Cohort Patterns in Smoking, Overweight and Obesity in East and West Germany:
The effect of education on present and future differences between the two parts of the country.

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1. Introduction:

Life expectancy in Germany has increased remarkably over the last decades (Christensen et al. 2009). Improvements result from reductions in mortality due to a variety of factors. Among those are healthier lifestyles and improved medical provisions and treatments (Oeppen and Vaupel 2002, Cutler et al. 2007) Despite these improvements, we have experienced a shift from acute illnesses to chronic diseases, for instance cardiovascular diseases, cancers, respiratory diseases, skin diseases or metabolic diseases (Hurrelmann 2006) that pose major challenges for our health care system today. Although advances in life expectancy are mostly due to improvements in cardiovascular mortality (Nolte et al. 2000a), we have observed an increase in the prevalence of risk factors causing chronic health conditions and cardiovascular mortality. In relation to this, smoking and obesity have been identified as the most important risk factors for population health and premature mortality (Cutler et al. 2007, Preston and Wang 2006, Preston et al. 2010, Doblhammer et al. 2009).

Several studies have shown that smoking increases the risk for cardiovascular diseases, (e.g., heart disease, stroke, high blood pressure or arteriosclerosis), inflammations of the respiratory tract (e.g., bronchitis, inflammation of the trachea) and maligne neoplasms of the respiratory tract (e.g., lung cancer, larynx) (International Agency for Research on Cancer 2004; U.S. Department of Health and Human Services 2004, Lampert and Burger 2004, Gesundheitsberichterstattung des Bundes 2006). For Germany, it is estimated that per year about 100.000-140.000 people die from smoking related illnesses (John and Hanke 2001, Schulze and Mons 2005, Völzke et al. 2006a), which accounts for about 14 percent of all annual deaths. Smoking reduces the body's defenses, increases the likelihood of infections, and accelerates the progression of illnesses and health disorders. It also reduces individual well-being and quality of life

(Lampert and Burger 2005). Moreover, smoking puts economic burdens to society. (Neubauer et al. 2006, Ruff et al. 2000) It is estimated that the total economic costs add up to 17 billion euro per year (Welte et al. 2000).

Likewise, overweight and obesity are related to a number of chronic conditions and premature mortality. They promote diabetes, cardiovascular diseases, as well as several types of cancer. Furthermore, overweight and obesity cause high blood pressure and high cholesterol levels (Cutler et al. 2007). Despite their negative effects on the risk of disability, the effect on mortality is controversial, with a higher body-mass-index being beneficial at advanced ages (Doblhammer et al. 2010). Ultimately overweight and obesity raise health expenditures (Andreyeva et al. 2007). At an individual level, obese people are faced with bias and discrimination in a number of spheres, ranging from professional life to intimate relationships. (Vartanian 2010).

In order to estimate the consequences that smoking, overweight and obesity impose on future population health and subsequent future health care demands, and to enforce prevention strategies successfully, careful monitoring of trends and patterns in these risk factors is crucial.

Typically, studies analyzing trends in smoking and obesity in Germany look at age-related smoking patterns using single or repeated cross-sectional surveys. However, economic, social and political conditions may change over time, effecting people at different ages differently. Therefore, variations between birth cohorts should also be considered when explaining changing health trends. Yet, for Germany information on patterns in smoking and overweight and obesity by birth cohorts is scarce.

This study seeks to tackle this shortcoming. In a first step, we look at variations in the three risk factors smoking, overweight and obesity between twelve different birth cohorts on the basis of the German micro-census. The micro-census is a particularly rich data source for studying these risk factors, which has not been used widely. Secondly, we will examine whether there are differences in the risk factor profiles between low and highly educated individuals and whether these differences vary between East and West Germany. Finally, on the basis of our results, we will discuss possible consequences for the future health of the elderly in relation to the development of the three risk factors. We

focus on individuals above age 60. We are particularly interested in the cohorts born until 1945, and those born between 1946 and 1970. The former are the people aged 60 and above in 2005, the latter those aged 60 and above in the years to come until 2030.

2. The Current Situation in Germany

2.1. Trends in Smoking, Overweight and Obesity in East and West Germany

In the following section we provide an overview of trends and patterns in the three risk factors smoking, overweight and obesity in Germany. We put a special emphasis on differences between East and West Germany because Germany is a country that is characterized by the "natural experiment" of the reunification. Therefore, it is predestined to be explored in regard to the long-term effects of different socioeconomic and political environments on the health of the elderly, including the division of the country after World War II, as well as its reunification in the years 1989/1990. In this context, life expectancy is a good indicator for population health. Until the 1970s, life expectancy at birth in Germany was almost equal between the East and the West. Since then, life expectancy has increased constantly in the West, while it almost stagnated in the East. Since Germany's reunification 1989/90 life expectancy between East and West Germany has equaled and is almost at the same level today. These improvements are mostly due to improvements in cardiovascular mortality. (Nolte et al. 2000a).

Hence, analyzing variations in the risk factor profile between East and West Germany, helps answering the question, whether it is likely that disparities between East and West Germany are continuing to disappear or if it is probable that health trends will disperse again in the future.

Smoking

According to the Robert-Koch Institute (Robert-Koch-Institut 2006a) the number of male smokers in the total German population in the year 2004 is 36.5 percent. For women, prevalences are lower, however, 27 percent report that they are daily or occasional smokers. For both sexes, smoking prevalences are highest in younger ages and decrease with age, whereby tobacco consumption is highest in the middle age groups.

Concerning East-West differences, latest data from 2009 show that there exist almost no differences between males and females in East and West Germany. However, whereas smoking prevalences are slightly lower for females in East Germany (East 25.6 percent; West 26 percent), males in the East smoke more frequently than their West German counterparts. (East 35.4 percent; West 33.3 percent) (Robert-Koch-Institut 2009). Lampert and Burger (2004 and 2005) looked at trends in smoking between 1984 and 2003 based on four National Health Surveys and the first wave of the German National Telephone Health Survey conducted in 2003. They show that overall smoking prevalences have declined for males in East and West Germany. The prevalences for males in West Germany decreased from 41.6 percent in 1984/85 to 37.7 percent in 2003. Prevalences for East German males declined from 39.5 percent in 1990/92 to 38.9 percent in 2003. In contrast, the number of female smokers has increased over time. Prevalences for females in West Germany have increased continuously from 26.7 percent in 1984/85 to 32.3 percent in 2003. For East German females, prevalences increased from 21.8 percent in 1990/92 up to 28.7 percent in 1998. However, they decreased again to 26.1 percent in 2003. Helmert and Buitkamp 2004 explored trends in smoking between 1985 and 2002, using the four National Health Surveys 1984-1998, as well as three waves of the "Bertelsmann Health Monitor" and found similar results.

Overweight and Obesity

Data on overweight (defined as a body mass index above 25 kg/m²) and obesity (defined as a body mass index above 30 kg/m²) for the year 2004 show that about two thirds of the male population and half of the female population above age 18 is considered either overweight or obese. The share of overweight males in Germany is 50.8 percent, for females it is 35.5. There is almost no difference in obesity between males (19.2 percent) and females (17 percent). For both sexes, obesity prevalences are increasing with age, whereby prevalences are higher for age group 50-59 for males and 60-69 for females (Mensink et al. 2005, Robert-Koch-Institut 2006a).

Concerning overweight and obesity, prevalences are slightly higher in East Germany for both sexes. For overweight, differences are only marginal (Males: 51.1 percent East; 50.8 percent West; Females: 36.1 percent East; 35.4 percent West), whereas they are

more pronounced for obesity (Males: 18 percent East; 16.8 percent West; Females: 23.2 percent East; 18.5 percent West). (Robert-Koch-Institut 2006a). According to the Nationale Verzehrsstudie 2006 (Robert-Koch-Institut 2009), the obesity prevalences for East German females aged 18 to 80 is 22.9 percent, for West German females it is 20.6 percent, but there are no differences for males' prevalences (East 20.6 percent, West 20.5 percent).

