

The Future Burden of Overweight and Obesity in the Population age 50+ in Germany - Cohort and Period Projections until 2030

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1. Introduction

Life expectancy has increased remarkably over the past decades in almost all industrialized countries. Reasons are reductions in infant mortality in the first part of the 19th century, as well as overall improved life conditions and better nutrition (McKeown et al. 1975, McKeown 1983). Since the second part of the century, enormous gains have been made in old age mortality due to improved medical treatments and provisions and overall healthier life styles. Enormous gains could also be achieved through reductions in smoking attributed mortality especially lung cancer and cardiovascular mortality (Cutler et al. 2007, Preston 2009; Wang and Preston 2009) However, critics alert that gains in life expectancy might be offset by worldwide increasing numbers of overweight and obese people (Stewart et al. 2009, Olshansky et al. 2005 Byles 2009, Finucane et al. 2011).

There exist a vast amount of literature, documenting the various consequences of overweight and obesity. Whereas the negative effect of overweight and obesity on mortality is controversial, with a higher body-mass-index being beneficial at advanced ages (Doblhammer et al. 2010), they are related to a number of chronic conditions and old age disability. (Doblhammer et al. 2009). 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, Sassi 2010, Christensen et al. 2009, Bleich et al. 2007). 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).

Over the last years, overweight and obesity have increased worldwide. In a nationwide survey, recently published in *the Lancet*, Finucane et al. (2011) estimated trends in population mean body mass index for adults 20 years and older in 199 countries between 1980 and 2008. They showed that the mean body mass index increased

worldwide by 0.4 kg/m² for males and by 0.5 kg/m² per decade for females. They estimate that the total number of overweight adults (BMI >25kg/m²) in 2008 is 1.46 billion adults with about 500 million of those being obese (BMI>30kg/m²) The worldwide age-standardized prevalence of obesity for men increased from 4.8 percent in 1980 to 9.8 percent in 2008 and for women from 7.9 percent to 13.8 percent. However, there exist regional differences with an interregional range per decade of 1.4 kg/m² for males and 1.9 kg/m² for females. The authors found highest obesity prevalences in 2008 in North American men and southern African women. However, they also found regions with flat trends or even potential decreases. These were central and Eastern Europe for women, and central Africa and south Asia for men.

Forecasts indicate that this worldwide increasing trend is supposed to continue in the future. Kelly et al. (2008) projected that the worldwide number of overweight will increase from 937 million in 2005 to 1.35 billion in 2030 and the number of obese from 396 million to 573 million individuals, only considering changes in the population structure. Assuming that the trend in the increase of overweight and obesity will continue, the authors even expect the worldwide number of overweight and obese to increase to 2.16 billion overweight and 1.12 billion obese individuals.

The consequences of an increasing number of overweight and obese people are manifold. An increasing number of overweight and obese people results in an increasing number of obesity related-illnesses and co-morbidities. These affect overall population health and mortality (Olshansky et al. 2005), and put economic burdens to the health care system (Arterburn et al. 2004).

Studies found that worldwide systolic blood pressure and total serum cholesterol levels decreased in wealthy countries, but increased in low and middle-income countries. Danaei et al. 2011; Farzadfar et al. 2011). However, gains in the wealthy countries are most likely due to improved risk factor control through in medical treatments (Cutler et al. 2007, Christensen et al. 2009).

Another study from the United States revealed that whereas hospitalizations because of ischemic strokes in the US decreased among middle-aged people between 1994 and 2007, they increased sharply among those under age 35. Obesity and hypertension are assumed to play a key role in these dramatic increases (Tong et al. 2011).

