RESEARCH REPORT

Pathways between socioeconomic determinants of health

E Lahelma, P Martikainen, M Laaksonen, A Aittomäki

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See end of article for authors' affiliations

Correspondence to: Professor E Lahelma, Department of Public Health, PO Box 41, 00014 University of Helsinki, Finland; eero.lahelma@helsinki.fi; www.kttl.helsinki.fi

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Study objective: Many previous studies on socioeconomic inequalities in health have neglected the causal interdependencies between different socioeconomic indicators. This study examines the pathways between three socioeconomic determinants of ill health.

Design, setting, and participants: Cross sectional survey data from the Helsinki health study in 2000 and 2001 were used. Each year employees of the City of Helsinki, reaching 40, 45, 50, 55, and 60 years received a mailed questionnaire. Altogether 6243 employees responded (80% women, response rate 68%). Socioeconomic indicators were education, occupational class, and household income. Health indicators were limiting longstanding illness and self rated health. Inequality indices were calculated based on logistic regression analysis.

Main results: Each socioeconomic indicator showed a clear gradient with health. Among women half of inequalities in limiting longstanding illness by education were mediated through occupational class and household income. Inequalities by occupational class were largely explained by education. A small part of inequalities for income were explained by education and occupational class. For self rated health the pathways were broadly similar. Among men most of the inequalities in limiting longstanding illness by education were mediated through occupational class and income. Part of occupational class inequalities were explained by education. Two thirds of inequalities by income were explained by education and occupational class.

Conclusions: Parts of the effects of each socioeconomic indicator on health are either explained by or mediated through other socioeconomic indicators. Analyses of the predictive power of socioeconomic indicators on health run the risk of being fruitless, if interrelations between various indicators are neglected.

Health inequalities have been abundantly studied using various socioeconomic indicators, such as education,[1–4] occupational social class,[5–7] income,[8–13] ownership and wealth,[14 15] and deprivation.[16–18] While health research in the USA has often relied on education, the European tradition has relied more on occupational social class.[3 16 19 20] Studies examining the associations of each socioeconomic indicator with morbidity or mortality have repeatedly shown consistent gradients.

Arguments for and against the relative merits of one or another socioeconomic indicator have been proposed. Such studies have typically sought to identify the ''independent impact'' of a particular socioeconomic determinant on health, while adjusting for one or more additional indicators.[17 20 21] The purpose then has been to find the most important socioeconomic indicator. While such an approach may have merits in its own right, it nevertheless overlooks the complex socioeconomic pathways through which health inequalities are produced. We still lack studies analysing pathways between the various socioeconomic determinants of health. Rather than arguing a priori for the merits of one socioeconomic indicator, we examine the pathways and interrelations between three key current socioeconomic indicators of health—that is, education, occupational social class, and income.

CONCEPTUAL MODEL

Educational attainment, occupational social class, and income are probably the most often used indicators of current socioeconomic status in studies on health inequalities. Each indicator is likely to reflect both common impacts of a general hierarchical ranking in society as well as particular impacts specific to the indicator[14 19 20 22 23]:

(1) Educational attainment is usually acquired by early adulthood. The specific nature of education is knowledge and other non-material resources that are likely to promote healthy lifestyles. Additionally, education provides formal qualifications that contribute to the socioeconomic status of destination through occupation and income.

(2) Occupation based social class relates people to social structure. Occupational social class positions indicate status and power, and reflect material conditions related to paid work.

(3) Individual and household income derive primarily from paid employment. Income provides individuals and families necessary material resources and determines their purchasing power. Thus income contributes to resources needed in maintaining good health.

The causal order of various socioeconomic indicators as determinants of health has been ''elaborated'' within the methodology on the logic of survey analysis, starting before the boom of multivariate statistical analysis.[19 24 25] The association between the independent and dependent variable is examined while bringing a third variable into the analysis. Following these considerations education is typically acquired first over the life course. Education contributes to occupational class position and through this to income. The effect of education on income is assumed to be mediated mainly through occupation.