Mensink et al (2005) looked at trends in overweight and obesity between 1984 and 2003 based on four National Health Surveys and the first wave of the German National Telephone Health Survey conducted in 2003. They show that the share of overweight for West German males has remained relatively constant between 1984/85 and 2003 (about 50 percent of the total population) whereas obesity prevalences have increased from 15 to 17 percent. An exception is the age group 25-34, where they found pronounced increases in both groups. For East German males they observed stable prevalences in overweight between 1991/92 and 1998, but an increase between 1998 and 2003 from 48 to 51 percent. For obesity, in contrast, they found an increase between 1991/92 and 1998 from 21 to 25 percent but no change between 1998 and 2003. For females in West Germany the percentage of overweight was lower in 1998 compared to previous years but increased up to 34 percent in 2003. The share of obese females increased between 1984/85 and 1998, but decreased until 2003 to 17 percent. For East German females, they observed increasing overweight prevalences from 31.6 percent in 1991/92 to 37 percent in 2003, but no change in obesity (25 percent).

Combining data from the four National Health Surveys 1984-1998 with all three waves of the "Bertelsmann Health Monitor" conducted between 2002 and 2003, Helmert and Strube 2004 observed an increase in the prevalence of moderate obesity between 1985 and 2002 for males from 16,2 percent to 22.5 percent and for females from 16.2 to 23,5 percent. For the same period they found increases in severe obesity for males from 1.5 to 5.2 percent and for females from 4.5 to 7.5 percent.

Based on data from the German Mikrocensus, the prevalences of obesity for people above age 18 increased between 1999 and 2005 by two percent for both sexes in both parts of the country. Hence, differences between East and West have remained within the observational period (Robert-Koch-Institut 2009).

2.2. Cohort Patterns in Smoking, Overweight and Obesity

In the first part of the 20th century, consumption of tobacco was reserved almost exclusively for males. In particular, smoking in public did not correspond to the image of females and was therefore strongly rejected (Hess in Lampert & Burger 2005). According to Lampert and Burger 2005 more then two thirds of all males, but only one third of all females was smoking in the birth cohort 1906-29. Whereas prevalences remained relatively constant over succeeding birth cohorts for males, prevalences for females increased rapidly from birth cohort 1930-1939 onwards and have approximated those of males until birth cohort 1970-1985 (Lampert and Burger 2005).

Brenner 1993 found that the peak prevalence of smoking in the 1911 to 1929 birth cohort was 60 percent. This peak prevalence increased continuously over succeeding birth cohorts and reached a maximum of over 70 percent in the 1941 to 50 birth cohort. However, the peak prevalences for the cohort 1951 to 1960 and 1961 to 1970 are considerably lower.

For Germany there exist no studies analyzing cohort patterns in overweight and obesity. In a study for the United States, Reither et al. 2009 show that birth cohort membership influences the odds of obesity. They find that cohorts born during the first half of the 20th century tended to have declining odds of obesity, relative to cohorts born toward the end of the 19th century. However, the probabilities of more recent cohorts have tended to increase since the late 1950s and early 1960s.

3. The influence of education on smoking, overweight and obesity

Education is an important factor influencing health. In many studies, education is used as a proxy for socioeconomic status. The advantage of education compared to income or occupation is that education is easy to measure and generally fixed early in life. Furthermore, attained educational level anticipates future occupational chances and income and, thus, affects access to material resources. Generally, better educated people have better health knowledge, as well as the necessary financial means to apply this knowledge (e.g., to buy healthy food or medical requirements). At the same time, they

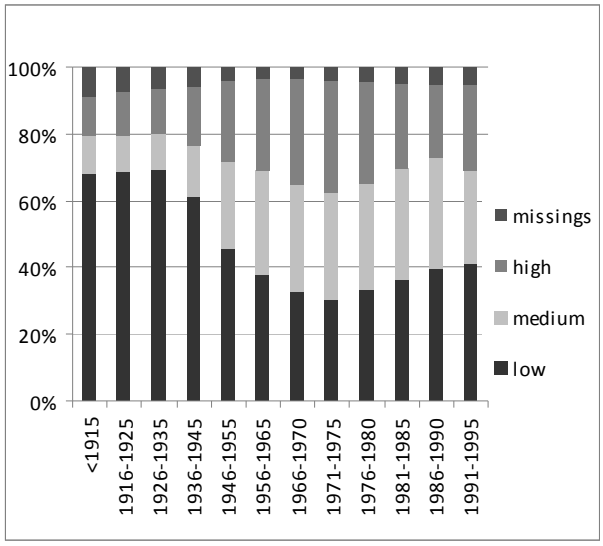
restrain more often from detrimental lifestyles than low educated people (Doblhammer et al. 2009).

The expansion of education in Germany, starting in the 1950s, led to a general increase in educational participation for all societal groups. Moreover, the duration for individuals inside the educational system has increased, as well as the number of graduates with high degrees (Becker and Lauterbach 2008 (Hadjar and Becker 2009).

For Germany, Becker and Lauterbach 2008 found that in 1965 only 16 percent of 13-year-old students received more than secondary education (Gymnasium). This number increased to 30 percent at the end of the 1980s. At the same time, the number of students who received only elementary education (Hauptschule) dropped from 70 to 40 percent.

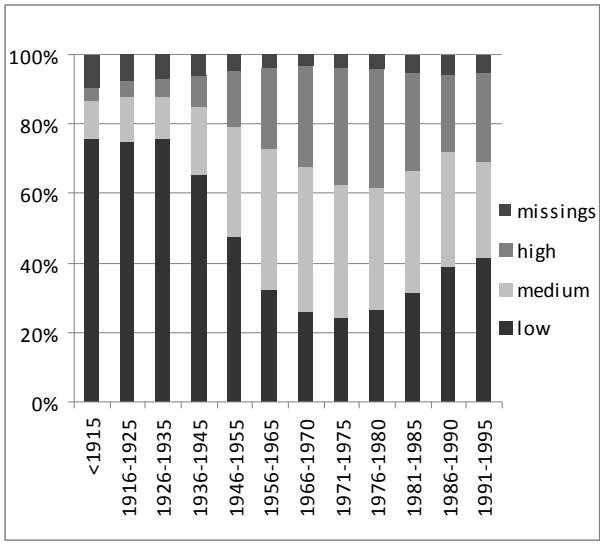
Figure 1 and Figure 2 present the proportion of individuals belonging to the low, medium and high educational group by birth cohort for males and females. In the four oldest birth cohorts, two-third of the male population belongs to the low educational group. From cohort 1946-1955 onwards we observe a shift in this trend, i.e. the proportion of individuals with a low educational degree declines whereas that with medium and high degrees increase. Of those individuals who were born after 1970, only one third belongs to the low educational group. This educational effect is more pronounced for females than for males.

Figure 1: Change in the Proportion of Males with Low, Medium and High Educational Degree by Birth Cohort



Source: German Micro-census 1995, 1999, 2003, 2005, own calculations

Figure 2: Change in the Proportion of Females with Low, Medium and High Educational Degree by Birth Cohort



Source: German Micro-census 1995, 1999, 2003, 2005, own calculations

These changes are reflected by overall improvements in health and increases in life expectancy. Hence, we would also expect to find improvements in the overall risk factor profile over succeeding birth cohorts.

Nonetheless, the influence of educational level on smoking and dietary patterns has been well established, generally finding better health outcomes for higher educated people. (Escobedo et al. 1990, Helmert et al. 2001, Lampert & Burger 2004, 2005, Hurrelmann and Albert 2006, Helmert and Strube 2004, Mensink et al. 2005).

According to Brenner 1993 in cohorts born before 1920, smoking prevalences were only slightly lower in men with higher levels of education compared to less educated men. However, whereas peak prevalences fell from 70 percent to about 40 percent for high educated males beginning in the 1970, only minor decreases in the less educated males of the same birth cohort were observed. In contrast, smoking for females born before 1920 was very unlikely. Prevalences increased substantially over succeeding birth cohorts approximating level of males, whereby he found no differences in this development between educational states.

There are a number of other personal characteristic promoting smoking, overweight and obesity than discussed above; In this paper we will only present the effects of age, cohort and education although important influencing factors are accounted for in our analysis.

Research indicates, for instance, that marriage has health promoting effects due to greater financial and material resources, greater social support and better health related behavior. (Doblhammer et al. 2009) Studies on smoking show that males living alone from age 45 onwards as well as young fathers have higher smoking prevalences than males in partnership. Lowest prevalences were found for males in partnership and without children (Lampert and Burger 2005). For females highest smoking prevalences were found for single mothers, whereas females in partnership with children have lowest prevalences (Lampert and Burger 2005). Helmert and Buitkamp 2004 show that divorced males have 50% higher smoking prevalences compared to married men, and divorced females smoke twice as much as married women. In contrast, marriage is positively associated with overweight and obesity. However, this seems to be true only for males. For females, no clear relationship was found (Sobal and Rauschenbach 2003, Sobal et al. 2009).