For Germany, literature on overweight and obesity has focused on past and recent trends (Helmert and Strube 2004, Mensink et al. 2005, Robert Koch Institut 2006b). According to the Microcensus 2009 (Statistisches Bundesamt 2010), 51.4 percent of the total population above age 18 is overweight or obese. Of those 36.7 percent are considered overweight (classified as BMI between 25 and 29.9 kg/m²) and 14.7 percent are obese (BMI of 30 kg/m² and above). Sex specific prevalences show that males are more often overweight than females. Whereas 44.4 percent of males, but only 29.1 of females age 18+ are overweight. Regarding obesity, differences are less. 15.7 percent of males and 13.8 percent of females are obese.

However, to our knowledge no attempts have been made to forecast future trends in these risk factors. Therefore, the aim of this paper is to forecast the future number of overweight and obese people until 2030 in Germany. Studies on overweight or obesity make seldom efforts to disentangle the effects that the time-related factors birth cohort and period have on these risk factors. This may lead to erroneous interpretations concerning the relationship between body-mass-index and age, and thus makes reliable forecasts difficult (Sassi et al. 2009).

In our study we overcome this shortcoming and estimate the number of overweight and obese people aged 50+ on the total population age 50+ until 2030 comparing two approaches, a cohort approach and a period approach. The cohort approach projects the number of overweight and obese people considering distinct age-specific prevalences for each birth cohort. The advantage of this approach is that different weight patterns across generations that might have developed due to different dietary and physical activity patterns are considered. Studies show that there exist cohort effects in overweight and obesity. (Juhaeri et al. 2003, Lahti-Koski et al. 2001, Dal Grande et al. 2005, Reither et al. 2009). For Germany, Westphal and Doblhammer (2011) found cohort effects especially in obesity with more recent birth cohorts having higher obesity prevalences. By contrast, the period approach reflects if all groups of the population are exposed to the same influencing mechanisms in a certain time period. Studies suggest that sedentary life styles and unhealthy diets have contributed to a generalized increase in body weight in the whole population. (Sassi et al. 2009).

Germany is a country that has historically originated from two different socioeconomic and political environments. Therefore, we perform our analysis separately for East and West Germany to detect, whether there are differences between the two parts of the country.

2. Data and Methods

Our analysis is based on the Scientific Use File (SUF) of the German Microcensus, and on the 12th coordinated population projection by federal states published by the Federal Statistical Office. The SUF is a 70 percent subsample of the original Microcensus sample, which is provided for scientific usage without restrictions. The German Microcensus is a one percent household sample conducted once a year since 1957 in the former BRD, and, since 1991, also in East Germany. Participation in the survey is obligatory by law.¹

Registered residents living in private households or public institutions, including foreign households, are eligible to participate. Family members of foreign armed forces and diplomatic missions are not included in the sample. The participating households are randomly selected by cluster sampling.

Information on overweight and obesity is included for the years 1999, 2003 and 2005. All three waves were pooled into one dataset, thus the dataset for overweight and obesity includes 1,335,134 individuals.

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). According to WHO standards, respondents with a BMI below 18.5 were classified as underweight, those with a BMI between 18.5 and 24.9 were placed in the normal weight category, those with a BMI between 25 and 30 were classified as overweight, and those with a BMI above 30 were categorized as obese.

For the final analysis, we excluded individuals who provided incomplete information on weight and height. The final sample size is 532.915.

The 12th population projection provides comparable information about the

¹ For more information see www.destatis.de

development of the German population until 2060. The present data is based on the medium variant (model 1-W1). This variant assumes that the total fertility rate remains constant at 1.4 children per women. Moreover it assumes an increase of life expectancy at birth for boys of 8 years and for girls of 7 years until 2060. The annual external migration balance is assumed to increase up to 100.000 persons until 1014 and thereafter remains at this level until 2060. The data for East and West Germany include the federal states Baden-Württemberg, Bayern, Bremen, Hamburg, Hessen, Niedersachsen, Nordrhein-Westfalen, Rheinland-Pfalz, Saarland and Schleswig-Holstein for West Germany and Brandenburg, Mecklenburg-Vorpommern, Sachsen, Sachsen-Anhalt, Thüringen and Berlin for East Germany.

