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The role of behavioural factors in explaining socio-economic differences in adolescent health: A multilevel study in 33 countries☆

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ABSTRACT

Attempts to describe and explain socio-economic differences in health have mainly focused on adults. Little is known about the mechanisms of the relationship between socio-economic status (SES) and health in adolescence including inconsistent findings between SES and health among young people. Data were derived from representative samples of 13 and 15-year-old students in 33 European and North American countries ($n = 97{,}721$) as part of the Health Behaviour in School-aged Children (HBSC) study 2001/2002. Multilevel logistic regression models were used to investigate socio-economic differences in self-rated health among adolescents and the contribution of health-related behaviours to the explanation of such differences. Odds ratios of self-rated health by family affluence were calculated before and after adjustment for behavioural factors (tobacco smoking, physical activity, television use, breakfast intake, consumption of fruits and vegetables). On average, adolescents from low affluent families had an odds ratio for low self-rated health of 1.84 for boys and 1.80 for girls, compared to those from high affluent families. The majority of behavioural factors were significantly associated with family affluence in all countries and explained part of the relationship between self-rated health and family affluence. Smoking, physical activity and breakfast consumption showed the largest independent effect on health. The present study suggests that behavioural factors in early adolescence partly account for the association between self-rated health and socio-economic status. Prevention programmes should target unhealthy behaviours of adolescents from lower socio-economic groups to help prevent future life-course disadvantages in terms of health and social inequalities.

Introduction

Socio-economic status (SES) has a profound effect on health and health behaviour (Lahelma, 2006; Mackenbach, 2006). However, social inequalities in health among adolescents have been discussed far less frequently and in less depth than those of adults (Chen, Matthews, & Boyce, 2002; von Rueden, Gosch, Rajmil, Bisegger, & Ravens-Sieberer, 2006; Spencer, 2006). In addition, a number of studies have suggested an attenuation of socio-economic differences in health in adolescence (Spencer, 2006; West, 1997). Regarding self-rated health (SRH), a mixed picture is observed. Some studies have found no or only slight SES differences for self-rated health (Glendinning, Love, Hendry, & Shucksmith, 1992; Rahkonen, Arber, & Lahelma, 1995; Siahpush & Singh, 2000; Tuinstra, Groothoff, van den Heuvel, & Post, 1998; West, 1988) while others report clear health differences across indicators of SES at individual level (i.e. differences between socio-economic groups within countries) (Call & Nonnemaker, 1999; Goodman, 1999; van der Lucht & Groothoff, 1995; Starfield, Riley, Witt, & Robertson, 2002; West, 1997).

Others have identified and reported on the relationships between self-rated health and macro/contextual indicators of SES,

☆ The World Health Organization "Health Behaviour in School-Aged Children" survey is a WHO/EURO collaborative study. The international coordinator of the 2001-2002 study was Professor Candace Currie, University of Edinburgh, Scotland; the data bank manager was Dr. Oddrun Samdal, University of Bergen, Norway. Carine Vereecken is postdoctoral researcher funded by the Flemish Research Foundation – Flanders (FWO). We would like to thank Anette Andersen and Ulrike Ravens-Sieberer for comments on a previous version of the manuscript.

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typically assessed at the level of the community, region or country rather than at the level of the individual; these approaches often considered the role of inequality between geographical locations. For example, Torsheim and colleagues found substantial social inequalities in self-rated health in adolescence across European and North American countries at individual and country level (Torsheim et al., 2004). Area deprivation effects were generally stronger at the country level than at the school level. In another analysis, it was also found that country level economic inequality seems to increase the probability of poor self-rated health since adolescents living in the group of countries with highest inequalities had more than 2:1 odds of reporting poor health, even when controlled for individual level affluence and family support (Torsheim, Currie, Boyce, & Samdal, 2006).

Thus far, little is known about the underlying factors and mechanisms on the relationship between SES and health in adolescence including possible equalisation processes (Chen et al., 2002; Goodman, 1999). Similar to the literature on the description of social inequalities in health, attempts to explain these differences have mainly focused on adults. The debate on the explanation of socio-economic differences in health in adulthood has concentrated primarily on the contribution of behavioural (for example, smoking and physical activity) versus material/psychosocial factors (for example, physical working conditions, lack of social support) (Schrijvers, Stronks, van de Mheen, & Mackenbach, 1999; Stronks, van de, Looman, & Mackenbach, 1996). Interestingly, the relative importance of different (groups of) determinants is still under debate (van Oort, van Lenthe, & Mackenbach, 2005). However, health behaviours such as smoking, malnutrition, excessive consumption of alcohol and lack of physical activity explain a large part of the existing health inequalities as they are strongly linked to mortality and morbidity outcomes as well as socio-economic position (Mackenbach, 2006). For example, the socio-economic patterning of smoking and heavy drinking becomes increasingly unequal and these behaviours explain even up to half of social inequalities in health in some countries (Lahelma, 2006).

