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**Income, income, or income?**

**The effects of different income measures on health in a national survey**

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**Background:** The effects of six income types (household post- government income, OECD-weighted household post- government income, individual net income, corrected monthly household income, and household net income from wages) on subjective health were compared in order to examine to what extent their effects are different.

**Methods:** Data from the German Socio- Economic Panel 2007 were used. The analyses were based on the subsample of 30 to 60 year old women and men (N=11,471), incomes were divided into 10 groups of equal size. In addition education, gender, and age are considered.

**Results:** The effects of the household incomes were similar by ranging from OR=3.1 to 3.7. For individual income the effect was lower (OR=2.1). This has to be interpreted against the backdrop of a large number of subjects with missing income information. This group consists of not employed, unemployed, and retired individuals.

**Conclusion:** The five types of household incomes can be considered as interchangeable with respect to their effects on subjective health. In empirical studies household-based measures are appropriate if material resources or the purchasing power of households shall be depicted. Individual income is a different measure that should be chosen if the individual position in terms of status or material success is to be measured.

## **Background**

Studies on health inequalities are usually based on income, occupational position and education. Each indicator is associated with health-related outcomes, but the relative size of effects of a given indicator depends on the outcome chosen.[1] For income different indicators are available. This includes variations of individual incomes and household-based measures,[2-4] but occasionally the type of income had not been specified.[5] Besides data at individual level, some studies were conducted with aggregate-level income where area-based measures had been used.[6-8] This leads to the question what may be depicted by measuring income. In the literature there is consensus that income provides options for leading a less stressful and a healthier life (including good housing, safe neighbourhoods and leisure activities), protection from chronic financial stress, access to resources, protection against hardship and options for coping successfully with difficulties and adversity.[9] It can also be maintained that income is indicative of one's economic position and worth on the labour market. Besides these material aspects income has also symbolic meanings as an indicator of success, and it indicates individuals' relative position in society. Wilkinson complemented this by highlighting the function of income for the subjective experience of justice, fairness, and for the degree of the integration into society. According to these assumptions increasing income differentials may lead to unfavourable social comparisons and to the experience of social deprivation.[8;10]

From the background of these considerations it is helpful to know which indicator has the strongest effects on health, but comparisons between different types of income have rarely been performed. In an earlier paper Kawachi and Kennedy considered different measures depicting income distribution and concluded that the type of income did not matter.[6] This study had however been conducted with aggregated measures, and the results may not be generalized to indicators at micro-level.

There are more income measures that have been used in studies on health inequalities, but up to now there are no systematic comparisons, even more comprehensive reviews did not take them into account. [11] Comparisons that have been performed with income at micro- level so far are devoted to the comparison of absolute income (i.e. income that can be assigned to subjects or families at individual level) and income distributions between societies or regions.[11;12] This emphasis is mainly due to a scientific debate that arose from Wilkinson's hypothesis of relative deprivation.[13;14]

A comparison of incomes at micro-level was performed by Fritzell, Neramo and Lundberg.[4] They considered *individual annual earnings* from paid labour and compared it with the *equivalent disposable income* that takes the number of household members into account. Their procedure was similar to, but not identical with the OECD Equivalence Scale.[15] The odds ratio of rating one's subjective health as bad turned out to be higher if individual earnings were used. In a similar study Rahkonen et al. used gross individual income and (OECD-) household equivalent income from Finland and Great Britain with respect to subjective health by also taking education and social class into account.[16] The analyses were restricted to the age groups 25 to 64 years. Based on their results the authors concluded that household equivalent income might be a more appropriate indicator than a measure that refers to a single individual without considering the purchasing power of the household he or she is part of.

Since the comparisons cited above included only two measures, it makes sense to compare more types of income thus making it possible to evaluate the results of studies where differing income measures were applied.

The indicators used in the following analyses can be grouped into three categories: **The first one** includes household measures that do not take the number of members into account. Three will be examined: The monthly household income, the corrected household net income from wages, and the household income from all sources. **The second category** includes household-

based measures that are broken down by household members according to the OECD-equivalence scale as published in 1982,[15] in particular the corrected household income, and the total household income from all sources, again broken down by the number of household members. **The third category** consists of a purely individual measure, respondents' current monthly net income.