We used a logistic regression model to explore period, cohort and age patterns in our data. We included age as a third degree polynomial starting with the youngest age 25 up to 85. We included ten year birth cohorts, with the youngest one being born 1980 and the oldest 1903, except for the oldest birth cohort in which we included the years 1903-1910. Period is included as numerical variable taking the value 1 for the year 1999, 5 for 2003 and 7 for 2005.

Cohort Projection

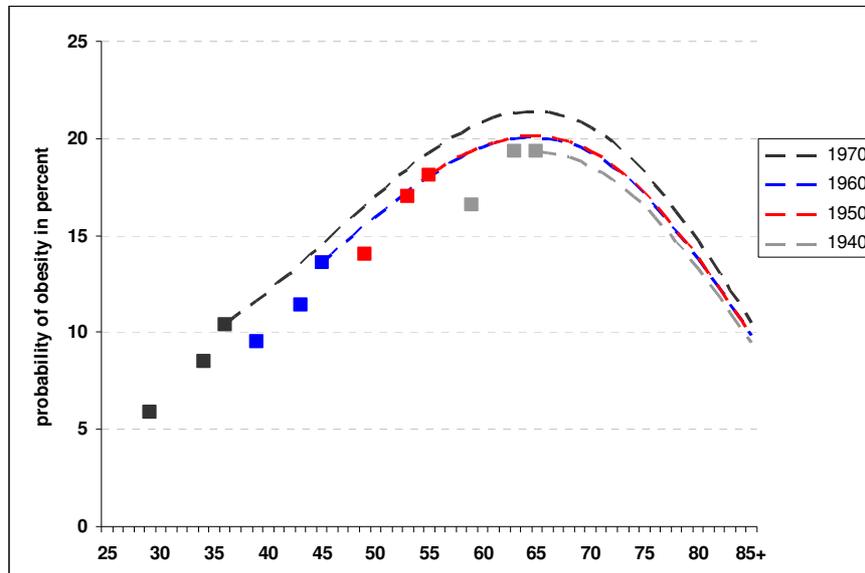
Using the polynomial from our logistic regression model, we estimated the age-specific profile of the proportion of overweight and obese people. Starting with the last observed age of a specific cohort we extended the proportions into the future by adjusting the estimated age-profile to the cohort level. For example, for cohort 1960 we observe data for age 39 to 45. Starting with the proportion at 39 we adjust the estimated age-profile from the model to the level at age 39 and use the adjusted proportions for ages 40 to 85 as projections for the future (see Figure 1). We used this method, because in our model age and cohort were highly correlated. We display the results for people aged 50+.

Period Projection

Using the estimates from our logistic regression model we extrapolate future overweight and obesity prevalences of people aged 50+ by extrapolating the polynomial of the age

factor with the period trend. The period variable takes the value 12 for the year 2010, and 32 for the year 2030.

Figure 1: Cohort approach: Observed data and extension using the polynomial of the age-effect from the logistic regression model



For both approaches we combined the estimated probabilities with the 12th population projection for Germany to project the number of overweight and obese people until 2030.