Documenting and investigating the origin of these patterns in adolescence can be challenging; primarily because most of the well-known determinants of health inequalities in adulthood have had little time to develop their health damaging effect in adolescence. However, there is some evidence that individual behaviours are contemporaneously associated with a variety of undesirable health outcomes during adolescence (Boreham et al., 1999; Geckova, 2002; Holmen, Barrett-Connor, Holmen, & Bjermer, 2000). For research that is orientated towards prevention and health promotion it is important to explore which mechanisms and factors determine socio-economic differences in adolescent health. While research on health inequalities in adulthood has shifted from description to explanation of the relationship between SES and health, studies in adolescence have mainly focussed on descriptive approaches and bivariate relationships. To our knowledge no study has explored more complex relationships between socio-economic status, health-related behaviour and self-rated health in adolescence. The aim of the present study is to analyse socio-economic differences in self-rated health among adolescents in a wide range of European countries, the US, Canada and Israel and to assess the contribution of health behaviours (tobacco smoking, physical activity, sedentary behaviour, consumption of fruits and vegetables and eating habits) at the individual and country level to the explanation of socio-economic differences in self-rated health. Thus our hypotheses are that there will be significant associations between SES and health behaviours; between SES and self-rated health; and between health behaviours and self-rated health. In addition, we hypothesise that health behaviours will mediate the relationships between SES and self-rated health.

Data and methods

Analyses were based on the Health Behaviour in School-aged Children (HBSC) study 2001/2002 (Currie et al., 2004). The HBSC study is a WHO collaborative cross-national survey, conducted in an increasing number of countries (see http://www.hbsc.org). The overall goal of the study is to gain new insights into, and to increase understanding of health behaviour, lifestyles and their context in young people. The survey instrument is an international standard questionnaire (Currie, Samdal, & Boyce, 2001). The questionnaire consists of a number of core questions, which are similar in all participating countries, and additional focus questions, which allow participating countries to include other questions of national interest. The uniform measures, sampling and implementation procedures of the HBSC study, designed to be consistent across the participating countries, provide the unique opportunity to allow between-country comparisons.

Sample

The 2001/2002 survey included a total of 35 countries/regions from Europe, North America and Israel. In each country, cluster sampling was used, where the primary cluster was the school class. Schools and classes within schools were selected to be representative for 11-, 13- and 15-year-old schoolchildren. The recommended minimum sample size for each country was 1536 students per age group, to assure a 95% confidence interval of $+/-$ 3% for prevalence estimates. The sample size included a design factor of 1.2 because of the cluster sampling (the design factor of 1.2 was based on analyses of the 1993/1994 and 1997/1998 survey) (Roberts, Tynjala, Currie, & King, 2004). The data were collected by means of standardised questionnaires, administered in school classrooms according to the international protocol. The response rate at the level of the school was in general high, with a majority of countries above 80%. A high proportion of participants answered the questions used in this study (95–99% across items). Ethical approval for each national survey was obtained according to the national guidance and regulation in place at the time of data collection. The present analysis is based on 46,895 male and 50,826 female students from 33 countries. Data from France and the French-speaking part of Belgium were not included as some relevant variables were measured with deviating response categories. The analysis were restricted to 13 and 15-year-olds as the prevalence of 11 year old pupils engaging in some of the health risk behaviour was too low and the extent of 'health damaging' effects of such behaviours was likely to be even smaller. Table 1 provides further information about the survey and the study population.

Measurement

Self-rated health (SRH) was measured through the single item 'Would you say your health is…. (1) excellent; (2) good; (3) fair; (4) poor'. This indicator has been used extensively in public health research, in particular with adults (Benjamins, Hummer, Eberstein, & Nam, 2004). In the current analysis responses were dichotomised into excellent/good vs. fair/poor because young people who rated their health as fair or poor may be at particular risk.

Behavioural factors

Health behaviours are often divided into three key domains: substance use, physical activity and nutrition. Our intention was to include indicators from each of the domains in order to reflect the spectrum of behavioural factors as well as possible. Smoking status was defined on the basis of the question "How often do you smoke tobacco at present?" Possible responses were: 'every day', 'at least

Table 1
Country information for the 2001/2002 HBSC survey, 13- and 15-year-olds.

