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Determinants and Consequences of Health Behaviour: New Evidence from German Micro Data

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Determinants and Consequences of Health Behaviour:

New Evidence from German Micro Data*

Brit S. Schneider, Udo Schneider

Abstract

The economic costs of chronic health conditions and severe illnesses like diabetes, coronary heart disease or cancer are immense. Several clinical trials give information about the importance of individual behaviour for the prevalence of these illnesses. Changes in health relevant behaviour may therefore lead to a decline of avoidable illnesses and related health care costs. In this context, we use German micro data to identify determinants of smoking, drinking and obesity. Our empirical approach allows for the simultaneity between adverse health behaviour and self-reported health as a measure of the individual health capital stock. We can show that health behaviour is related to the socioeconomic status of an individual. Furthermore, we find gender-specific differences in behaviour as well as differences in the determinants of drinking, smoking and heavy body weight in particular.

JEL-Classification: I12, C31, D12

Keywords: health behaviour; multivariate probit; education; labour force participation

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1. Introduction

Unhealthy behaviours like smoking, alcohol abuse or obesity are known causes of chronic health conditions. Several studies estimate negative health consequences of a high BMI[1], namely increased mortality, increased risk of coronary heart disease, osteoarthritis, diabetes mellitus, hypertension and cancer. In this context, Sturm (2002) estimates that obesity is equivalent to twenty years' aging related to chronic diseases. Furthermore, being overweight has the same negative consequences as smoking or problem drinking. For the health care system, this leads to high economic costs. Current or ever smoking is associated with an average increase of $230 for inpatient and ambulatory care, resulting in a 21 percent increase in health care costs and 23-30 percent in medication costs.

The demand for medical care due to obesity is about 2-8 percent of overall health care budgets in Europe (WHO, 2005). For Germany, Sander and Bergemann (2003) estimate the total costs of obesity at € 2,709-5,682 million, including the direct costs of obesity and the indirect costs of four co-morbidities: non-insulin-dependent diabetes mellitus, myocardial infarction, hypertension, and stroke. Therefore, total costs must even be greater if overweight is additionally taken into account.[2] Finkelstein et al. (2009) estimate rising per capita medical spending in the United States due to a higher prevalence of obesity. Compared to normal-weight individuals, spending was $1429 or 42 percent higher in 2006. 8.5 percent of Medicare spending, 11.8 percent of Medicaid spending and 12.9 percent of out of pocket spending are related to obesity with increasing tendency.

To counteract rising health care expenditures, it is necessary to start a process of rethinking in order to achieve changes in attitudes towards health. Health politics generally tries to imple-

[1] BMI = Body Mass Index, calculated as weight in kilograms divided by height in meters squared. Obesity means a BMI of 30 or greater. For being overweight, the BMI ranges between a value of 25 and 29.9 (see World Health Organization, 2003 for a classification in more detail).

[2] The expenditures of the German sickness funds related to nutrition based illnesses are about 30 % of total treatment expenditures. Additionally, high costs arise due to respiratory illnesses and cardiovascular diseases.

ment personal responsibility through financial incentives, for example using demand side cost-sharing rules. For these to be effective, knowledge about the determinants of health related behaviour is essential. It must be assured that a lack of patients' responsibility can be separated from missing abilities to handle the own health capital stock.

In his seminal work, Grossman (1972) treats health behaviours as investments in health, leading to a high health capital stock. The necessity of investing in health results from the idea that health underlies an age-dependent depreciation rate. Besides direct utility aspects of a good health status, productivity is higher and illness rates and therefore absence from work are lower.

Following the idea of Grossman, we treat health as a capital stock which can be enhanced through investments and which depreciates over time. But unlike the Grossman model, we treat health depreciation not only as a consequence of aging but assume that it is also affected by adverse health behaviour. Smoking, heavy drinking, being overweight or even obese may be relevant depreciation factors, whereas non-smoking, no or moderately drinking and body weight in a normal range may be seen as (the consequences of) health investments. In this context, we discuss the relationship between health related behaviour and health. We give a literature overview about empirical research on adverse health behaviour and their health consequences as well as an overview of related economic costs. As a shortcoming, most of these studies only investigate health consequences but are not interested in causes of smoking, drinking or heavy body weight. Our aim is to close this gap between research on behaviour and health. Therefore, we apply an empirical approach that allows for the simultaneity between different forms of adverse health behaviour and self-reported health as a measure of the individual health capital stock. Furthermore, we take a look on gender heterogeneity.

2. On the Relationship between Health Related Behaviour and Health

The channels through which health related behaviour affects health are diverse, and it is of main interest which factors determine adverse health behaviour. Obesity for instance is known as a central risk factor for health. The most severe diseases related to heavy body weight are "hypertension and hyperlipidaemia (major risk factors), coronary heart disease, ischaemic stroke, type 2 diabetes, certain types of cancer, osteoporosis and psychosocial problems" (World Health Organization WHO, 2005, 1), among others. Smoking is associated with an increase in the risk of death due to a higher risk of cardiovascular diseases, lung and oral cancer (Krueger and Chang, 2008; Moore and Hughes, 2001). For cardiovascular diseases, a combination of obesity and smoking leads to even higher health risks (Thefeld, 2000).

The effects of alcohol consumption on health are somewhat ambiguous. Several studies show that low alcohol intake is inversely related to coronary heart disease, whereas alcohol abuse is responsible for an increased risk of cirrhosis and several types of cancer. Therefore, the relationship between alcohol consumption and health is often depicted as a J-shaped curve, with higher mortality rates for non-drinkers and heavy drinkers (see Conduit et al., 1998; Di Castelnuovo et al., 2008, for an overview).

