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Are health inequalities rooted in the past? Income inequalities in metabolic syndrome decomposed by childhood conditions

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Background: Early life is thought of as a foundation for health inequalities in adulthood. However, research directly examining the contribution of childhood circumstances to the integrated phenomenon of adult social inequalities in health is absent. The present study aimed to examine whether, and to what degree, social conditions during childhood explain income inequalities in metabolic syndrome in mid-adulthood. **Methods:** The sample ($N = 12\ 481$) comprised all 40- and 50-year-old participants in the Västerbotten Intervention Program in Northern Sweden 2008, 2009 and 2010. Measures from health examinations were used to operationalize metabolic syndrome, which was linked to register data including socioeconomic conditions at age 40–50 years, as well as childhood conditions at participant age 10–12 years. Income inequality in metabolic syndrome in middle age was estimated by the concentration index and decomposed by childhood and current socioeconomic conditions using decomposition analysis. **Results:** Childhood conditions jointed explained 7% (men) to 10% (women) of health inequalities in middle age. Adding mid-adulthood sociodemographic factors showed a dominant contribution of chiefly current income and educational level in both gender. In women, the addition of current factors slightly attenuated the contribution of childhood conditions, but with paternal income and education still contributing. In contrast, the corresponding addition in men removed all explanation attributable to childhood conditions. **Conclusions:** Despite that the influence of early life conditions to adult health inequalities was considerably smaller than that of concurrent conditions, the study suggests that early interventions against social inequalities potentially could reduce health inequalities in the adult population for decades to come.

Introduction

The seeds of social inequalities in adult health are believed to be sown during early life.[1,2] This notion is based on two empirically established associations: on the one hand, that the circumstances which one is born into influences adult socioeconomic prospects,[3,4] and on the other, that early life also matters for adult

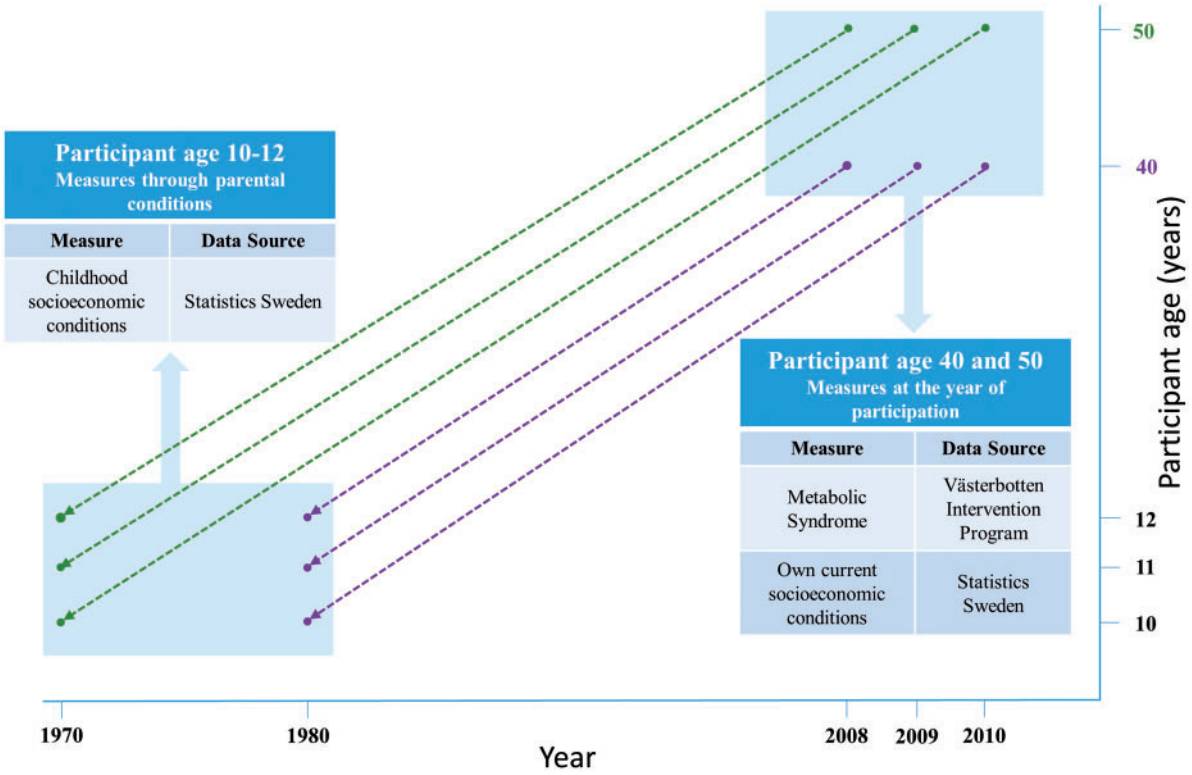

Figure 1 Overview of the design, measures and data sources by year (*x* axis) and age (*y* axis) of participants

health.[5–8] However, whether these pieces of evidence truly amount to childhood circumstances being important for the integrated phenomenon of adult social inequalities in health has, to our knowledge, not been specifically examined. Therefore, the present study set out to investigate whether, and to what degree, social conditions during childhood explain income inequalities in metabolic syndrome in mid-adulthood.