3. Results

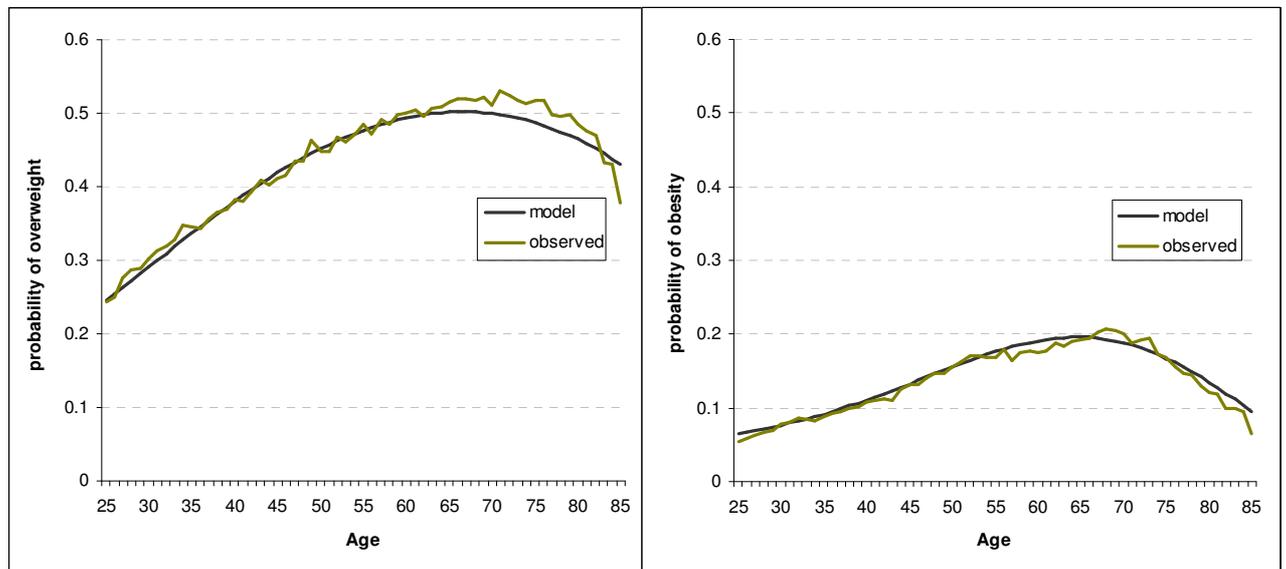
Table 1 shows the beta-coefficients and p-values from our logistic regression model. We found only slight variations between birth cohorts for both overweight and obesity with slightly higher risks for the older cohorts and increasing risks for the youngest. Hence, there is only a minor cohort effect. However there seems to be a clear period effect: the risk of overweight decreased annually by 0.7 percent whereas the risk of obesity increased by 2.8 percent per year.

Figure 2 displays the empirical proportions of overweight and obesity by age and the estimated proportions by our logistic regression model. The curves are almost identical; hence it is reasonable to use the estimated age profile for our projections.

Table 1: Beta-coefficient from logistic regression model for overweight and obesity

	Overweight		Obesity	
	β -coefficient	p-value	β -coefficient	p-value
Age	0.063012	0.000	-0.044960	0.008
Age ²	-0.000162	0.432	0.002297	0.000
Age ³	-0.000003	0.013	-0.000020	0.000
Period	-0.006900	0.000	0.028060	0.000
1971-1980	0.038443	0.257	0.020909	0.689
1961-1970	-0.005648	0.814	-0.007266	0.833
1951-1960	-0.030733	0.044	0.051078	0.016
1941-1950			RG	
1931-1940	0.056212	0.000	0.090876	0.000
1921-1930	0.084622	0.001	0.033781	0.330
1903-1920	-0.152311	0.000	-0.248862	0.000
Constant	-2.502453	0.000	-2.871615	0.000

Figure 2: Empirical Proportions of overweight and obesity by age and estimated proportions by logistic regression model



Overweight

Table 2: Projected absolute number of overweight people aged 50+ 2010 -2030 according to the cohort approach

in 1000	Cohort Projection			% total population 50+
	Males	Females	Total	
2010	7685	8263	15948	48.1
2015	8409	8722	17131	47.7
2020	8965	9041	18005	47.6
2025	9105	9120	18225	48.0
2030	9129	9093	18222	48.0

Table 3: Projected absolute number of overweight people aged 50+ 2010 -2030 according to the period approach

in 1000	Period Projection			% total population 50+
	Males	Females	Total	
2010	7487	8145	15633	47.1
2015	8032	8557	16589	46.1
2020	8352	8839	17190	45.3
2025	8205	8778	16982	44.5
2030	7989	8657	16647	43.7

Table 2 depicts the absolute projected number of overweight people aged 50+ from 2010 to 2030 for the cohort approach. The results show that the absolute number of overweight people is projected to increase by 14% from 15.9 Mio individuals in 2010 to 18.2 Mio in 2030. The number of overweight males is expected to rise from 7.7 Mio to 9.1 Mio and for females from 8.3 Mio to 9.1 Mio for females. However, the total share of overweight individuals aged 50+ on the total population 50+ is projected to remain constant at about 48 percent over the whole forecasting horizon.

