap after Reunification. Cause of death data for divided Germany obviously contain too much uncertainty to provide reliable results.

Tables 1 and 2 show the results of the decomposition of the West-East difference in  $e_0$  into the contributions of the main cause of death groups. Negative values represent lower East German mortality, positive values represent excess East German mortality. The results given in table 1 make it clear that there is only one specific cause of death chapter (main group of causes of death) mainly responsible for the excess mortality of Eastern German women, namely diseases of the circulatory system (see also Nolte *et al.*, 2000c)<sup>9</sup>. In 1991, differences in mortality for this cause of death chapter contributed 1.91 years to the overall difference in life expectancy at birth between West and East Germany of 2.61 years. In relative terms, the impact of this cause of death chapter rose steadily in the ten observation years. In 2000, the differences in mortality conditions due to diseases of the circulatory system were considerably higher than the overall difference in  $e_0$ . The differences in mortality due to diseases of the circulatory system between East and West German women caused a Western advantage in life expectancy at birth of 1.14 years, while the overall difference is only 0.46

<sup>8</sup> Heinemann *et al.* (1998) mentioned that also the WHO rule of assigning a single underlying cause of death was apparently not always followed by GDR physicians, in particular the special rule applying to cardiovascular deaths (see also Bertz *et al.*, 1991)

<sup>9</sup> There are some hints that the same holds for the divergence in mortality trends among East and West German women prior to Reunification (Eisenblätter *et al.*, 1981; Barth *et al.*, 1996; Heinemann *et al.*, 1996).

Figure 8 – Age-standardised death rates for cause of death-chapter “Neoplasms” (ICD 9: 140-239, ICD 10: C00-D48) for men in Germany, 1980-2000



Notes: 1991-1997 ICD 9, 1998-2000 ICD 10; 1991-1997 Western Germany including West-Berlin, 1998-2000 Western Germany including Berlin; standard: average population of Germany 1995.

Source: own calculations.

years. Consequently, the extreme disadvantage of East German women in circulatory diseases is counteracted by other causes of death with West German excess mortality, such as neoplasms and diseases of the respiratory system that show a continuously increasing disadvantage for West German women. Since 1996, the disadvantage of East German women regarding circulatory diseases mortality is higher than the disadvantage in overall mortality (in this year the difference in circulatory diseases mortality contributed 1.33 years to the West-East difference in  $e_0$ , the overall difference was 1.24 years).

Table 1 – Decomposition of the difference in  $e_0$  between West and East Germany into the contributions of the main cause of death-chapters, women 1991-2000

	ICD 9	ICD 10	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
<b>Total difference in <math>e_0</math></b>	-	-	<b>2.61</b>	<b>2.35</b>	<b>1.72</b>	<b>1.69</b>	<b>1.43</b>	<b>1.24</b>	<b>0.91</b>	<b>0.88</b>	<b>0.52</b>	<b>0.46</b>
Certain infectious and parasitic diseases	001-139	A00-B99	-0.04	-0.05	-0.05	-0.05	-0.07	-0.06	-0.06	-0.06	-0.10	-0.12
Neoplasms	140-239	C00-D48	+0.02	+0.05	+0.02	+0.04	-0.04	-0.07	-0.05	-0.05	-0.11	-0.17
Diseases of the circulatory system	390-459	I00-I99	+1.91	+1.70	+1.33	+1.43	+1.34	+1.33	+1.07	+1.19	+1.16	+1.14
Diseases of the respiratory system	460-519	J00-J99	+0.07	+0.06	-0.02	-0.05	-0.05	-0.08	-0.08	-0.11	-0.14	-0.14
Diseases of the digestive system	520-579	K00-K93	+0.25	+0.23	+0.18	+0.18	+0.20	+0.16	+0.13	+0.12	+0.09	+0.17
Symptoms not elsewhere classified	780-799	R00-R99	-0.08	-0.08	-0.09	-0.12	-0.12	-0.14	-0.13	-0.23	-0.25	-0.29
Injury, poisoning and external causes	800-999	S00-T98	+0.39	+0.33	+0.28	+0.27	+0.22	+0.21	+0.17	+0.23	+0.15	+0.16
Other diseases	-	-	+0.10	+0.11	+0.07	-0.01	-0.05	-0.11	-0.13	-0.20	-0.27	-0.28

Notes: 1991-1997 ICD 9, 1998-2000 ICD 10; 1991-1997 West Germany including West-Berlin, 1998-2000 West Germany including Berlin.

Source: own calculations.

Table 2 – Decomposition of the difference in  $e_0$  between West and East Germany into the contributions of the main cause of death-chapters, men 1991-2000

	ICD 9	ICD 10	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
<b>Total difference in <math>e_0</math></b>	-	-	<b>3.35</b>	<b>3.16</b>	<b>2.89</b>	<b>2.86</b>	<b>2.45</b>	<b>2.22</b>	<b>1.99</b>	<b>1.70</b>	<b>1.59</b>	<b>1.61</b>
Certain infectious and parasitic diseases	001-139	A00-B99	-0.12	-0.12	-0.14	-0.12	-0.13	-0.12	-0.09	-0.08	-0.10	-0.12
Neoplasms	140-239	C00-D48	+0.06	+0.13	+0.23	+0.18	+0.22	+0.17	+0.20	+0.20	+0.26	+0.31
Diseases of the circulatory system	390-459	I00-I99	+1.59	+1.47	+1.31	+1.34	+1.22	+1.21	+0.97	+0.93	+0.86	+0.93
Diseases of the respiratory system	460-519	J00-J99	+0.17	+0.14	+0.07	+0.04	+0.05	+0.03	-0.01	-0.02	-0.05	-0.06
Diseases of the digestive system	520-579	K00-K93	+0.56	+0.60	+0.56	+0.57	+0.53	+0.49	+0.47	+0.44	+0.45	+0.47
Symptoms not elsewhere classified	780-799	R00-R99	-0.09	-0.09	-0.11	-0.08	-0.14	-0.15	-0.10	-0.15	-0.21	-0.24
Injury, poisoning and external causes	800-999	S00-T98	+1.04	+0.90	+0.84	+0.79	+0.74	+0.70	+0.62	+0.49	+0.57	+0.49
Other diseases	-	-	+0.14	+0.13	+0.13	+0.14	-0.04	-0.12	-0.06	-0.10	-0.20	-0.19

Notes: 1991-1997 ICD 9, 1998-2000 ICD 10; 1991-1997 West Germany including West-Berlin, 1998-2000 West Germany including Berlin.  
Source: own calculations.