Early life matters for future life chances, by intergenerational transmission of educational attainment and wealth, and subsequent occupational and financial conditions.[3,4] Within life course epidemiology, childhood socioeconomic conditions have been linked to adult risk factors such as obesity and metabolic syndrome, and to cardiovascular outcomes including morbidity and mortality,[5,6,8,9] although this also seems to be disease-specific and vary across contexts.[7,8] To explain such links, explanatory life course models have been formulated: (i) a 'sensitive life course model'[6,10] hypothesizes that childhood social conditions have an enduring impact on health independent of adult social conditions, whereas (ii) a 'social chain of risk life course model'[10] instead posits an importance of intergenerational transmission from parent to offspring, and with adult social conditions standing for the immediate health impact.

Whereas childhood circumstances thus appear to be important for both adult socioeconomic conditions and adult health, this does not necessarily equate to childhood contributing to the compound phenomenon of social inequalities in adult health. Indeed, despite the widespread and established belief that this is the case[1,2] it has not, to our knowledge, been subject to empirical examination. This knowledge gap may partly be stemming from the common mix-up of determinants of health with determinants of health inequalities.[11] In addition, conventional regression models are poorly suited to handle complex outcomes such as inequality measures, and more appropriate techniques such as decomposition analysis of the concentration index[12] are still relatively rare within epidemiology.

The present study aimed to examine the contributions of childhood socioeconomic conditions to income-related inequalities in mid-adult health in Northern Sweden, with and without consideration of adulthood conditions. Metabolic syndrome was chosen as health outcome since it, and similar outcomes, have been shown to relate to disadvantageous circumstances during upbringing in Northern Sweden and in other contexts,[9,13–18] and may therefore be appropriate for the question of early life roots of adult health inequalities.

Methods

Study population and data

Participants comprised all 40- and 50-year-old women and men who participated in the regional Västerbotten Intervention Program (VIP) in Northern Sweden in 2008–10 ($N = 12\ 481$). Health measures from the examinations performed as part of the VIP program[19] were used to operationalize metabolic syndrome (waist circumference, blood pressure, high-density lipoprotein cholesterol (HDL-C), triglycerides and oral glucose tolerance). The VIP program design, activities and response rates have been described elsewhere.[19,20]

Health measures from VIP were linked to national register data from Statistics Sweden through the Umeå SIMSAM Lab microdata infrastructure.[21] As shown in figure 1 (see supplementary data), register data covered current socioeconomic conditions of the participants at age 40 and 50 years in the year of participation (2008, 2009 or 2010), as well as childhood conditions measured through the parents when the participant was 10–12 years of age (1970 and 1980, respectively).

Due to internal drop-out, the effective sample for the main analyses was 10 612 individuals (85% of the original sample).

Variable definition

Metabolic syndrome

Metabolic syndrome (1 = present; 0 = absent) was operationalized using the definition of the International Diabetes Federation,[22]

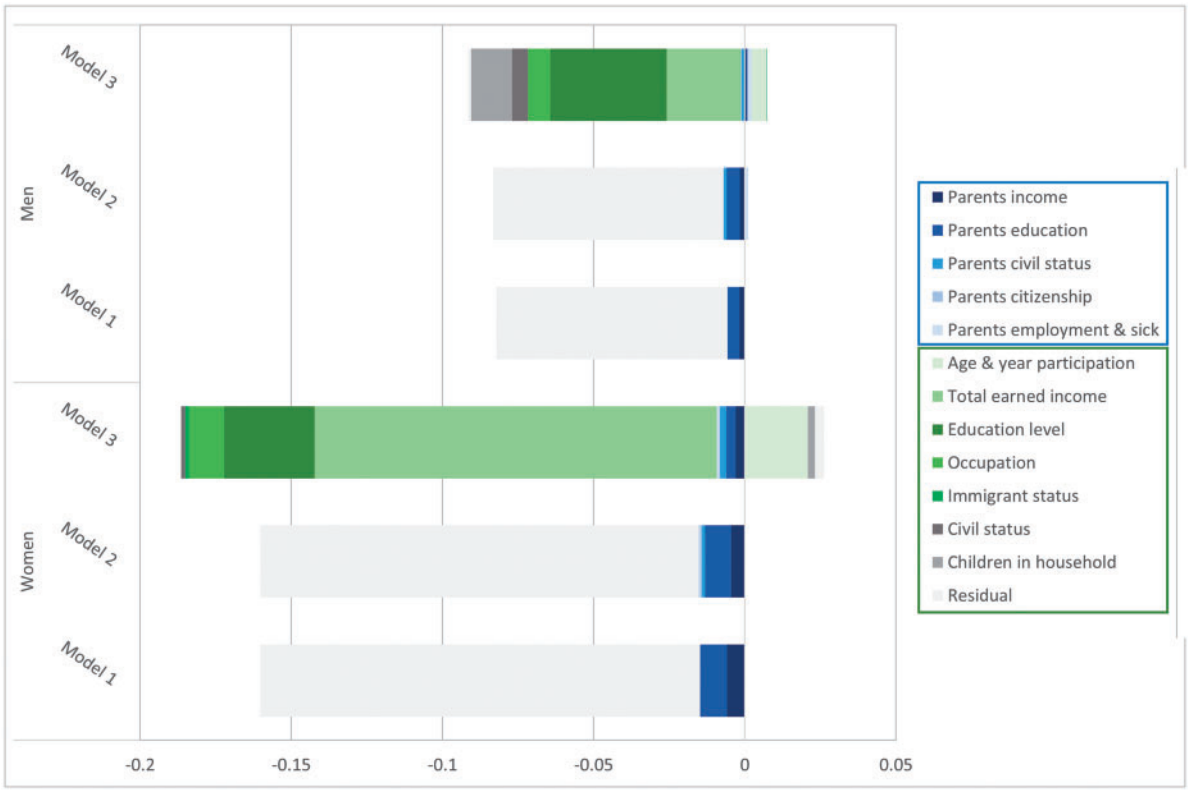

Figure 2 Summary of decomposition of income inequalities in metabolic syndrome: absolute contributions of childhood and current socioeconomic factors to the concentration indices of women and men, respectively.