According to the period approach (Table 3), the absolute number of overweight people age 50+ is expected to increase by only 6 percent from 15.6 Mio in 2010 to 16.6 Mio in 2030. Yet, the projected share of overweight people on the total population age 50+ is projected to decrease from 47.1 percent in 2010 to 43.7 percent in 2030

Figure 3: Projected share of overweight males and females aged 50+ on the total population 50+ until 2030 according to the cohort and the period approach

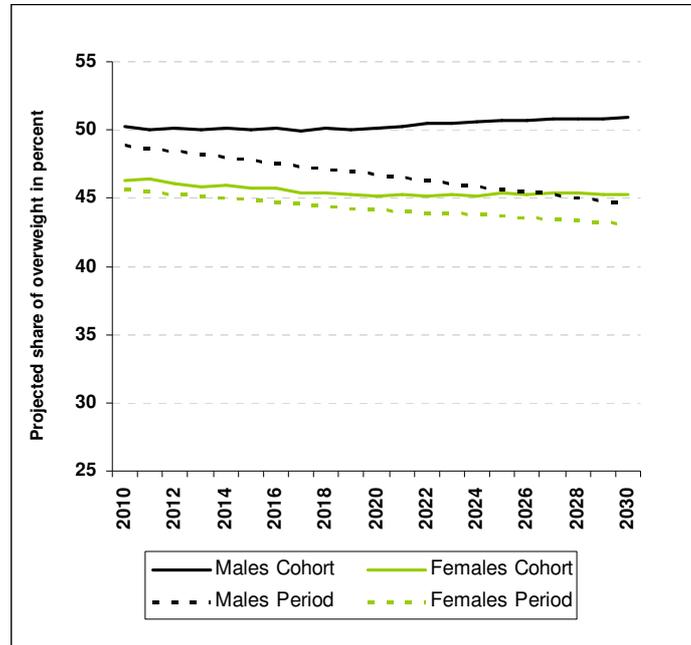


Figure 3 shows the projected share of overweight males and females aged 50+ on the total population in that age group for both scenarios. Again we find stable probabilities for males and females according to the cohort approach, albeit probabilities are higher for males. According to the period approach the share of overweight males will drop from 49 percent in 2010 to 45 percent in 2030. We expect females' overweight probabilities to decline from 46 to 43 percent.

Table 4 depicts the projected absolute number of obese people aged 50+ until 2030 according to the cohort approach. Overall we projected an increase in the number of obese people by 8% from 5.8 Mio in 2010 to 6.3 Mio in 2030. Whereas the absolute number of obese males is expected to increase by 19 percent from 2.8 Mio to 3.4 Mio, we project the number of females to decrease by 2% from 2.96 Mio to 2.91 Mio. However the share of obese people 50+ on the total population 50 + circles at about 17 percent. According to the period approach, the absolute number of obese people aged 50+ increases substantially from 6.2 Mio in 2010 to 10.8 Mio in 2030. This 75 percent increase is similar for males and females. The share of obese people on the total population age 50+ is projected to increase from 19.1 percent to 28.8 percent in 2030.