Given the harmful health consequences of adverse health behaviours like smoking, heavy drinking, fast food consumption and lack of exercise, theory suggests that there are a lot of impact factors on health behaviour and health, e. g. education, the relative income position of an individual household, the socio-economic status as a whole and labour force participation.

In general, education yields better health knowledge which is important to understand the health effects of one's actions. For instance, better educated individuals know more about the long-term health risks of overweight, so it can be expected that they pay more attention to their nutrition in order to watch their weight. In addition, better educated people know about the hazardous consequences of smoking. Kenkel (1991) for instance shows that education has

a significant negative impact on smoking and alcohol drinking, while the impact on doing sports is significantly positive. Moreover, education is highly correlated with labour income leading to high opportunity costs of illness. Last, the efficiency of the health production is also determined through the individual's education level, first because of an efficient allocation of medical services and second because of the knowledge how to use them (Kenkel 1995).

Labour force participation should be considered as another important factor on health relevant behaviour. First, long working hours reduce leisure time and health investment activities. There is less time disposable for recreation, doing sports or even consuming some health services for preventive purposes. Second, the kind of work is decisive for its health depreciation rate (Leigh, 1983; Kemna, 1987). On the one hand, people like blue collar workers with physically exhausting jobs may be less willing or less able to exercise after work. On the other hand, managers mostly have a stressful job with long working hours. To cope with high stress levels, they may face a high risk of being a smoker, to drink alcohol or to have excess weight (Schofield, 1996; Shields, 2000; Krueger and Chang, 2008). Third, working conditions and education both determine earned income, which is itself fundamental for health related behaviour. Low income individuals e. g. tend to consume cheaper meals with low nutritional value. As a consequence, the risk of overweight or even obesity is much higher at low incomes (Bhattacharya et al., 2004).

Apart from these three direct effects of labour force participation on health relevant behaviour the opportunity costs of illness rise with labour income, which means that illness reduces current and future earnings. Because of this, the benefits of healthful activities are largest for well educated people with high labour income (Gilleskie and Harrison, 1998; Schneider et al., 2007). Unemployed face lower opportunity costs as being ill reduces the chances of returning into the labour force. As a consequence, economic incentives for health investment activities

are lower. Mathers and Schofield (1998) show for instance that besides a poorer mental health, those who are unemployed have greater odds of suffering chronic illnesses. There is also some evidence that unemployed people tend to higher levels of smoking, alcohol use and poor diet.

3. Sample design

Regarding these findings, the relation between individual behaviour and health is of simultaneous nature. The different forms of health relevant behaviour, e. g. smoking, drinking or obesity, are health risk factors on their own, but the magnitude of the health impact rises if two or more behavioural patterns are present (Thefeld, 2000). To estimate the dependence of health on behaviour, we use data from the German Socio-Economic Panel (SOEP), a representative longitudinal study of private households in Germany.[3] Explicitly, we focus on the year 2006 where different variables concerning health status and health behaviour are included, namely smoking and alcohol consumption. Furthermore, the BMI is incorporated in the dataset.[4] As commonly used, we take a BMI ≥ 30 as a binary measure of obesity (World Health Organization, 2003). Individual health is included as a self-reported variable with five categories. All four variables of interest are binary or categorical ones. Hence, a simultaneous model for qualitative dependent variables is used. Among this class of models, the multivariate probit model allows for a recursive structure, i. e. that the behaviour variables directly enter the health equation. Moreover, the estimation approach accounts for a possible correlation of the residuals. With respect to this estimation strategy, all dependent variables have to be transformed into binary variables. In the SOEP, smoking behaviour is measured twofold: First, the database contains information on the amount of cigarettes or cigars smoked per day.

[3] The data used in this publication were made available to us by the German Socio-Economic Panel Study (SOEP) at the German Institute for Economic Research (DIW), Berlin.
[4] Similar indicators are used by Vita et al. (1998). They show that mortality rates and disability risks depend on tobacco consumption, physical exercises, and nutrition.

Second, a dichotomous variable indicating whether the respondent currently smokes is provided. While there is evidence that smoking more than 20 cigarettes per day increases the risk of cardiovascular diseases dramatically, one has to keep in mind that smoking per se increases the risk of several forms of cancer and respiratory diseases (Sturm, 2002). Therefore, we use the binary indicator of current smoking to account for the various health effects. The frequency of alcohol consumption is measured by the four categories regularly, occasionally, seldom, and never. Because of the anticipated J-shape of alcohol consumption on health, we focus on the highest category of drinking, so the variable alcohol takes the value 1 if the respondent drinks at least one of the following beverages regularly: beer, wine or champagne, spirits, and mixed drinks.

The self-assessed health variable in the dataset might be vulnerable to reporting heterogeneity. For the correction of self-assessed health, questions that rely on the so-called SF-12v2 indicators (Andersen et al., 2007) are used to compute a new health stock variable which takes the value 1 if health is assessed above average and 0 otherwise (see chapter 4).[5]

The independent variables can be divided into predisposing and socioeconomic variables (see table I). First, four age categories capture the deterioration of health with age due to co-morbidity risks. In addition, partnership and children are indicators for the family structure of the respondent. Behavioural differences between Eastern and Western Germans are of interest as well as differences between Germans and foreigners.

Second, socioeconomic variables are included to explain the economic environment. The first variables in this category, namely income, economic worries and unemployment, determine the money disposable for consumer and health care goods. First, the net household equivalent income is computed. In a second step, five income categories are built to account for differences in the relative income position of the households (Federal Statistical Office, 2006).