which include the following criteria: (i) waist circumference ≥80 cm for women and ≥94 cm for men; and (ii) two or more of the following four criteria: (a) increased triglycerides (≥1.7 mmol/l) or specific treatment for that lipid abnormality; (b) reduced HDL-C (<1.29 mmol/l for women and <1.03 mmol/l for men) or specific treatment for that lipid abnormality, (c) increased blood pressure (systolic blood pressure [SBP] ≥130 mmHg or diastolic blood pressure [DBP] ≥85 mmHg) or treatment of hypertension, (d) increased fasting glucose (≥5.6 mmol/l) or diagnosed type 2 diabetes.

Individual socioeconomic status

The socioeconomic indicator used to rank the population was total earned income measured in the year of participation (2008/2009/2010). This measure covers all taxable earnings of an individual over the course of any given year, but not income from capital.

Determinants of health inequalities

Determinants of inequalities included current and childhood socioeconomic conditions with plausible links to metabolic syndrome and to individual financial conditions:[9,23,24]

Current socioeconomic factors were measured at the year of participation (2008/2009/2010) and included: age (40/50 years); income (quintiles); education (post-secondary education/secondary education/compulsory education); occupation (managers and upper professionals/middle non-manual/low non-manual/skilled manual/unskilled manual); immigration status—if the individual had migrated to Sweden at any time after birth—yes/no); civil status (married/unmarried/divorced or separated/widowed) and having children in the household (yes/no).

Childhood socioeconomic factors at age 10–12 years comprised: paternal and maternal income (quartiles, due to high percentage of mothers with no income) and education (post-secondary education/secondary education/primary education); civil status (married/unmarried/divorced/widowed); citizenship (Swedish/non-Swedish); unemployment benefits (yes/no) and sick benefit (no known benefits/low benefits: <90th percentile [<4289 SEK per year)/high benefits: >90th percentile (>4290 SEK per year)].

Statistical analysis

Drop-out analysis

Median income of the present sample differed by <2% from official statistics of the Västerbotten population for both genders. Internal drop-out ($N = 1869$) was mostly explained by incomplete health data. Missing women reported slightly less frequently living with children in the household (57% vs. 61% $P = 0.004$), while missing men slightly more often reported to be immigrants (10% vs. 7% $P = 0.04$). However, there were no differences with regard to any of the childhood conditions or for current sociodemographics (all P values > 0.10).

Inequality analysis

Inequality was measured by the concentration index (C), using income as the socioeconomic indicator and metabolic syndrome as the health outcome. The concentration index is expressed as follows:[12](1)

$$C = \frac{2}{\mu} \sum_{i=1}^{n} h_i R_i - 1 \quad (1)$$

Where h_i is the outcome of interest; μ is the mean or proportion of h; n is the number of people and Ri is the rank of individuals according to their socioeconomic status, from the most disadvantaged to the least disadvantaged. The value of the C can

Table 1 Current and parental characteristics at age 40 and 50 years of women and men who participated in the regional Västerbotten Intervention Program in Northern Sweden in 2008–10

	Women		Men	
	N	%	*N*	%
Current conditions at participant age 40 and 50 years				
Metabolic syndrome				
Yes	1322	25.1	1782	33.4
No	3947	74.9	3561	66.7
Age				
40 years	3114	48.2	2939	48.8
50 years	3343	51.8	3083	51.2
Year of participation				
2008	2204	34.1	2000	33.2
2009	2069	32.0	1939	32.2
2010	2184	33.8	2083	34.6
Total earned income (SEK)				
Lowest quintile	128 270	20.0	158 978	20.0
2	218 077	20.0	276 985	20.0
3	258 657	20.0	321 312	20.0
4	296 603	20.0	374 109	20.0
Highest quintile	409 312	20.0	531 111	20.0
Education level				
Compulsory education	2521	39.1	3344	55.7
Secondary education	2123	33.0	1580	26.3
Post-secondary education	1799	27.9	1085	18.1
Occupation				
Managers	285	4.6	515	9.0
Upper professionals	1243	20.2	931	16.2
Middle non-manual	1284	20.9	999	17.4
Lower non-manual	679	11.0	249	4.3
Skilled manual	2292	37.3	2808	48.9
Unskilled manual	366	6.0	243	4.2
Economically active				
Yes	5739	88.9	5545	92.2
No	715	11.1	471	7.8
Immigrant status				
Yes	623	9.7	492	8.2
No	5834	90.4	5530	91.8
Civil status				
Unmarried	2036	31.5	2444	40.6
Married, cohabiting	3587	55.6	3004	49.9
Divorced	773	12.0	563	9.4
Widowed	61	0.9	11	0.2
Children in household				
Yes	3759	58.2	3369	56.0
No	2695	41.8	2647	44.0
Parental conditions at participant age 10–12 years				
Father income				
Lowest quartile	1301	21.9	1288	22.8
2	1438	24.2	1341	23.8
3	1528	25.7	1463	25.9
Highest quartile	1680	28.3	1548	27.5
Mother income				
Lowest quartile	2075	34.4	1933	34.0
2	846	14.0	878	15.5
3	1619	26.9	1491	26.2
Highest quartile	1488	24.7	1380	24.3
Father education				
Compulsory education	3494	60.9	3301	60.7
Secondary education	1804	31.4	1763	32.4
Post-secondary education	441	7.7	378	7.0
Mother education				
Compulsory education	3780	64.2	3569	64.0
Secondary education	1645	27.9	1601	28.7
Post-secondary education	462	7.9	407	7.3
Father civil status				
Married, cohabiting	5226	90.5	4993	91.1
Unmarried	246	4.3	220	4.0
Divorced	265	4.6	243	4.4
Widowed	38	0.7	24	0.4
Mother civil status				
Married, cohabiting	5233	88.2	5047	89.7
Unmarried	292	4.9	239	4.3
Divorced	307	5.2	256	4.6
Widowed	102	1.7	83	1.5