Due to different sets of belief and moral concepts, life styles and, thus, health behaviors might also differ between Germans and individuals with foreign family

background. For smoking, studies show that male migrants have lower prevalences than Germans at younger ages, however higher prevalences for migrants were found in the middle age groups. For non-German females lower prevalences were found in all age groups (Lampert & Burger 2005). Studies on overweight and obesity show that middle-aged females with migration background have higher prevalences of overweight and obesity compared to their German counterparts. This might be explained by different weight consciousness and body images as well as lower physical activity. However, the difference disappears above age 75. For males, no differences between German and Non-Germans were found (Robert-Koch-Institut 2008).

Moreover, studies find variations in smoking, overweight and obesity between federal states. The Robert-Koch-Institut 2009 report increases of obesity between 1999 and 2005 in all federal states, whereby increases were similar between East and West Germany. Yet, they find only minor increases of one percent in Bremen und Thüringen, but four percent in Saarland and Mecklenburg-Western Pomerania. For smoking highest prevlences were found for females in Berlin (27 percent), Mecklenburg-Western Pomerania (26 percent) and Hamburg (25 percent). Females in Saxony have lowest smoking prevalences (17 percent) followed by Bavaria and Baden-Württemberg (19 percent) and Thüringen (20 percent). For males, smoking prevalences are highest in Mecklenburg-Western Pomerania (39 percent). Likewise, prevalences are high in Brandenburg, Thüringen, Sachsen-Anhalt and Berlin, Bremen and Hamburg (36 percent). Lowest prevalences are found in Bavaria and Baden-Württemberg with 27 percent.

Differences in risk factor frequency do also exist in respect to community size. Studies show that smoking prevalences are higher in metropolitan areas than in rural areas (Völzke et al. 2006b). This seems to be especially true for females. Helmert and Buitkamp 2004 find that females living in communities with more than 500.000 inhabitants have 50 percent higher smoking prevalences compared to females living in communities with less than 5.000 inhabitants. For obesity, in contrast, the opposite seems to be true. Helmert and Strube 2004 find higher prevalences with decreasing community size. In communities with less than 5000 inhabitants roughly 25 percent are obese, whereas this is true for only 15 percent in communities with more than 500.000 inhabitants.

Beyond, we include income type in our analysis. Individuals who receive their monthly income from gainful occupation are supposed to have a better risk factor profile compared to those who receive there monthly income predominantly through state subsidies. An explanation is that unemployment and subsidy dependency impose stress on individuals for which smoking and poor dietary patterns might serve as stress coping mechanisms.

4. Data and Methods

Our analysis is based on the German Micro-census, which is a 1% percent household sample conducted once a year since 1957 in the former BRD and since 1991 also in East Germany. The participation in the survey is obligatory by law. The questionnaire generally comprises two parts: the stationary basic program that provides information on socio-demographics and allows for a regular supervision of the labor market, and the annual complement program that provides further information on occupational aspects. Beyond, there are additional programs containing information on changing topics, of which health is one part. The response to these questions is optional.

Eligible for participation are registered residents living in private households or public institutions, including also foreign households. Family members of foreign armed forces and diplomatic missions are not included in the sample. The participating households are randomly selected by cluster sampling. Since homeless people cannot be captured with cluster sampling, they are naturally excluded from the survey.

The interviews are predominantly conducted by interviewers through paper and pencil personal interviewing (PAPI) or, since the 1990s, also by computer assisted personal interviews (CAPI). Yet, 20 percent of the interviewees provide their information in written form. Since the German Microcensus is a household sample, all participants of the household are directly interviewed or a proxy provides information on all underage household members.

The Scientific Use File (SUF), on which we base our analysis, is a 70% subsample of the original sample, provided for scientific usage without restrictions. Information on smoking and obesity is provided in the additional health program. Until 2004, only 45% percent of the original sample was included in the additional program, however, since

2005 the whole sample is incorporated. Sampling weights are provided to correct for systematic missings, random sampling errors and to adjust the data to the total population.

Information on smoking is included for the years 1995, 1999, 2003 and 2005. For obesity, information is only available for the last three years. The overall sample size for each wave is about 500.000 individuals.

All three, respectively, four waves were pooled into one dataset. Thus the dataset on smoking contains 1.978.464 individuals, that for obesity 1.335.134 individuals.

In a first step, we estimate a logistic regression model for each of the three dependent variables according to formula (I)

$$\ln\left(\frac{p}{1-p}\right) = \beta_0 + \sum_{i=1}^{n} \beta_i x_i \qquad \text{(I)}$$

x_i denotes the covariates age, cohort, period of observation, nationality, marital status, income type, educational status, federal states and community size. The covariates are included as dummy variables taking the value 1 if a characteristic applies and 0 if otherwise; β_i denotes the estimator of the logistic regression model.

Based on the logistic regressions we estimate probabilities of the dependent variables (smoking, overweight, obesity) according to formula (II)

$$p = \frac{e^{\beta_0 + \beta_j x_j}}{1 + e^{\beta_0 + \beta_j x_j}} \qquad \text{(II)}$$

j denotes the respective independent variable (e.g. cohort, age, cohort by education) keeping the value of the other covariates constant in the reference groups.

We estimate interaction models to explore variations in each of the three dependent variables between low and high educational groups. We estimate all logistic regression models separately for males and females in East and West Germany.

The smoking variable was generated by the two variables that were asked in the same wording for all four included waves: “Are you a current smoker?” and “Have you ever smoked in the past?” Possible answer categories for both questions were regularly, occasionally, no and no answer. Those who reported to smoke on a regular or occasional basis at present or smoked in the past are classified as ever smokers. Those who have neither smoked in the past nor smoke at present are classified as never smoker. Children below age ten are not asked questions on smoking, thus, they are excluded as default missings. Individuals who did not answer or for whom smoking status could not be clearly determined, for instance because they provided no answer for the first questions but answered *no* for the second one, were also excluded from the analysis. Thus, the sample size after all exclusions is 921.741.

The data on overweight and obesity are based on self reported measurements on weight and height. Body Mass Index (BMI) was calculated by dividing the weight by the squared height (kg/m²). A BMI below 18.5 was classified as underweight, individuals with a BMI between 18.5 and 24.9 belong to the normal weight category, those with a BMI between 25 and 30 are classified as overweight, and those with a BMI above 30 as obese. For individuals below age 18, percentiles according to Kromeyer-Hauschild et al. 2001) were used, to account for the differences in body composition between children and adults. Children below age 10 were not asked questions on weight and height, thus they are excluded as default missings. Individuals, for whom no information on both weight and height was available, were excluded as well. Thus, the final sample size for analyzing overweight and obesity was 530.908.

Included covariates are age, cohort, period of observation, nationality, marital status, income type, educational status, federal states and community size.

To control for age effects we included the following five year age groups in our analysis: 10-14, 15-19, 20-24, 25-29, 30-34, 35-39, 40-44, 45-49, 50-54, 55-59, 60-69, 70-74, 75-79, 80-84, 85-89, 90-94 and 95+. In all models, the reference group is age 20-24.

To estimate the cohort effect, we include the following twelve birth cohorts: <1915, 1916-1925, 1926-1935, 1936-1945, 1946-55, 1956-1965, 1966-1970, 1971-1975, 1976-1980, 1981-1985, 1986-1990 and 1991-1995. For all models, the reference group is the

birth cohort 1946-1955. We focus on cohorts born until 1945, and born between 1946 and 1970. The former are the people aged 60+ today, the latter those aged 60+ in the years to come until 2030.

We generated the variable educational status by combining information on educational degree. Individuals with no or only basic education (elementary school) are classified as low educated. Those with a secondary degree - in Germany individuals who received ten years of school education- are considered medium educated. Those with more than secondary education are classified as highly educated. Children below age 15 and students who haven't finished their first degree yet, are excluded as default missings. Where applicable in those cases, we assigned individuals below age 20, who have not received their first degree yet, the educational status of the household principal.

