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Original article

Socio-economic inequality in multiple health complaints among adolescents: international comparative study in 37 countries

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Abstract

Objectives: To use comparable data from many countries to examine 1) socio-economic inequality in multiple health complaints among adolescents, 2) whether the countries' absolute wealth and economic inequality was associated with symptom load among adolescents, and 3) whether the countries' absolute wealth and economic inequality explained part of the individual level socio-economic variation in health complaints.

Methods: The Health Behaviour in School-aged Children (HBSC) international study from 2005/06 provided data on 204,534 11-, 13- and 15-year old students from nationally random samples of schools in 37 countries in Europe and North America. The outcome measure was prevalence of at least two daily health complaints, measured by the HBSC Symptom Check List. We included three independent variables at the individual level (sex, age group, family affluence measured by the Family Affluence Scale FAS) and two macro level measures on the country's economic situation: wealth measured by Gross National Product (GNP) and distribution of income measured by the Gini coefficient.

Results: There was a significant socio-economic variation in health complaints in 31 of the 37 countries. The overall OR (95 % CI) for 2+ daily health complaints for all countries was 1.31 (1.27–1.36) in the medium versus high FAS group and 2.07 (2.00–2.14) in the low versus high FAS group. This socio-economic gradient in health complaints attenuated somewhat in the multilevel models which included macro level data. There was no association between GNP and health complaints. The OR for high symptom load was 1.35 (1.08–1.69) per 10 % increase in Gini coefficient. The socio-economic gradient in health complaints at the individual level was somewhat attenuated in the multilevel models which included macro level data.

Conclusions: There was a significant association between low FAS and high level of health complaints in 30 of 37 countries. Health complaints increased significantly by increasing income inequality in the country.

Keywords: Adolescents – Comparative study – Complaints – HBSC – School survey – Social inequalities.

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Introduction

Health complaints such as pain and mental health problems are common among adolescents[1] and such health complaints are sensitive to socio-economic environmental factors[1–3]. Poverty is a well-known risk factor for ill health among children and adolescents[4–6]. Whether there is a social gradient in health among young people is less obvious. A range of studies have demonstrated such a gradient, i.e. a steady increase in prevalence of ill health with decreasing socioeconomic position (SEP) of the parents[7]. Documentation for such a gradient exists for many indicators of ill health, e.g. severe asthma (but not milder expressions of asthma)[8,9], injuries and violent deaths[10–12], symptom load and multiple complaints[13–15], life quality[16], overweight and obesity[17].

Other studies found no such social gradient[18–20]. West[21,22] have suggested that there is an equalisation in health in adolescence. This hypothesis suggests that the transition from childhood to youth is associated with a change from health inequality to relative equality. West[21] suggests that equalisation may be related to changing exposure to peer group, youth culture, and other influences in youth which attenuate or reverse the influences of family SEP on health. This idea is supported by Vågerö & Östberg[23] and has attracted much attention within social epidemiology[4,11,23,24] although Chen et al.[24] show that the situation varies across health outcomes and that there seems to be a socio-economic gradient for common complaints among both children and adolescents. It is important to further examine to which degree – or under which circumstances – there is such an equalisation in health.

Equalisation may be relevant for health behaviour rather than health: in adolescence, risk behaviour is often the norm. For example, there was no significant association between SEP and alcohol consumption at the age of 15[1,25,26]. The relationship between SEP and smoking also seems to be complex and different from one country to another[1].

The available studies are difficult to compare because of differences in study design, study population, and measurements of both the independent variable SEP and the dependent variable health. The cited studies use a variety of indicators of SEP, most often parental income, parental education, parental occupational social class, and social deprivation of the residential area. The cited studies also focus on different health outcomes and it may not be fair to compare their findings because they may show different associations with SEP[24]. On the other hand, social inequality in health is a general observation across health measures among adults[27,28].

It is possible that socio-economic inequalities in health vary by country because they may be sensitive to the country's absolute affluence or the magnitude of economic inequality in the country. There is a need for internationally comparative studies based on standardised study populations and standardised measurements of SEP and health and studies which study social inequalities in health simultaneously on a micro (individual) and a macro (country) level.

