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ORIGINAL ARTICLE

Are spouses' socio-economic classifications interchangeable? Examining the consequences of a commonly used practice in studies on social inequalities in health

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Abstract

Objectives Indicators of socio-economic position are not always available for all subjects. To avoid losses of large parts of study populations, missing data are replaced by spouses' information. Despite this commonly practiced solution, systematic analyses of the consequences on substantive results of studies are rare. We examined the consequences of assigning the educational position of subjects to their partners.

Methods German statutory health insurance data from 2005 ($N = 1{,}801{,}744$) and 2011 ($N = 1{,}987{,}707$) were used. Diagnoses of type 2 diabetes were used as outcome. Effects were examined in terms of differences in diabetes prevalence and by the reproduction of social gradients in women and men as compared to their partners.

Results Social gradients were reproduced for subjects and for their partners, but diabetes prevalences were higher in partners.

Conclusions From a pragmatic point of view the practice of replacing missing information by spouses' information turned out as viable. However, the usefulness of this solution has to be examined in every case anew, because it may not be suitable for every health-related outcome.

Keywords Type 2 diabetes · Socio-economic position · Health inequalities · Education

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Introduction

In studies on health inequalities socio-economic position is usually depicted by education, occupation, or income (Geyer et al. 2006; Braveman et al. 2005, 2011; Lahelma et al. 2008), but these indicators may not be available for all individuals enclosed in the respective study. To avoid losses of significant segments of samples or for preventing biased results, missings are replaced by their spouses' information (Arber and Ginn 1993). The socio-economic position of a family had also been determined by the husband even if the relevant information was available (Gliksman et al. 1995). In cases of individuals' information being unavailable, the socio-economic category of one person was transferred to the partner, usually from husband to wife (Geyer et al. 2004; Lidfeldt et al. 2007; Ni et al. 2013). Despite this frequently chosen solution, the literature on resulting biases and about its practicability is scarce. In the literature a discussion evolved whether it was permitted to use husbands' socio-economic position and transfer it to wives (Goldthorpe 1983; Baxter 1994; Sorensen 1994; Zipp and Plutzer 1996). It was discussed whether the assumption holds that husbands and wives have the same socio-economic position so that they can be used as interchangeable. Arber and Ginn (1993) compared individuals' own position (the so-called "individualistic" approach) with spouses' classification (the so-called "conventional" approach) and concluded that both procedures led to the same substantive results. Goldthorpe (1983) and Baxter (1994) developed arguments in favor of the "conventional" view. Taken together, the findings are not quite clear as a few data-based analyses are available (Arber and Ginn 1993). Three lines of reasoning are helpful for structuring this issue:

Recent studies are suggesting context effects: irrespective of socio-economic status, being a spouse of a person with a cardiovascular disease may increase own risks due to shared socio-environmental factors (Leong et al. 2014; Di Castelnuovo et al. 2007, 2009; Hippisley-Cox and Pringle 1998). On the one hand, spouses seem to have similar health risks, which in turn may support the assignment of education from one partner to the other. On the other hand, spouses with different educational levels may influence each other. The assignment of education does not depict the direction of this influence. Monden et al. (2003) claimed that the partner's educational attainment may have a strong effect on one's own health status, namely a positive one if the partner's education level is higher and vice versa. Strogatz et al. (1988) as well as Bosma et al. (1995) used spouses' socio-economic classifications and reported that husbands of women with superior education had lower mortality risks.

Homogamy is the second argument in favor of the assignment of socio-economic categories from one partner to the other. Many studies have shown that choices of partners are based on similarities of social backgrounds like educational attainment (Blackwell 1998; Kalmjin 1998). Furthermore, educational homogamy is more frequent among couples with higher educational levels. This may be explained by increasing qualification levels of women over the last decades as well as by the function of extended education periods as "marriage markets" (Schwartz and Mare 2005). Even if these findings endorse assigning the education between spouses, educational homogamy cannot be applied to all couples and the assignment procedure might lead to errors in couples with different educational backgrounds.