Table 2 shows that the situation is different for men. Here, there are three main cause of death chapters that have a remarkable influence on Eastern German excess mortality. Additionally to circulatory diseases (which have in all years a lower absolute impact on the overall differences than in the case of women), the diseases of the digestive system (mainly diseases of the liver) and the chapter “injury, poisoning and certain other consequences of external causes” (mainly resulting from traffic accidents) make a major contribution to the total West-East difference in  $e_0$ <sup>10</sup>. The two latter causes are essentially responsible for the excess mortality of East German men at younger adult ages indicating the impact of alcohol misuse and road traffic accidents (see also Häussler *et al.*, 1995; Nolte *et al.*, 2000c, 2002)<sup>11</sup>. Especially striking was the extreme rise in fatal traffic accidents in East German after Reunification, reflecting the sudden availability of western cars combined with increases in drunken driving, erosion of safety controls, poor transport infrastructure, and a possible deterioration of rescue services (Winston *et al.*, 1999; Nolte *et al.* 2000c). Furthermore, neoplasms also show a more or less continuously increasing effect on Eastern German excess mortality among men. Among women, the impact of this cause of death category changed from a Western German advantage until 1994, to a current Eastern German advantage.

#### 4.3 West-East German differences in health-related behaviour

In this section health (and thus mortality)-related behaviour for East and West populations is analysed, *i.e.* individual risk factors connected to cardiovascular diseases (see Bormann *et al.*, 1991) that turned out to be mainly responsible for East German excess mortality (cf. tables 1 and 2). As was already mentioned, previous surveys showed that a number of leading cardiovascular risk factors have been different to the disadvantage of Eastern German women and men, supporting the hypothesis that individual behaviours and lifestyles strongly affect mortality differences between West and East Germany (Dinkel, 1994; Heinemann *et al.*, 1996; Gjonça *et al.*, 2000), as well as between Western and Eastern Europe (Nolte *et al.*, 2004). The only remarkable difference is the fact that East German women smoked considerably less frequently than their counterparts in the West (Bormann *et al.*, 1991; Heinemann and Greiser, 1993; Heinemann *et al.*, 1996). This

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<sup>10</sup> More detailed cause of death categories were elaborated by Luy (2004).

<sup>11</sup> The fact that data about deaths from liver cirrhosis were not published in the former GDR (Höhn and Pollard, 1990, 1991) indicates that these causes might also be responsible for the increasing male mortality in younger ages in the later 1980s. However, Ramstedt (2002) questioned the validity of data about explicitly alcohol-related mortality.

could be one factor explaining higher mortality among West German women from diseases of the respiratory system and neoplasms (cf. table 1), the latter being mainly caused by malignant neoplasms of the respiratory organs (Luy, 2004). However, during the 1990s, the number of female smokers increased considerably more in the East than in the West resulting in almost comparable numbers of female smokers in both parts of Germany (Junge and Nagel, 1999; Luy, 2003). As Luy (2003) has shown with data from the German micro census, this development is mainly due to young adult ages, where East German women now have the higher share of smokers.

The German Life Expectancy Survey (*LES*) enables the examination of several health-related variables regarding lifestyles or aspects of daily life with possible impacts on morbidity and mortality. The latter can be seen as indicators for satisfaction with the specific conditions of life in Eastern and Western Germany and thus as indicators for life quality. Therefore, the share of people declaring themselves to be satisfied with housing conditions, leisure time, occupational status, income, and health in general is analysed at the two time points of the *LES*. All numbers are age-standardised using the whole *LES* sample (women and men) at the time of the first observation as standard population<sup>12</sup>. In figures 9 and 10, the development from the first to the second survey is shown by an arrow connecting the results of the first and the second survey. These are given as dots representing the share of satisfied West Germans on the x-axes and of East Germans on the y-axes. Identical values for Eastern and Western German women (figure 9) respective men (figure 10) would lie on the diagonal line printed in the figures. Consequently, points in the upper triangle represent higher percentages in East Germany, points in the lower triangle higher percentages in West Germany.

Among both sexes West Germans are more satisfied than their East counterparts with all measured aspects of daily life. This holds for both observation times, all points are placed in the lower triangle of figures 9 and 10. But there are some notable differences between the sexes. Among women in both parts of Germany satisfaction with leisure time, housing conditions, health, and income increased from the first to the second observation (figure 9). Only satisfaction with occupational status decreased, in Western Germany from 79.5% to 77% and slightly more pronounced in Eastern Germany from 65% to 60%. With the exception of satisfaction with the housing situation, differences between East and West German women in satisfaction with all other measured aspects of daily life increased during the observed time spans. Among men, differences between East and West