Macro-economic circumstances such as wealth of the nation and how this wealth is distributed also have implications for health. Traditional indicators of population health such as infant mortality or life expectancy improve by increasing wealth until a certain level of wealth of the country[29]. It is not known whether this relationship is valid also for self-reported measures of health status such as multiple complaints among adolescents and we want to study this relationship. Further, indicators of population health such as life expectancy and infant mortality increases by increasing economic equality, e.g. measured by the Gini index for income inequality[4,30,31]. An unequal distribution of family affluence is strongly associated with a high proportion of adolescents reporting poor self-rated health[33]. Again, we need studies which analyse the relationship between the distribution of wealth and soft measures of health status, in this case multiple complaints among young people.

In this paper we used comparable data from 37 countries to examine

1) socio-economic variations in health complaints among adolescents within and among countries,
2) whether the countries' absolute wealth and economic inequality was associated with health complaints, and
3) whether the countries' absolute wealth and economic inequality explained part of the individual level socio-economic variation in health complaints.

The paper focuses on young people who suffer from a high level of health complaints.

Methods

Design and study population

We used data from the 2005/06 international comparative cross-sectional study Health Behaviour in School-aged Children (HBSC) which aims to gain insight into and further understanding of adolescent health[1]. The research group in each participating country adhered to the international research protocol's requirements regarding sampling, study population, data collection and measurements. The sampling plan included young people who attended general schools (but not schools for students with special needs) in three age groups, 11-, 13- and 15-year olds in a random sample of schools or classes in each country i.e. cluster sampling. The researchers had to tailor their sampling procedures in order to cover these age groups.

Table 1. Descriptive information about the sample and applied variables.

Country (PI)	N	% reporting 2+ daily health complaints	Distribution by FAS			GNP 2004, USD	Gini 2004 %
			Low	Medium	High		
Austria (Dür)	4848	7.8 %	12.6 %	45.4 %	42.1 %	33700	29.1
Belgium[1] (Maes, Piette)	8787	11.1 %	12.9 %	41.8 %	45.3 %	32119	33.0
Bulgaria (Vasileva)	4854	17.5 %	32.4 %	50.8 %	16.7 %	9032	29.2
Canada (Boyce)	5930	11.6 %	8.8 %	38.9 %	52.3 %	33375	32.6
Croatia (Kuzman)	4968	12.8 %	29.5 %	48.3 %	22.2 %	13042	29.0
Czech Republic (Csémy)	4782	10.6 %	29.8 %	46.6 %	23.7 %	20538	25.4
Denmark[2] (Due)	5741	7.9 %	7.9 %	41.2 %	50.9 %	33973	24.7
Estonia (Aasvee)	4484	11.6 %	31.9 %	43.6 %	24.5 %	15478	35.8
Finland (Tynjälä)	5249	7.8 %	12.7 %	45.8 %	41.6 %	32153	26.9
France (Godeau)	7155	14.1 %	12.3 %	38.2 %	49.6 %	30386	28.3
Germany (Ravens-Sieberer)	7274	8.7 %	13.2 %	40.0 %	46.8 %	29461	28.3
Greece (Kokkevi)	3715	20.5 %	25.3 %	47.4 %	27.4 %	23381	34.1
Hungary (Németh)	3532	11.7 %	28.6 %	46.7 %	24.8 %	17887	26.9
Iceland (Bjarnason)	9540	11.5 %	2.4 %	26.0 %	71.7 %	36510	25.0
Ireland (Nic Gabhainn)	4894	8.9 %	23.4 %	56.2 %	20.5 %	38505	34.3
Israel (Harel-Fisch)	5686	22.7 %	24.0 %	46.0 %	35.1 %	25864	39.2
Italy (Cavallo)	3951	15.6 %	21.1 %	45.7 %	21.9 %	28529	36.0
Latvia (Pudule)	4245	11.7 %	32.6 %	45.6 %	21.9 %	13646	37.7
Lithuania (Zaborskis)	5632	15.4 %	37.6 %	46.1 %	16.3 %	14494	36.0
Luxembourg (Wagener)	4387	10.0 %	8.3 %	22.0 %	58.7 %	60228	26.0
Malta (Massa)	1404	16.7 %	34.7 %	49.8 %	15.5 %	19189	30.9
Netherlands (Vollebergh)	4274	6.4 %	7.8 %	40.7 %	51.5 %	32684	30.9
Norway (Samdal)	4711	7.7 %	3.9 %	27.4 %	68.8 %	41420	25.8
Poland (Mazur)	5489	14.5 %	32.2 %	43.5 %	24.3 %	13847	34.5
Portugal (Gaspar de Matos)	3919	7.4 %	24.0 %	43.5 %	32.9 %	20410	38.5
Romania (Baban)	4684	22.1 %	44.9 %	42.4 %	12.7 %	9060	31.0
Russia (Komkov)	8232	14.8 %	47.6 %	40.9 %	11.5 %	10845	39.9
Slovakia (Morvicova)	3882	15.2 %	45.8 %	40.0 %	14.2 %	15871	25.8
Slovenia (Jericek)	5130	6.7 %	10.8 %	43.8 %	45.4 %	22273	28.4
Spain (Moreno Rodriguez)	8891	12.5 %	14.9 %	45.8 %	39.3 %	27169	34.7
Sweden (Marklund)	4415	8.6 %	6.5 %	37.6 %	55.9 %	3255?	25.0
Switzerland (Kuntsche)	4621	6.7 %	9.1 %	43.0 %	47.9 %	35633	33.7
TFYRMacedonia[3] (Kostarova)	5281	14.7 %	39.5 %	43.7 %	16.9 %	7200	39.0
Turkey (Ercan)	5639	31.9 %	69.9 %	24.8 %	5.3 %	8407	43.6
Ukraine (Balakireva)	5069	10.4 %	56.5 %	36.9 %	6.6 %	6848	28.1
United Kingdom[4]	15382	9.9 %	13.0 %	38.1 %	49.0 %	33238	36.0
United States (Iannotti)	3892	17.1 %	11.2 %	33.8 %	55.0 %	41980	40.8
Whole study (Currie)[5]	204573	12.6 %	22.7 %	40.9 %	36.4 %	–	–