[5] The SF-12v2 is a health related questionnaire especially on aspects of quality of life covering the dimensions physical and mental health (Andersen et al., 2007).

Furthermore, working conditions are implemented as explanatory variables. Working hours are used to explain the trade-off between work, health investment, and leisure, and to control for working conditions which are not covered through the variables 'civil servant' and 'blue collar', respectively. To control for the expected nonlinear effects, dummy variables for different classes of working hours are created. We are also interested in possible effects of education on health behaviour and health. Therefore, four education variables as well as two variables containing information about the educational level of the parents are included. By using private and supplemental health insurance as additional explaining variables we can account for differences in moral hazard effects (Kenkel, 2000) of different types of health insurance.

< table I around here>

If one takes a look at the descriptive statistics in table II, it is obvious that there are gender differences with respect to health related behaviour. In detail, 31.92 percent of men are currently smokers and 25.52 percent of women. 25.39 percent of males respond that they drink alcohol regularly, but only 7.4 percent of females. The prevalence of obesity is not significantly different between both sexes (17.18 vs. 16.72 percent).[6] 57.48 and 55.73 percent range their health above average.

<table II around here>

Given the assumption that negative health consequences are driven by the quantity of adverse health behaviours and given the adverse behaviours smoking, drinking or being obese, it is of interest how many respondents behave entirely healthy or unhealthy.

[6] Sturm (2002) mentions that weight is often underreported in interviewer-based surveys while height is overreported. Although our data corresponds with data from the German Federal Statistical Office, it may be that the prevalence of obesity is even higher.

<table III around here>

Here, data shows again major differences between males and females. While 56.69 percent of females are without any adverse behaviour, only 42.06 percent of males behave entirely healthy. Moreover, only 0.22 percent of women state that they are frequent drinkers, smokers and obese while this is true for 1.45 percent of men.[7]

4. Estimation method

Reporting heterogeneity and health capital stock

Self-reported measures of health and their validity have caused a considerable debate (Jones, 2007). The self-assessed health variable might be vulnerable to a reporting bias because of anticipation and measurement heterogeneity (Hagan et al., 2008; Hernández-Quevo et al., 2005). The original health variable in the dataset (SAH) is a five-point scale variable ranging from very good to bad. To correct for a possible reporting heterogeneity, we apply a technique proposed by Disney et al. (2006). We estimate a model of self-assessed health as a function of objective health measures *m*, e. g. the utilisation of health care or physical and mental well-being as well as personal characteristics *x* like age and education (Disney et al., 2006). First, we can write the unobservable health status as a function of *x* and *m* and unobservables u_{it}:

$$\eta_{it} = x_{it}^{'} \beta + m_{it}^{'} \gamma + u_{it} \tag{1}$$

[7] Although the Socio-Economic Panel is a representative dataset in general, in our sample Eastern Germans are overrepresented due to non-responses and drop outs. Concerning the insurance status, the fraction of fully privately insured corresponds to the actual level in Germany. Taking into account that Eastern Germans are overrepresented in this dataset and that their earned income is below average, the share of fully private insured might be slightly biased upwards.

Instead of η_{it}, the categorical variable self-assessed health h_{it} is observed in the data set. This variable may be measured with a reporting error since the assessment of health may depend on age, education and health problems. Hence, the latent health stock h_{it}^{*} as the counterpart of the observed self-assessed health is a function of the unobservable health status η_{it} and a reporting error ε_{it}:[8]

$$h_{it}^{*} = \eta_{it} + \varepsilon_{it} \tag{2}$$

The latent health variable can be linked to the dichotomous indicator h_{it} using the following observation mechanism:

$$h_{it} = j\,, \quad \text{if} \quad \mu_{j-1} < h_{it}^{*} < \mu_{j}\,, j = 1\,, \ldots, 5 \tag{3}$$

Equation (3) shows that our observable health variable takes the value j if the latent health stock lies between the two thresholds μ_{j-1} and μ_j. Combining this observation mechanism with equation (1), the model can be estimated using ordered probit techniques. Using the predicted values, we can normalise the health stock using a z-transformation. This yields a health capital stock with a zero mean and a constant variance of one. Furthermore, positive values of our health capital stock variable indicate that the respondent's health is above the sample mean in this period.

In the estimation at hand, we use the variables physical functioning, role physical, bodily pain, vitality, social functioning, role emotional, and mental health. These are elements of the SF-12v2 indicators mentioned above (for a detailed description see Andersen et al., 2007). The descriptive statistics are shown in table IV. Table V refers to the estimation results.

[8] Disney et al. (2006) assume that the error terms in (1) and (2) are uncorrelated.

<table IV around here>

<table V around here>

These results presented in table 5 are then used to calculate the health capital stock as a linear prediction. Together with the estimated cut-points, this prediction is taken to generate a new self assessed health variable.