Subjective health will be used as dependent variable. It is a global indicator of health-related impairments and associated with a variety of outcomes as well as with perceived distress and well-being. Subjective health was shown to be associated with mild and severe disorders, with need of help by various reasons, with a high degree of distress, and with a low perception of control.[17;18] Thus it is rather unspecific, but in an earlier report to the WHO it was recommended for measuring health in comparative studies.[19]

A national dataset containing a variety of income measures will be used. The analyses were guided by two research questions:

- Are all income measures associated with impaired subjective health?
- Are the effects of individual-based incomes different from household-based measures?

## **Methods**

The data were derived from the Socio-Economic Panel (SOEP) 2007. The SOEP is a nationwide longitudinal survey project located at the German Institute for Economic Research (Deutsches Institut für Wirtschaftsforschung -DIW Berlin). It was set up for providing representative and timely data for Germany in order to monitor social change and stability in living conditions as well as the development of wealth and poverty. The SOEP covers the residential population of Germany including those without German nationality. As the focus was on households, individuals living in nursing homes, hospitals and military installations were not included.

The first wave was carried out in 1984, and regular follow-ups are conducted in order to catch up with recent developments. Panel attrition is compensated for by sampling new subjects in order to obtain a sufficiently large number of cases and to avoid biases in the composition of respondents. Information is collected by means of face-to-face- interviews. Detailed accounts of the SOEP with data descriptions and manuals have been published elsewhere,[20] and extensive information can be found in the internet: [www.diw.de/SOEP](http://www.diw.de/SOEP). The data of all women and men between 30 and 60 years of age were included in the following analyses.

**Ethics approval:** Approval of an ethics committee was not necessary because the analyses were performed with an already existing dataset collected by an external institution, the DIW.

**Income:** As the economic development of Germany is one of the major goals of the SOEP, income was measured in different ways. All types of income were depicted at a continuous data level and in EURO currency. For the following analyses the incomes were divided into 10 equal groups. This rather fine-grained division should make differences between measures more visible and result in higher effect sizes at the upper ends of the distribution.

The following types of income will be compared:

**Group 1: Household incomes without considering the number of household members**

- *Household post-government income from all sources:* This variable depicts the sum of total family income from labour earnings, asset flows, private retirement income, private transfers, public transfers, and social security pensions minus total family taxes.[21]
- *(Corrected) monthly household net income* depicts the income of all household members irrespective of household size. This information is based on individual incomes as described above, but supplemented by household-based transfers such as maternity benefits, grants, nursing fees and alimonies. These items were summarized

by adding up the respective single positions. The corrected income is a generated measure that should be the most accurate one with respect to the available financial resources of a household. Thus the effects of this income measure should be higher than those of the last-named one.

- *The monthly household net income from all wages*

### **Group 2: Household- based incomes at individual levels**

- *Weighted household post-government income according to OECD equivalence measures*: The former income measure is broken down by the number of individuals in the household as proposed by the Organization for Economic Cooperation and Development (OECD) in order to depict the disposable amount of money of each family member.[15] A single adult is weighted as 1.0, each additional adult is given the weight 0.7, and each child is counted 0.5.
- *Corrected household net income weighted by the number of household members according to OECD- recommendations.*[15]

### **Group 3: Income at individual basis**

- *Individual net income per month*: Depicts the monthly individual net income of a respondent irrespective of household size. This does not take eventual fluctuations over the year into account.

**Education:** Subjects were classified according to the highest educational degree attained: 8/9 years of school, 10 years of school, and 12/ 13 years of school. Subjects with missing information were again assigned into a separate category.