A third argument against the aforementioned practice assumes its inappropriateness as assigning a socio-economic category of a partner to the other (usually to a female) neglects his or her individuality and may thus be inherently problematic (Goldthorpe 1983; Baxter 1994). In any case the inappropriateness assumption also implies that in empirical terms the assignment should lead to biased results.

A final consideration is pragmatic as in the absence of information on socio-economic position researchers have to decide how to handle these cases with missing information. One option is to exclude them from analysis thus resulting in a significant loss of data and severely biased findings. An alternative is the assignment of socio-economic indicators of women or men to their spouses, thus making the available information a proxy measure (Geyer et al. 2004; Lidfeldt et al. 2007; Ni et al. 2013). This procedure might influence the results, but it is not clear to what extent the error amounts. This particular subject has not been addressed in research on social inequalities in health.

In the following analyses, this topic will be dealt with using type 2 diabetes (T2D) as an example. In earlier studies marked social gradients were reported (Dasgupta et al. 2010; Geyer et al. 2004, 2006; Lee et al. 2013). As a database we will use the data of a German statutory health insurance. For main-insured subjects information on education, occupation and individual income is available. For family-insured (spouses and children), information on socio-economic indicators is not available. In the analyses to follow we will impute socio-economic indicators to spouses. If the assignment of socio-economic indicators is a viable procedure, the same health risks and social gradients should be obtained in main-insured and in family-insured.

Type 2 diabetes is a public health-relevant disease whose onset occurs at an ever-earlier age, consequently a professionally active age (Tunceli et al. 2005; Whiting et al. 2011; Narasimhan and Weinstock 2014). This permitted to use the socio-economic status information which was only present for individuals in employment. Furthermore, case numbers of T2D patients are much larger than those of other diseases like myocardial infarction or stroke leading to more robust results. A population-based representative study estimated the overall prevalence rate of known type 2 diabetes in individuals aged 18–79 years in Germany at 7.2 % (7.4 % in women, 7.0 % in men) (Heidemann et al. 2013).

The goal of the study is to present a systematic analysis examining the consequences of assigning socio-economic classifications from individuals to their partners.

Methods

Based on the foregoing considerations, the following research questions will be addressed:

1. Can the social gradient of type 2 diabetes obtained for main-insured be reproduced for family-insured?
   Given the similarities between spouses concerning socio-environmental factors as well as educational homogamy, social gradients should be reproduced in family-insured individuals.
2. Are there differences in the prevalence of type 2 diabetes between main-insured and family-insured?
   As no previous study addressed this issue, a hypothesis on differences of health risks between the two groups was not formulated.
3. Will differences between main-insured and family-insured be reproduced for women and men?
   As for the second question, there were no empirical grounds for formulating a hypothesis.

Data

Data of a German statutory health insurance (Allgemeine Ortskrankenkasse Niedersachsen) will be used. It covers approximately one-third of the population of the state of Lower Saxony. The data were collected for accounting purposes and contain demographic variables as well as outpatient ICD-diagnoses made by physicians. For this study the two most distant available years (2005 and 2011) were used. This makes it possible to reproduce the findings of 1 year with data of the other thus claiming that the findings can be reproduced. Due to the fluctuation among the insurance population, only datasets of women and men were used who were either insured during the entire year, or if they had died, in the year of observation.

In Germany health insurance is mandatory for all residents, and there are two types of health insurance: statutory and private. The former covers the vast majority of the population. In the German statutory health insurance system the division between main-insured and family-insured individuals derives out of the fact that employed individuals are main-insured and coverage is transferred to family members if they are not in employment. Consequently, both groups of insured have the same healthcare coverage. Data on education, occupation and individual income of main-insured individuals are routinely transferred from employers to health insurances. Therefore, education information is only available for main-insured. Family-insured are exempted from paying insurance fees. In the following analyses only individuals aged 18–60 years will be included because among the insured over 60 the rate of missing data on education exceeds 50 % due to retirement. Data were not available for subjects younger than 18 years, furthermore the majority of T2D cases concentrates on higher age groups. Legally married couples and individuals in a civil union which includes same-sex couples were included.