The Multivariate Probit Model

The estimation approach can be seen as a generalization of the bivariate probit model presented in Maddala (1983). In our specific case, the model consists of three reduced-form equations and one structural equation:[9]

$$\begin{aligned} y^{*}_{1i} &= && \beta_1' X_{1i} + \varepsilon_{1i} \\ y^{*}_{2i} &= && \beta_2' X_{2i} + \varepsilon_{2i} \\ y^{*}_{3i} &= && \beta_3' X_{3i} + \varepsilon_{3i} \\ y^{*}_{4i} &= \delta_{41}\, y_{1i} + \delta_{42}\, y_{2i} + \delta_{43}\, y_{3i} + && \beta_4' X_{4i} + \varepsilon_{4i} \end{aligned} \tag{4}$$

Here, we have m=1,…, 4 equations and i=1,.., N observations. X_{mi} are vectors of exogenous variables, β_m the associated parameter vectors and ε_{1i}, …, ε_{Mi} are normally distributed errors with a constant variance var(ε_{mi})=1. As a result of the theoretical considerations about the health production process, we identify two classes of binary dependent variables: first, health behaviour of the individual and second, our corrected measure of self-assessed health. The recursive structure of the multivariate probit represents the distinction between the dependent

[9] Balia and Jones (2008) estimate the influence of selected health behaviours on health and subsequent mortality using a multivariate probit model. They transform the categorical variable self-assessed health into a binary indicator that takes value 1 if individual perceived health is excellent or good, and 0 if it is fair or poor.

variables as follows. The equations for the health behaviour variables are reduced-form equations. The health equation is a structural equation with the health behaviour variables as explanatory factors.

The covariance between the error terms of equations *j* and *k* can be expressed as correlations $\rho_{jk}=\rho_{kj}$ (Cappellari and Jenkins, 2003). They measure in how far unobserved factors influence health relevant behaviour, health outcome and self-assessed health simultaneously. All equations in (4) can be estimated separately as single probit models but the estimated coefficients would be inefficient because the correlation between the error terms is neglected. Only in the case of independent error terms ε_{mi} (all ρ are not significantly different from zero) it is possible to deal with the above model as independent equations (Maddala, 1983).[10]

Model identification

The estimation of a recursive multivariate probit model requires further assumptions for the identification of the model parameters. For the model given in equation (4), Maddala (1983) shows using a constant only model that the number of parameters to be estimated is larger than the number of probabilities. In this case, the parameters in the structural equation are not identified. To answer this problem, Maddala proposes that at least one of the reduced-form exogenous variables must not be included in the structural equation as explanatory variable. On the contrary, the structural equations may contain variables not included in the reduced-form equations. In contrast to this and according to Wilde (2000) the parameters of the model are identified as long as there is at least one varying exogenous regressor.

In our approach, we impose exclusion restrictions and test their validity. For the reduced form equations, we use the complete set of predisposing and socioeconomic variables. In the health

[10] Knapp and Seaks (1998) provide a Hausman test for the exogeneity of a dummy variable in a probit model, which is based on the estimated correlation coefficients.

equation, we hypothesize that parental education is without influence on health assessment and is therefore excluded.

For the selection of the appropriate set of exclusion restrictions measures of goodness-of-fit are used. First, the Akaike information criterion (AIC) and second, the Bayesian information criterion (BIC) are employed (Long, 1997). These information criteria can be used to compare different model specifications. The BIC has the weight on more parsimonious models than the AIC. That model which possesses the lowest value of the AIC or BIC is chosen as the best (Verbeek, 2008).

The results for the information criteria for the two specifications are presented in table VI. For both subsamples, the information criteria of the Maddala and the Wilde approach are relatively close to each other. Regarding the female sample, both AIC and BIC are lower when estimating without parental education as explanatory variables in the health equation. In contrast to this, for the males only the BIC prefers the restricted setting. This is confirmed by the result of a likelihood ratio test for both samples at the 5%-level.

<table VI around here>

5. Estimation results

The results indicate that behaviour is determined through different impact factors for males and females (see tables VII and VIII). Concerning the income variables, for females relative poverty leads to a higher probability of being a smoker or being obese, while relative prosperity lowers the likelihood of obesity. In addition, relative prosperity goes along with regular alcohol consumption. Last, smoking is positively related to strong economic worries. For males, only a positive relationship between relative poverty and smoking can be found, while relative prosperity again goes along with a higher probability of drinking alcohol regularly. In

the obesity equation, there are no direct income effects for men. In contrast to female behaviour, males who state strong economic worries tend to drink alcohol less often but there exists a positive relationship with obesity.

Theory suggests that being in the labour force goes along with higher opportunity costs of adverse health behaviour. Therefore, a positive relationship between moderate working hours and behaviour was expected for both sexes, while long working hours may lead to alcohol or tobacco consumption to cope with stress. Surprisingly, no such effect can be found in the equations for males. Here, only being unemployed is positively related to smoking and drinking. In contrast, there exist strong labour force effects for women. In general, women who work tend to smoke and drink alcohol more often but are obese less frequently. Being unemployed raises the probabilities of smoking and alcohol consumption but has no effect on obesity.

Regarding education effects, there are only minor differences between males and females, but the results are again somewhat surprising. First and as expected, education reduces tobacco consumption and excessive body weight. Second and against our expectations, the probability of drinking alcohol rises with the educational status.

<table VII and VIII around here>

Given these effects on health relevant behaviour, it is of interest which factors are the main determinants of health. Results show that for males, drinking alcohol and obesity are of negative impact on health, while smoking is without any significant effect. Furthermore, health is positively influenced by a high relative income position and by being in the labour force. Except for men with a university degree, education is without any impact on health. For females, results are different again. Here, drinking influences health assessment positively, but being

obese is not relevant for health assessment. While being in the labour force is again related to a high probability of good health, income is without any impact for women. Last, strong positive effects for education can be found.

Concerning the estimation technique, the main advantage of the multivariate probit model is that it considers a possible dependency between the equations. Therefore, it is possible to test whether health behaviour is endogenous for health. The four estimated equations involve six correlation coefficients ρ_{jk} which measure the pairwise correlation between the three health relevant behaviour indicators and the health variable. Four of the correlation coefficients are of significance for males and three for females (see table IX). The null hypothesis of no joint significance of these parameters is rejected using a likelihood ratio test. These results imply that the equations are not stochastically independent and that single probit estimates would have led to inefficient standard errors. Moreover, the dependent variables of the first three equations can be treated as endogenous in the health equation.