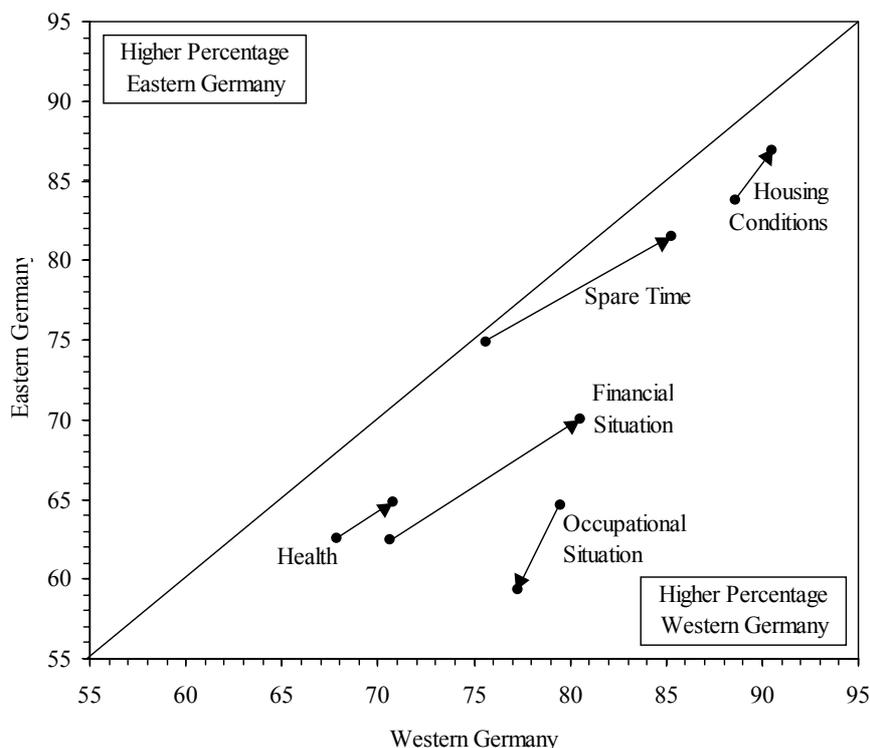
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<sup>12</sup> Since the age composition of the Eastern and Western German *LES* samples are almost identical, the age-standardised results do not differ significantly from the crude numbers.

Germany decreased for three aspects of daily life, namely health, housing, and income (figure 10). Increasing differences can only be found in satisfaction with leisure time and occupational status, but in both cases the increase is almost negligible. Comparable to women, satisfaction for men regarding occupational status decreased in both parts of Germany. Contrary to women, where this decrease is much more pronounced among East Germans, the decrease in satisfaction with occupational status decreased similarly among West and East German men, respectively from roughly 80% to 74 % and 65.5% to 59.5%. Also contrary to women, among men satisfaction with health decreased. In Western Germany the share of men satisfied with their health fell from 71.5% to 67.5%, while remaining almost constant in East Germany (a slight decrease from 63.5% to 63%). This could be explained by the longer observation time and thus longer ageing among West German men. On the other hand, although the observation time for West German women is the same they reported an increased satisfaction with their health status. East and West Germans see their biggest quality improvements in their financial situation and leisure time (represented by the longest arrows in figures 9 and 10). In East Germany, satisfaction with housing conditions shows the highest relative increase. Nevertheless, results show that among both women and men, the West-East difference in satisfaction with most measured aspects of daily life increased during the 1990s. Consequently, a convergence of psychological conditions resulting from daily life conditions connected with the quality of life can not contribute to decreasing mortality differences.

A completely different picture can be seen regarding indicators for health-related lifestyles and cardiovascular risk factors. Investigated risk groups are smokers (variable "smoking"), drinking less than two glasses of high proof spirits daily ("renunciation of high proof spirits"), the overweight ("overweight"), hyper cholesterol ("hyper cholesterol"), high blood pressure ("high blood pressure"), those declaring to live healthily ("health-conscious lifestyle") and those that do not practise sports regularly, *i.e.* less than at least once a week ("lack of physical activity"). All questions referred to the current month of the survey and are exclusively self-reported. This has to be taken into account when interpreting the following results, that are presented similarly as the analysis of indicators of general life quality. Among almost all variables differences between East and West Germans decreased, indicating an adjustment of lifestyles and cardiovascular risk factors (see figures 11 and 12). Although there were considerable differences between the East and West German women at the time of first observation, differences among all measured variables decreased and became almost negligible (figure 11). Among men a similar picture can be seen, apart from

Figure 9 – Changes between the two LES-waves in satisfaction with different aspects of daily life of Eastern and Western German women

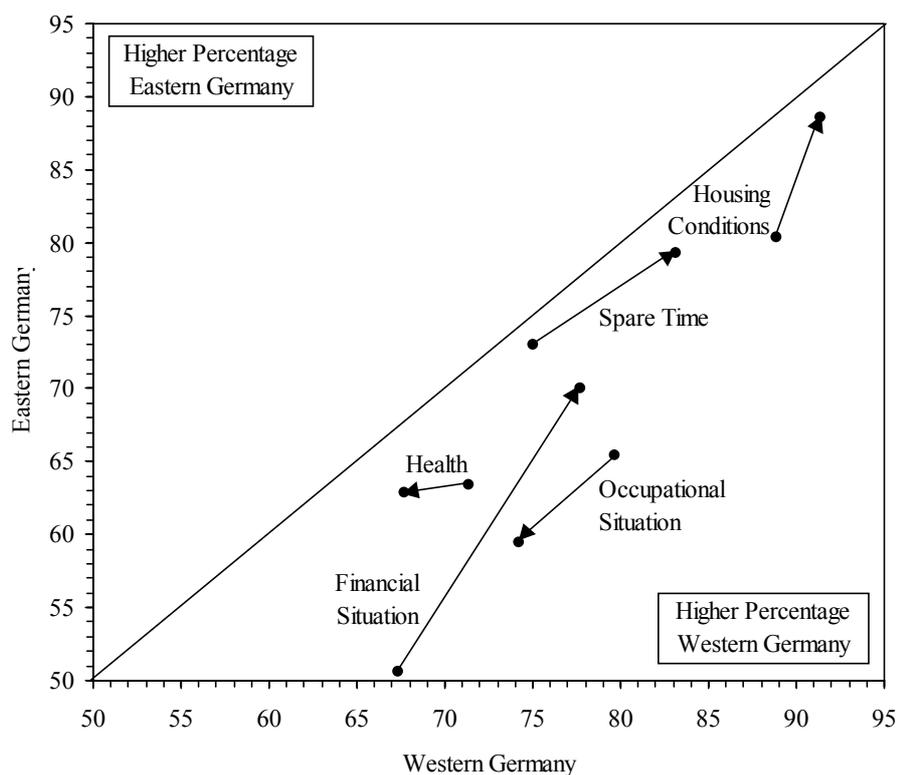


*Note:* the values represent age-standardised percentages of persons declaring satisfaction with different aspects of daily life at the times of the two LES-waves (connected with arrows describing the development from the first to the second wave); first wave in Western Germany: 1984/86, first wave in Eastern Germany: 1991/92; second wave: 1998; standard: complete LES-sample of first wave.