For the interaction models, education takes only the values high and low, whereby the low category includes also individuals with medium education. In all models, the reference group is high education.

We consider the four marital states single, married, divorced and widowed, whereby single persons serve as reference category in all models.

We distinguish between Germans and non-Germans. The Non-German group includes all individuals whose first nationality is not German. We are not distinguishing between different nationalities. In all models Germans serve as reference group.

The variable income type distinguishes between gainful occupation, state subsidies, other support than public, and personal assets. Gainful occupation serves as reference group for all models.

The regional variable federal state comprises all 16 German States and is adopted as provided in the original data set.

The variable community size is divided into communities with less 20.000, 20.000 to 500.000 and more than 500.000 inhabitants.

The variable East and West Germany was generated by combining information on federal states. Berlin was divided into East and West according to the code key provided by the Statistical Office.

Moreover, we control for the period of observation, with 1999 as reference category for all models.

5. Results

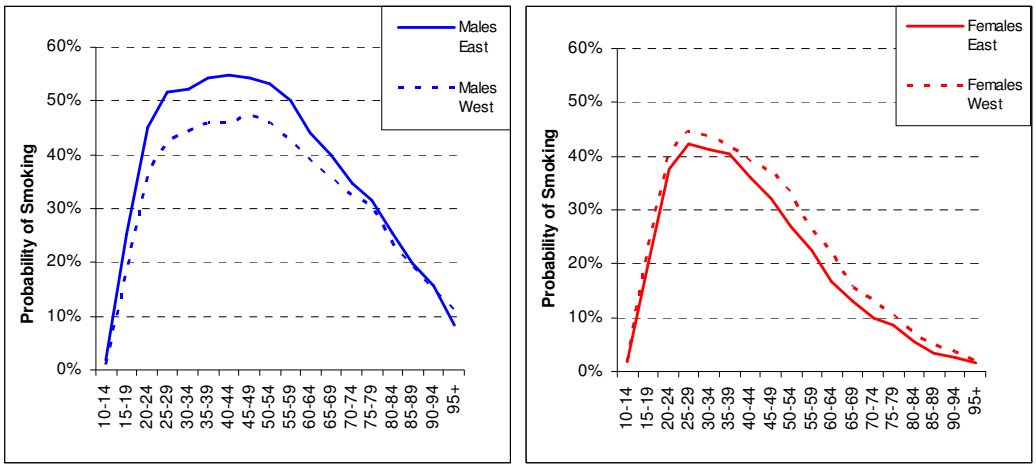
The presented results are based on probabilities derived from the logistic regression models, i.e. the presented percentages account for possible structural changes in the study population due to the covariates included in the analysis. Although this paper focuses on cohort effects and their differences between East and West Germany we first present age-specific profiles and the general effect of education on the three risk factors.

5.1. Age Effect

Figure 3 presents the age effect for smoking. Up to middle ages the probability of smoking increases with age and declines thereafter partly reflecting mortality selection. At young ages, there are no considerable differences between males and females. Between age 15 and 19, about 25 percent report that they have ever made smoking experiences. This probability increases to about 50 percent between age 25 and 29. For females, smoking probabilities are with 47 percent highest for this age group and decline over succeeding age groups. Probabilities for males are continuously increasing until age 45 to 49 (57 percent) and decrease thereafter. There are differences in smoking probabilities between East and West Germany. West German females have slightly higher smoking probabilities than females in the East. In contrast, probabilities are lower for West German males. This picture holds true for all age groups, except for males where probabilities are nearly the same from age 75 onwards.

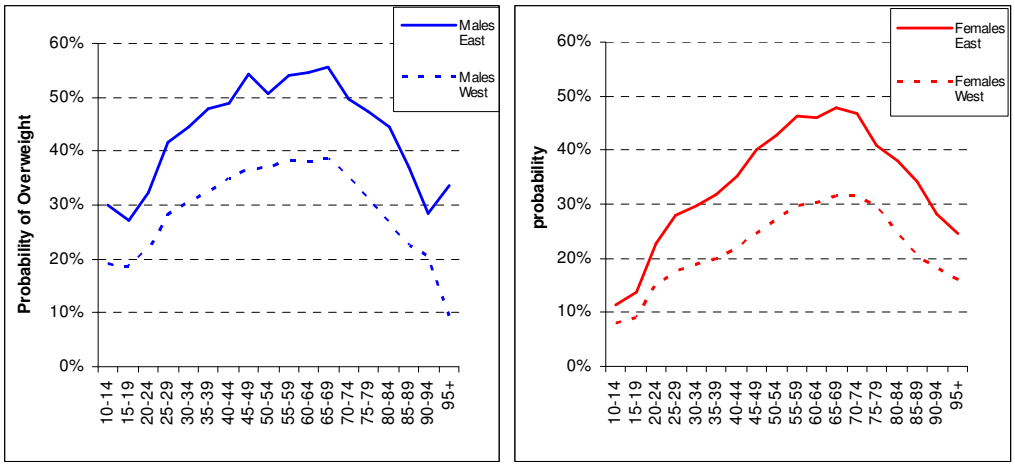
Overweight is continuously increasing with age up to approximately age 75 (Figure 4). Thereafter, we observe a decrease in the probability of overweight for both sexes which is probably due to selection effects of mortality and weight-loss due to morbidity. Probabilities are generally higher for males than for females, except at old ages, where they are the same. Although the profile of the age effect is the same in East and West Germany, probabilities are higher in the East for both sexes. The peak prevalence for East German males is 55 percent; that for West German males is about 40 percent. For females, this difference is even more pronounced. The peak prevalence in the East is 50 percent whereas it is about 30 percent in the West.

Figure 3: Probability of Smoking for Males and Females in East and West Germany by Age Groups



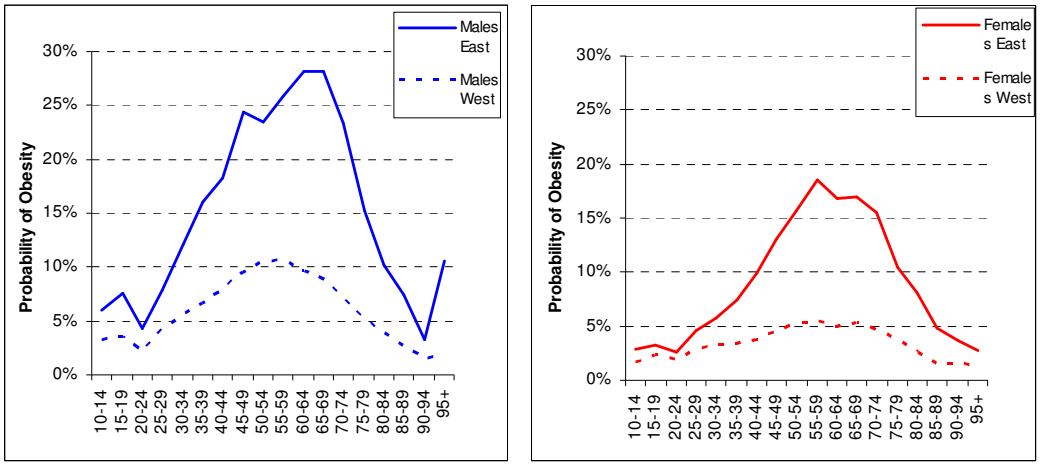
Controlled for: cohort, educational status, marital status, nationality, period of observation, income type, federal states, community size

Figure 4: Probability of Overweight for Males and Females in East and West Germany by Age Groups



Controlled for: cohort, educational status, marital status, nationality, period of observation, income type, federal states, community size, smoking status

Figure 5: Probability of Obesity for Males and Females in East and West Germany by Age Groups



Controlled for: cohort, educational status, marital status, nationality, period of observation, income type, federal states, community size, smoking status

Obesity is increasing with age (Figure 5) and peaks at ages 65 to 69 for males and at ages 55 to 59 for females. The probability of obesity is considerably higher for males than for females for all age groups up to age 75. There are pronounced differences between East and West Germany with higher probabilities in the East. Whereas the peak-prevalence for males in the East is 28 percent, it is only ten percent for males in the West. For females in the East, the peak-prevalence is 18 percent, whereas it is only six percent for females in the West.