<table IX around here>

6. Conclusion and policy implications

In our analysis, health production is viewed as a multi-level process in order to distinguish between health behavioural aspects and health. From a theoretical point of view, the importance of the individual's health behaviour for the health production process is beyond controversy. To test for the determinants of health behaviour and self-assessed health, we apply a multivariate probit approach consisting of three reduced form equations and one structural equation. By using this procedure, it is possible to account for the endogeneity of smoking, alcohol consumption and obesity for health.

Estimation shows that health behaviours as well as their consequences on health are gender-specific. To sum up our findings, income, working hours and education are the main socio-economic determinants of behaviour but differ in direction and strength. What do these results tell us for policy implications?

First, men and women with a higher education tend to smoke less than individuals without graduation. Furthermore, a university degree has a negative influence on obesity for both sexes. This implies that further information campaigns about the hazardous health consequences of smoking and heavy body weight may help to reduce their prevalence especially for people with lower education. In contrast to this, better educated individuals have a higher probability of drinking alcohol regularly. These results indicate that for alcohol consumption a lack of information does not exist. Following Cawley (2008), one possible explanation is the existence of peer group or bandwagon effects, which go along with the social acceptance of drinking.

Second and only for females, working hours are of main importance for health relevant behaviour. In detail, women in the labour force tend to be smokers more often, which is again due to peer group effects. Furthermore, smoking as well as drinking alcohol may be consequences of a high stress level. In contrast, women who work less than 42 hours a week are significantly less obese, indicating that this group faces higher opportunity costs of absence from work due to heavy body weight related illnesses. Furthermore, Andreyeva (2006) points that unemployment increases the risk of obesity. In our estimations, no unemployment effects can be found compared to those who do not work for some other reason; nevertheless, due to strong negative effects of working hours on excessive body weight, getting women in the labour force may be another way to reduce the prevalence of obesity and therefore health care costs.

Third, both education and labour force participation are main determinants of labour income, which is a principal component of family household net income. The estimation shows that relative poverty is an important impact factor for tobacco consumption, while drinking alcohol is positively influenced by a high socioeconomic status. In addition, higher income lowers the probability of being obese for women. For men, the income position is without any effect on heavy body weight.

The dependence of smoking on socioeconomic status raises the question of financial incentives to induce healthy behaviours. Therefore, rising taxes on tobacco may lower consumption, given a negative price elasticity of smoking (Cawley, 2008). In Germany taxation of alcoholic mixed drinks in 2004 in combination with a prohibition of sale for underage individuals led to a significantly decrease in consumption. According to our estimation results, especially high income individuals tend to drink even more than those in middle income positions. Therefore, higher taxes are unlikely to reduce drinking significantly for the group in relative prosperity.

What policy implications can we draw from the estimated effects of behaviour on health? Here, results are once again different for males and females. Alcohol and obesity both reduce the reported health status for males. For women, only a positive effect of drinking on health can be found. The difference in the effects of alcohol consumption may be due to an unobserved level effect and the J-shape argument of drinking. First, it seems probable that there exist differences in the amount of alcohol intake for those who state regular drinking as a result of variation in the interpretation of regular drinking. Second, the J-shape argument indicates that regular but moderate drinking of wine and beer goes along with positive health consequences or psychic well-being as part of the health status, compared to those who are teetotallers or heavy drinkers (Mukamal et al., 2006).

For both sexes, smoking is without any significant health effect. Here, individuals face the consequences of their behaviour later in life and not in direct relation to their actions. Hence, further information campaigns to achieve a social taboo seem necessary as well as a ban from working places or restaurants. Furthermore, it seems that high calorie intake is not primarily a question of income but a question of education. Further information about the ingredients and the nutritional value of convenience food may help to reduce the prevalence of obesity.

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Tables

Table I: Description of the variables

Endogenous variables	
Smoker	tobacco consumption yes/no
Alcohol	drinks alcohol regularly yes/no
Obesity	overweight in terms of age-adjusted BMI yes/no
Health	self-assessed health above-average
Predisposing variables	
Age 17-29	respondent 17 to 29 years old yes/no (reference group)
Age 30-44	respondent 30 to 44 years old yes/no
Age 45-59	respondent 45 to 59 years old yes/no
Age 60-74	respondent 60 to 74 years old yes/no
Age >74	respondent older than 74 years yes/no
Partnership	living together with a partner yes/no
Children	at least one child younger than 16 years in household yes/no
Eastern Germany	living in Eastern Germany yes/no
Turkey	nationality Turkish yes/no
Rest of World	other nationality not German yes/no
Socioeconomic variables	
Rel. poverty	less than 50 % of the mean of equivalent household net income
Tenous prosperity	50-75 % of the mean of equivalent household net income
Middle income position	75-125 % of the mean of equivalent household net income (reference group)
Higher income	125-150 % of the mean of equivalent household net income
Rel. prosperity	more than 150 % of the mean of equivalent household net income
Economic worries	strong worries about own economic situation yes/no
Civil servant	civil servant yes/no
Blue-collar	blue-collar yes/no
Unemployed	long-term unemployment in 2005 and unemployed at the time the survey was conducted in 2006 yes/no
Working h. 1-21	1-21 hours effectively worked per week yes/no
Working h. 22-42	22-42 hours effectively worked per week yes/no
Working h. >42	more than 42 hours effectively worked per week yes/no
Secondary school	secondary school degree or no completed education (reference group)
O-level	first public examination in secondary school yes/no
High school	general qualification for university entrance yes/no
University	university degree yes/no
Education	currently in some sort of education yes/no
Private health ins.	fully private insured yes/no
Supplemental ins.	private supplemental health insurance yes/no
Risk averse	respondent is risk averse yes/no
Risk taker	respondent is risk taker yes/no
Renovation	house is at least partly in need of renovation yes/no
Mother O-level	mother at least O-Level education yes/no
Father O-level	father at least O-Level education yes/no