Country	Principal investigator	*N*
Austria	Wolfgang Dür	2839
Belgium (Flemish)	Lea Maes	4136
Canada	William Boyce	2720
Croatia	Marina Kuzman	2926
Czech Republic	Ladislav Csémy	3321
Denmark	Pernille Due	2937
England	Antony Morgan	3818
Estonia	Mai Maser	2690
Finland	Jorma Tynjälä	3459
Germany	Klaus Hurrelmann	3541
Greece	Anna Kokkevi	2555
Greenland	Michael Pedersen	585
Hungary	Anna Aszmann	2738
Ireland	Saoirse Nic Gabhainn	1863
Israel	Yossi Harel	3607
Italy	Franco Cavallo	2845
Latvia	Iveta Pudule	2270
Lithuania	Apolinaras Zaborskis	3777
Malta	Marianne Massa	1340
Netherlands	Wilma Vollebergh	2792
Norway	Oddrun Samdal	3358
Poland	Barbara Woynarowska	4235
Portugal	Margarida Gaspar de Matos	1763
Russia	Alexander Komkov	5513
Scotland	Candace Currie	2655
Slovenia	Eva Stergar	2455
Spain	Carmen Moreno Rodriguez	3721
Sweden	Ulla Marklund	2409
Switzerland	Holger Schmid	3116
TFYR Macedonia	Lina Kostarova	2757
Ukraine	Olga Balakireva	2898
USA	Mary Overpeck	3546
Wales	Chris Roberts	2536
Total		97,721

once a week, but not every day', 'less than once a week' or 'never'. Adolescents who smoke at least once a week were considered to be regular smokers and were contrasted against infrequent and non-smokers. Physical activity was measured with a 60 min Moderate to Vigorous Physical Activity (MPVA) screening measure (Prochaska, Sallis, & Long, 2001). This measure is based on two questions: 1) on how many days in the past week and 2) in a typical week students were physically active for 60 min or more. When summing the two items and halving the score, a score of five or more classifies the respondent as meeting the primary recommendation of more than 1 h of moderate activity a day on most days.

Television viewing was used as an indicator of sedentary behaviour and was assessed by asking pupils how many hours they usually watched television (including videos) on weekdays (Monday–Friday) and on the weekend (Saturday and Sunday). The nine possible responses were 'none at all', 'about half an hour a day', 'about 1 h a day', 'about 2 h a day' up to 'about 7 or more hours a day'. Following Vereecken et al., both items were combined into one variable representing the average hours of TV watching per day (Vereecken, Todd, Roberts, Mulvihill, & Maes, 2006). Response options were recoded into '4 h or more' (excessive television-viewers) versus fewer hours. In order to determine eating habits, an item on the regular intake of breakfast on school days was included in the analyses. The item was dichotomised in 'having breakfast daily' vs. 'less than daily'. Regarding the consumption of fruit and vegetables, students were asked how many times a week they usually eat these foods. The response options were: 'never', 'less than once a week', 'about once a week', 'two to four days a week', 'five to six days a week', 'once a day, every day', 'every day, more than once'. Both food items were dichotomised into 'daily' vs. 'less than daily'.

Socio-economic status

Socio-economic status was measured with the 'Family Affluence Scale (FAS)' which has been developed by HBSC as an alternative measurement of socio-economic status for adolescents (Boyce & Dallago, 2004; Currie et al., 2008; Torsheim et al., 2006). This validated measure consists of four different items, which are designed to reflect the level of material well-being in families: Does your family own a car (0, 1, 2 or more), do you have your own bedroom for yourself? (no = 0, yes = 1), how many times did you travel away on holiday with your family during the past 12 months? (0, 1, 2, 3 or more), and how many computers does your family own (0, 1, 2, 3 or more). For the latter two items the two highest response categories ("2", "3 or more") were combined. A composite FAS score was calculated by summing the responses to these four items ranging from 0 to 7. However, owing a computer or a car may have varying relevance in different countries. To partly overcome this problem the FAS-scale was recoded within each country into tertiles (high, medium, low) with cut-off points depending on the FAS distribution within the countries (Richter, Leppin, & Nic Gabhainn, 2006; Vereecken, Inchley, Subramanian, Hublet, & Maes, 2005).

Analyses

All analyses were carried out separately by gender. Effects of age (dummy coded with two age groups: 13 and 15) were controlled for in each analyses. To account for the clustered structure of the data, a multilevel analysis was performed (Snijders, 1999) using the software HLM 5.05 (Raudenbush, Bryk, & Congdon, 2001). The conventional 5% level was used to determine statistical significance. The data indicate that a hierarchical four level model including separate variances at the student level, the level of classes, the level of schools and country level would account for the data structure. Following previous HBSC analyses, it was decided to conduct a two-level model without school/class as additional levels of analysis. This decision for a more parsimonious model takes into account the results of a previous HBSC analysis which showed that only 3–6% of the random effects on self-rated health were accounted for by the class level (Torsheim et al., 2004). Previous research also suggests that subjective health outcomes differ little across schools and that any bias due to not modelling a random school-level intercept variance would be relatively small (Torsheim et al., 2006; Torsheim & Wold, 2001). In addition, as for some countries reliable identification of school membership was not available it was decided to carry out a two-level model. Thus, a multilevel model with second order penalized quasi-likelihood estimation was used to enable accurate variance estimates despite the fact that the number of second level units (countries) is small relative to the number of first level units (pupils). Random intercept and random slope models were specified and tested.