Figure 1 presents a schematic conceptual model of the three key indicators of current socioeconomic status, summarising their assumed pathways. Our model probably best applies to middle aged employed people with a crystallised socioeconomic position. Gender is likely to modify the interrelations as women's position at the labour market differs from that of men. However, Finnish women take full time jobs practically as often as men.[26]

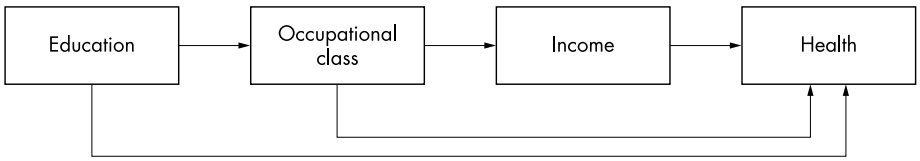

Figure 1 Pathways between socioeconomic determinants of health.

AIMS OF THE STUDY

The main aim is to examine the interrelations and pathways between education, occupational social class, and household income as determinants of health in a cohort of middle aged employed women and men. We will specifically examine:

(1) The magnitude of health differences by each socioeconomic indicator;

(2) Whether causally preceding socioeconomic indicators explain the effects of succeeding indicators on health;

(3) Whether the causally succeeding socioeconomic indicators mediate the effects of preceding indicators on health; and

(4) Whether each socioeconomic indicator is associated with health net of the other indicators.

DATA AND METHODS

Data

This study is part of the Helsinki health study on middle aged women and men employed by the City of Helsinki, the capital of Finland.[27] The City of Helsinki employs about 40 000 people (72% women). All main branches, such as general administration, health care, social welfare, education, culture, public transport, and technical services, except energy services, were included.

Baseline survey data from 2000 and 2001 were used. In each year those reaching 40, 45, 50, 55, and 60 years were mailed a questionnaire. The size of the sample was 6243 (80% women). The response rate was 68% for both years.[28]

Socioeconomic indicators

Educational attainment was measured by a question on the highest completed educational degree: (1) basic education (up to nine years); (2) secondary education including high school or vocational education (10–12 years); and (3) higher or university level education (13 years or more).

Occupational social class was derived from the personnel register of the City of Helsinki linked to questionnaire data for those who gave permission (77%). For the rest occupation was completed from the questionnaires. Four classes, based on a person's own occupation, were distinguished. Three white collar classes were obtained from the City of Helsinki socioeconomic classification, and the manual class was obtained from Statistics Finland socioeconomic classification[29]: (1) upper white collar; (2) intermediate white collar; (3) lower white collar; and (4) manual workers. The upper white collar class includes managers and professionals, such as doctors and teachers. The intermediate white collar class includes semi-professionals, such as nurses among women, and foremen and technicians among men. The lower white collar class includes clerical employees and other female dominated non-professional occupations within the social and healthcare sectors, such as child minders, assistant maids, and home assistants. Male manual workers include mostly transport and other technical workers, whereas female manual workers include mostly cleaning and canteen workers.

Household income was derived from the questionnaire asking the respondent to estimate his/her household's monthly disposable income, net of taxes and transfers. Four income groups ranging from less than 1260 to over 4200 euros were used. Household income was equivalised for household size, based on marital status and number of adults and children. Four categories were used: (1) living alone; (2) with other adults; (3) with dependent children; or (4) with other adults and dependent children.

Health indicators

Limiting longstanding illness was asked by a question: ''Do you have any longstanding illness, disability, or infirmity?'' If the answer was ''yes'', the follow up question was: ''Does your illness/disability restrict your work or does it limit your daily activities (gainful employment, housework, schooling, studying)?'' Those answering ''yes'' had limiting longstanding illness. This indicator emphasises the consequences of illness and functional ability,[30] and is related to the medical disease model.[31]

Self rated health was obtained by asking the respondents to assess whether their health in general was ''excellent'', ''very good'', ''good'', ''fair'', or ''poor''. We analyse self rated health *as below good*—that is, combining categories ''fair'' and ''poor''. Self rated health incorporates physical, emotional, and personal components to comprise health related ill being.[32 33] Self rated health has good test-retest reliability,[34 35] and predicts subsequent mortality.[36 37]

Statistical analyses

Unadjusted prevalence data and age adjusted odds ratios (OR) from logistic regression analyses were calculated. ''Inequality indices'' and their 95% confidence intervals (CI) were estimated. These indices are obtained from logistic regression analysis by estimating a continuous regression coefficient. This gives a stable estimate of health inequalities as data for all socioeconomic categories are used. The index is a total effect measure taking into account both the strength of the differences in ill health as well as the distribution of the study population into socioeconomic categories. The index imposes linearity on the association between each socioeconomic indicator and health. Departures from linearity can be assessed from tables 2 and 3. The index values have an intuitive interpretation as the average change in ill health (in terms of odds ratio) for each step down the socioeconomic hierarchy.