The following variables will be used in the analyses:

Age is used as a continuously scaled variable. In the stratified analyses of prevalence rates the three age categories are used: 18–30, 31–45, and 46–60 years.

Diagnoses of T2D are drawn from outpatient information in terms of ICD-10 diagnoses. Individuals are classified as having T2D if ICD-10 code E11 is assigned. Other types of diabetes (ICD-10 codes E12-14), type 1 diabetes (ICD-10 code E10) and diabetes in pregnancy (ICD-10 code O24) are excluded from the analyses. We do not use medication data to identify T2D patients because not all are treated with insulin.

Educational level is used as indicator of socio-economic status in terms of vocational training. The available categories are "without vocational training", "with vocational training" and "university degree". We used vocational education instead of school education since it depicts the highest acquired educational level and is better documented in our data.

Due to the administrative nature of the insurance data, information on potentially confounding variables like individuals' weight or lifestyle factors was not present and, therefore, could not be considered in the analyses.

Statistical analyses

As a first step prevalence rates of T2D will be estimated for 2005 and 2011. This will be done separately for women and for men, by educational level, by insurance status, and age in categories (18–30, 31–45, 46–60). In the second step, logistic regression models will be used:

- Separate models for main-insured and family-insured spouses will be applied to determine effects of educational level on T2D. Independent measures are educational level (in three categories with the highest one as reference) and age as continuously scaled variable. The dependent variable is the diagnosis of T2D.
- The diabetes risks as dependent measure on type of insurance will be estimated for each level of education. Now the independent variables will be type of insurance (family-insured/main-insured) and age as continuously scaled variable. Again, the dependent variable diagnosis of T2D will be used with the main-insured as reference category.

Our insurance data do not represent a sample, but an entire population. Thus, there are no imprecisions in measurement and reporting confidence intervals and significance levels would be meaningless. Therefore, only odds ratios are presented.

All regression models are estimated separately for women and men. Stata 11MP (Stata Corp. 2009) was used for data management and for the statistical analyses.

Results

For 2005, our study population comprised $N = 1{,}801{,}744$ individuals (46 % men). Insured without information on education and individuals aged over 60 were excluded due to >50 % cases with missing information on education. Finally, the analyses were carried out for 759,896 insured in 2005 with 377,876 men and 286,731 women with information on educational level. We transferred the information of main-insured to their spouses in 95,289 cases (13 %) with 9392 being family-insured men (2 % of all men) and 85,897 family-insured women (30 % of all women).

For 2011, the data of $N = 1{,}987{,}707$ individuals (47 % men) were available. After the exclusion of individuals without information on education and those over 60 years of age, a study population of 897,011 insured remained with 454,913 males and 335,116 females with data on education. In 106,982 cases (12 %) we transferred information on education from main-insured spouses to 9597 family-insured men (2 % of all men) and 97,385 family-insured women (29 % of all women).

Frequencies

The frequencies of the relevant variables are displayed in Table 1. It contains the distributions of gender, age and educational level for 2005 and 2011 with the family-insured after spouses' educational categories were assigned. In both years, the majority of insured individuals completed vocational training with a higher share in men, thus most of the family-insured spouses whom partner's educational classification was assigned to were women. This holds for 2005 as well as for 2011. The share of main-insured with university degree is generally lower.

Type 2 diabetes prevalence rates

For 2005, the overall prevalence rates (age >18) of T2D were 8.8 % in men and 9.9 % in women. The respective figures for 2011 are 11.4 % in men and 12.1 % in women. Below the age of 60 prevalence rates were lower: in 2005, 3.8 % men and 3.1 % women had a diagnosis, whereas in 2011 4.9 % men and 4.2 % women had T2D indicating an increase over the years. In the age group below 30 the diabetes rates are very low. Table 2 shows the prevalence rates by gender, age, and educational level of the insurance population in 2005 and 2011.