[1] Includes Flemish speaking part of Belgium (PI: L. Maes) and French speaking part (PI: D. Piette)
[2] Greenland not included because lack of GNI and gini information
[3] The Former Yugoslav Republic of Macedonia
[4] Includes England (PI: A. Morgan), Scotland (PI: C. Currie) and Wales (PI: C. Roberts)
[5] Study population excluding Greenland 204 573, if Greenland included n = 205 939).

Countries and schools vary in the degree of age homogeneity of grades. In some countries like Sweden the age homogeneity was high and the three age groups corresponded to specific grades. In other countries and schools with less age homogeneity it was necessary to combine several grades to cover the target age groups. In general, the response rate at the level of the school was high with a majority of countries above 80 %.

In each participating country the sample included students in these three age groups in a random sample of schools or school classes and in most countries, national representative samples were drawn. In some countries, samples were stratified to ensure representation by e.g. geography, ethnic background, and school type. The recommendation was to sample approximately 1,500 students in each of the three age groups.

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The final study population was 205,939, 100,233 boys and 104,301 girls. The distribution across the three age groups (mean ages 11.6, 13.6 and 15.6) was 66,707, 69,954, and 67,873. We combined the study populations from the Flemish and French speaking parts of Belgium into one country because data on GNP and Gini were available for the country but not for the separate regions. For the same reason, we combined the three study populations in England, Scotland and Wales into one UK study population. Finally, we excluded Greenland for which there was no separate information on GNI and Gini. Table 1 shows the participating countries, the Principal Investigators, and the study population in each country.

Data collection: The participating students completed the internationally standardised HBSC questionnaire[1,34,35] after instruction from a teacher, a research assistant, or other relevant adult person. The data collection was anonymous and the students participated voluntarily after informed consent. The countries had very different requirements for ethical assessment of the studies. In some countries like Scotland the study underwent a formalised and extensive ethical assessment and approval. Other countries like Denmark this type of fully anonymous survey does not require ethical approval and the researchers had to ask the school management, the board of parents, and the board of students for ethical approval and consent. The study's international data bank cleaned the data which resulted in an international file which comprises 204 534 students across 41 countries or regions[1,34,35].

Measurements

The outcome measure was the HBSC Symptom Check List (HBSC-SCL)[36–39] based on eight items: "In the last 6 months: how often have you had the following? 1) headache, 2) stomach-ache, 3) back ache, 4) feeling low, 5) irritability or bad temper, 6) feeling nervous, 7) difficulties in getting to sleep, and 8) feeling dizzy". The response code was "about every day", "more than once a week", "about every week", "about every month", and "rarely or never".

We consider daily presence of two or more health complaints as a serious strain and we defined a dichotomous measure "at least two health complaints about every day" versus others. The prevalence of isolated and clustered subjective health complaints is high among adolescents[39–42]. There is no known certain threshold apparent to distinguish „normal" health complaints from intolerable and serious conditions in the population as in the clinical practice as in research. In this study the presence of at least two health complaints about every day was chosen as target variable to study more severe cases which may have a major negative impact on everyday quality of life. Table 1 shows the proportion of students with at least two health complaints every day in each of the participating countries.