Table II: Descriptive statistics (n=9976)

	Male	N=4132	Female	N=4581
Variable	Mean	Std. Dev.	Mean	Std. Dev.
Endogenous variables				
Smoker	0.3192	0.4662	0.2552	0.4360
Alcohol	0.2539	0.4353	0.0740	0.2618
Obesity	0.1718	0.3773	0.1672	0.3732
Health	0.5748	0.4944	0.5573	0.4968
Predisposing variables				
Age 30-44	0.3044	0.4602	0.2921	0.4548
Age 45-59	0.2561	0.4365	0.2611	0.4393
Age 60-74	0.2236	0.4167	0.2059	0.4044
Age >74	0.0699	0.2551	0.0819	0.2742
Partnership	0.7328	0.4425	0.6830	0.4653
Children	0.2796	0.4488	0.2980	0.4574
Eastern Germany	0.2851	0.4515	0.2796	0.4489
Turkey	0.0346	0.1828	0.0273	0.1629
Rest of World	0.0503	0.2187	0.0513	0.2206
Socioeconomic variables				
Rel. poverty	0.0833	0.2763	0.1067	0.3088
Tenous prosperity	0.2101	0.4074	0.2438	0.4294
Higher income	0.1007	0.3009	0.0902	0.2864
Rel. prosperity	0.1416	0.3487	0.1135	0.3173
Economic worries	0.2478	0.4318	0.2617	0.4396
Civil servant	0.1307	0.3371	0.1530	0.3600
Blue-collar	0.2167	0.4120	0.0840	0.2775
Unemployed	0.0296	0.1693	0.0323	0.1768
Working h. 1-21	0.0194	0.1378	0.1155	0.3196
Working h. 22-42	0.2897	0.4537	0.2685	0.4432
Working h. >42	0.2916	0.4546	0.0967	0.2956
O-level	0.2894	0.4536	0.3388	0.4734
High school	0.1087	0.3113	0.1225	0.3279
University	0.2140	0.4101	0.1570	0.3638
Education	0.0748	0.2631	0.0849	0.2788
Private health ins.	0.1498	0.3569	0.0819	0.2742
Supplemental ins.	0.1130	0.3167	0.1377	0.3447
Risk averse	0.2364	0.4250	0.3558	0.4788
Risk taker	0.2962	0.4566	0.1814	0.3854
Renovation	0.2773	0.4477	0.2794	0.4488
Mother O-level	0.2270	0.4189	0.2441	0.4296
Father O-level	0.2556	0.4362	0.2657	0.4417

Table III: Shares of respondents drinking, smoking or being obese (in percent)

	Male			
	non-smoker		smoker	
	not obese	obese	not obese	obese
drinks alcohol not regularly	42,06	9,56	19,89	3,10
regular alcohol consumption	13,38	3,07	7,48	1,45

	Female			
	non-smoker		smoker	
	not obese	obese	not obese	obese
drinks alcohol not regularly	56,69	12,57	19,84	3,49
regular alcohol consumption	4,78	0,44	1,96	0,22

Table IV: Descriptive statistics health variables

	Male		Female	
Additional variables	Mean	Std. Dev.	Min	Max
SAH	2.6268	0.9472	2.7108	0.9585
Handicap	0.1428	0.3499	0.1166	0.3209
Hospital	0.1067	0.3088	0.1369	0.3437
1-2 doctor visits	0.3548	0.4785	0.3707	0.4830
3-4 doctor visits	0.1517	0.3588	0.2056	0.4042
at least 5 doctor visits	0.1251	0.3309	0.1777	0.3823
Physical functioning	50.2097	9.9242	48.5586	10.4497
Role physical	50.4936	9.8977	48.4472	10.3399
Bodily pain	50.2161	9.8383	48.7392	10.4457
Vitality	50.3684	9.7242	48.7319	10.0824
Social functioning	50.3707	9.8357	48.7376	10.6430
Role emotional	50.6225	9.5372	48.5711	10.5158
Mental health	51.2436	10.0891	48.6149	10.1642

Table V: Estimation results self-assessed health

	Male		Female	
Age 30-44	0.2977***	(0.000)	0.2592***	(0.000)
Age 45-59	0.6679***	(0.000)	0.5649***	(0.000)
Age 60-74	0.6214***	(0.000)	0.6162***	(0.000)
Age >74	0.4751***	(0.000)	0.5444***	(0.000)
O-level	-0.0256	(0.570)	-0.0683	(0.110)
High school	-0.0746	(0.248)	-0.0463	(0.445)
University	-0.1379***	(0.005)	-0.1018**	(0.047)
Handicap	0.3194***	(0.000)	0.2277***	(0.000)
Hospital	0.2024***	(0.002)	0.1012*	(0.058)
1-2 doctor visits	0.2143***	(0.000)	0.2030***	(0.000)
3-4 doctor visits	0.4321***	(0.000)	0.4303***	(0.000)
at least 5 doctor visits	0.6511***	(0.000)	0.5697***	(0.000)
Physical function-ing	-0.0388***	(0.000)	-0.0389***	(0.000)
Role physical	-0.0189***	(0.000)	-0.0207***	(0.000)
Bodily pain	-0.0314***	(0.000)	-0.0301***	(0.000)
Vitality	-0.0256***	(0.000)	-0.0191***	(0.000)
Social functioning	-0.0086***	(0.003)	-0.0056**	(0.026)
Role emotional	-0.0012	(0.686)	0.0004	(0.886)
Mental health	-0.0094***	(0.000)	-0.0153***	(0.000)
N	4132		4581	
AIC	7606.4021		8675.2875	
BIC	7751.9120		8823.1699	
Log pseudo-Likelihood	-3780.2011		-4314.6437	
Wald test ($\chi^2(28)$)	2267.40***		2504.58***	
Pseudo R^2	0.3106		0.3034	

p-values in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table VI: Comparison of additional exclusion restrictions for the health equation