(continued)

Table 1 Continued

	Women		Men	
	N	%	*N*	%
Father citizenship				
Swedish	5755	98.7	5448	98.7
Other country	74	1.3	72	1.3
Mother citizenship				
Swedish	5580	98.6	5551	98.4
Other country	85	1.4	90	1.6
Father unemployment benefits				
No unemployment benefits	6215	96.3	5765	95.7
Unemployment benefits	242	3.8	257	4.3
Mother unemployment benefits				
No unemployment benefits	6223	96.4	5809	96.5
Unemployment benefits	234	3.6	213	3.5
Father sick benefits				
No known benefits	3417	52.9	3097	51.4
Low benefits	2234	34.6	2173	36.1
High benefits	806	12.5	752	12.5
Mother sick benefits				
No known benefits	3725	57.7	3360	55.8
Low benefits	2103	32.6	2037	33.8
High benefits	631	9.8	625	10.4

vary between −1 and +1, where a negative (positive) value indicates that the outcome is concentrated among individuals with relatively low (high) income, and C equals zero under perfect equality. As the health outcome was binary, we applied the normalization proposed by Wagstaff et al.[12,25] to the concentration index and to the decomposition.

To estimate the contribution of current and childhood conditions to the health inequalities, a Wagstaff-type decomposition analysis of the C was used.[12] Based on regression analysis of a health variable on a set of k determinants, for any linear additive regression model of health (y), such as:(2)

$$y = \propto + \sum\nolimits_k \beta_k x_k + \varepsilon \quad (2)$$

the concentration index for y, C, can be written:(3)

$$C = \sum_k (\beta_k \overline{x}_k / \mu) C_k + GC_\varepsilon / \mu \quad (3)$$

Where μ is the mean of y (outcome), $\overline{X}^k$ is the mean of X_k (determinants), C_k is the concentration index for X_k (defined analogously to C), and GC_ε is the generalized concentration index for the error term (ε). C is equal to a weighted sum of the concentration indices of the k determinants, where the weight for X_k is the elasticity of y with respect to X_k. The residual component GC_ε/μ reflects the socioeconomic-related inequality not explained by systematic variation in the determinants across socioeconomic groups.[12] To handle the non-linear outcome, a probit model with marginal/partial effects evaluated at sample means was used to calculate the contributions of the k determinants.[12]

Decomposition analyses were run with the concentration index of metabolic syndrome as the dependent variable. In model I, childhood conditions measured as maternal/paternal income and education were entered as independent factors; in Model II, maternal/paternal civil status, citizenship, unemployment and sick benefits were added; and in Model III, adulthood conditions were added. All analyses were performed on women and men separately to capture gender-specific patterns.[9] Rerunning the analyses with only maternal and only paternal factors led to similar general inferences (data not shown).

Ethical considerations

This study was conducted as part of the Umeå SIMSAM Lab research, approved by the Regional Ethics Committee in Umeå (2010-157-31Ö).

Results

The characteristics of the study population are shown in table 1. Metabolic syndrome was more prevalent among men (33.4%) than among women (25.1%). Women were better educated than men, but at the same time had lower income and less frequent managerial positions. Childhood/parental conditions were fairly similar between women and men.

The concentration indices of metabolic syndrome (reported as 'Inequality (total)' in the bottom row of tables 2 and 3) were negative, indicating that this condition was concentrated among the less affluent population, with larger inequalities among women (C = −0.160; CI 95%: −0.124, −0.197) than among men (C = −0.082; CI 95%: −0.049, −0.115). In next step, these concentration indices were decomposed by childhood and current socioeconomic conditions.

The contribution of each determinant to the concentration indices are reported in table 2 (women) and table 3 (men), and visualized in figure 2 (see supplementary data). Estimates can be read as follows: e.g. in table 2 model I, women with fathers in the lowest income quartile had a 4.7% higher probability of having metabolic syndrome than women with fathers in the highest income quartile, when all other variables were held constant ('Coeff'). The elasticity (frequency weighted coefficient) for this category was 0.041 ('Elast.') and it was concentrated among lower income women in mid-adulthood (a negative CI of −0.102; 'CI'). By multiplying the values in the 'Elast.' and 'CI' columns, this group's contribution to inequality amounts to −0.004 ('Cont to C'), thus constituting 2.6% of the total C of −0.160 (the bottom of 'Cont to C' column). The interpretations presented below focuses on the joint contributions of childhood conditions.