We measured SEP by the Family Affluence Scale (FAS) which is simple and easy to answer even for young adolescents[1,43]. FAS includes four items (assignment of points shown in parentheses): Does your family own a car, van or truck? "No" (0), "yes one" (1), "yes two or more" (2). Do you have your own bedroom for yourself? "No" (0), "Yes" (1). During the past 12 months, how many times did you travel away on holiday (vacation) with your family? "Not at all" (0), "once" (1), "twice" (2), "more than twice" (2). How many computers does your family own? "None" (0), "one" (1), "two" (2,) and "more than two" (2), range 0–7.

We categorised the students into high (6–7 points), medium (4–5 points) and low (0–3 points) FAS. In the least wealthy countries this resulted in a very high proportion of the study population being exposed to low affluence. This was not appropriate for the calculation of the association between FAS and symptom load and we also used an alternative categorisation into high (6–7 points), medium (3–5) and low (0–2).

The analyses used four covariates: sex, age group, country affluence measured by Gross National Product (GNP) per capita, and the level of income inequality in the country measured by the Gini index. The Gini index represents the distribution of income among citizens and is calculated by plotting the cumulative percentages of total income received against the cumulative number of recipients on a Lorenz curve plot, starting with the poorest individual or household. The area between this curve and a hypothetical line of perfect equality is expressed as a percentage. Theoretically, the Gini index ranges from 0 (perfect equality) to 1 (perfect inequality). We extracted information on GNP and Gini in the year 2004 from the World Bank (http://hdrstats.undp.org/indicators), Eurostat (data on Malta and Luxembourg, www.eurofound.europa.eu/areas/qualityoflife/eurlife/) and CIA (data on Iceland, www.cia.gov/library/publications/the-world-factbook/fields). Tab. 1 shows GNP and Gini for the participating countries.

Statistical procedures

We had to exclude 8,820 students (4.3 % of the total study population) from the analyses, 1 366 from the Greenlandic study and another 7 454 because of missing data regarding FAS or multiple complaints. The probability of missing information on multiple complaints increased with decreasing family affluence, $p < 0.0001$.

The first analytical step was age and gender adjusted logistic regression analysis of the association between FAS and the dichotomous measure for multiple complaints for each country. We repeated these analyses with two cutpoints for low FAS to see how much the association between FAS and

Table 2. Age adjusted OR (95 % CI) for 2+ daily health complaints by FAS in each country and in the total study population.

Country	High FAS	Medium FAS	Low FAS
Austria	1	1.20 (0.94–1.54)	**2.04 (149–2.80)**
Belgium [1)]	1	**1.29 (1.10–1.50)**	**2.00 (1.64–2.43)**
Bulgaria [4)]	1	0.86 (0.69–1.07)	1.17 (0.94–1.46)
Canada	1	**1.52 (1.27–1.81)**	**2.13 (1.64–2.77)**
Croatia [4)]	1	0.80 (0.64–1.00)	1.12 (0.89–1.43)
Czech Republic	1	1.17 (0.92–1.50)	**1.29 (1.01–1.68)**
Denmark	1	**1.24 (1.00–1.53)**	**1.92 (1.38–2.66)**
Estonia	1	1.15 (0.90–1.47)	**1.54 (1.20–1.99)**
Finland	1	0.99 (0.79–1.24)	**1.48 (1.09–2.00)**
France	1	**1.39 (1.20–1.62)**	**1.93 (1.58–2.35)**
Germany	1	**1.41 (1.17–1.69)**	**2.09 (1.66–2.64)**
Greece	1	1.08 (0.89–1.32)	**1.46 (1.17–1.82)**
Hungary	1	1.22 (0.93–1.61)	**1.50 (1.12–2.00)**
Iceland	1	**1.68 (1.46–1.93)**	**4.20 (3.11–5.68)**
Ireland [4)]	1	0.78 (0.59–1.01)	1.19 (0.89–1.60)
Israel	1	**1.41 (1.21–1.65)**	**1.98 (1.67–2.35)**
Italy	1	1.08 (0.87–1.32)	**1.79 (1.42–2.26)**
Latvia	1	0.96 (0.74–1.25)	**1.30 (1.00–1.69)**
Lithuania	1	1.22 (0.96–1.56)	**2.20 (1.74–2.78)**
Luxembourg	1	**1.30 (1.04–1.62)**	**1.85 (1.33–2.57)**
Malta	1	0.84 (0.54–1.29)	1.08 (0.69–1.67)
Netherlands	1	**1.51 (1.16–1.98)**	**1.71 (1.11–2.65)**
Norway	1	**1.27 (1.08–1.73)**	**2.85 (1.86–4.35)**
Poland	1	0.96 (0.79–1.17)	1.18 (0.97–1.45)
Portugal	1	1.25 (0.92–1.70)	**1.87 (1.35–2.58)**
Romania	1	1.02 (0.81–1.30)	**1.51 (1.19–1.91)**
Russia	1	0.84 (0.69–1.03)	0.99 (0.81–1.21)
Slovakia	1	1.00 (0.75–1.34)	1.23 (0.93–1.62)
Slovenia	1	0.99 (0.78–1.26)	1.38 (0.98–1.95)
Spain	1	**1.29 (1.12–1.49)**	**2.09 (1.75–2.49)**
Sweden	1	**1.42 (1.13–1.78)**	**2.01 (1.38–2.94)**
Switzerland	1	**1.46 /1.13–1.88)**	**1.94 (1.33–2.83)**
TFYR Macedonia	1	0.90 (0.71–1.13)	**1.32 (1.05–1.65)**
Turkey	1	0.80 (0.61–1.05)	1.02 (0.79–1.31)
Ukraine [4)]	1	0.94 (0.62–1.41)	1.25 (0.84–1.85)
United Kingdom[2)]	1	**1.49 (1.32–1.68)**	**2.07 (1.77–2.42)**
United States	1	**1.56 (1.30–1.87)**	**2.04 (1.59–2.62)**
Whole study[3)]	1	**1.31 (1.27–1.36)**	**2.07 (2.00–2.14)**