5.2. The Influence of Education on Smoking, Overweight and Obesity.

Table 1 shows the odds ratios for smoking by educational status. For all models, individuals with high education serve as the reference group. For males in East and West Germany, we find a clear educational gradient with highest smoking risks in the lowest educational group. These differences are significant. For females, in contrast, we find no significant differences in the risk of smoking between educational groups for both parts of the country.

Table 1: Effect of Education on Smoking

	Males						Females					
	East			West			East			West		
	OR	CI low	CI up	**OR**	CI low	CI up	**OR**	CI low	CI up	**OR**	CI low	CI up
low	**2.13**	2.04	- 2.23	**1.92**	1.89	- 1.96	**1.63**	1.54	- 1.73	**1.55**	1.51	- 1.58
medium	**1.88**	1.81	- 1.96	**1.62**	1.58	- 1.65	**1.73**	1.65	- 1.80	**1.50**	1.47	- 1.54
missings	**1.41**	1.25	- 1.59	**1.41**	1.35	- 1.48	**1.55**	1.36	- 1.77	**1.21**	1.15	- 1.27

Controlled for: age, cohort, marital status, nationality, period of observation, income type, federal states, community size,

Table 2 presents the odds ratios for the risk of overweight. For males in East Germany we find the lowest risk of overweight in the highest educational group. However, there are no significant differences between medium and low education. In contrast, for males in West Germany, a clear social gradient is observed. For females, we also find a clear educational gradient in both parts of the country, with the lowest risk of overweight in the highest educational group.

Table 2: Effect of Education on Overweight

	Males						Females					
	East			West			East			West		
	OR	CI low	CI up	**OR**	CI low	CI up	**OR**	CI low	CI up	**OR**	CI low	CI up
low	**1.38**	1.30	- 1.46	**1.67**	1.63	- 1.71	**1.79**	1.68	- 1.92	**2.10**	2.04	- 2.16
medium	**1.35**	1.29	- 1.42	**1.33**	1.29	- 1.37	**1.42**	1.35	- 1.50	**1.41**	1.37	- 1.46
missings	**1.26**	1.05	- 1.50	**1.42**	1.32	- 1.54	**1.29**	1.08	- 1.54	**1.61**	1.49	- 1.74

Controlled for: age, cohort, marital status, nationality, period of observation, income type, federal states, community size, smoking status

Table 3 depicts the influence of educational status on obesity. Here, we find a clear educational gradient for both sexes in both parts of the country. All differences are statistically significant.

Table 3: Effect of education on obesity

	Males						Females					
	East			West			East			West		
	OR	CI low	CI up	**OR**	CI low	CI up	**OR**	CI low	CI up	**OR**	CI low	CI up
low	**2.35**	2.16	- 2.56	**2.86**	2.76	- 2.97	**3.95**	3.58	- 4.36	**4.03**	3.84	- 4.23
medium	**1.85**	1.71	- 2.00	**1.73**	1.65	- 1.81	**2.04**	1.87	- 2.23	**1.86**	1.76	- 1.96
missings	**1.61**	1.26	- 2.06	**2.30**	2.06	- 2.58	**1.93**	1.50	- 2.47	**2.80**	2.50	- 3.13

Controlled for: age, cohort, marital status, nationality, period of observation, income type, federal states, community size, smoking status

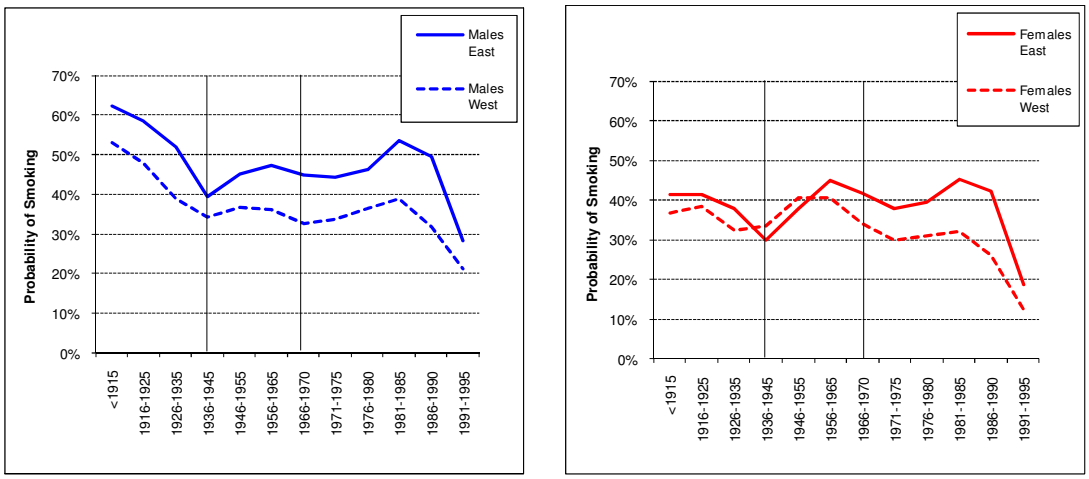
5.3. Cohort Effects

In the following, we present the results of the cohort analysis. We focus on the cohorts born before 1945 and the cohorts born between 1946 and 1970. The former are named pre-1945-cohorts, the latter post-1945-cohorts. The pre-1945 cohorts comprise individuals who are 60 and older in 2005, the post-1945-cohorts include people who will be 60 years and older up to 2030. In the presentation of the results we focus on these two groups of cohorts. Nevertheless the following figures do also contain information about cohorts younger than 1970 in order to allow a visual impression, how risk factors might develop among the elderly beyond 2030.

5.3.1. Cohort Effect of Smoking

Figure 6: Probability of Smoking for Males and Females in East and West Germany by Birth Cohort

Males **Females**



Controlled for: age, educational status, marital status, nationality, period of observation, income type, federal states, community size

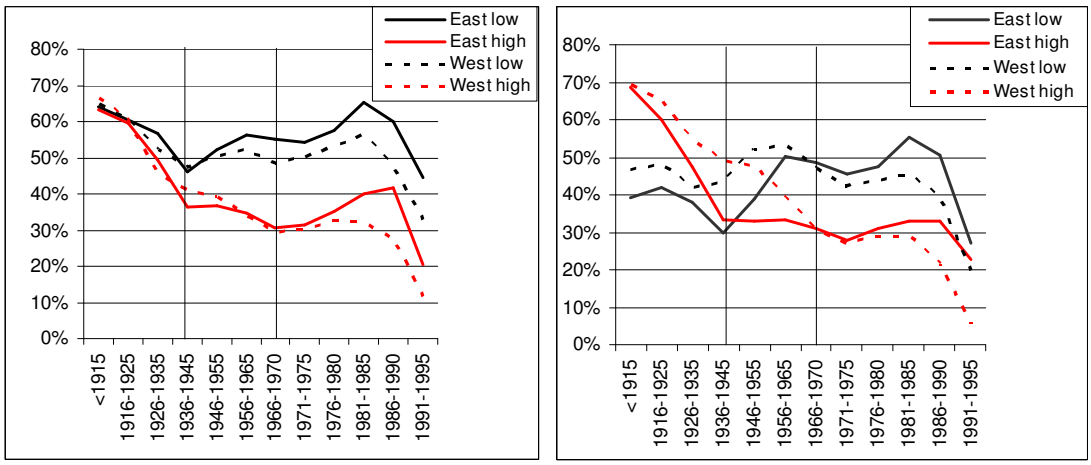
For males in the pre-1945-cohorts smoking probabilities are decreasing over succeeding birth cohorts (Figure 6). Although probabilities are generally higher in the East, we find no difference in the cohort pattern between East and West Germany. In the East, the smoking probability has decreased from 60 percent in the oldest cohort to 40 percent in the cohort 1936-1945. In the West probabilities decreased from 55 percent to 35 percent. For the post-1945-cohorts we find a divergence of smoking trends between East and West Germany. Whereas probabilities remain relatively stable at about 35 percent for males in the West, they have increased in the East from 40 to about 50 percent.

For females there is a converging trend for the pre-1945-cohorts. Overall, smoking probabilities are decreasing in both parts of the country whereby probabilities are slightly lower in the West. However, probabilities increase again in the West from cohort 1926-1935 onwards, whereas they continue to decrease in the East. For the post-1945-cohorts smoking trends are diverging between East and West Germany. Probabilities are increasing until birth cohort 1956-1965 in both parts of the country, whereby probabilities are slightly higher in the West! In the subsequent birth cohorts, smoking probabilities decrease in both parts of the country. This decline is more pronounced

among West German females, explaining the diverging trend.