*Source:* German Life Expectancy Survey.

one major exception. Not drinking high proof spirits was and still is considerably higher in West Germany (in 1998 64% compared to only 50% in East Germany). This indicates that alcohol abuse is still significantly higher among East German men. This finding fits the description of the development of age- and cause of death-specific mortality differences between West and East Germany in the 1990s. Another remarkable aspect is that among the cohorts included in the *LES* the number of smokers decreased similarly among East and West German men as well as among West German women, but remained almost constant among East German women (9% in

Figure 10 – Changes between the two LES-waves in satisfaction with different aspects of daily life of Eastern and Western German men



*Note:* the values represent age-standardised percentages of persons declaring satisfaction with different aspects of daily life at the times of the two LES-waves (connected with arrows describing the development from the first to the second wave); first wave in Western Germany: 1984/86, first wave in Eastern Germany: 1991/92; second wave: 1998; standard: complete LES-sample of first wave.

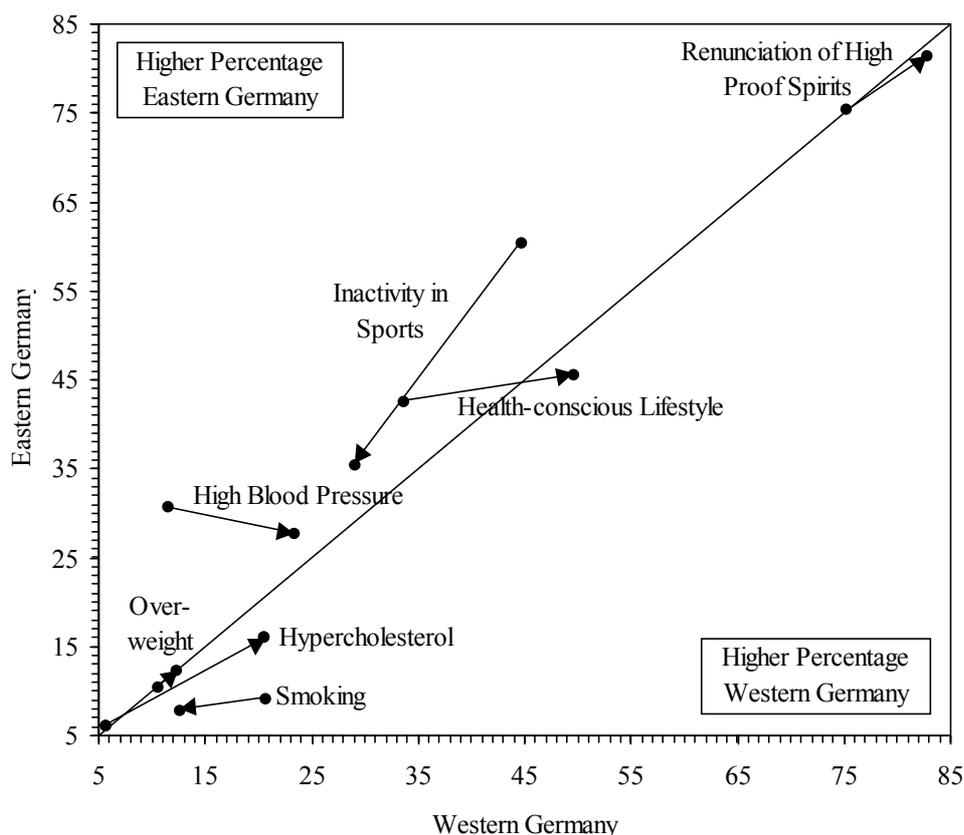
*Source:* German Life Expectancy Survey.

1991/92 and 8% in 1998)<sup>13</sup>. Although the number of female smokers in the *LES* sample is still slightly lower in East Germany (among West German women this was still 12.5% in 1998) this, together with the already mentioned finding of an increased number of smokers among young Eastern

<sup>13</sup> Since the *LES* is restricted to persons born in 1952 and earlier, these results do not contradict to the findings about overall smoking numbers that were described above.

German women (Luy 2003), indicates that the former advantage of East German women here could change to their disadvantage.

Figure 11 – *Changes between the two LES-waves in cardiovascular risk factors of Eastern and Western German women*