The variation by country was expressed as variance partitioning coefficient respectively intraclass correlations (ICC) and indicates the proportion of variance in the outcome that is attributable to differences between the countries. Variance partitioning coefficients (ICCs) were also calculated for the 'proportion' of variance in the outcome which was attributable to the variation of slope-coefficients across countries. The reliability of the population variation was tested in advance – that is the proportion of the cross-country variation in the intercepts or slopes that is attributable to 'true' variation in the parameters between countries. These 'true' parameter differences are separated from differences that are due primarily to sampling variability. The fixed effects coefficients (with 95% CI) for the association between the outcome and the behaviours/family affluence were calculated. In addition, the 95% CI for

the estimated across-country-variation of these coefficients were computed (Snijders, 1999).

In general, the following three conditions must hold to establish mediation (Baron & Kenny, 1986): 1) the independent variable (FAS) must affect the mediator (behavioural factors), 2) the independent variable (FAS) must be shown to affect the dependent variables (SRH), and 3) the mediator (behavioural factors) must affect the dependent variable (SRH). If all these conditions hold in the predicted direction, then the effect of the independent variable (FAS) on the dependent variable (SRH) must be less when regressing the dependent variable on both the independent variable and the mediator(s) compared to regressing the dependent variable on the independent variable alone. In addition to these three conditions, it is important to rule out interaction between the mediator and the independent variable.

To examine the mediating effect of behavioural factors on the association between SES and health, we first calculate multilevel logistic regression models to analyse the relationship between self-rated health and family affluence. The highest group of family affluence served as the reference category with odds ratios being computed for the other two groups in comparison. Next, we examined whether the different behaviours were related to family affluence, using separate logistic regression models for each of the behaviours. As all behaviours significantly differed by family affluence all of them were used in further analyses. In a next step, behavioural factors were added simultaneously as one block to a model containing the family affluence measure and age in order to quantify the contribution of behavioural factors to socio-economic differences in SRH (Model 1: Family affluence + age compared to Model 2: Family affluence + age + behavioural factors). This contribution was evaluated by the percentage change in odds ratios for SRH in the different socio-economic groups due to the addition of the behavioural correlates $[(OR_{(model\ 1)} - OR_{(model\ 2)})/(OR_{(model\ 1)} - 1) \times 100]$ (van Oort et al., 2005; Schrijvers et al., 1999; Stronks et al., 1996). Prior to the assessment of mediation the interaction between each behavioural factor and FAS on general health was examined using logistic regression analyses. The interactions were statistically non significant for physical activity and consumption of fruit. A significant but non-sizeable interaction (Difference in Nagelkerke $R^2 = <0.001$) was observed for consumption of vegetables, watching television, smoking tobacco and breakfast.

Results

Socio-economic differences in adolescent self-rated health (SRH)

Table 2 shows the results of the multilevel logistic regression models for the association between family affluence and SRH stratified by gender. The variance partitioning coefficient for the random intercept indicated that about 19.5% (23.3%) of the variation within boys (girls) self-rated health is attributable to differences between countries. The reliability estimates for the country variation for boys (girls) was 0.802 (0.844). In an 'average' country a significant odds ratio for less than good health of 1.21 for the medium and 1.84 for the low family affluence group was estimated for boys. For girls the estimates were 1.19 for the medium and 1.80 for the low family affluence group. Neither the random coefficient variance of medium FAS nor low FAS reached statistical significance for either gender, suggesting no evidence for cross-national variation in the relationship with self-rated health. The reliability estimates for these country variations were also rather low: FAS medium = 0.036 (0.136); FAS low = 0.097 (0.192) for boys (girls). For the population of countries it would be expected that for 95% of the countries the odds ratios would fall between 1.20 and 1.23 for the medium and between 1.75 and 1.93 for the low family affluence group in boys. For girls the estimated range was 1.13 to 1.25 for medium FAS and 1.65 to 1.97 for low FAS.