Obesity

Table 4: Projected absolute number of obese people aged 50+ 2010 -2030 according to the cohort approach

	Cohort Projection			% total population 50+
in 1000	Males	Females	Total	
2010	2830	2962	5792	17.5
2015	3082	3025	6107	17.1
2020	3308	3041	6349	16.9
2025	3393	3017	6410	17.0
2030	3380	2909	6289	16.8

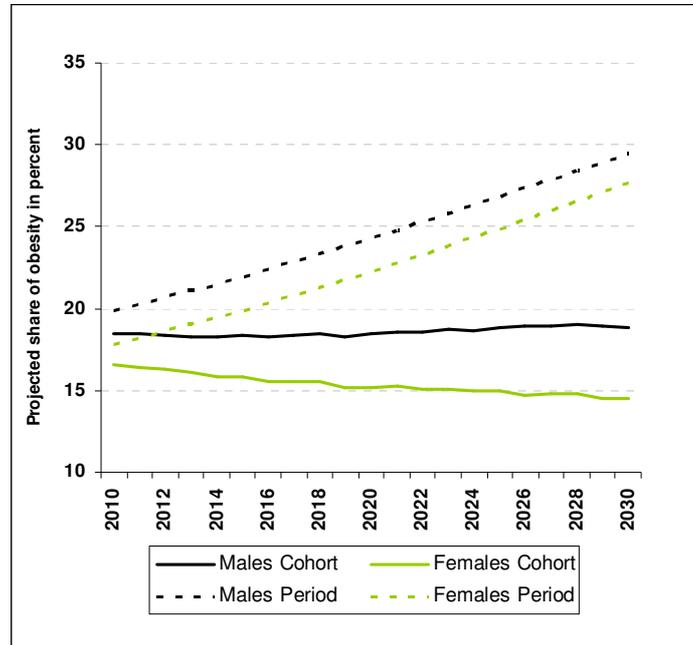
Table 5: Projected absolute number of obese people aged 50+ 2010 -2030 according to the period approach

	Period Projection			% total population 50+
in 1000	Males	Females	Total	
2010	3046	3175	6221	19.1
2015	3690	3796	7486	21.2
2020	4345	4453	8798	23.5
2025	4826	5003	9829	26.2
2030	5277	5551	10827	28.8

Figure 4 depicts the projected proportion of obese males and females aged 50+ for both approaches. For the cohort approach we found stable probabilities for males and slightly decreasing probabilities for females. According to the period approach the share of obese males is projected to increase from 20 to 30 and for males from 18 to 28 percent.

Our results show that variations in overweight and obesity are more influenced by period effects than cohort effects. Therefore in the following we present our results for East and West Germany only focusing on the results of the period projection.

Figure 4 : Projected share of obese males and females aged 50+ on the total population 50+ until 2030 according to the cohort and the period approach



East-West differences

Figure 5 compares the projected proportion of overweight males and females aged 50+ in East and West Germany according to the period approach. For males, there are no differences between East and West Germany. In both parts of the country we project the share of overweight people aged 50+ on the total population age 50+ to decrease from 49 to 45 percent. For females we find higher overweight prevalences in the East. Until 2030 we expect also reductions in both parts of the country. Moreover, we expect the difference to disappear due to stronger overweight reductions in the East. Figure 6 shows the projected share of obese males and females aged 50+ on the total population age 50+ in East and West Germany. Again, for males we found almost no East-West differences. In both parts of the country, we projected the probability of obesity to increase by about 10 percent points, whereby increases are slightly stronger in the West. For females there exist remarkable differences between both parts of the country. In 2010, 16 percent in the West, but 23 percent in the East are obese. These shares are predicted to increase to 25 percent in the West and to 38 percent in the East until 2030.

Figure 5: Projected proportions of overweight males and females aged 50+ on the total population in East and West Germany until 2030 according to the period approach