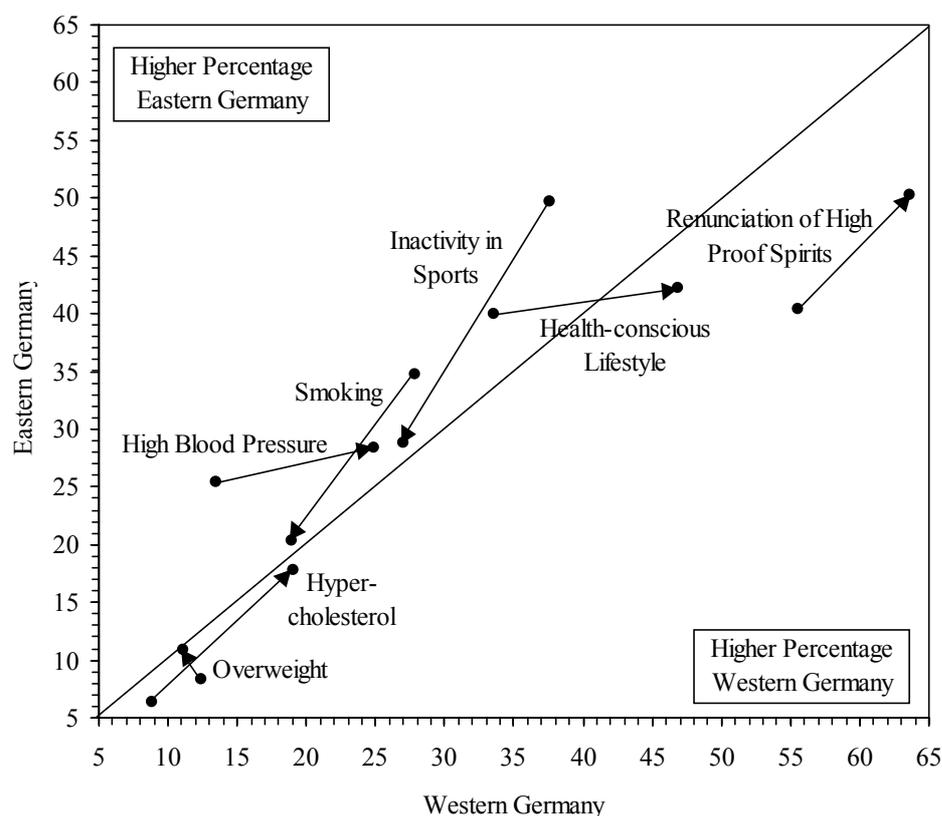


*Note:* the values represent age-standardised percentages of persons reporting different cardiovascular risk factors at the times of the two LES-waves (connected with arrows describing the development from the first to the second wave); first wave in Western Germany: 1984/86, first wave in Eastern Germany: 1991/92; second wave: 1998; standard: complete LES-sample of first wave.

*Source:* German Life Expectancy Survey.

Figures 11 and 12 indicate a convergence of lifestyles for East and West German women and men. The “shock of adoption” takes on a completely new meaning in this context. This is strongly supported by findings regarding obesity, nutrition, and use of medical services, showing

Figure 12 – Changes between the two LES-waves in cardiovascular risk factors of Eastern and Western German men



*Note:* the values represent age-standardised percentages of persons reporting different cardiovascular risk factors at the times of the two LES-waves (connected with arrows describing the development from the first to the second wave); first wave in Western Germany: 1984/86, first wave in Eastern Germany: 1991/92; second wave: 1998; standard: complete LES-sample of first wave.

*Source:* German Life Expectancy Survey.

also the adjustment between Eastern and Western Germans in recent years (Bergmann and Mensink, 1999; Bergmann and Kamtsiuris, 1999; Mensink *et al.*, 1999) as well as various analyses by Mueller and Heinzl-Gutenbrunner (2001) also using the LES. The decisive question is if the convergence of health-related lifestyles can explain the convergence of mortality differences. Therefore, information about individual risk factors are used to estimate a Cox-Regression model on the mortality of the LES

respondents. The biggest problem when comparing East and West German *LES* samples is the different calendar years of the first survey. As a consequence, the same birth cohorts can only be observed at different ages or *vice versa* and the observed time spans for East and West Germans are of different length. To solve this problem, the chosen starting point for the longitudinal analysis is October 12<sup>th</sup> 1992, the day on which the last individual of the first survey in Eastern Germany was interviewed. At this time, the number of living people is 6,053 in the West German *LES* sample (2,951 women and 3,102 men) and 1,222 in the East German *LES* sample (639 women and 583 men). For all recorded individuals it had to be assumed that the examined health-related behaviours did not change until this day<sup>14</sup>. Until the end of the observation in 1998, 595 of the 7,275 individuals available for this event history analysis deceased, 486 deaths occurred in the West (163 women, 323 men) and 109 in the East German sample (49 women, 60 men).

The complete Cox-Regression models are presented and described in detail elsewhere (Luy, in press), while in table 3 only the results regarding the impact of cardiovascular risk factors are shown. The variables included are the same as those described above and shown in figures 11 and 12, used as dummy variables representing those belonging to the diverse (self-reported) risk groups compared to all others (excluding those who refused to answer). All models are controlled for age, models 2 additionally for income and the variables regarding satisfaction with different aspects of daily life; Cox-Regressions for men are time-dependent. In model 1 for both sexes the mortality of individuals belonging to the East German sample is significantly higher (95% level) than those from the West German sample, as was to be expected according to the macro level analysis (figure 1). The aim of model 2 is to investigate if the difference in individual mortality between East and West Germany loses significance when the model is controlled for the measured cardiovascular risk factors.

The analysis for women shows that the only risk group with statistically significantly higher mortality compared to the other *LES* respondents are current smokers<sup>15</sup>. Once all measured cardiovascular risk factors are included (model 2), the variable East Germany is no longer statistically

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<sup>14</sup> For the West German sample this is a strong assumption since the information is from interviews that were done six to eight years before, but it is the only way to analyse the impact of individual lifestyles on mortality differences between Western and Eastern Germans with the *LES*.

<sup>15</sup> The lacking significance of most cardiovascular risk factors in these models is probably due to the short observation time and the low statistical power of the East German *LES* sample that includes only a small number of observed deaths (see also Helmert, 2003).

Table 3 – Results<sup>a</sup> of Cox-Regression on the mortality of women and men, Germany 1992-1998

	Women			Men <sup>b</sup>	
	M1	M1a	M2	M1	M2
Eastern Germany	1.41 *	1.54 **	1.38	1.72 *	1.92 *
Smoking		2.27 ***	2.64 ***		1.80 ***
Renunciation of H. P. Spirits			1.01		0.82
Overweight			1.21		1.20
Hyper Cholesterol			0.82		0.88
High Blood Pressure			1.31		1.40 *
Health-conscious Lifestyle			1.29		1.26
Inactivity in Sports			1.11		2.21 ***
-2 Log L	3280.3 ***	3240.3 ***	2196.7 ***	5956.1 ***	4066.0 ***
<b>Number of Cases</b>	<b>3590</b>	<b>3566</b>	<b>2826</b>	<b>3684</b>	<b>2705</b>

Notes: <sup>a</sup> models 1 and 1a controlled for age; model 2 controlled for age, income, and psychological conditions (measured by the variables of satisfaction with different aspects of daily life as described in text); all variables are dummy variables, for reference groups see text  
<sup>b</sup> Cox-Regressions for men are time-dependent.