In women, childhood socioeconomic conditions as parental income and education jointly explained 9.2% of the adult income inequality in metabolic syndrome (Model I), which increased to 9.6% when adding further parental sociodemographic variables (Model II). The most important contribution came from paternal education and income, followed by maternal education and civil status (Model II). By adding current sociodemographic factors in middle-age (Model III) the joint contribution of early life conditions was moderately reduced (from 9.6% to 6.0%) but with paternal income, education and maternal civil status still contributing. The addition of current factors also revealed a considerable contribution of particularly own income and to a lesser degree of educational level.

Table 2 Women income-related inequalities in metabolic syndrome decomposed by childhood and current socioeconomic factors

	Model I						Model II						Model III					
	Coeff	Elast.	CI	Cont to C	%	Adj %	Coeff	Elast.	CI	Cont to C	%	Adj %	Coeff	Elast.	CI	Cont to C	%	Adj %
Childhood socioeconomic factors																		
Father's income																		
Lowest quartile	0.047*	0.041	−0.102	−0.004	2.6	22.9	0.040*	0.035	−0.102	−0.004	2.2	14.3	0.014*	0.012	−0.102	−0.001	0.8	0.5
2	0.032*	0.031	−0.044	−0.001	0.8	7.4	0.029	0.028	−0.044	−0.001	0.8	5.0	0.024	0.023	−0.044	−0.001	0.6	0.5
3	0.026	0.026	−0.021	−0.001	0.4	3.1	0.027	0.028	−0.021	−0.001	0.4	2.4	0.024	0.025	−0.021	−0.001	0.3	0.2
Highest quartile																		
Mother's income																		
Lowest quartile	0.002	0.003	−0.077	0.000	0.2	1.4	−0.002	−0.003	−0.077	0.000	−0.2		−0.006	−0.008	−0.077	0.001	−0.4	
2	−0.020	−0.011	−0.054	0.001	−0.4		−0.019	−0.011	−0.054	0.001	−0.4		0.027	0.015	−0.054	−0.001	0.5	0.4
3	0.007	0.007	−0.001	0.000	0.0	0.0	0.007	0.007	−0.001	0.000	0.0	0.0	0.010	0.011	−0.001	0.000	0.0	0.0
Highest quartile																		
Father's education																		
Compulsory	0.065*	0.141	−0.056	−0.008	4.9	42.3	0.071*	0.152	−0.056	−0.008	5.3	34.5	0.044*	0.095	−0.056	−0.005	3.3	2.4
Secondary	0.018	0.020	0.094	0.002	−1.2		0.027	0.030	0.094	0.003	−1.7		0.026	0.029	0.094	0.003	−1.7	
Post-secondary																		
Mother's education																		
Compulsory	0.078*	0.182	−0.023	−0.004	2.6	23.0	0.083*	0.194	−0.023	−0.005	2.8	18.4	0.032	0.075	−0.023	−0.002	1.1	0.8
Secondary	0.020	0.021	0.057	0.001	−0.7		0.027	0.028	0.057	0.002	−1.0		0.018	0.018	0.057	0.001	−0.6	
Post-secondary																		
Father's employment																		
Non-employed							0.047	0.007	−0.023	0.000	0.1	0.7	0.047	0.007	−0.023	0.000	0.1	0.1
Employed																		
Mother's employment																		
Non-employed							0.049	0.007	−0.077	−0.001	0.3	2.2	0.057	0.008	−0.077	−0.001	0.4	0.3
Employed																		
Father's civil status																		
Married, cohabiting																		
Unmarried							−0.058	−0.009	−0.122	0.001	−0.7		−0.033	−0.005	−0.122	0.001	−0.4	
Divorced							−0.054	−0.009	−0.114	0.001	−0.6		−0.034	−0.005	−0.114	0.001	−0.4	
Widowed							0.141*	0.003	−0.117	0.000	0.2	1.6	0.079	0.002	−0.117	0.000	0.1	0.1
Mother's civil status																		
Married, cohabiting																		
Unmarried							0.099*	0.018	−0.125	−0.002	1.4	9.0	0.117*	0.021	−0.125	−0.003	1.6	1.2
Divorced							0.040	0.007	−0.077	−0.001	0.4	2.4	0.028	0.005	−0.077	0.000	0.3	0.2
Widowed							0.016	0.001	−0.059	0.000	0.0	0.2	0.003	0.000	−0.059	0.000	0.0	0.0
Father's citizenship																		
Swedish																		
Other country							0.076	0.003	−0.094	0.000	0.2	1.3	0.034	0.002	−0.094	0.000	0.1	0.1
Mother's citizenship																		
Swedish																		
Other country							0.049	0.003	−0.053	0.000	0.1	0.6	0.056	0.003	−0.053	0.000	0.1	0.1
Father's sick benefits																		
No known benefits																		
Low benefits							−0.016	−0.022	0.038	−0.001	0.5	3.4	−0.012	−0.017	0.038	−0.001	0.4	0.3
High benefits							0.029	0.014	−0.033	0.000	0.3	1.9	0.037*	0.018	−0.033	−0.001	0.4	0.3
Mother's sick benefits																		
No known benefits																		
Low benefits							−0.007	−0.010	0.051	0.000	0.3	2.0	−0.002	−0.003	0.051	0.000	0.1	0.1