In the group of main-insured above the age of 30 prevalence rates are declining with increasing educational level, and diabetes risks remain similar between main-insured men and women up to the age of 45. Above 30 years, main-insured men have higher prevalence rates than main-insured women.

Family-insured men and women are lower in number, but their prevalence rates are higher than in their main-insured spouses. This difference holds at every educational level and in every age category. The only exception is due to the absence of diagnosed diabetes cases in men aged 18–30 with assigned university degree in 2005 as well as in 2011. In the group of family-insured spouses especially above 30, prevalence rates are declining with increasing education level in the same way as in the group of main-insured. The highest diabetes risks emerged in 46–60-year-old men without vocational training (own and assigned) in 2011.

Table 1 Frequencies of main-insured and family-insured (with assigned education) women and men by gender, age categories and educational level (Germany 2005, 2011)

Frequencies		2005				2011			
		Men		Women		Men		Women	
Age	Education level	Main-insured	Family-insured spouses	Main-insured	Family-insured spouses	Main-insured	Family-insured spouses	Main-insured	Family-insured spouses
18–30	Without voc. training	25,874	255	19,588	4018	55,387	291	42,391	3265
	With voc. training	76,611	443	64,059	9743	74,269	426	61,782	7542
	University degree	7378	58	7728	388	4643	36	5357	383
31–45	Without voc. training	27,054	1252	24,306	8795	25,060	1042	18,671	9070
	With voc. training	123,223	2058	82,051	33,190	123,404	1775	79,768	33,279
	University degree	4785	172	4758	742	7848	189	6905	1133
46–60	Without voc. training	21,248	1965	27,181	5613	27,813	2084	30,643	7588
	With voc. training	89,747	3018	54,619	23,049	133,117	3525	85,406	34,571
	University degree	1956	171	2441	359	3372	229	4193	554
Total		377,876	9392	286,731	85,897	454,913	9597	335,116	97,385

Table 2 Type 2 diabetes prevalence rates: main-insured and family-insured (with assigned education) by gender, age categories and educational level (Germany 2005, 2011)

Type 2 diabetes prevalence rates		Men		Women	
Age	Education level	Main-insured *N* (%)	Family-insured spouses *N* (%)	Main-insured *N* (%)	Family-insured spouses *N* (%)
2005					
18–30	Without voc. training	56 (0.22)	5 (1.96)	81 (0.41)	23 (0.57)
	With voc. training	191 (0.25)	1 (0.23)	227 (0.35)	64 (0.66)
	University degree	9 (0.12)	0 (0)	15 (0.19)	3 (0.77)
31–45	Without voc. training	480 (1.77)	43 (3.43)	408 (1.68)	258 (2.93)
	With voc. training	1743 (1.41)	65 (3.16)	853 (1.04)	568 (1.71)
	University degree	42 (0.88)	4 (2.33)	28 (0.59)	7 (0.94)
46–60	Without voc. training	1642 (7.73)	205 (10.43)	1489 (5.48)	470 (8.37)
	With voc. training	5839 (6.51)	264 (8.75)	1959 (3.59)	1319 (5.72)
	University degree	103 (5.27)	12 (7.02)	47 (1.93)	22 (6.13)
Total		10,105 (2.67)	599 (6.38)	5107 (1.78)	2734 (3.18)
2011					
18–30	Without voc. training	148 (0.27)	1 (0.34)	194 (0.46)	36 (1.1)
	With voc. training	232 (0.31)	3 (0.7)	291 (0.47)	56 (0.74)
	University degree	14 (0.3)	0 (0)	23 (0.43)	2 (0.52)
31–45	Without voc. training	710 (2.83)	40 (3.84)	516 (2.76)	383 (4.22)
	With voc. training	2595 (2.1)	58 (3.27)	1307 (1.64)	805 (2.42)
	University degree	73 (0.93)	3 (1.59)	73 (1.06)	18 (1.59)
46–60	Without voc. training	3013 (10.83)	361 (17.32)	2573 (8.4)	964 (12.7)
	With voc. training	11,490 (8.63)	502 (14.24)	4416 (5.17)	2791 (8.07)
	University degree	213 (6.32)	13 (5.68)	130 (3.1)	34 (6.14)
Total		18,488 (4.06)	981 (10.22)	9523 (2.84)	5089 (5.23)