	Male		Female	
	I. with exclusion restrictions	II. without exclusion restrictions	I. with exclusion restrictions	II. without exclusion restrictions
AIC	17448.04	17446.46	15822.23	15824.24
BIC	18302.12	18313.20	16690.23	16705.11
Likelihood	-8589.02	-8586.231	-7776.114	-7775.12
LR-Test	5.5781 (0.061)	Chi^2 (2, α=0.05) =5.99	1.9868 (0.370)	Chi^2 (2, α=0.05) =5.99

Table VII: Estimation results (males, N=4132)

	(1) Smoker		(2) Alcohol		(3) Obesity		(4) Health	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
Smoker							-0.4156	(0.190)
Alcohol							-0.5859**	(0.014)
Obesity							-1.0004***	(0.000)
Age 30-44	0.0720	(0.404)	0.1005	(0.281)	0.1792	(0.110)	-0.7031***	(0.000)
Age 45-59	-0.0720	(0.431)	0.1962**	(0.044)	0.3889***	(0.001)	-1.3642***	(0.000)
Age 60-74	-0.5615***	(0.000)	0.3766***	(0.001)	0.3251***	(0.010)	-1.4831***	(0.000)
Age >74	-0.9194***	(0.000)	0.1911	(0.151)	0.0617	(0.683)	-2.0374***	(0.000)
Partnership	-0.1775***	(0.003)	-0.0838	(0.153)	0.2239***	(0.001)	-0.0021	(0.973)
Children	-0.1383**	(0.017)	0.1225**	(0.043)	-0.0720	(0.275)	0.1637***	(0.008)
Eastern Germany	0.0016	(0.976)	0.0570	(0.281)	0.0569	(0.326)	-0.1110**	(0.033)
Turkey	0.3191***	(0.007)	-0.8128***	(0.000)	-0.0477	(0.716)	0.0577	(0.667)
Rest of World	0.2341**	(0.015)	-0.2875***	(0.007)	0.0846	(0.430)	-0.0013	(0.990)
Rel. poverty	0.3959***	(0.000)	-0.0937	(0.308)	0.0320	(0.737)	0.0632	(0.513)
Tenous prosperity	0.0374	(0.516)	-0.0986	(0.102)	0.0605	(0.334)	-0.0628	(0.286)
Higher Income	0.0508	(0.503)	0.1203	(0.106)	-0.0493	(0.562)	0.1696**	(0.030)
Rel. prosperity	-0.0027	(0.971)	0.1306*	(0.070)	-0.0093	(0.909)	0.2384***	(0.001)
Economic worries	0.2150***	(0.000)	-0.1163**	(0.035)	0.1168**	(0.040)	-0.2805***	(0.000)
Civil servant	0.0685	(0.319)	0.0183	(0.790)	-0.0084	(0.915)	0.0181	(0.796)
Blue-collar	0.1060*	(0.099)	0.1304*	(0.052)	-0.0522	(0.474)	0.0826	(0.219)
Unemployed	0.3042**	(0.021)	0.3905***	(0.005)	-0.0397	(0.785)	0.2534*	(0.074)
Working h. 1-21	-0.2083	(0.228)	-0.1944	(0.268)	0.0202	(0.915)	0.0195	(0.911)
Working h. 22-42	-0.0337	(0.681)	0.0118	(0.887)	-0.0128	(0.888)	0.2812***	(0.001)
Working h. >42	0.1257	(0.117)	-0.0275	(0.737)	0.0628	(0.473)	0.2417***	(0.003)
O-level	-0.0897	(0.104)	0.0574	(0.313)	-0.1049*	(0.090)	0.0533	(0.349)
High school	-0.2752***	(0.000)	0.1620**	(0.044)	-0.1229	(0.174)	0.0495	(0.553)
University	-0.5024***	(0.000)	0.1660**	(0.016)	-0.2022***	(0.009)	0.2150**	(0.014)
Education	-0.2161**	(0.035)	-0.2624**	(0.022)	-0.0770	(0.582)	-0.1207	(0.340)
Private health ins.	-0.1459**	(0.040)	0.1324*	(0.051)	-0.1347*	(0.089)	-0.0428	(0.547)
Supplemental ins.	-0.0338	(0.628)	0.0877	(0.204)	-0.0154	(0.842)	-0.1274*	(0.072)
Risk averse	-0.0872	(0.115)	-0.0714	(0.193)	0.0505	(0.389)	-0.1602***	(0.003)
Risk taker	0.1449***	(0.004)	-0.0000	(1.000)	-0.0061	(0.914)	0.1187**	(0.021)