Socio-economic differences in health behaviour in adolescence

The associations between family affluence and the six different health behaviours for girls and boys are seen in Table 3. Regarding weekly smoking, a significant association was found for boys and girls with a slightly increased risk of regular smoking with low FAS. For the population of countries it would be expected that 95% of the countries would display odds ratios between 0.72 and 1.80 for boys and 0.77 to 1.77 for girls. That is, for some countries no association or even a reversed association would be expected. Regarding physical inactivity (less than 5 days a week) a higher risk for medium and especially low FAS was observed. From the multilevel analysis it would be expected that this relationship is observable in 95% of the countries. Excessive television use showed strong and consistent associations with FAS for both genders. For low FAS in 95% of the countries a significant higher risk for excessive television use would be expected.

In addition, children from low affluent families tended to have breakfast every school day less often than children from high affluent families. For the population of countries however it was estimated that 95% of the countries would show odds ratios for the low FAS group between 0.49 to 1.16 for boys and 0.57 to 1.23 for girls, indicating that for some countries no, or even a reversed association could be possible. Daily fruit consumption was also less common among children from low affluent families than among their high affluent counterparts. In only a few countries it could be expected that no such association is found for low FAS, the corresponding 95% population variation ranges from 0.37 to 1.02 for boys and from 0.31 to 1.08 for girls. The figure for daily consumption of vegetables was

Table 2
Association between family affluence and self-rated health (poor/fair), 13- and 15-year-old students, random intercepts, random slopes model, adjusted for age.

	Boys						Girls					
	Point estimate OR	95% CI	*P* (OR)	95% Population variation	Variance partitioning coefficient (VPC)	*P* (VPC)	Point estimate OR	95% CI	*P* (OR)	95% Population variation	Variance partitioning coefficient (VPC)	*P* (VPC)
Random intercept					0.195	<0.001					0.233	<0.001
Family affluence												
High	1.00	–		–	–		1.00	–		–	–	
Medium	1.21	(1.14–1.29)	<0.001	(1.20–1.23)	0.002	0.239	1.19	(1.13–1.25)	<0.001	(1.13–1.25)	0.005	>0.500
Low	1.84	(1.70–1.99)	<0.001	(1.75–1.93)	0.007	0.157	1.80	(1.68–1.94)	<0.001	(1.65–1.97)	0.011	0.125

Reliability of population variation (boys/girls): Random intercept: 0.802/0.844; FAS medium: 0.036/0.136; FAS low: 0.097/0.192.

Table 3
Associations between family affluence and health risk behaviour, 13- and 15 year old students, random intercepts, random slopes models.[a]

	Boys						Girls					
	Point estimate OR	95% CI	P (OR)	95% Population variation	Variance partitioning coefficient (VPC)	P (VPC)	Point estimate OR	95% CI	P (OR)	95% Population variation	Variance partitioning coefficient (VPC)	P (VPC)
Smoking (at least once a week)												
FAS medium	0.93	(0.86–1.01)	0.114	(0.77–1.13)	0.025	0.045	0.98	(0.90–1.08)	0.689	(0.81–1.19)	0.026	0.007
FAS low	1.14	(1.00–1.31)	0.057	(0.72–1.80)	0.092	<0.001	1.17	(1.02–1.32)	0.029	(0.77–1.77)	0.083	<0.001
Physical activity (less than 5 days/week)												
FAS medium	1.17	(1.11–1.24)	<0.001	(1.07–1.28)	0.008	0.069	1.29	(1.21–1.38)	<0.001	(1.13–1.47)	0.013	0.004
FAS low	1.34	(1.26–1.43)	<0.001	(1.21–1.49)	0.011	0.069	1.57	(1.45–1.71)	<0.001	(1.31–1.88)	0.023	0.005
Television use (4 h or more)												
FAS medium	1.16	(1.08–1.25)	<0.001	(1.00–1.36)	0.017	0.004	1.28	(1.20–1.35)	<0.001	(1.18–1.38)	0.008	>0.500
FAS low	1.58	(1.44–1.72)	<0.001	(1.21–2.05)	0.038	0.001	1.72	(1.55–1.89)	<0.001	(1.29–2.28)	0.044	0.001
Breakfast (every school day)												
FAS medium	0.91	(0.84–0.99)	0.017	(0.74–1.12)	0.023	0.001	0.98	(0.92–1.05)	0.520	(0.83–1.15)	0.017	0.006
FAS low	0.75	(0.66–0.86)	<0.001	(0.49–1.16)	0.074	<0.001	0.83	(0.75–0.93)	0.002	(0.57–1.23)	0.062	<0.001
Fruits consumption (daily)												
FAS medium	0.79	(0.73–0.85)	<0.001	(0.64–0.97)	0.023	0.002	0.78	(0.73–0.84)	<0.001	(0.64–0.96)	0.022	0.001
FAS low	0.61	(0.54–0.70)	<0.001	(0.37–1.02)	0.100	<0.001	0.58	(0.51–0.67)	<0.001	(0.31–1.08)	0.130	<0.001
Vegetable consumption (daily)												
FAS medium	0.79	(0.74–0.85)	<0.001	(0.71–0.89)	0.011	0.051	0.80	(0.76–0.84)	<0.001	(0.74–0.86)	0.006	0.161
FAS low	0.66	(0.61–0.72)	<0.001	(0.58–0.76)	0.018	0.004	0.60	(0.55–0.65)	<0.001	(0.49–0.73)	0.025	0.002