Table 3 Odds ratios for type 2 diabetes by educational level for main-insured and family-insured men and women controlled for age (Germany 2005, 2011)

Odds ratios	Educational level	2005		2011	
		Men	Women	Men	Women
Main-insured	University degree	1	1	1	1
	With voc. training	1.31	1.72	1.49	1.52
	Without voc. training	1.55	2.51	1.92	2.38
Family-insured	University degree	1	1	1	1
	With voc. training	1.27	1.07	2.58	1.35
	Without voc. training	1.52	1.66	3.22	2.32

Logistic regression models

Odds ratios of type 2 diabetes by educational level (Table 3)

The impact of educational level on diabetes risks was examined using logistic regression models. Separate analyses were performed for main-insured and for family-insured. The highest education level ("university degree") was used as reference category.

In main-insured individuals diabetes risks are increasing with decreasing educational level, i.e., the well-known social gradient was reproduced. The social differences are more pronounced in women, and among the main-insured

Table 4 Odds ratios for diagnoses of type 2 diabetes for family-insured as compared with main-insured as reference category controlled for age

Odds ratios	2005		2011	
Educational level	Men	Women	Men	Women
University degree	1.38	2.58	0.87	1.76
With voc. training	1.39	1.60	1.57	1.56
Without voc. training	1.40	1.71	1.53	1.71

Every odds ratio is based on a separate analysis (Germany 2005, 2011)

women without vocational training the highest risks emerged, and this applies for 2005 (OR = 2.51) and for 2011 (OR = 2.38).

In family-insured spouses the social gradients were reproduced for women and for men. This was the case for both years data were available for. Comparing the odds ratios of main- and family-insured does not lead to a consistent conclusion on the direction of differences, i.e., whether the odds ratios are larger or smaller in main-insured or in family-insured.

Differences of type 2 diabetes by type of insurance

Differences in diabetes risks between family-insured spouses and main-insured individuals were examined using logistic regression models. The main-insured were the reference category (Table 4).

The odds ratios are indicating that the risk of a T2D-diagnosis is higher in family-insured. This holds for men and women at all educational levels for 2005 as well as for 2011 with the only exception being family-insured men with assigned university degree. The results are also indicating higher diabetes risks among family-insured women. For 2005 those with a university degree had the highest risk (OR = 2.58).

Discussion

This study was conducted to gauge the consequences of assigning socio-economic classifications from individuals to their partners. We used statutory health insurance data of 2 years, thus having the advantage of large case numbers. The first question referred to the reproduction of social gradients in main-insured and in family-insured. This was clearly confirmed as social gradients for T2D emerged for both types of insured and in both datasets. This finding speaks in favor of the homogamy assumption that postulates similar health risks within couples. This in turn can be used as an argument in favor of assigning socio-economic categories from one spouse to the other. This was counterbalanced by the findings in response to the second and the third question, i.e., whether the prevalence rates of main-insured and family-insured are of the same size and whether this applies to women and men. Diabetes rates of family-insured turned out to be higher at all educational levels. Family-insured male partners of individuals with university degree are the only exception as in this group there is no marked increase in diabetes risk. If this would be due to educational homogamy we should find the same tendency in the opposite case, but we did not. Family-insured women with assigned university degree of their partners show an even higher risk than main-insured women with own university degree. This finding is one key argument against the assignment practice and supports the above-mentioned conclusions of Strogatz et al. (1988) and Bosma et al. (1995) who reported that men have lower mortality risks if their wives are higher educated. Hence, the assignment of education neglects differences in education levels between spouses.