Firstly, gross inequality indices were calculated adjusting for age and family composition. Secondly, the index value for each socioeconomic indicator was ''elaborated'' by bringing the other socioeconomic indicators into the regression model, while following the assumed causal order of our conceptual model (fig 1). For example, to the extent that entering education into the model attenuates the associations of occupational class or income with health the original associations are ''explained''. Furthermore, if the association between education and health is attenuated when occupational class or income is entered into the model the original association is ''mediated'' through these other socioeconomic indicators. Finally, the inequality index for each socioeconomic indicator was examined net of the two other indicators.

DISTRIBUTIONS OF SOCIOECONOMIC INDICATORS

The proportion of men with higher education was somewhat larger than that of women (table 1). Comparatively more upper white collar were men than women. The intermediate

Table 1 Distribution of socioeconomic indicators, women and men (%)

	Women (n = 4991)	Men (n = 1252)
Education	%	%
Higher	24	32
Secondary	32	27
Basic	44	41
Occupational class		
Upper white collar	29	42
Intermediate white collar	17	20
Lower white collar	43	11
Manual worker	11	28
Household income		
More than 3400 euros/month	22	23
2100–3400 euros/month	39	49
1300–2000 euros/month	30	23
Less than 1300/euros month	10	5

white collar class was fairly equal among men and women, but the proportion of the lower white collar class was much larger among women than men. The proportion of the manual class was larger among men. Household income was somewhat higher among men than women.

All three socioeconomic indicators were associated with each other, with correlation coefficients ranging from 0.31 to 0.78. Highest correlations were found between education and occupational social class. Correlations between household based income and individual based education as well as occupational class, were lower.

ASSOCIATIONS OF EACH SOCIOECONOMIC INDICATOR WITH HEALTH

All three socioeconomic indicators showed clear and consistent inequalities for limiting longstanding illness (table 2). Among men inequalities in limiting longstanding illness by income deviated from a linear association. Health was somewhat better in the lowest income group than in the next one, but this difference was statistically non-significant. Also in a number of other instances the confidence intervals are wide and the socioeconomic groups do not necessarily differ from each other at the 5% level.

Assessing inequalities by using odds ratios only two categories are compared at a time. We found among women particularly large inequalities for limiting longstanding illness by household income, with an odds ratio of 2.56 for the lowest income group. Inequalities by education and occupational social class were less than those by income. Among men inequalities for limiting longstanding illness were largest by occupational social class, with an odds ratio of 2.07 for the manual workers. Inequalities by education and income were almost as large.

Also for self rated health as below good each socioeconomic indicator showed consistent inequalities (table 3). Overall, these inequalities were larger than those for limiting longstanding illness.

Largest inequalities for self rated health were found by household income, with odds ratios of 2.99 (women) and 3.03 (men) for the lowest income group. For men this was slightly different from limiting longstanding illness where occupational class inequalities were largest.

PATHWAYS BETWEEN SOCIOECONOMIC INDICATORS FOR LIMITING LONGSTANDING ILLNESS

Gross inequality indices (adjusted for age and family composition) for all three socioeconomic indicators in table 4 broadly confirm the results found in tables 2 and 3. For women gross inequality indices for limiting longstanding illness were largest by income (1.35, CI 1.22 to 1.49), second largest by education (1.28, CI 1.16 to 1.41) and smallest by occupational social class (1.19, CI 1.11 to 1.28).