\* p < 0.05, \*\* p < 0.01, \*\*\* p < 0.001.

Source: German Life Expectancy Survey.

significant. However, according to the described female smoking habits in Germany and the *LES* results presented in figure 11 this result is quite puzzling since the share of smokers was and still is higher among Western German women. Cox-Model 1a, controlling solely for current smokers and excluding other cardiovascular risk factors, shows that smoking alone in fact does not account for the survival disadvantages of East German women. In this model, the odds ratio for East Germany increases as well as its statistical significance. Consequently, the fact that the variable “Eastern Germany” loses its significance in model 2 can be attributed to the counteracting effects of all included variables and probably to the loss of case numbers (see table 3). Among men, three types of cardiovascular risk groups with statistically significantly higher mortality are found, namely smokers, those with high blood pressure, and those who do not practising any sport. Despite controlling for individual risk factors, the variable “Eastern Germany” remains statistically significant on the 95% confidence level.

Although the results provided by the *LES* must be treated with caution, because of the very high number of censored and missing cases, they indicate that individual lifestyles have no significant impact on East German excess mortality. Consequently, the rapid convergence of cardiovascular risk factors between the East and West German populations should not significantly contribute to the decrease in overall mortality differences. At least, there is no result indicating that individual lifestyles could play a decisive role in causing mortality differences between West and East German women and men in the course of the 1990s. In this way the results support the expectation that changing lifestyles cannot have short term impacts on survival conditions of such import as to explain the observed mortality trends at a macro level.

#### *4.4 Changes in medical and nursing care*

Most scholars assume that East German’s backward medical technology before and its rapid improvement after Reunification are the decisive factors explaining the former widening and recent closing of the West-East German mortality gap (Chruscz, 1992; Dinkel, 1994, 1999; Schott *et al.*, 1994; Becker and Boyle, 1997; Gjonça *et al.*, 2000). Similarly medical technology is thought to be responsible for the general West-East mortality differences in Europe (Boys *et al.*, 1991; Mackenbach *et al.*, 1996; Velkova *et al.*, 1997; McKee and Nolte, 2004). Regarding Germany, this explanation is confirmed by the fact that throughout the 1990s mortality was lowest in Eastern German agglomerates and urban areas, where access to medical care is better, than in rural areas (Bucher, 2002; Mai, 2004). However, direct

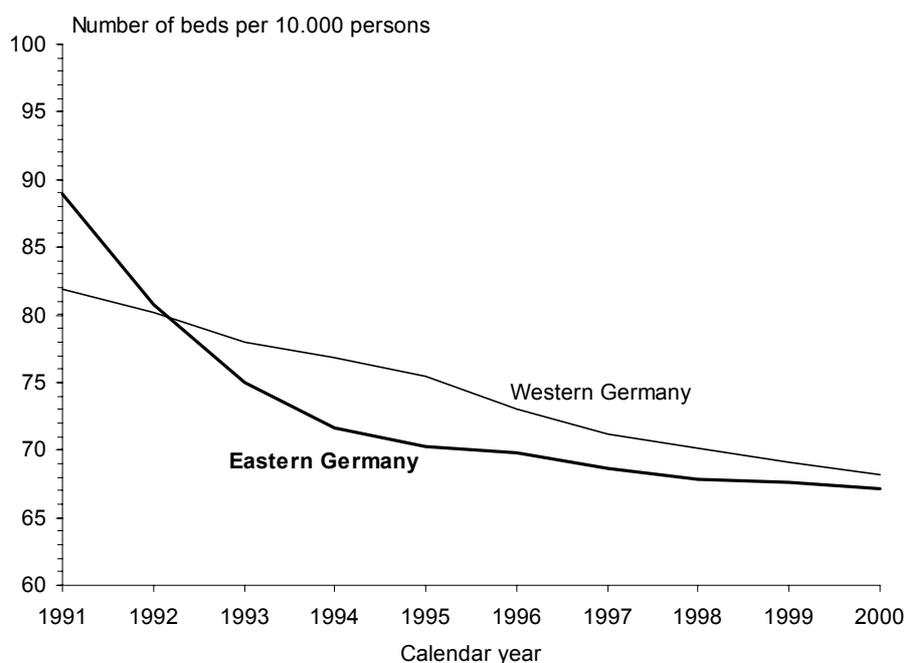
examinations of the impact of the new and improved medical conditions in Eastern Germany do not support this hypothesis. Using Rutstein *et al.*'s (1976) until today continuously improved concept of causes of death that are considered to be responsive to medical care (the so-called "amenable deaths"), Nolte *et al.* (2002) and Luy (2004) independently analysed the impact of those causes on the closing of the West-East German mortality gap in the 1990s<sup>16</sup>. Both studies came to the same result, that is that changes in medical conditions in Eastern Germany did not seem to influence the steady decline in East German excess overall mortality. Assuming the Western German mortality conditions due to causes of death responsive to medical care for both, the Eastern and Western German population, shows that the relative impact of amenable causes on  $e_0$  does not diminish, but remains at a constant level of around 20% for men and around 30% for women during the whole of the 1990s (Luy 2004). It has to be concluded that for both women and men, the modernised East German health system was not responsible for the rapid reduction in Western-Eastern German mortality differences. The causes of death responsive to medical care follow more or less the same trend as overall mortality, and do not show any decline in their relative impact as would be expected if there were a decisive effect. Figure 13 shows that also the development in the quantitative supply of medical care cannot be responsible for changing mortality differences. The number of available beds in hospitals decreased in both West and East Germany in the course of the 1990s. This trend was even more pronounced in East Germany, where at the beginning of the 1990s the number of hospital beds per 10,000 persons was higher than in West Germany, but today is slightly lower.