The analyses on associations between educational level and T2D have produced consistent social gradients for main as well as for family-insured, for women and men, and for both years. If the reproduced social gradient is used as basis for a recommendation, the assignment of education could be appropriate. However, the distinctly higher diabetes risk among family-insured in general rather contradicts an assigning of education. Different prevalence levels between subgroups might lead to a misinterpretation of health risks in terms of an overestimation of prevalences if all individuals are considered together. As a conclusion, future studies should perform subgroup analyses before imputing socio-economic information. Finally it should be explained why family-insured spouses have higher risks of T2D. Between 2005 and 2011 they were not employed for at least one year, so it may be concluded that context effects might have occurred. Longer time periods out of employment may increase health risks: Vagerö and Lahelma (1998) found that women who did not have an occupation had higher risks of heart diseases than women in employment. Müller et al. (2013) reported that unemployment and T2D were linked only in women. It is, however, just as conceivable that individuals with T2D are less likely to be employed as the disease and related comorbidities might lead to incapacity for work (Tunceli et al. 2005; Minor 2013). In data of statutory health insurances missing education information is not at random and therefore implies effects on outcomes. This contextual factor suggests separate analyses for the subgroup of family-insured individuals.

Our dataset is not a sample, it represents a population, i.e., all insured individuals of a statutory health insurance. Thus, it remains to be considered whether or to what extent our findings apply to populations beyond our insured individuals. In an earlier paper it was examined whether the distributions of age, gender, employment rate and qualification differ from those of the state of Lower Saxony and entire Germany (Jaunzeme et al. 2013). Comparing the years 2004–2009, the distributions did not differ markedly, except for qualification. In our insurance population the mean qualification level was lower.

As we have data of a whole population, large case numbers are available thus permitting to consider also relatively small groups. This refers to males who are not in paid employment while their partners are the main breadwinner of the family, and it also applies to younger patients. As health insurance data are administrative in nature, problems of surveys do not occur. This refers to forgetting or to selective nonresponse as the likelihood to participate in surveys decreases with deteriorating health status (Richiardi et al. 2002; Hoffmann et al. 2004).

Limitations

Finally, the following limitations of our approach have to be mentioned. We used T2D as an example, and it has to be considered whether the procedure can be applied to other outcomes, socio-economic indicators, or data sources. Our findings do not apply to individuals over 60 years. Estimating T2D risks by educational level was not possible due to the high percentage of missing data on education for this age group. Furthermore, we have to consider errors in the coding of T2D by physicians referring to errors due to software routines, the assignment of ICD-codes, and omitted diagnoses. The inclusion of type 1-cases should rarely affect the results as only a small percentage of patients with diabetes belongs to this group: 80–90 % of all diabetes diagnoses in German adults apply to T2D (Deutsche Diabetes-Hilfe 2012; Icks et al. 2005). Lifestyle factors and body measures like height or weight were not included and could thus not be taken into account as potential confounders in the analyses.

Conclusion

Taking all aspects together, the assignment of education to spouses in order to avoid loss of cases for analyses appears to be a viable solution from a pragmatic point of view, nevertheless some limiting conditions apply. The assignment approach is reproducing social gradients, but higher diabetes risks in family-insured spouses are opting against the assignment procedure. As the social gradient was reproduced at a higher level, the prevalence rates by education would be overestimated if the data of all individuals are considered together. The conclusion from this study is that the assignment procedure can be used in studies on health inequalities, but wherever possible, researchers should examine each group with missing information on socio-economic indicators before performing their analyses.

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Compliance with ethical standards

Conflict of interest None.

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