Figure 7: Educational Differences in the Probability of Smoking by Cohort, Sex and East/West Germany

Males Females



Controlled for: age, marital status, nationality, period of observation, income type, federal states, community size,

The analysis of cohort patterns by educational groups (Figure 7) shows that in the pre-1945-cohorts reductions in male probabilities of smoking are similar in East and West Germany, and in both educational groups. In contrast, for males in the post-1945-cohorts, we find differing trends between both parts of the country, particularly within the low educational group. Whereas smoking probabilities decline equally in the high educational groups, we find increases in smoking in the low educational group up to birth cohort 1956-1965. The increase is larger in the East. In the subsequent cohorts, smoking probabilities decrease as well in both parts of the country, with a lower decrease, however, in the East. Hence, the observed diverging smoking trend between East and West Germany is mainly caused by stronger increases followed by weaker reductions in smoking in the low educational group in the East.

The cohort analysis by educational groups for smoking females reveals a quite complex pattern reflecting female uptake of smoking in the two educational groups. For the pre-1945-cohorts there are diverging trends within educational groups between East and West Germany, but a convergence of trends between educational groups within each

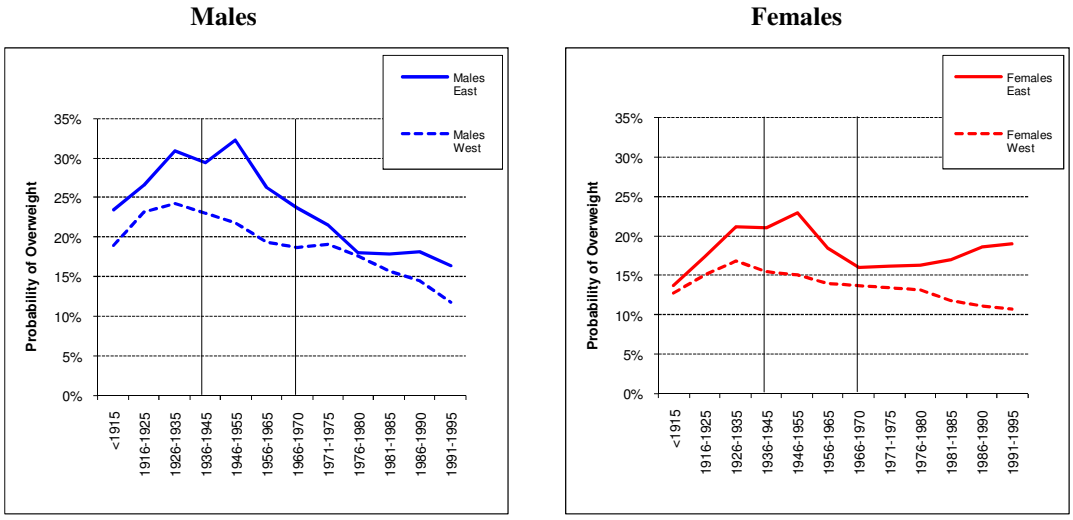
part of the country. Within the high educational group, smoking probabilities are constantly decreasing over succeeding birth cohorts. This decline is more pronounced in the East, resulting in a divergence of trends between both parts of the country. Within the low educational group there is a decrease in both parts of the country until birth cohort 1926-1935. However, whereas smoking probabilities are further decreasing in the East, they increase in the West. Hence, the converging trend between East and West Germany for the pre-1945-cohorts is caused by stronger decreases in smoking in the high educational group in the East and by an increase in the low educational group in the West.

For females in the post-1945-cohorts we find converging trends between East and West Germany within educational groups, but a divergence of educational groups within each part of the country. The probability of smoking within the high educational group is stagnating in the East at a level of about 30 percent, whereas it is decreasing for females in the West, resulting in the convergence of trends. Within the low educational group smoking probabilities are increasing in both parts of the country. However, this increase is stronger in the East resulting also in a convergence of trends.

Hence, the observed divergence between East and West Germany for females in the post-1945-cohorts results from two converging trends within the educational groups.

5.3.2. *Cohort Effect of Overweight*

Figure 8 Probability of Overweight for Males and Females in East and West Germany by Birth Cohort



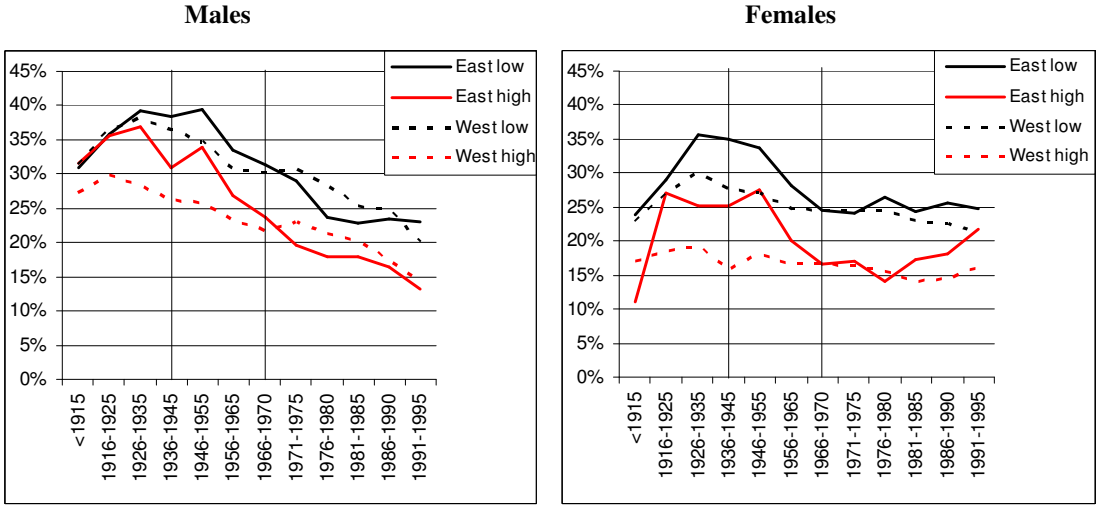
Controlled for age, educational status, marital status, nationality, period of observation, income type, federal states, community size, smoking status

Figure 8 presents the results for the cohort analysis of overweight. Overall, the probability of overweight is higher in East Germany for both males and females. For males we find a parallel cohort pattern for the pre-1945-cohorts. For them, the probability of overweight is increasing until birth cohorts 1926-35 and decreases thereafter in both parts of the country. For males in the post-1945-cohorts there exist two opposing trends. Up to cohorts 1946-1955 we observe a strong increase in the probability of overweight in the East, whereas probabilities decrease in the West. Hence, for these cohorts, trends in overweight are diverging. Over the subsequent cohorts, the trend is converging again, due to a decrease in overweight that is stronger in the East.

For females in the pre-1945-cohorts there exists a diverging trend between East and West Germany. Up to birth cohort 1926-1935 probabilities of overweight are increasing in both parts of the country, however increases are stronger in the East. For the subsequent cohorts we find a decrease in overweight probabilities that is more pronounced in the West. For the post-1945-cohorts we find the same pattern as for males, i.e a diverging

trend up to cohort 1946-1955 due to strong increases in the East that is followed by a sharp decrease over succeeding birth cohorts.

Figure 9: Educational Differences in the Probability of Overweight by Cohort, Sex and East/West Germany



Controlled for: age, marital status, nationality, period of observation, income type, federal states, community size, smoking status

Figure 9 depicts the results of the cohort analysis by educational groups. In both educational groups the probability of overweight is higher in the East than in the West. For males, there is a decline in overweight from the 1915-1926 cohorts onwards. In the most recent post-1945 cohort this decline is stronger for males in the East, particularly those with high education, resulting into a convergence of overweight between the two parts of the country.

A departure from this general trend exists for the 1946-1955-cohort in the East due to an intermediary peak in overweight for both educational groups, which does not exist in the West. Interestingly, for the birth cohort 1946-1955 the East-West difference equals the difference between educational groups in the West.