We next calculated the reduction of the inequality index for limiting longstanding illness by education while adjusting for occupational class and income. Among women 29% of these inequalities were mediated through occupational class ((1.28–1.20)/(1.28–1)×100), and 39% through income (table 4). After adjusting simultaneously for occupational class and income educational inequalities were negligible. For occupational social class we found that two thirds of the inequalities for limiting longstanding illness could be explained by education. Adjusting simultaneously for both education and income resulted to negligible occupational class inequalities. A fifth of inequalities for women's limiting longstanding illness by household income were explained both by education and by occupational class.

Among men gross inequality indices for all three socioeconomic indicators show that for limiting longstanding illness inequalities were largest by education (1.35, CI 1.12 to 1.62) (table 4).

Table 2 Limiting longstanding illness by socioeconomic indicators, unadjusted prevalence (%) and odds ratio (OR) adjusted for age and family composition, women and men

	Women		Men	
	%	OR (95% CI)	%	OR (95% CI)
Education				
Higher	13	1.00	12	1.00
Secondary	17	1.50 (1.21 to 1.86)	19	1.86 (1.22 to 2.83)
Basic	22	1.70 (1.40 to 2.08)	21	1.92 (1.31 to 2.81)
Occupational class				
Upper white collar	15	1.00	13	1.00
Intermediate white collar	16	1.23 (0.97 to 1.56)	19	1.53 (1.01 to 2.33)
Lower white collar	20	1.50 (1.24 to 1.80)	20	1.72 (1.03 to 2.88)
Manual worker	22	1.60 (1.24 to 2.06)	23	2.07 (1.42 to 3.00)
Household income				
More than 3400 euros/month	12	1.00	15	1.00
2100–3400 euros/month	18	1.52 (1.22 to 1.90)	16	1.04 (0.70 to 1.55)
1300–2000 euros/month	20	1.82 (1.42 to 2.35)	23	1.85 (1.15 to 2.96)
Less than 1300 euros/month	26	2.56 (1.85 to 3.54)	18	1.49 (0.67 to 3.32)
All	100		100	
(Number)	(4991)		(1252)	

Table 3 Self rated health as below good by socioeconomic indicators, unadjusted prevalence (%) and odds ratio (OR) adjusted for age and family composition, women and men

	Women		Men	
	%	OR (95% CI)	%	OR (95% CI)
Education				
Higher	20	1.00	19	1.00
Secondary	22	1.24 (1.03 to 1.50)	26	1.60 (1.12 to 2.28)
Basic	34	1.88 (1.58 to 2.23)	39	2.51 (1.83 to 3.43)
Occupational class				
Upper white collar	22	1.00	21	1.00
Intermediate white collar	22	1.14 (0.92 to 1.42)	31	1.61 (1.13 to 2.29)
Lower white collar	29	1.56 (1.32 to 1.83)	29	1.67 (1.07 to 2.61)
Manual worker	39	2.27 (1.82 to 2.83)	39	2.48 (1.80 to 3.42)
Household income				
More than 3400 euros/month	19	1.00	24	1.00
2100–3400 euros/month	25	1.48 (1.22 to 1.79)	28	1.23 (0.88 to 1.72)
1300–2000 euros/month	32	2.09 (1.68 to 2.60)	35	2.03 (1.34 to 3.06)
Less than1300 euros/month	38	2.99 (2.24 to 4.00)	39	3.03 (1.54 to 5.85)
All	100		100	
(Number)	(4991)		(1252)	

Among men two thirds of inequalities for limiting longstanding illness by education were mediated through occupational social class. A small part of these inequalities were mediated through income. Adjusting simultaneously for both occupational class and income, these inequalities were negligible. Of men's occupational class inequalities for limiting longstanding illness 23% were explained by education. Inequalities by occupational class net of education and income were still found (1.21, CI 1.01 to 1.45). Half of inequalities for men's limiting longstanding illness by income were explained by education and somewhat more by occupational social class. Net of both education and income occupational class inequalities were negligible.

PATHWAYS BETWEEN SOCIOECONOMIC INDICATORS FOR SELF RATED HEALTH

Overall, the gross inequalities were larger for self rated health than for limiting longstanding illness (table 5). Among women gross inequalities by income were somewhat larger (1.44, CI 1.32 to 1.57) than by education (1.39, CI 1.27 to 1.51) and occupational class (1.30, CI 1.21 to 1.38).