**Subjective health:** The question on current self- rated health had to be answered on a 5- point rating scale with “1=very good”/ to “5=bad”. Analogous to earlier studies,[22-24] the categories 1 to 3 and 4 to 5 were counted together in order to obtain a binary outcome variable with the most favourable category as standard of comparison in the regression analyses (table 1). Using only the most extreme categories might be a possible alternative approach. This



might result in higher odds ratios, but since subjective health is unevenly distributed (with the lowest numbers of responses on the worst health rating), low case numbers will impair the yield of statistically stable results.

#### Statistical procedures

Multivariate logistic regression models were used for the main analyses with odds ratios as the appropriate statistic. All income variables were divided into 10 groups of approximately equal size. Income and education measures were scaled in such a way that the highest category was used as standard of comparison. Thus the odds ratios have to be interpreted as increases of the statistical “chance” of rating one’s own health as “rather bad/ bad” as compared to the highest income level. A relationship was accepted as statistically significant if  $p < 0.05$ . All statistical analyses were performed using STATA version 10SE.[25]

#### **Results**

The data of 11,471 women and men between 30 and 60 years were available. The basic distributions are displayed in table 1.

**Table 1: Basic distributions of the indicators used in the analyses**

<b>Gender (N/ %)</b>		<b>Age in years</b>				<b>Subjective health</b>			
Female	Male	30-39	40-49	50-60	Mean/ Sd	Very good to satis- factory	“Poor/ bad”	Missing data	
6,031/ 52.6%	5,440/ 47.4%	3,162/ 27.6%	4,263/ 37.2%	4,046/ 35.3%	45.5/ 8.4	9,788/ 85.3%	1,661/ 14.5%	22/ 0.2%	
<b>Marital status</b>									
<b>Married</b>		<b>Single</b>		<b>Widowed</b>		<b>Divorced</b>		<b>Separated</b>	
8,060/ 67.3%		1,703/ 14.2%		205/ 1.7%		1210/ 10.5%		293/ 2.6%	
<b>Number of children in the household</b>									
0		1		2		3		>3	
6,518/ 56.8%		2,351/ 20.5%		2008/ 17.5%		481/ 4.2%		113/ 1%	
<b>Nationality</b>									
German		Turkish		Italian		Greek		Other	
10,646/ 92.8%		264/ 2.3%		124/ 1.1%		72/ 0.6%		365/ 3,2%	
<b>School education: Highest educational degrees (N/ %)</b>									
8/9 years		10 years			12/ 13 y.		missing		
3,301/ 28.8%		4,012/ 35.0%			3,195/ 27.9%		963/ 8.4%		
<b>Occupational status and occupational position</b>									
Un- skilled/ semi- skilled	Skilled manual	Skilled non- man	Inter- mediate occup.	Pro- fession- als	Retired	No employ- ment	Officially unem- ployed	Appren- ticeship	Missing
1,601/ 14.0%	1,236/ 10.8%	2,915/ 25.4%	1,494/ 25.4%	1,813/ 15.8%	418/ 3.6%	958/ 8.4%	820/ 7.2%	54/ 0.5%	76 /0.7%
<b>Missing values in income measures (N/ %)</b>									
Household post- government income from all sources	Corrected household net income	Monthly household net income from wages	Household post- government income, OECD- equivalent	Corrected household net income, OECD- equivalent	Individual net income from wages				
0	435/ 3.8%	575/ 5.0%	0	435/ 3.8%	2,265/ 19.8%				

For individual income a large number of missing values emerged. These cases were cross-tabulated with occupational status, education, and gender (table 2). It turned out that most of them were unemployed with or not employed without seeking a job, in early retirement, and they were predominantly female.

**Table 2: Distribution of characteristics of respondents without individual net income from wages**

Not employed	Un-employed	In education	Early retired	Employed, currently no income	Self-employed	N
956 (42.2%)	820 (36.2%)	35 (1.5%)	418 (18.5%)	9 (0.4%)	27 (1.2%)	2,265
Education						
8/9 years	10 years	12/ 13 y.	missing	Mean age in years (M/Sd)	Gender (women)	
393 (17.4%)	728 (32.1%)	868 (38.3%)	276 (12.2%)	47.0/ 9.2		1,615 (71.3%)

At first the associations between income measures need to be considered in order to assess the probabilities for duplicate results. The standardized rank order correlations are ranging between  $r=0.40$  and  $r=0.94$  (table 3), thus indicating that there are empirical overlaps between measures, but most of them have also unique variance.