(continued)

Table 2 Continued

	Model I						Model II						Model III					
	Coeff	Elast.	CI	Cont to C	%	Adj %	Coeff	Elast.	CI	Cont to C	%	Adj %	Coeff	Elast.	CI	Cont to C	%	Adj %
High benefits							−0.043*	−0.017	−0.108	0.002	−1.1		−0.034	−0.013	−0.108	0.001	−0.9	
Current conditions																		
Age																		
40 years																		
50 years													0.123*	0.253	0.101	0.026	−16.0	
Year of participation																		
2008																		
2009													0.010	0.012	−0.044	−0.001	0.3	0.2
2010													−0.035*	−0.047	0.088	−0.004	2.6	1.9
Total earned income																		
Lowest quintile													0.148*	0.118	−0.998	−0.118	73.5	53.7
2													0.084*	0.067	−0.502	−0.033	20.9	15.2
3													0.084*	0.067	−0.003	0.000	0.1	0.1
4													0.045*	0.036	0.513	0.018	−11.5	
Highest quintile																		
Education level																		
Compulsory													0.059*	0.091	−0.342	−0.031	19.5	14.2
Secondary													0.041*	0.054	0.025	0.001	−0.9	
Post-secondary																		
Occupation																		
Managers and upper professionals																		
Middle non-manual													−0.025	−0.021	0.433	−0.009	5.5	4.0
Lower non-manual													−0.030	−0.025	0.145	−0.004	2.3	1.6
Skilled manual													0.004	0.002	−0.178	0.000	0.2	0.1
Unskilled manual													−0.002	−0.003	−0.316	0.001	−0.7	
Immigrant status													0.013	0.005	−0.227	−0.001	0.7	**0.5**
Civil status																		
Unmarried													0.023	0.029	−0.065	−0.002	1.2	0.9
Married																		
Divorced													0.000	0.000	−0.008	0.000	0.0	
Widowed													0.060	0.002	0.222	0.001	−0.3	
Children in household													−0.031*	−0.072	−0.032	0.002	−1.4	
Inequality (total)				−0.160						−0.160						−0.160		
Standard error				0.019						0.019						0.019		
Residual				−0.146						−0.145						0.003		

*: $P<0.05$.

Coeff, marginal effects from the probit model; Elast, elasticity; CI, concentration index of the social determinants; Cont to C, contribution to the overall concentration index; %, unadjusted percentage calculated on the overall explained portion of the C; Adj %, adjusted percentage calculated on the total explained portion that make contributions in the same direction of the overall concentration index.

Table 3 Men income-related inequalities in metabolic syndrome decomposed by childhood and current socioeconomic factors

	Model I						Model II						Model III					
	Coeff	Elast.	CI	Cont to C	%	Adj %	Coeff	Elast.	CI	Cont to C	%	Adj %	Coeff	Elast.	CI	Cont to C	%	Adj %
Childhood socioeconomic factors																		
Father's income																		
Lowest quartile	0.035*	0.024	−0.161	−0.004	4.7	23.0	0.029	0.020	−0.161	−0.003	3.9	17.0	0.006	0.004	−0.161	−0.001	0.8	0.6
2	0.020	0.014	−0.121	−0.002	2.1	10.1	0.014	0.010	−0.121	−0.001	1.5	6.5	0.009	0.006	−0.121	−0.001	0.9	0.7
3	0.020	0.015	0.072	0.001	−1.3		0.015	0.012	0.072	0.001	−1.0		0.019	0.015	0.072	0.001	−1.3	
Highest quartile																		
Mother's income																		
Lowest quartile	−0.039*	−0.039	−0.064	0.003	−3.1		−0.027	−0.028	−0.064	0.002	−2.2		−0.020	−0.020	−0.064	0.001	−1.6	
2	−0.082*	−0.038	−0.025	0.001	−1.1		−0.082*	−0.038	−0.025	0.001	−1.1		−0.015	−0.007	−0.025	0.000	−0.2	
3	−0.030	−0.024	0.033	−0.001	0.9	4.6	−0.029	−0.023	0.033	−0.001	0.9	4.0	−0.016	−0.013	0.033	0.000	0.5	0.4
Highest quartile																		
Father's education																		
Compulsory	0.039	0.064	−0.043	−0.003	3.4	16.3	0.035	0.057	−0.043	−0.002	3.0	13.0	0.023	0.039	−0.043	−0.002	2.0	1.5
Secondary	0.024	0.021	0.100	0.002	−2.5		0.018	0.016	0.100	0.002	−1.9		0.037	0.033	0.100	0.003	−4.0	
Post-secondary																		
Mother's education																		
Compulsory	0.112*	0.199	−0.039	−0.008	9.5	46.0	0.109*	0.194	−0.039	−0.008	9.2	39.9	0.037	0.066	−0.039	−0.003	3.1	2.3
Secondary	0.066*	0.053	0.086	0.005	−5.5		0.060*	0.048	0.086	0.004	−5.0		0.027	0.021	0.086	0.002	−2.2	
Post-secondary																		
Father's employment																		
Non-employed							0.033	0.004	−0.101	0.000	0.5	2.2	0.013	0.002	−0.101	0.000	0.2	0.2
Employed																		
Mother's employment																		
Non-employed							0.057	0.006	−0.006	0.000	0.0	0.2	0.060	0.006	−0.006	0.000	0.0	0.0
Employed																		
Father's civil status																		
Married, cohabiting																		
Unmarried							0.030	0.003	−0.064	0.000	0.3	1.1	0.068	0.007	−0.064	0.000	0.6	0.4
Divorced							−0.106*	−0.013	−0.039	0.000	−0.6		−0.067	−0.008	−0.039	0.000	−0.4	
Widowed							0.076	0.001	−0.227	0.000	0.3	1.1	0.047	0.001	−0.227	0.000	0.2	0.1
Mother's civil status																		
Married, cohabiting																		
Unmarried							−0.019	−0.002	−0.101	0.000	−0.3		−0.026	−0.003	−0.101	0.000	−0.4	
Divorced							0.119*	0.015	−0.084	−0.001	1.6	6.8	0.097*	0.012	−0.084	−0.001	1.3	0.9
Widowed							0.001	0.000	−0.088	0.000	0.0	0.0	0.026	0.001	−0.088	0.000	0.1	0.1
Father's citizenship																		
Swedish																		
Other country							−0.005	0.000	−0.023	0.000	0.0		−0.026	−0.001	−0.023	0.000	0.0	
Mother's citizenship																		
Swedish																		
Other country							0.036	0.002	−0.086	0.000	0.2	0.7	0.058	0.003	−0.086	0.000	0.3	0.2
Father's sick benefits																		
No known benefits																		
Low benefits							0.010	0.011	0.036	0.000	−0.5		0.026	0.028	0.036	0.001	−1.3	
High benefits							0.014	0.005	−0.029	0.000	0.2	0.8	0.029	0.011	−0.029	0.000	0.4	0.3
Mother's sick benefits																		
No known benefits																		
Low benefits							0.025	0.026	0.101	0.003	−3.2		0.040*	0.041	0.101	0.004	−5.0	