Among women more than half of inequalities for self rated health by education were mediated through occupational class and a third through income (table 5). Net of occupational class and income inequalities were negligible. These pathways are in accordance with limiting longstanding illness. Inequalities for women's self rated health by occupational social class equally followed what was found for limiting longstanding illness. Of these inequalities 43% were explained by education and a third was mediated through income. Net of education and income occupational class inequalities for women's self rated health were modest (1.12, CI 1.01 to 1.25). Almost a fifth of inequalities for women's self rated health by income were explained by education and a third by occupational class. Net of education and occupational class inequalities remained (1.29, CI 1.17 to 1.43).

Among men the gross inequalities for self rated health were larger by education (1.58, CI 1.35 to 1.85) than by income (1.44, CI 1.20 to 1.73) and occupational class (1.34, CI 1.21 to 1.49) (table 5). This order was found for limiting longstanding illness as well.

For self rated health inequalities by education were largest even after simultaneous adjustment for occupational social class and household income. More than a third of these inequalities were mediated through occupational class and a small part through income. Net of occupational class and income inequalities by education remained (1.31, CI 1.04 to 1.65). More than half of inequalities for self rated health by occupational class were explained by education and a small part mediated through income. Net of education and income occupational class inequalities were negligible. Also more than half of inequalities for men's self rated health by income were explained by both education and occupational class. Net of education and occupational class these inequalities were negligible.

SUMMARY AND DISCUSSION

In the vast amount of studies on socioeconomic inequalities in health, surprisingly little attention has been devoted to the pathways between various socioeconomic indicators. This study sought to examine pathways and interrelations between education, occupational social class, and household income as determinants of health.

Overview of the results and discussion

Our study reconfirms that clear and consistent health inequalities by all three socioeconomic indicators can be found among women as well as men. Inequalities were larger for self rated health than for limiting longstanding illness. Following our conceptual model we found pathways between the three key current socioeconomic determinants of health.

Key points

- The production of health inequalities is a complex process in which interrelations between various socioeconomic indicators, such as education, occupational class, and income, need to be taken into account in their temporal order.
- Parts of the effects of each socioeconomic indicator can be either explained by or mediated through other socioeconomic indicators.
- Various socioeconomic indicators are not interchangeable but partially independent and partially interdependent determinants of health.
- Studies on health inequalities should avoid seeking a single "best" socioeconomic indicator.

Table 4 Inequality index for limiting longstanding illness by socioeconomic indicators and gender, estimated from different logistic regression models*

	Gross effect	Education+Class	Education+Income	Class+Income	Education+Class+Income
Women					
Education	1.28 (1.16 to 1.41)	1.20 (1.03 to 1.39)	1.17 (1.06 to 1.30)	–	1.14 (0.98 to 1.33)
Occupational class	1.19 (1.11 to 1.28)	1.06 (0.95 to 1.20)	–	1.11 (1.02 to 1.20)	1.02 (0.90 to 1.15)
Household income	1.35 (1.22 to 1.49)	–	1.27 (1.14 to 1.41)	1.28 (1.14 to 1.43)	1.27 (1.13 to 1.42)
Men					
Education	1.35 (1.12 to 1.62)	1.11 (0.85 to 1.45)	1.29 (1.05 to 1.57)	–	1.06 (0.81 to 1.40)
Occupational class	1.26 (1.12 to 1.43)	1.20 (1.01 to 1.44)	–	1.24 (1.09 to 1.42)	1.21 (1.01 to 1.45)
Household income	1.28 (1.03 to 1.58)	–	1.14 (0.90 to 1.45)	1.12 (0.88 to 1.42)	1.11 (0.87 to 1.42)

*All models adjust for age and family composition.

Among women about 50%–75% of educational inequalities for both health indicators were mediated through occupational social class and household income. Sixty per cent or more of inequalities by occupational class were explained by education and mediated through income. However, only a small part of inequalities by income could be explained by education and occupational class.

Among men 40%–80% of health inequalities by education were mediated through occupational social class and income. Only about 20% of occupational class inequalities for limiting longstanding illness were explained by education or mediated through income, whereas for self rated health 60% could be explained by education. A large part of inequalities by income were explained by education and occupational class.