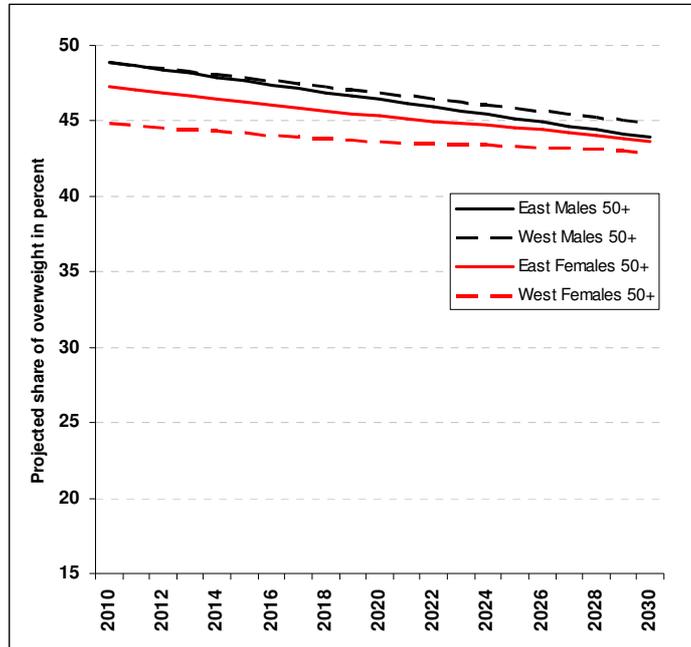
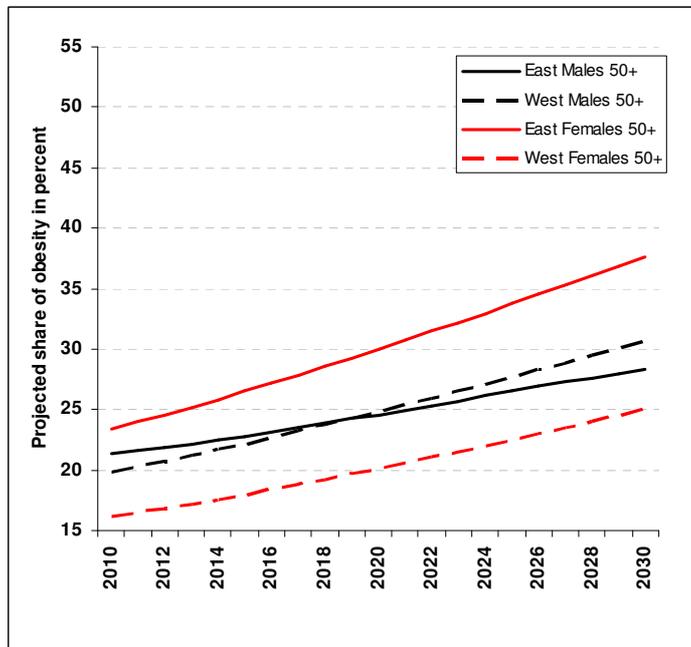


Figure 6: Projected proportions of obese males and females aged 50+ on the total population in East and West Germany until 2030 according to the period approach



4. Discussion

The aim of this study was to project the future number of overweight and obese people aged 50+ for Germany until 2030. In our projection we tried to disentangle cohort and period effects and applied two different approaches.

According to the cohort approach, we projected the absolute number of overweight people age 50+ to increase from 15.948 Mio individuals to 18.222 Mio in 2030. However, the total share of overweight people is projected to remain constant at 48 percent over the forecasting horizon. For obesity we expect the absolute number to rise from 5.792 Mio to 6.289 Mio. The share of obesity on the total population 50+ is predicted to remain at about 17% percent. Thus, the projected share of people 50+ on the total population who are either overweight or obese remains at about 65 percent according to this approach.

According to the period approach, the absolute number of overweight people aged 50+ is expected to increase from 15.633 Mio in 2010 to 16.647 Mio in 2030. Yet, the total share of the overweight population 50+ is projected to decrease slightly from 47 to 44 percent. Concerning obesity we expect remarkable increases in the absolute number of obese people from 6.221 Mio to 10.827 Mio. The share of obesity on the total population 50+ also increases from 19 percent in 2010 to 29 percent in 2030.

Hence, according to this approach we expect the share of overweight and obesity in the population aged 50+ to increase further from 66 percent in 2010 to about 73 percent in 2030, with strong increases in obesity.