(continued)

Table 3 Continued

	Model I						Model II						Model III					
	Coeff	Elast.	CI	Cont to C	%	Adj %	Coeff	Elast.	CI	Cont to C	%	Adj %	Coeff	Elast.	CI	Cont to C	%	Adj %
High benefits							0.046*	0.014	−0.088	−0.001	1.5	6.7	0.067*	0.021	−0.088	−0.002	2.2	1.7
Current conditions																		
Age																		
40 years																		
50 years													0.149*	0.229	0.026	0.006	−7.1	
Year of participation																		
2008																		
2009													0.014	0.014	−0.027	0.000	0.5	0.3
2010													−0.008	−0.008	0.076	−0.001	0.7	0.5
Total earned income																		
Lowest quintile													0.025	0.015	−1.004	−0.015	18.7	14.0
2													0.012	0.007	−0.498	−0.003	4.2	3.2
3													−0.032	−0.019	0.005	0.000	0.1	0.1
4													−0.019	−0.011	0.503	−0.006	7.0	5.2
Highest quintile																		
Education level																		
Compulsory													0.112*	0.187	−0.242	−0.045	55.0	41.2
Secondary													0.093*	0.074	0.091	0.007	−8.1	
Post-secondary																		
Occupation																		
Managers and upper professionals																		
Middle non-manual													−0.010	−0.005	0.299	−0.001	1.8	1.4
Lower non-manual													−0.053*	−0.028	0.266	−0.007	9.0	6.7
Skilled manual													0.030	0.004	−0.189	−0.001	0.9	0.7
Unskilled manual													−0.004	−0.006	−0.343	0.002	−2.6	
Immigrant status													−0.003	−0.001	−0.232	0.000	−0.2	
Civil status																		
Unmarried													0.021	0.026	−0.183	−0.005	5.7	4.3
Married																		
Divorced													0.023	0.006	−0.073	0.000	0.6	0.4
Widowed													0.033	0.000	0.411	0.000	−0.1	
Children in household													−0.059*	−0.099	0.138	−0.014	16.6	12.5
Inequality (total)				−0.082						−0.082						−0.082		
Standard error				0.017						0.017						0.017		
Residual				−0.076						−0.076						−0.001		

*: $P<0.05$.

Coeff, marginal effects from the probit model; Elast, elasticity; CI, concentration index of the social determinants; Cont to C, contribution to the overall concentration index; %, unadjusted percentage calculated on the overall explained portion of the C; Adj %, adjusted percentage calculated on the total explained portion that make contributions in the same direction of the overall concentration index.

In men (table 3), parental socioeconomic conditions together explained a slightly smaller fraction of the health inequalities than in women (7.0% and 7.4%—Model I and II, respectively). For the individual contributions in Model I and II, the most important contributor was maternal education, followed by paternal income and education, whereas maternal civil status and income were of less importance. The addition of current conditions in men removed all explanation attributable to childhood conditions (Model III). In contrast to women, current education was more important than income for explaining the inequalities in men.