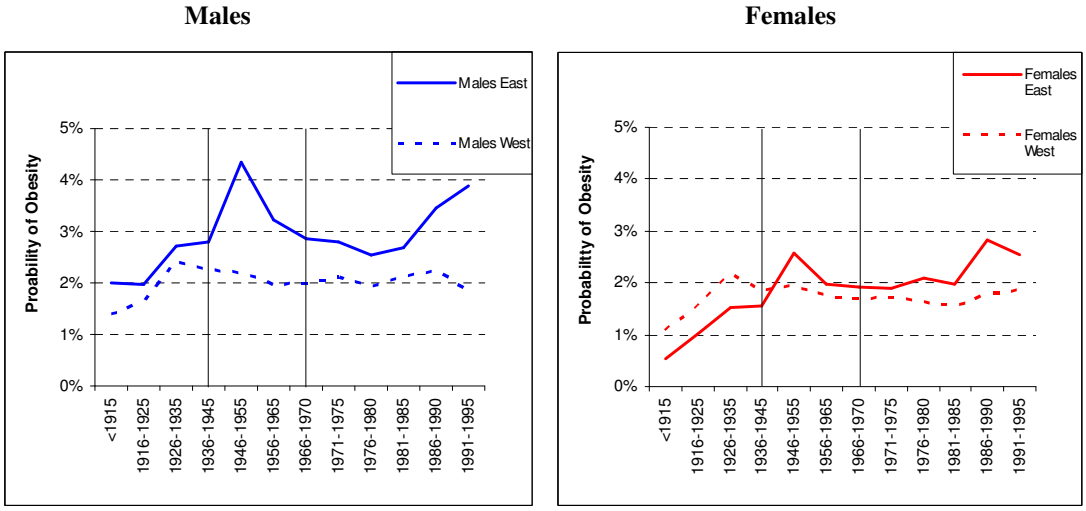
For females in the pre-1945-cohorts there exists a diverging trend within the low educational group, but a parallel trend within the high educational group, albeit overweight probabilities are higher in the East.

For the post-1945-cohorts we find a similar cohort pattern by educational groups as for males with a peak in overweight for the cohort 1946-55 in the high educational group in the East

5.3.3. Cohort Effect of Obesity

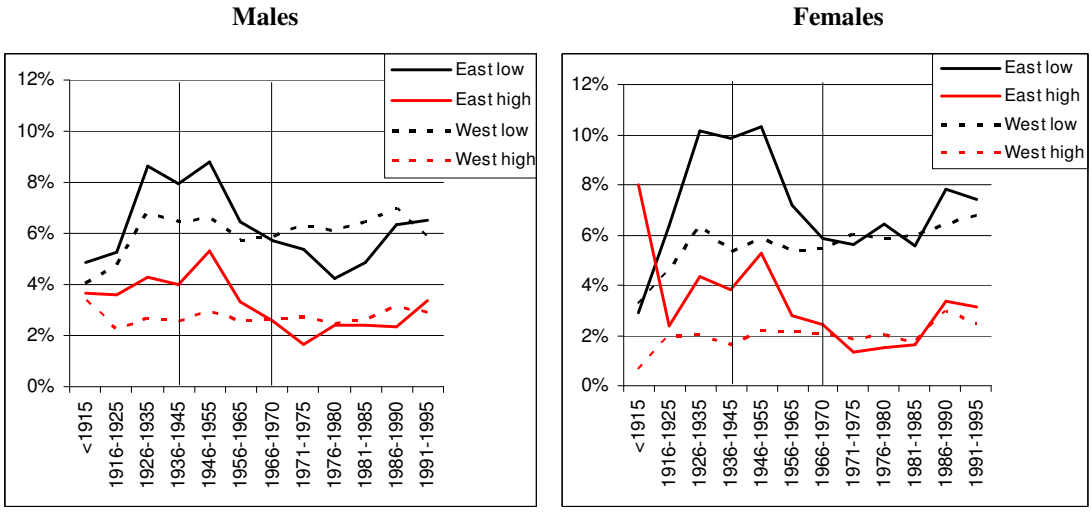
Starting with the 1926-1935-cohort the two parts of the country start to diverge in the obesity patterns of males. We find strong increases in East German males that peak in the 1946-1955-cohort followed by a decrease up to the 1966-1970-cohort (Figure 10). At the same time obesity levels among West German males remain unchanged at approximately two percent. Cohort-trends are similar for females, however, they result in smaller differences between the two parts of the country. Cohort patterns in obesity develop similarly in both educational groups. It is interesting to note that differences between East and West Germany are particularly large among low-educated females.

Figure 10: Probability of Obesity for Males and Females in East and West Germany by Birth Cohort



Controlled for: age, educational status, marital status, nationality, period of observation, income type, federal states, community size, smoking status

Figure 11: Educational Differences in the Probability of Obesity by Cohort, Sex and East/West Germany



Controlled for: age, marital status, nationality, period of observation, income type, federal states, community size, smoking status

5.4. Discussion:

The aim of this paper is to analyze variations in the three risk factors smoking, overweight and obesity between twelve different birth cohorts. We examined whether there are differences in the risk factor profiles between East and West Germany and whether these differences depend on education. Considering the current trends and patterns in the three risk factors, in the following we discuss possible consequences for the health status of the future elderly population until 2030.

Concerning smoking, our results show that differences between educational groups will become more important in the future than they are today. For males we find a clear diverging trend between educational groups in both parts of the country, with higher probabilities in the low educational group. However, whereas there exist no considerable differences in smoking patterns within the high educational group we find a widening gap between both parts of the country in the low educational group, favoring males in the West. Hence, for the future we expect a widening gap in the probability of smoking between East and West Germany for males due to increasing disparities within the low educational group.

For females we also expect increasing differences between both parts of the country, due to stronger reductions in smoking in the West. Nonetheless, we expect smoking disparities between educational groups to increase in both parts of the country as well, albeit differences between the East and the West within educational groups will diminish.

Hence, education is the most important driver for disparities in smoking with higher smoking rates among people with low educational status. Several studies have shown that smoking prevalences are varying across social groups, generally finding lower smoking prevalences among individuals with higher social status. This finding is often explained by a generally lower health consciousness among people of lower socioeconomic status. Moreover, socially disadvantaged groups are faced more frequently with a physically and mentally burdening work environment and have more often problems and conflicts within the family (Lampert and Burger 2005). Hence, smoking might serve, mistakenly, as a compensator for these stressors. Thus, in order to reduce smoking successfully in the future, policy measures should target especially individuals in the low educational group and aim at reducing smoking promoting stressors and settings.

Our results on overweight and obesity show that overall, probabilities are declining over succeeding birth cohorts in both parts of the country. However, we observe a strong diverging trend between East and West Germany for both sexes in both educational groups with very strong increases in probabilities in the East, particularly for the cohorts born between 1946 and 1955. This might reflect the 'thrifty phenotype hypothesis' (for review see Leon 2004). This hypothesis proposes that poor nutrition in foetal and early infant life results in the development of a metabolism which is well equipped to survive in harsh environments. If the environment later in life, however, does provide high energy- food and is full of plenty, this leads to an increased risk of a variety of health problems such as diabetes, and cardiovascular disease. Since we can assume nutritional deficiencies in pregnant females (and hence their fetuses) during World War II and shortly after (especially in East Germany due to the occupation by the UDSSR) in connection with opulent food especially in times of reconstructing Germany, these cohorts may have developed the thrifty phenotype to a larger extent than the previous or the following cohorts. Unfortunately, due to data limitations we cannot analyze the

central indicator of the thrifty phenotype hypothesis, namely diabetes type II, however, it is well known that diabetes and obesity go hand in hand.

For the subsequent cohorts we find a converging trend between East and West Germany, however, differences between educational groups persist, with higher rates of overweight and obesity in the low educational group. Hence for the future elderly population we expect a gap between East and West for both sexes especially for the cohorts born after the Second World War that is reducing over succeeding birth cohorts, yet educational differences are expected to remain.

Literature suggest that gains in life expectancy over the last decades might be offset in the future by increases in overweight and obesity. (Cutler et al. 2007, Olshansky et al. 2005). Although our analysis shows that probabilities of overweight and obesity are decreasing over succeeding birth cohorts, the share of obese and overweight people on the total population will increase in the future, since a greater number of people reaches ages in which overweight and obesity are more likely. Hence, in order to reduce negative health consequences, measures to reduce weight and enhance physical activity are indispensible. Again, special attention should be paid to individuals with low educational status.