Our results are in line with findings from other countries. In an OECD study Sassi and Colleagues (Sassi et al. 2009, Sassi 2010) found different weight patterns between Australia, Canada, England and the US on the one hand and Austria, France, Italy and Spain on the other. For the former group of countries they projected stable or slightly declining rates of overweight until 2020, but substantial increases in obesity rates. For the latter group of countries they predicted constant or slightly decreasing rates of overweight and moderate increases in obesity. In another comparative study of Switzerland, France, the UK, the US and Australia, Schneider et al. (2010) projected that the prevalence of overweight will stagnate until 2020 in Switzerland, France, the UK and the US whereas they projected increases for Australia. By contrast, the authors expected continued

increases in obesity for all countries, except Switzerland. Dal Grande et al. (2005) projected that the number of South Australian males above age 18 will be 26.4 percent and that of females 29.3 percent in 2013. They also found that younger birth cohorts had greatest percentage increases. In an obesity projection for the United States, Basu (2009) predicted that the absolute levels of obesity will remain high (26 percent) among adults, but the growth seems to have stagnated. For children, however, he expected continuous increases in obesity. Within the framework of the project Foresight - Tackling Obesity, Butland et al. (2007) projected the distribution of people across various BMI categories in the UK until 2050. Whereas in 2004 almost one quarter of the British population (23.6 percent males; 23.8 percent females) was obese, this percentage is estimated to increase to 36 percent for males and 28 percent for females in 2015. Until 2025 it is expected that the number of obese males is 47%, for females 36%. This percentage is supposed to increase to 60% respectively 50% until 2050.

This is, to our knowledge, the first study projecting the number of overweight and obese people for Germany. This study helps disentangling and understanding how the time-related factors birth cohort and period of observation have an influence on being overweight or obese. Our findings show that it is rather period than cohort effects that are responsible for past increases in overweight and obesity. If we consider only the cohort structure, future increases in the number of overweight and obesity will be merely a result of population aging with more people reaching ages at which overweight and obesity are more likely. However, in the past years sedentary life styles and unhealthy eating patterns have contributed to weight increases across the whole population. Hence, it is very likely that the results from the period approach provide a more probable picture of what to expect in the future, i.e. slight decreases in overweight, but remarkable increases in obesity in the population aged 50+. If no measures are taken to counteract these developments, Germany will be faced with alarming proportions of obesity as observed in the UK, the United States or Australia in the near future. This increase would challenge not only our health care system, but also many spheres in the public sector with obesity more health threatening than overweight.

Concerning East-West differences we found a similar development for overweight males and females in both parts of the country, but large differences in obesity for

females. We found highest obesity prevalences for females in the East but lowest probabilities among females in the West. For the future we expect this difference to continue. In the context of this paper we did not analyze the determinants of these differences. Thus, future research needs to address the question by which individual characteristics of the respondents or structural disparities between the two parts of the country these differences are caused.

The advantage of our study is the dataset we use. The German Microcensus includes a large number of individuals and also contains the institutionalized population.

A shortcoming of this study is its estimated age-profile which we kept constant over all birth cohorts for the cohort approach. However, it is possible that this age profile has changed across generations, especially among younger cohorts who could have higher overweight and obesity prevalences at young ages. Therefore we would underestimate the future number of overweight and obese in the future.

Further, body mass index might not be the choice as indicator for overweight and obesity, since other measures have proven to be more accurate. For example, body mass index neglects body muscle mass, which is not detrimental adipose tissue. Measures like waist to hip ratio, waist to height ratio or waist circumference are more suitable to identify fatness. However, body mass index is still commonly used and available in many studies.

Our results show that the observed increasing trend in obesity in the population aged 50+ in Germany is likely to continue in the future. If not counteracted, there will be an increased need for rehabilitation measures in the near future. Therefore, measures aiming at weight loss and weight education should be intensified. A special emphasis should be put on females in East Germany.

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