Discussion

To our knowledge, this is the first study specifically examining whether, adult social inequalities in health are explained by socioeconomic conditions in early life. Firstly, we found that despite men having higher prevalence of metabolic syndrome, women displayed larger health inequalities. Secondly, although individual contributions of childhood factors were small, their joint contribution was not insubstantial and accounted for 7–10% of the adult health inequalities; in women independently of, and in men completely dependent on, adult conditions. Thus, although current socioeconomic conditions were by far more important for adult health inequalities, our findings indicate that health inequalities indeed are partly rooted in the past, and with different patterns for women and men.

The findings of higher socioeconomic disparities in metabolic syndrome among women are in accordance with previous studies.[26,27] Our findings also expand previous research demonstrating that childhood conditions predict adult metabolic syndrome;[9,13–15] whereas explaining health is different from explaining health inequalities, the greater inequalities and childhood contribution in women compared to men mirror previous reports on a stronger link in women between early life socioeconomic conditions and both metabolic syndrome[9] and obesity.[5,28] These findings could possibly also be heuristically expressed within the frame of life course models, where the findings in women are analogous to a sensitive period life course model, with a long-term impact of early life conditions irrespective of how life turns out in adulthood.[10] In contrast, the findings in men are more consistent with a social chain of risk life course model.[10] Although the specific social chains responsible for this finding were not examined in this study, they likely involve the intergenerational transmission of social inequalities from parent to offspring, which then track across the individual life course.

It is important to emphasize that our results also demonstrate that current factors play a considerably larger independent role in adulthood health inequalities than do childhood factors, even taking possible mediation into account. The important role of adulthood income and education in explaining inequalities in metabolic syndrome, as well as the different effects of these factors among women and men, have been identified before.[26,27] These findings suggest that the structural problem of income inequality should be addressed, and gender differences taken into account when designing and implementing social policies and preventive interventions.

Our findings thus give a glimpse of how the social inequalities of the parental generation can reappear as health inequalities in the current adult population. This process could be understood as an example of embodiment:[29,30] societal arrangements (macro phenomenon of social inequalities of parent generation), which by a pathway of embodiment (micro phenomenon of intergenerational transmission of social conditions from parents to offspring) eventually become biologically incorporated by the individual life courses (micro phenomenon of health impact) and thereby contribute to population patterns of disease decades later (macro phenomenon of health inequalities in the offspring generation). It is however worth noting that the childhood socioeconomic conditions seen in this study reflect specific features of the Swedish society during the 1970s and 1980s (e.g. with less participation of women in the labour market).

Together, the findings imply that a life course approach may be helpful for understanding and addressing social inequalities in adult health.[1] A life course approach to health inequalities would also comprise exploring the life-course underpinnings of health inequalities more broadly, e.g. the dynamics of inequalities and determinants across the life course[31] and the role of social inequalities during adolescence and young adulthood in entrenching the health inequalities later in life.

Methodological considerations

The main strengths of the present study are the longitudinal design, a large sample, the multiple sources of linked data as well as the use of a novel statistical approach.

The study population is a sample of the total population of Västerbotten aged 40 or 50 years in 2008–10, namely those who participated in VIP. Previous investigations of the participation and non-response have found that men, immigrants and financially disadvantaged people are slightly underrepresented in VIP relative to the population of Västerbotten.[20] In the present sample, however, the median income was similar to population values and there was little evidence of serious selection bias due to incomplete data, and most importantly not with respect to income or the key exposures in childhood. Nevertheless, the extent of selection bias is ultimately unknown.

The biological measurements were all following standard procedures,[19] metabolic syndrome was operationalized according to established criteria[22] and the socioeconomic and demographic factors were retrieved from registers, which ensures their accuracy and precision. However, the income variable only comprises individually earned income and does not take into account non-taxed earnings, wealth or shared income from family members. The selection of childhood factors was limited to those available in Umeå SIMSAM lab, and it is likely that a more comprehensive set of variables, e.g. child health, family relations and material conditions, would have made additional contributions.

Regarding the analysis, the decomposition technique cannot provide causal inference, does not identify mediating pathways,[12] and also relies on linear models. In our case, we used the Wagstaff correction[12,25] for both the concentration index and the decomposition analysis to handle the non-linear outcome, however, other correction methods also exists to deal with binary outcomes,[32] which possibly could lead to different estimates than those of the present report. Another weakness of the method is the lack of support for confidence intervals for some point estimates, such as the adjusted percentage, which would have been illustrative.

Conclusion

This study suggests that adult social inequalities in health indeed are partly rooted in the past—in social inequalities of the parental generations during childhood—and that the means by how these early roots are manifested in adulthood differ between women and men. Although the influence of early life conditions to adult health inequalities was considerably smaller than that of current conditions, the study suggests that early interventions against social inequalities potentially could reduce social inequalities in health in the adult population for decades to come. The study also exemplifies the need for a life course approach to the study of and action against social inequalities in health.

Supplementary data

Supplementary data are available at *EURPUB* online.

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Conflicts of interest: None declared.

Key points

- Early life conditions have an established influence on both socioeconomic conditions and health in adulthood.
- However, no study has directly examined whether childhood circumstances also contribute to the integrated phenomenon of adult social inequalities in health.
- This study demonstrates that income inequalities in health are partly rooted in social inequalities of the parental generations
- Still, the contribution of current conditions to adult health inequalities is considerably greater than that of childhood conditions.
- Interventions against social inequalities in childhood have the potential to prevent social inequalities in health in the adult population for decades to come.

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