Literature

Andreyeva, T.; P.-C., M. and van Soest, A. (2007): "Obesity and Health in Europeans Aged 50 Years and Older". *Public Health* 121: 497-509.

Becker, R. andLauterbach, W. (2008): "Bildung als Privileg - Ursachen, Mechanismen, Prozesse und Wirkungen". in: R. Becker and L. Wolfgang: *Bildung als Privileg. Erklärungen und Befunde zu den Ursachen der Bildungsungleichheit.* Wiebaden, VS Verlag für Sozialwissenschaften.

Brenner, H. (1993): "A Birth Cohort Analysis of the Smoking Epidemic in West Germany". *Journal of Epidemiology and Community Health* 47: 54-58.

Christensen, K.; Doblhammer, G.; Rau, R. et al. (2009): "Ageing Populations: The Challenges Ahead". *The Lancet* 374: 1196-1208.

Cutler, D. M.; Glaeser, E. L. andRosen, A. B. (2007): "IS THE US POPULATION BEHAVING HEALTHIER? " NBER Conference on Retirement Research. Cambridge, Massachusetts U.S.A.

Doblhammer, G.; Hoffmann, R.; Muth, E. et al. (2010): "The Effect of Sex, Obesity and Smoking on Health Transistions: A Statistical Meta-Analysis". in: G. Doblhammer and R. Scholz: *Ageing, Care Need and Quality of Life*. Wiesbaden, VS Verlag. 114 - 142.

Doblhammer, G.; Hoffmann, R.; Muth, E. et al. (2009): "A Systematic Literature Review of Studies Analyzing the Effects of Sex, Age, Education, Marital Status, Obesity, and Smoking on Health Transitions". *Demographic Research* 20: 37-64.

Escobedo, L. G.; Anda, R. F.; Smith, P. F. et al. (1990): "Sociodemographic Characteristics of Cigarette Smoking Initiation in the United States. Implications for Smoking Prevention Policy". *JAMA* 264(12): 1550-1555.

Gesundheitsberichterstattung des Bundes (2006): "Gesundheit in Deutschland".

Hadjar, A. andBecker, R., Eds. (2009): Expected and Unexpected Consequences of the Educational Expansion in Europe and the U.S.

Helmert, U.; Borgers, D. andBammann, K. (2001): "Soziale Determinanten des Rauchverhaltens in Deutschland: Ergebnisse des Mikrozensus 1995". *Sozial- und Präventivmedizin/Social and Preventive Medicine* 46(3): 172 - 181.

Helmert, U. andBuitkamp, M. (2004): "Die Veränderung des Rauchverhaltens in Deutschland von 1985-2002". *Gesundheitswesen* 66: 102-104.

Helmert, U. andStrube, H. (2004): "Die Entwicklung der Adipositas in Deutschland im Zeitraum von 1985 bis 2002". *Gesundheitswesen* 66: 409-415.

Hurrelmann, K. (2006): "Gesundheitssoziologie. Eine Einführung in Sozailwissenschaftliche Theorien von Krankheitsprävention und Gesundheitsförderung". Weinheim und München, Juventa Verlag.

Hurrelmann, K. andAlbert, M. (2006): "Jugend 2006 - 15. Shell Jugendstudie". Frankfurt am Main, S. Fischer Verlag.

International Agency for Research on Cancer (2004): "Tobacco Smoke and Involuntary Smoking". IARC Monographs on the Evaluation of the Carciogenic Risk to Humans,

John, U. andHanke, M. (2001): "Tabakrauch-attributable Mortalität in den deutschen Bundesländern". *Gesundheitswesen* 63(6): 363-369.

Kromeyer-Hauschild, K.; Wabitsch, M.; Kunze, D. et al. (2001): "Perzentile für den Body-Mass-Index für das Kindes- und Jugendalter unter Heranziehung

verschiedener deutscher Stichproben". *Monatsschrift Kinderheilkunde* 149(8): 807 - 818.

Lampert, T. andBurger, M. (2004): "Rauchgewohnheiten in Deutschland - Ergebnisse des telefonischen Bundes-Gesundheitssurveys 2003". *Gesundheitswesen* 66: 511-517.

Lampert, T. andBurger, M. (2005): "Verbreitung und Strukturen des Tabakkonsums in Deutschland". *Bundesgesundheitsblatt. Gesundheitsforschung. Gesundheitsschutz* 48: 1231-1241.

Leon, D. A. (2004): "Biological Theories, Evidence and Epidemiology". *International Journal of Epidemiology* 33: 1167-1171.

Mensink, G. B. M.; Lampert, T. andBergmann, E. (2005): "Übergewicht und Adipositas in Deutschland 1984-2003". *Bundesgesundheitsblatt. Gesundheitsforschung. Gesundheitsschutz* 48: 1348-1356.

Neubauer, S.; Welte, R.; Beiche, A. et al. (2006): "Mortality, Morbidity and Costs attribuable to smoking in Germany: update and a 10-year comparison". *Tobacco Control* 15: 464-471.

Nolte, E.; Shkolnikov, V. andMcKee, M. (2000a): "Changing Mortality Patterns in East and West Germany and Poland.I: Long Term Trends (1960-1997)". *Journal of Epidemiology and Community Health* 50: 890-898.

Oeppen, J. andVaupel, J. W. (2002): "Broken Limits to Life Expectancy". *Science* 296(1029-1031).

Olshansky, J. S.; Passaro, D. J.; Hershow, R. C. et al. (2005): "A Potential Decline in Life Expectancy in the United States in the 21st Century". *The New England Journal of Medicine* 352: 1138-1145.

Preston, S. H.; Glei, D. A. and Wilmoth, J. R. (2010): "A New Method for Estimating Smoking-Attributable Mortality in High Income Countries". *International Journal of Epidemiology* 39: 430-438.

Preston, S. H. and Wang, H. (2006): "Sex Mortality Differences in the United States: The Role of Cohort Smoking Patterns". *Demography* 43(4): 631-646.

Reither, E. N.; Hauser, R. M. and Yang, Y. (2009): "Do birth cohorts matter? Age-Period-Cohort Analyses of the Obesity Epidemic in the United States". *Social Science and Medicine* 69: 1439-1448.

Robert-Koch-Institut (2006a): "Telefonischer Gesundheitssuvey des Robert Koch-Instituts (2.Welle)".

Robert-Koch-Institut (2008): "Migration und Gesundheit". Gesundheitsberichterstattung des Bundes,

Robert-Koch-Institut (2009): "20 Jahre nach dem Fall der Mauer: Wie hat sich die Gesundheit in Deutschland entwickelt?" Beiträge zur Gesundheitsberichterstattung des Bundes,

Ruff, L. K.; Volmer, T.; Nowak, D. et al. (2000): "The Economic Impact of Smoking in Germany". *European Respiratory Journal* 16: 385-390.

Schulze, U. andMons, U. (2005): "Trends in cigarette smoking initiation and cessation among birth cohorts of 1926-1970 in Germany". *European Journal of Cancer Prevention* 14: 477-483.

Sobal, J.; Hanson, K. L. andFrongillo, A. (2009): "Gender, Ethnicity, Marital Status and Body Weight in the United States". *Obesity* 17(12): 2223-2231.

Sobal, J. andRauschenbach, B. S. (2003): "Gender, Marital Status and Body Weight in Older U.S. Adults". *Gender Issues* (Summer 2003).

U.S. Department of Health and Human Services (2004): "The Health Consequences of Smoking: A Report of the Surgeon General". National Center for Chronic Disease Prevention and Health Promotion, Atlanta.

Vartanian, L. R. (2010): "Disgust and Perceived Control in Attitudes Towards Obese People". *International Journal of Obesity*: 1-6.

Völzke, H.; Neuhauser, H.; Moebus, S. et al. (2006a): "Rauchen: Regionale Unterschiede in Deutschland". *Deutsches Ärzteblatt* 103(42): A2784 - A2790.

Völzke, H.; Neuhauser, H.; Moebus, S. et al. (2006b): "Urban-Rural Disparities in Smoking Behaviour in Germany". *BMC Public Health* 6(146).

Welte, R.; Koenig, H.-H. andLeidl, R. (2000): "The Costs of Health Damage and Productivity Losses Attributable to Cigartette Smoking in Germany". *European Journal of Public Health* 10(1): 31-38.