**Table 3: Rank order correlations of the indicators of social differentiation as used in the analyses**

	Household post-government income from all sources	Corrected household net income	Monthly household net income from wages	Household post-government income, OECD-equivalent	Corrected household net income, OECD-equivalent	Individual net income from wages
Household post-government income from all sources	1					
Corrected household net income	0.86	1				
Monthly household net income from wages	0.84	0.94	1			
Household post-government income, OECD-equivalent	0.74	0.62	0.62	1		
Corrected household net income, OECD-equivalent	0.74	0.73	0.71	0.86	1	
Individual net income from wages	0.40	0.43	0.43	0.43	0.46	1
Education	0.30	0.32	0.33	0.33	0.35	0.28

If the results of the regression analyses (tables 4-6) are considered in comparison, it appears that the highest odds ratios emerged in the lowest income categories. This is in accordance with initial expectations, but a clear gradient with increasing odds ratios with decreasing incomes emerged only for household post-government income. For all other measures there are some deviations from this pattern in the intermediate categories.

If the lowest categories of household incomes are considered, their effects are appearing as remarkably similar ranging from OR=3.3 to OR=3.7. This differs from “individual net income” as the only measure that had been assessed on a purely individual basis. For the highest 10% of the income distribution an OR=2.1 was obtained. In contrast to the household-based measures the individual income was computed with a large number of missing data reflecting the heterogeneous number of individuals not living on income from wages (table 2). All subjects were counted together, and a high odds ratio (OR=4.3) was obtained.

In all cases for education a social gradient emerged with the lowest educational degree being associated with the highest odds ratio of rating one’s health as bad.

In most cases gender effects were not or only marginally significant. In model 6 the effect is clearly interpretable and indicates that women have rated their health as better than men. Statistically speaking, for age the results are indicating that, depending on the line of analysis, the odds of rating subjective health as bad increases at about 5 to 6% per year in this period between 30 and 60 years of age.

**Table 4: Odds ratios of income deciles for the first group of income measures**

	<b>Group1: Household incomes without considering the number of household members</b>			
	Model 1: Household post- government income from all sources		Model 2: Corrected household net income in €	
	OR	95% CI	OR	95% CI
<b>Income (deciles)</b>				
1 <sup>st</sup>	1	--	1	--
2 <sup>nd</sup>	0.95	0.72-1.24	0.88	0.67-1.17
3 <sup>rd</sup>	1.26	0.97-1.63	1.07	0.82-1.40
4 <sup>th</sup>	1.41	1.09-1.83	1.41	1.09-1.83
5 <sup>th</sup>	1.42	1.09-1.84	1.18	0.90-1.54
6 <sup>th</sup>	1.45	1.12-1.88	1.29	0.98-1.71
7 <sup>th</sup>	1.59	1.23-2.07	1.48	1.14-1.92
8 <sup>th</sup>	1.71	1.32-2.21	1.49	1.14-1.95
9 <sup>th</sup>	2.17	1.69-2.80	2.38	1.85-3.07
10 <sup>th</sup>	3.71	2.89-4.75	3.11	2.59-4.23
Unclass.	--	---	1.38	0.99-1.92
<b>Education</b>				
12/ 13 yrs.	1	--	1	--
10 years	1.20	1.03-1.39	1.19	1.02-1.37
8/9 yrs.	1.54	1.32-1.80	1.53	1.29-1.74
Other	1.65	1.34-2.03	1.63	1.35-1.99
Gender (female)	1.09	0.99-1.21	1.12	1.01-1.24
Age	1.056	1.049-1.063	1.055	1.049-1.060