Up to this point not even one of the expected factors responsible for East German excess mortality fully explains the convergence of East and West German survival conditions. One factor that has not been taken into consideration so far is the availability of nursing care, since all efforts were focused on the impact of medical care. Nursing care includes institutions like hospices and old people's homes. The problems in analysing the impact of nursing care are manifold. First, official statistics only provide information about crude numbers of different aspects connected with nursing care, such as the numbers of medical and non-medical staff or beds in nursing care institutions (Statistisches Bundesamt, 2001). Second, the direct linkage of

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<sup>16</sup> It should be noted that the differentiation between the amenable and non-amenable categories is necessarily imprecise and somewhat arbitrary, and there will be some overlap since not all diseases defined as amenable are completely responsive to ideal medical care (see Forster, 1996; Nolte *et al.*, 2004). However, according to the growing number of studies using this concept, it seems to be accepted to provide a good indicator for measuring the impact of medical care on survival conditions.

Figure 13 – *Number of beds per 10,000 persons in hospitals in Eastern and Western Germany, 1991-2000*



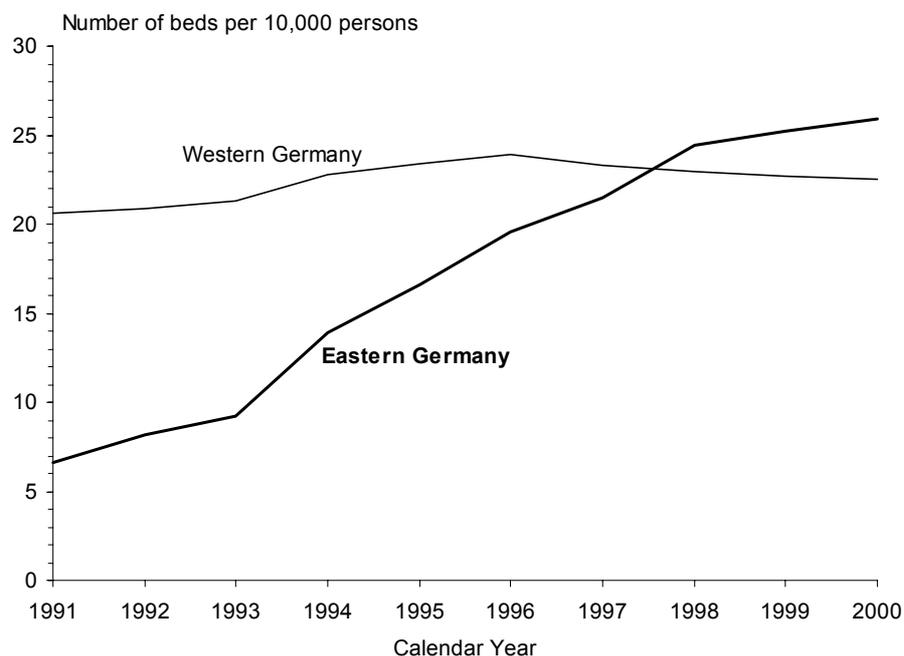
Source: Statistisches Bundesamt, 2001.

mortality and nursing care is technically impossible, at least with official German population statistics, because of the lack of data<sup>17</sup>. Moreover such an examination makes no sense since it can be expected that mortality inside nursing care institutions is higher than mortality outside, especially in the higher and highest age groups where changes in mortality differences between East and West Germany determine the overall trend. If people did not have serious health problems they would not be housed in nursing care institutions. Thus, the role of changes in nursing care can only be useful examined with the help of specific indicators such as the relative support with such institutions. Figure 14 shows one of these kind of indicators that is trends for available number of beds in such institutions in both East and West Germany from 1991 to 2000. While in West Germany the support with nursing care remained almost constant, at a level of around 22 per 10,000

<sup>17</sup> Only since 1999 has the Statistical Office of Germany (Statistisches Bundesamt) started to publish more detailed statistics on the basis of nursing cases every two years.

persons for the decade, in East Germany the number of beds in nursing care institutions increased steadily from only 7 per 10,000 persons in 1991 to 26 in 2000. In the course of only seven years from 1991 to 1998 the quantitative support with nursing care became almost identical in both parts of Germany.

Figure 14 – *Number of beds per 10,000 persons in institutions of nursing care in Eastern and Western Germany, 1991-2000*



Source: Statistisches Bundesamt, 2001.

Although the relative number of available beds is only an indicator for a possible underlying effect on mortality conditions, it is the only variable found so far that corresponds to the observed mortality trends in Eastern and Western Germany. The connection between trends in life expectancy and support with nursing care could actually be of causal kind. The decisive difference between spending the last part of life (mainly) inside nursing care institutions as compared to staying at home is the permanent medical observation of the patients. This enables immediate medical intervention in the case of sudden and unexpected complications, keeping people alive that otherwise would have no or at least a considerable less chance of survival. Such effects can mainly be expected in the older and oldest age groups.

From this point of view it is indeed possible that greater (and better) support with different kinds of nursing care leads to a longer average life span by several months and thus could be the so far undetected decisive factor determining trends in old age mortality that are responsible for the former increase and recent decrease in overall mortality differences between Eastern and Western Germany. Furthermore, this hypothesis can also explain how East German excess mortality began and continued since the early 1970s. A consequence of last decades' population ageing is that a continuously increasing number of people reached older and oldest ages and thus those age segments that are mostly affected by nursing care and that are responsible for the observed trends in overall mortality differences between Eastern and Western Germany. Thus, differences in nursing care have the strongest impact on overall mortality the older the observed populations are.