Overall, we have shown that causally preceding education exerts its effects on health partly through causally succeeding occupational class and household income. We have also shown that the effect, for example, of income can be partly explained by education and occupational class. In addition to the found pathways, each socioeconomic indicator was also associated with health net of the other indicators.

Our results further confirm that gender is a potential moderator of the pathways between socioeconomic determinants of health. Among women less of inequalities by income could be explained by education and occupational class than among men. Household income is likely to equalise health inequalities between men and women as compared with individual income,[12] and household based socioeconomic indicators may be more powerful determinants of health among women than men. Previous studies have suggested that health inequalities among men might be primarily determined by their occupational class but among women by multiple socioeconomic indicators.[38 39] Our findings suggest that health inequalities are not produced by one single indicator among women or men but by a complex set of socioeconomic determinants.

Previous studies assessing pathways between socioeconomic indicators have used a variety of health outcomes, study designs, populations, and methodologies. These studies highlight the importance of studying pathways between socioeconomic determinants of mental health,[40] self reported global health indicators,[12 21] physical functioning,[3 41] and mortality[22 42–44] Yet, for the time being consistent patterns from these results cannot be judged.

Methodological considerations

Our sample was restricted to middle aged municipal employees of the City of Helsinki. The design was cross sectional and this limits strong causal interpretations of the results. Reverse causality cannot be ruled out as poor health may prevent people from maintaining their income level and this will contribute to health inequalities.[45] However, reverse causality is unlikely to account for health inequalities.[8 11 46] As we studied employed people, a healthy subset of the general population, generalisations should be made with caution because among the employed health inequalities are underestimated.[47]

The response rate was acceptable (68%), and according to non-response analysis the respondents represent the target population satisfactorily in terms of age, sex, socioeconomic status, and sickness absence.[28] Among our sample 80% were women and there is more random variation in the results for men than women.

Conclusion

This study, together with previous ones,[3 12 22 37] suggests that at least some part of the effect of each socioeconomic indicator on health is either explained by or mediated through other socioeconomic indicators. Instead of being interchangeable socioeconomic indicators are partially independent and partially inter-dependent determinants of health. Accordingly, future studies should not rely on any single socioeconomic indicator and ignore the others. Neither would it be sufficient for efforts to deepen our understanding of the production of health inequalities to search for just one statistically strongest socioeconomic indicator. In contrast, additional material indicators, such as wealth and poverty, as well as life course socioeconomic indicators from the parental home and youth should be incorporated in further studies. If

Table 5 Inequality index for self rated health as below good by socioeconomic indicators and gender, estimated from different logistic regression models*

	Gross effect	Education+Class	Education+Income	Class+Income	Education+Class+Income
Women					
Education	1.39 (1.27 to 1.51)	1.17 (1.02 to 1.34)	1.25 (1.14 to 1.37)	–	1.10 (0.97 to 1.27)
Occupational class	1.30 (1.21 to 1.38)	1.17 (1.06 to 1.30)	–	1.20 (1.11 to 1.29)	1.12 (1.01 to 1.25)
Household income	1.44 (1.32 to 1.57)	–	1.32 (1.20 to 1.46)	1.29 (1.17 to 1.43)	1.29 (1.17 to 1.43)
Men					
Education	1.58 (1.35 to 1.85)	1.37 (1.09 to 1.72)	1.48 (1.25 to 1.75)	–	1.31 (1.04 to 1.65)
Occupational class	1.34 (1.21 to 1.49)	1.15 (0.99 to 1.34)	–	1.29 (1.15 to 1.44)	1.14 (0.98 to 1.33)
Household income	1.44 (1.20 to 1.73)	–	1.20 (0.98 to 1.47)	1.21 (0.99 to 1.49)	1.15 (0.94 to 1.43)

*All models adjust for age and family composition.

the complex pathways between socioeconomic indicators are neglected, analyses of the predictive power of each socioeconomic indicator on health run the risk of being fruitless.

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Authors' affiliations

E Lahelma, M Laaksonen, A Aittomäki, Department of Public Health, University of Helsinki, Finland
P Martikainen, Population Research Unit, Department of Sociology, University of Helsinki, Finland and International Centre for Health and Society, Department of Epidemiology and Public Health, University College London Medical School, UK

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