**Table 5: Odds ratios of income deciles for the first and second group of income measures**

	<b>Group 1: Household incomes without considering the number of household members</b>		<b>Group 2: Household- based incomes at individual levels</b>	
	Model 3: Monthly household net income from wages		Model 4: Household post- government income, OECD- equivalent	
	OR	95% CI	OR	95% CI
<b>Income (deciles)</b>				
1 <sup>st</sup>	1	--	1	--
2 <sup>nd</sup>	1.09	0.84-1.46	1.37	1.07-1.76
3 <sup>rd</sup>	1.22	0.85-1.48	1.43	1.11-1.84
4 <sup>th</sup>	1.85	1.36-2.53	1.58	1.23-2.03
5 <sup>th</sup>	1.22	0.93-1.61	1.68	1.31-2.16
6 <sup>th</sup>	1.51	1.14-2.01	1.33	1.02-1.72
7 <sup>th</sup>	1.56	1.15-2.09	1.52	1.17-1.96
8 <sup>th</sup>	1.86	1.43-2.44	1.90	1.48-2.46
9 <sup>th</sup>	2.41	1.83-3.18	2.21	1.71-2.86
10 <sup>th</sup>	3.61	2.77-4.70	3.30	2.58-4.21
Unclassified	1.74	1.27-2.39	--	--
<b>Education</b>				
12/ 13 yrs.	1	--	1	--
10 years	1.18	1.01-1.37	1.23	1.06-1.44
8/9 yrs.	1.51	1.29-1.76	1.56	1.34-1.83
Other	1.59	1.29-1.96	1.60	1.30-1.98
Gender (female)	1.12	1.01-1.25	1.11	0.99-1.23
Age	1.054	1.047-1.061	1.060	1.053-1.068

**Table 6: Odds ratios of income deciles for the second and third group of income measures**

	<b>Group 2: Household- based incomes at individual level</b>		<b>Group 3: Income at individual basis</b>	
	Model 5: Corrected household net income, OECD- equivalent		Model 6: Individual net income from wages	
	OR	95% CI	OR	95% CI
<b>Income (deciles)</b>				
1 <sup>st</sup>	1	--	1	--
2 <sup>nd</sup>	1.18	0.91-1.54	1.24	0.92-1.67
3 <sup>rd</sup>	1.53	1.18-1.98	1.25	0.91-1.71
4 <sup>th</sup>	1.50	1.16-1.95	1.44	1.07-1.94
5 <sup>th</sup>	1.49	1.14-1.95	1.67	1.22-2.28
6 <sup>th</sup>	1.42	1.09-1.85	1.54	1.11-2.13
7 <sup>th</sup>	1.53	1.17-2.01	1.56	1.14-2.13
8 <sup>th</sup>	2.11	1.64-2.73	1.61	1.16-2.23
9 <sup>th</sup>	2.11	1.63-2.74	1.58	1.12-2.22
10 <sup>th</sup>	3.37	2.67-4.28	2.13	1.55-2.91
Missing	1.53	1.10-2.14	4.28	3.30-5.56
<b>Education</b>				
12/ 13 yrs.	1	--	1	--
10 years	1.20	1.03-1.40	1.20	1.03-1.41
8/9 yrs.	1.51	1.30-1.78	1.46	1.25-1.71
Other	1.52	1.23-1.88	1.53	1.24-1.89
Gender (female)	1.14	1.02-1.27	0.85	0.75-0.97
Age	1.061	1.053-1.068	1.050	1.043-1.057

## Discussion

The first research question asked whether all income measures are associated with subjective health, and this was indeed the case. The second question was directed towards differences between the six measures used in the analyses.

The incomes were divided into five weighted and unweighted household-based measures and an individual measure. It turned out that all types of household incomes had similar effects, while considerably lower odds ratios were obtained with individual income. The similarities between the household measures are remarkable since their correlations were moderate to high, but far from perfect. It did not matter whether the unweighted incomes were used or whether they were broken down by the number of household members. In order to extend these analyses, other types of household incomes should be considered, e.g. a modified OECD- measure as proposed in the 1990s,[26] or the Swedish classification as used by Fritzell et al.[4] However, against the backdrop of the findings reported here it can be assumed that the findings should be comparable with those presented in the foregoing analyses.