Reliability of population variation (boys/girls): FAS medium: 0.274–0.486/0.204–0.480; FAS low: 0.246–0.685/0.360–0.763.
[a] Separate analyses for each of the health risk behaviours, adjusted for age.

quite similar to that of fruits: Low affluent pupils had a lower odds ratio for eating vegetables daily than students from high affluent families in all considered countries. From the multilevel analysis it was estimated that this pattern would exist in 95% of the countries. Table 3 also shows that the reliability estimates for these associations vary between 0.274 and 0.763, between 27.4% and 76.3% of the observed cross-national differences in the strengths of association between FAS and health behaviour are attributable to 'true' parameter differences between the countries.

The contribution of behavioural factors to understanding socio-economic differences in health

Next, all behavioural factors were added simultaneously to the model including only age and FAS (Table 4). Comparison of the odds ratios of model 2 with model 1 indicates a mediating effect of the health behaviours in the relationship between family affluence and SRH. Adjusted for all behavioural factors, the OR's for family affluence among boys show a percentage decrease of 24% for low FAS and 14% for medium FAS. For girls, a similar reduction was found (23% for low FAS and 11% for medium FAS).

Additionally, all health behaviours showed a significant association with SRH in the context of all other predictors. With regard to cross-national variations it would be expected that this relationship would be apparent in at least 95% of all countries. Only for television use in boys and physical activity in girls the 95% interval includes countries were no such statistical significant association would be expected. The reliability estimates of these population variations ranged from 0.177 to 0.680 indicating that 17.7% to 68.0% of the observed cross-country variation in the regression coefficients to be attributable to 'true' parameter differences between the countries.

Discussion

There is still little known about the relation between socio-economic status and adolescent health. Our results are among the first that combine the description of socio-economic differences in subjective health with an analysis of the contribution of behavioural factors to this association. The results suggest a social gradient in self-rated health, i.e. an increasing risk of low SRH with decreasing family affluence in all countries. Second, we found that several behavioural factors are also significantly associated with family affluence. Some behaviours, especially smoking, are associated with family affluence only in some countries. Other behaviours, such as television use, fruit and vegetable consumption, are significantly associated with affluence in most countries. Third, even during adolescence, individual health behaviours are associated with negative health. The largest independent effect on health was found for smoking, physical inactivity and breakfast consumption. Fourth, the findings suggest that the relationship between SRH and family affluence is partly mediated by the unequal distribution of health behaviours which was found for majority of countries. However, the strength of this contribution differs across countries.

Comparison with previous research

The findings underline previous studies which observed social inequalities in SRH in adolescence (Call & Nonnemaker, 1999; Goodman, 1999; Koivusilta, Rimpela, & Kautiainen, 2006; van der Lucht & Groothoff, 1995; Piko & Fitzpatrick, 2001; Spencer, 2006; Starfield et al., 2002; West, 1997). It needs to be acknowledged, though, that there are other studies that could not confirm a socio-economic patterning of health in adolescents (Glendinning et al., 1992; Rahkonen et al., 1995; Siahpush & Singh, 2000; Tuinstra, 1998; West, 1988).

Table 4
Associations of self-rated health (poor/fair) with family affluence before and after adjustment of health risk behaviours, 13- and 15- year old students. Random intercepts, random slopes model, odds ratios.