## 5. CONCLUSIONS AND DISCUSSION

This paper may contribute towards a better understanding of mortality differences between East and West Germany. Since the 1970s, the advantage of West Germans grew steadily, and peaked around Reunification in 1990. At this time, differences in life expectancy at birth were almost 3 years among women and 3.5 years among men. This gap rapidly narrowed in the following decade. This occurred slightly faster for women, where in 1999 the West-East difference was only 0.5 years, or 17% of its former peak. For men, the corresponding difference decreased to 1.6 years (or to 45% of its former peak). The aim of this study was to find the factor(s) responsible or mainly responsible for affecting survival conditions in both directions in such a short time. To do this, different kinds of macro and micro level analyses were done using official German population statistics and the German Life Expectancy Survey (*LES*). The main results of this study are:

1. there are no cohort effects underlying the trends of increasing and decreasing East German excess mortality. This holds for both men and women. Consequently, the West-East German mortality differences can be attributed to pure period effects.
2. The age-specific causes of West-East mortality differences and their development are not the same for men and women. For women, both the increase in overall mortality differences before and the decrease after Reunification are located mainly in the older age groups, starting around age 60 and peaking between ages 75 to 84. For men, the distribution of age groups mainly contributing to excess East German mortality is considerably broader, and starts in the mid-30s.

3. Only men show additional East German survival disadvantages among younger adult ages following Reunification, counteracting the overall decline of West-East mortality differences, and appearing to be responsible for a reduced narrowing of the survival gap in comparison to women. This effect can be attributed almost exclusively to diseases of the digestive system (mainly due to diseases of the liver) and the cause of death chapter “injury, poisoning and certain other consequences of external causes” (mainly resulting from traffic accidents).
4. The causes of death responsible for East Germany’s excess mortality also differ between men and women. Due to different coding practices in the years when Germany was divided, causes of death data from before 1991 can not be used. In the years after Reunification, among women there is only one dominating cause of death chapter, namely diseases of the circulatory system. In the last years of observation, the disadvantage of East German women resulting from this causes of death chapter is even greater than the overall differences between West and East German women. Among men, there are three cause of death categories mainly contributing to East German excess mortality: diseases of the circulatory system, diseases of the digestive system, and the cause of death chapter “injury, poisoning and certain other consequences of external causes”.
5. The individual health-related behaviours seem to play no role for explaining the West-East German survival gap in the 1990s as could be expected according to the differences in the causes of death structures. The *LES* shows that health-related behaviours of East German women and men are adjusting to the West German lifestyle and that some of these cardiovascular risk factors in fact do influence survival probabilities. However, the results of event history analysis do not provide any indicator for a significant contribution of cardiovascular risk factors to mortality differences between West and East Germany.
6. There are still some gender-specific differences counteracting the general adoption of health-related behaviour. For example, the share of smokers was and is still significantly higher among East German men. Something similar can be seen regarding the intake of high-proof spirits. On the contrary, immediately after Reunification, the percentage of women smoking was lower in the East, but drew continuously closer to that of West German women. Especially young adult women in East Germany seemed to increase their share of active smokers. It is quite possible that the effects of these lifestyle differences between East and West German women and men might prevent a complete closing of the West-East German survival gap in the near future as could be expected when looking at general mortality trends.

7. The factor most scholars expected to be mainly responsible for closing the survival gap after 1990, namely the modernisation in East Germany's medical care system, turned out to have no decisive effect. Independent studies found that the causes of death responsive to medical care have no role to play in the explanation of the decrease in East German excess mortality. It turned out that even the availability of beds in hospitals shows neither significant differences between East and West Germany at the beginning of the 1990s nor a converging trend in the course of the 1990s, as do trends in overall mortality.
8. The only factor that shows a converging trend between East and West Germany comparable to the trends in mortality is the availability of nursing care. During the 1990s the West-East differences in support with nursing care diminished, being now more or less identical in both parts of Germany. This finding supports strong evidence that the improvement in East Germany's nursing care can be the decisive determinant for the observed convergence of East and West German survival conditions since they fit additionally to the observed age-specific causes of the West-East mortality differences.

The findings presented in this paper should be taken as initial indicators of the unexpected and underestimated effect of nursing care. The truth of this hypothesis would completely change the view of the causes of mortality differences between East and West Germany (and maybe similarly the view of the causes of the general survival gap between West and East Europe). As can be seen in the so far discussed reasons for East German excess mortality, the general idea was to find a factor making life in Western Germany (or "Western life" in general) healthier and thus better quality living conditions (or way of life) than in Eastern Germany. However, the results and the knowledge presented in this paper indicate that perhaps such a factor does not exist. Since important nursing care institutions, such as hospices, are mainly used by people of older ages in the last months or years of their lives, the expected effects of an increased use of nursing care would result much more in an increase of the quantitative length of life than in an increase of the length of a healthy and active life. Thus, the increasing mortality differences between West and East Germany until Reunification and the decreasing gap after could be caused to a much higher degree by a "technical" determinant than by real health-related factors such as lifestyles or the life-prolonging possibilities of medical care. This does not mean that all the discussed factors described at the beginning of this paper have no impact at all on mortality differences between West and East Germany. Since it is well known that all of these factors do influence general survival conditions we can also assume an impact on the differences in survival

conditions of the West and East German populations. Obviously mortality differences between West and East Germany are caused by a various number of different factors just as with other aspects of differential mortality. Thus, we should not “fall into the trap of trying to find an elusive single ‘ultimate cause’”, as Hobcraft (2004: 81) warned in the context of fertility analysis. However, none of the explanatory variables discussed so far for the West-East German survival gap fits the observed mortality trends measured with a pure technical parameter such as life expectancy at birth. The availability of nursing care could turn out to be the missing link among determining factors for the observed mortality trends and thus could be the piece missing in the puzzle of factors explaining East German excess mortality. Further research in this direction seems urgently to be needed. An analysis of trends in East and West German healthy life expectancy could be a promising instrument to test the central hypothesis presented in this paper.

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