The similarities of the effects among the household measures were surprising, because neither Rahkonen et al.[16] nor Fritzell et al.[4] considered unweighted household incomes. They are usually considered as inappropriate since they are assumed to measure individual resources only incompletely. In contrast, the new results are suggesting that this assumption may need revision. Households may allocate their means flexibly according to their necessities, and this has also effects on their members' assessment of health. This however holds only if the effects of income are to be interpreted in terms of purchasing power.

The lower odds ratios of personal income have to be interpreted with particular consideration of “unclassified” subjects, because in this group the highest odds ratios emerged. Personal income reflects earnings from wages and ignores individuals without any income, those living

on their partner's money, or those depending on transfer payments. This includes groups with high disease risks, such as unemployed, those on welfare, but also single parents and individuals with early retirement due to disease and disability. They are all included in the household-based measures and in the first five analyses, and their composition is rather heterogeneous with most of them being not employed (housewives) or officially unemployed. From this perspective household-based incomes are concealing a large number of conditions outside the conventional pattern of income from paid labour.

Finally it needs to be discussed which income measure should be used in future studies on health inequalities. Such a choice should however not be determined by the magnitude of relationships, but by the goals of a study. Then it needs to be settled what is being measured with different income indicators. Household income should be chosen if material resources or the purchasing powers of households are subject to examination. In contrast, individual income should be used if the individual position in terms of status, income hierarchies or material success in occupational life is to be depicted. The effects of the latter cannot only be explained by the material aspects of income, but also by the psychological consequences of one's socio-economic standing. This had been elaborated by Wilkinson who emphasized the importance of social comparisons,[8] and on the associated degree of controllability. Up to now, these relationships have rather been inferred than examined empirically.[9]

### Limitations

The conclusions derived from the findings are subject to some limitations. They are arising from the database and from the way the indicators had been used. The results apply only to the residential population living in households, and to the age groups between 30 and 60 years. The effects of different income measures may differ from those not covered in the analyses. [9;27]

The second limitation refers to the way income was used in the regression analyses. The distributions of the six measures were divided into 10 equally large subgroups in order to



analyze differences between income types in more detail. As a consequence the income differences between these groups are not the same, and a more fine-grained differentiation occurs in the intermediate categories while at the extreme ends the deviations within groups are broader. In the regression analyses of models 2 to 6 deviations from the inverse relationship between income and impaired health emerged. This can however not be explained by the income divisions into 10 groups because it was reported in studies where incomes were divided into broader categories. [1;4] At present no explanations for such inconsistencies are available.

In all analyses subjective health was used as outcome, thus implying that the results are only valid for this measure. In earlier studies it was shown to be dependent on social stressors such as unemployment or poor working conditions. [17;18] Besides by acutely emerging stressors it is influenced by social position while inconsistent effects were reported for social mobility in younger age groups that have not been considered in our analyses. [28;29]

In order to facilitate comparisons with other studies **the subjective health measure** was dichotomized as practiced in many earlier studies. [9;30;31] This was done at the expense of precision since the effects of the independent variables should be lower than under the condition of leaving the indicator in its original five-point scaling.

### ***Conclusion***

The findings of the comparisons are permitting recommendations for future studies on health inequalities: If household-based income measures are available, the choice is rather arbitrary since their effects on health are similar. Household measures cannot be replaced by individual income. The latter should be chosen if individual status or material success is to be measured. [9;27]

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**What is already known on this topic:**

Income and health-related measures are inversely related. The few available comparisons of individual and household-based income at micro-level led to the conclusion that the latter should be preferred, but no systematic comparisons on more than two income measures at micro-level are available.

**What this study adds:**

The effects of incomes at household level and household incomes broken down by the number of household members are similar in magnitude. Effects of individual incomes are smaller, but this is due to the high number of individuals without income. In empirical studies household-based measures are appropriate if material resources or the purchasing power of households shall be depicted. Individual income is a different measure that should be chosen if the individual position in terms of status or material success is to be measured.

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