	Boys						Girls					
	Point estimate OR	95% CI	P (OR)	95% Population variation	Variance partitioning coefficient (VPC)	P (VPC)	Point estimate OR	95% CI	P (OR)	95% Population variation	Variance partitioning coefficient (VPC)	P (VPC)
Model 1												
Family affluence												
High	1.00	–		–	–		1.00	–		–	–	
Medium	1.21	(1.14–1.29)	<0.001	(1.20–1.23)	0.002	0.239	1.19	(1.13–1.25)	<0.001	(1.13–1.25)	0.005	>0.500
Low	1.84	(1.70–1.99)	<0.001	(1.75–1.93)	0.007	0.157	1.80	(1.68–1.94)	<0.001	(1.65–1.97)	0.011	0.125
Model 2												
Family affluence												
High	1.00	–		–	–		1.00	–		–	–	
Medium	1.18	(1.10–1.27)	<0.001	(1.05–1.33)	0.016	0.285	1.17	(1.10–1.24)	<0.001	(1.06–1.29)	0.011	>0.500
Low	1.64	(1.49–1.80)	<0.001	(1.34–2.00)	0.033	0.123	1.62	(1.48–1.77)	<0.001	(1.22–2.15)	0.045	0.016
Smoking (at least once a week)	2.23	(1.97–2.52)	<0.001	(1.34–3.70)	0.099	<0.001	2.01	(1.82–2.22)	<0.001	(1.38–2.93)	0.058	<0.001
Physical activity (less than 5 days/week)	1.87	(1.70–2.05)	<0.001	(1.47–2.38)	0.033	<0.001	1.33	(1.21–1.46)	<0.001	(0.96–1.85)	0.046	<0.001
Television use (4 h or more)	1.13	(1.04–1.22)	0.008	(0.92–1.38)	0.026	0.002	1.21	(1.13–1.29)	<0.001	(1.01–1.44)	0.019	0.010
Breakfast (every school day)	0.70	(0.65–0.76)	<0.001	(0.58–0.85)	0.023	0.008	0.71	(0.66–0.76)	<0.001	(0.55–0.91)	0.028	<0.001
Fruits (daily)	0.80	(0.73–0.87)	<0.001	(0.70–0.92)	0.018	0.336	0.79	(0.73–0.84)	<0.001	(0.67–0.92)	0.017	0.013
Vegetables (daily)	0.88	(0.81–0.96)	0.005	(0.78–0.99)	0.016	0.101	0.93	(0.88–0.98)	0.010	(0.87–0.99)	0.006	0.277

Model 1: Reliability of population variation (boys/girls): FAS medium: 0.036/0.136; FAS low: 0.097/0.192.
Model 2: Reliability of population variation (boys/girls): FAS medium: 0.240/0.231; FAS low: 0.316/0.461; smoking: 0.680/0.637; physical activity: 0.462/0.611; Television hours: 0.416/0.422; Breakfast: 0.413/0.567; Fruits: 0.267/0.396; Vegetables: 0.239/0.177.

Further, our results confirm studies which identified weaker relationships between socio-economic status and adolescent tobacco use, indicating that socio-economic differences in adolescent smoking are not as pronounced as for adult smoking. However, other studies among adolescents from the US (Goodman & Huang, 2002; Lowry, Kann, Collins, & Kolbe, 1996), Northern Ireland (van Lenthe et al., 2001), Slovakia (Geckova, 2002), and the Netherlands (de Vries, 1995) did show clear socio-economic differences regarding tobacco use for comparable age groups and measures. So far it is unknown how these contradictory results can be explained. Our study also supports the hypothesis that there are socio-economic differences in various health behaviours such as physical inactivity, television viewing, as well as the consumption of fruits and vegetables among adolescents. Our cross-national findings, therefore, confirm results from previous individual country studies on television use and food habits (Bergstrom, Hernell, & Persson, 1996; Lien, Jacobs, & Klepp, 2002; Lowry et al., 1996; Vereecken, Maes, & De Bacquer, 2004). Unlike smoking, these behaviours are already established in childhood when parental influence is much stronger than in adolescence. This suggests that the determining role of socio-economic background for smoking patterns might emerge later in life (Chen et al., 2002; West, 1997). Studies which show that adolescent substance use is strongly linked to the student's own social position (i.e. educational level), but not to parental SES, support this argument (Bergstrom et al., 1996; Paavola, Vartiainen, & Haukkala, 2004).

Most detrimental health behaviours are established during adolescence and health behaviours tend to continue throughout adulthood and become determining factors for future health (Wardle et al., 2003). Information on possible pathways by which socio-economic health differences develop would facilitate the design of effective interventions to tackle the development of socio-economic differences in health at an early stage. Our results clearly show that a large part of the association between SRH and family affluence remains unexplained. In general, behavioural factors are only one possible mechanism to explain these socio-economic differences in health. Studies among adults suggest that material and psychosocial factors play an even larger role in the explanation of health inequalities (van Oort et al., 2005; Schrijvers et al., 1999), and the role of socio-economic patterning of structural and environmental factors, such as accessibility of services and opportunities are also likely to be important. It would be important to adapt these kinds of analyses to adolescents.