Renovation	0.0614	(0.197)	0.0767	(0.117)	0.0916*	(0.085)	-0.1207**	(0.017)
Mother O-level	-0.0807	(0.229)	-0.0184	(0.784)	-0.1798**	(0.025)	-	-
Father O-level	0.1331**	(0.037)	-0.0376	(0.544)	-0.0411	(0.574)	-	-
Constant	-0.2054*	(0.050)	-0.8905***	(0.000)	-1.2879***	(0.000)	1.5526***	(0.000)

p-values in parentheses: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table VIII: Estimation results (females, N=4581)

	(1) Smoker		(2) Alcohol		(3) Obesity		(4) Health	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
Smoker							-0.0785	(0.768)
Alcohol							0.9186***	(0.010)
Obesity							-0.3414	(0.464)
Age 30-44	-0.0822	(0.288)	0.1229	(0.294)	0.1743*	(0.095)	-0.5109***	(0.000)
Age 45-59	-0.1948**	(0.018)	0.3271***	(0.008)	0.4189***	(0.000)	-1.1077***	(0.000)
Age 60-74	-0.7107***	(0.000)	0.4382***	(0.002)	0.3705***	(0.002)	-1.4794***	(0.000)
Age >74	-1.2822***	(0.000)	0.5888***	(0.000)	0.3331**	(0.012)	-2.0335***	(0.000)
Partnership	-0.2910***	(0.000)	-0.0312	(0.646)	0.1095*	(0.052)	-0.0553	(0.335)
Children	0.0466	(0.420)	0.0235	(0.779)	-0.0773	(0.286)	0.1536**	(0.014)
Eastern Germany	-0.1201**	(0.025)	-0.1573**	(0.034)	0.0643	(0.262)	-0.0602	(0.256)
Turkey	-0.0921	(0.476)	-4.0285***	(0.000)	-0.0042	(0.975)	0.0756	(0.563)
Rest of World	0.0983	(0.304)	-0.2538	(0.107)	0.1537	(0.127)	-0.0957	(0.323)
Rel. poverty	0.3301***	(0.000)	-0.1519	(0.203)	0.1590*	(0.053)	0.0847	(0.318)
Tenous prosperity	0.0743	(0.178)	-0.0989	(0.220)	0.1109*	(0.053)	-0.0040	(0.944)
Higher Income	0.0411	(0.600)	0.1274	(0.190)	-0.1451	(0.124)	-0.0018	(0.982)
Rel. prosperity	-0.1080	(0.188)	0.2156**	(0.017)	-0.2318***	(0.009)	0.0543	(0.503)
Economic worries	0.1446***	(0.004)	-0.0308	(0.669)	0.0783	(0.142)	-0.3498***	(0.000)
Civil servant	0.0730	(0.257)	0.0040	(0.964)	0.0924	(0.244)	-0.1813***	(0.007)
Blue-collar	0.1418*	(0.073)	-0.2177*	(0.099)	0.1558*	(0.077)	-0.0809	(0.354)
Unemployed	0.4496***	(0.000)	0.3302*	(0.072)	-0.0558	(0.671)	0.0080	(0.950)
Working h. 1-21	0.1697**	(0.030)	0.1713	(0.124)	-0.1925**	(0.037)	0.3150***	(0.000)
Working h. 22-42	0.2141***	(0.001)	0.2389**	(0.012)	-0.2659***	(0.001)	0.2051***	(0.009)
Working h. >42	0.2859***	(0.001)	0.3358***	(0.003)	0.0664	(0.499)	0.0911	(0.324)
O-level	-0.1224**	(0.026)	0.2147***	(0.006)	-0.0668	(0.238)	0.2091***	(0.000)
High school	-0.4145***	(0.000)	0.2717**	(0.011)	-0.3431***	(0.000)	0.2286**	(0.014)
University	-0.5260***	(0.000)	0.3206***	(0.001)	-0.3740***	(0.000)	0.3320***	(0.000)
Education	-0.3079***	(0.001)	-0.0868	(0.532)	-0.2744**	(0.047)	0.1394	(0.217)
Private health ins.	-0.0514	(0.565)	0.0951	(0.343)	-0.0547	(0.571)	-0.0037	(0.966)
Supplemental ins.	0.0492	(0.437)	0.1730**	(0.026)	-0.0374	(0.606)	-0.1095*	(0.076)
Risk averse	-0.1021**	(0.037)	0.0028	(0.967)	0.0001	(0.999)	-0.1038**	(0.027)
Risk taker	0.2353***	(0.000)	0.1982***	(0.008)	-0.0434	(0.513)	0.1645**	(0.010)
Renovation	0.1353***	(0.004)	0.0245	(0.710)	0.0615	(0.229)	-0.1441***	(0.003)

Mother O-level	0.0742	(0.266)	0.0801	(0.350)	-0.0633	(0.430)	-	-
Father O-level	0.0705	(0.264)	0.1439*	(0.075)	-0.1019	(0.174)	-	-
Constant	-0.3182***	(0.002)	-2.0864***	(0.000)	-1.1576***	(0.000)	1.0199***	(0.000)

Table IX: Correlation Coefficients

	Males		
Correlation coefficients	rho21 = 0.1362***		
	rho31 = -0.1118***	rho32 = 0.0208	
	rho41 = 0.2143	rho42 = 0.3665***	rho43 = 0.3990***
LR-Test $Chi^2(5)$	44.8925***		
AIC	17448.0409		
BIC	18302.1206		
	Females		
Correlation coefficients	rho21 = 0.1100***		
	rho31 = -0.0503	rho32 = -0.1501***	
	rho41 = -0.0187	rho42 = -0.3033*	rho43 = -0.0348
LR-Test $Chi^2(5)$	22.0469***		
AIC	15822.2271		
BIC	16690.2329		