A range of others have supported the possible mediation of psychosocial factors. For example, Zambon et al. (2006) showed that Italian children from families with high socio-economic status were more likely to report ease of communication with father and best friend; but there were no SES differences for mother and teacher (Zambon, Lemma, Borraccino, Dalmasso, & Cavallo, 2006). Another study from Italy showed a greater sense of community (school connectedness) in schools of higher school level SES (Vieno, Perkins, Smith, & Santinello, 2005). In the US higher levels of school connectedness have been found in schools with more wealthy students (Thompson, Iachan, Overpeck, Ross, & Gross, 2006). Similarly, in Denmark, children from lower SES families as assessed by parents' occupational social class, were less likely to report: liking school, parental school support, school satisfaction, autonomy at school and school identification. Not all these associations were significant, but all are in the expected direction (Andersen, Holstein, & Due, 2006). Due et al. (2003) demonstrated that children from low SES families were less likely to have positive school-parent-child relations and were more likely to feel badly connected to their school, as compared to those from high SES families (Due, Lynch, Holstein, & Modvig, 2003).

Methodological considerations

This study was based on a large cross-national survey with national representative samples using identical instruments in all countries. However, as the HBSC study is based on cross-sectional data, it is limited in terms of the potential to establish causal relationships. Consequently, we aimed at identifying associations between SES and self-rated health, which persist in a cross-sectional study after adjusting for other variables. We investigated a wide range of behavioural parameters potentially associated with self-reported health, including measures of smoking, eating behaviour, fruit and vegetable consumption, physical activity, and sedentary behaviour.

Although interesting, it is important to note that our findings should not be interpreted as causal. We cannot infer that the relationships documented work in a singular trajectory – rather it is likely that there are reciprocal and synergistic influences at work between health behaviour and SES; that both are acting upon the other at multiple levels. In our study we assumed that health risk behaviour mediates the relationship between family affluence and self-rated health. But alternative hypotheses are also consistent with our cross-sectional results. One possibility is that both SRH and health behaviours are independently influenced by SES, which would result in an association of the two variables, and also in an apparent mediating effect of health behaviours on the association between SES and self-rated health. Another interpretation could be that the chain of causality goes in the opposite direction; that SRH, as a possible component of self-esteem, and its unequal distribution of across socio-economic groups influences health behaviours and their social patterning (Adler et al., 1994; Bosma, van de Mheen, & Mackenbach, 1999; DuBois et al., 2002; Gallo & Matthews, 2003; McLeod & Kessler, 1990). However, as the prevalence of many health behaviours is much higher than the prevalence of low self-rated health, the possibility for this hypothesis is limited. In order to really discriminate among these alternative hypotheses longitudinal studies are needed.

Another limitation of the analysis is that, for each risk behaviour, only a limited number of items could be included in the survey. Moreover, interpreting adolescent behavioural patterns obtained from self-reports can be difficult. Self-reports of health behaviours, especially smoking, may be influenced by social desirability. Nonetheless, it has been repeatedly shown that self-reports can claim a high degree of validity and reliability (Brener, Billy, & Grady, 2003; Newell, Girgis, Sanson-Fisher, & Savolainen, 1999; Zullig, Pun, Patton, & Ubbes, 2006). Additionally, dichotomous classifications of behavioural factors are crude and should therefore be interpreted cautiously.

It should also be acknowledged that the family affluence scale measures only one dimension of socio-economic position. In contrast to parental education and occupation, family affluence is much more related to income and material wealth. However, from a methodological point of view it is important to recognise that different SES indicators may give different and therefore complementary information. It would be interesting if other studies using different indicators of socio-economic status, could verify our results. Further, even though six health behaviours were analysed there may be other important lifestyle factors that were not included in this study.

Conclusions

The present study clearly indicates that self-rated health is associated with family material wealth across European and North American countries. It supports the hypothesis that behavioural factors such as smoking, sedentary behaviours and nutrition partly account for this association – even though the strength of this contribution varies across countries. Future studies should look at the effects of behavioural factors on self-reported health in relation to other social contexts such as school, peer groups and the media. These contexts comprise material and psychosocial stressors, which are likely to influence health. In addition, a closer look at macro-level characteristics (such as countries' school systems, Gross National Product (GNP) and income inequality) could shed additional light on the role of multilevel factors in the explanation of socio-economic differences in perceived adolescent health.

The observed large variation in self-rated health across countries implies that public health policy could benefit from taking into account the experiences from other countries regarding school or welfare system. Our results also suggest that public health interventions should aim at preventing unhealthy behaviours, such as irregular breakfast eating or insufficient physical activity, not only to avoid future chronic diseases, but also to improve adolescents' current well being. Additionally, the results suggest that targeting some of the behaviours (e.g. fruit and vegetables consumption), which are more strongly patterned by SES, may also have an impact on SES differences in health, in contrast to other less patterned behaviours (e.g. smoking). A further implication of our results, is that interventions should be as comprehensive as possible, not only aimed at changing individual behaviours, but targeted at different behaviours at the same time. A coherent and co-ordinated approach is required to maximise the potential synergy of any such interventions.

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