[1)] Includes both Flemish and French speaking part of Belgium. [2)] Includes England, Scotland and Wales. [3)] Applied total study population, n = 194 353. [4)] The association between FAS and multiple complaints becomes significant when we apply the alternative cut-off point for low FAS. Figures in bold: Statistically significant, $p < 0.05$.

symptom load was sensitive to the size of the highly exposed group, i. e. the low FAS group.

The second step was multilevel multivariate logistic regression analyses. Model 1 was empty and only showed the crude between-country variance in symptom load without considering any individual or country explanatory variables. This model calculates the country variance and intra class correlation (ICC). Model 2 included compositional characteristics of the study population (sex, age group, and FAS) as fixed effects. Model 3 also included the two country level macroeconomic variables (GNP per 1 000 USD and Gini per %) as fixed effects. We display the associations as odds ratio (OR) with 95 % confidence limits (95 % CI). We tested if there was a statistical interaction between GNP and FAS on multiple complaints but that was not the case.

Finally, in the third step, we wanted to be sure that the crude categorisation of the independent and dependent variable did not hide associations between FAS and symptom load. Therefore, we repeated all analyses in step one and two by use of linear regression analyses. In these analyses, the independent variable was FAS in its full range from 0 to 7, the dependent variable was number of daily health complaints in its full

Table 3. Age adjusted OR (95 % CI) for daily experience of each of the eight health complaints by FAS.

Complaint	High FAS	Medium FAS	Low FAS
Headache	1	**1.25 (1.20–1.31)**	**1.91 (1.82–2.00)**
Stomach ache	1	**1.19 (1.12–1.26)**	**1.64 (1.54–1.75)**
Back pain	1	**1.07 (1.02–1.12)**	**1.40 (1.33–1.47)**
Feeling low	1	**1.41 (1.35–1.48)**	**2.49 (2.38–2.61)**
Irritability or bad temper	1	**1.35 (1.30–1.40)**	**2.16 (2.07–2.24)**
Feeling nervous	1	**1.44 (1,39–1.51)**	**2.22 (2.13–2.31)**
Difficulties in getting to sleep	1	1.02 (0.98–1.05)	**1.18 (1.13–1.23)**
Feeling dizzy	1	**1.10 (1.04–1.16)**	**1.59 (1.50–1.69)**

Applied total study population, n = 194 353. Figures in bold: Statistically significant, $p < 0.05$.

range from 0 to 8, and the covariates age group, GNP and Gini were treated as continuous variables. In many instances, the linearity assumption was not supported by the data and we decided not to present these analyses in the article.

Results

Descriptive information

Tab. 1 shows that the prevalence of students with at least two daily health complaints varies considerably across countries, from less than 10 % in a range of countries mostly in the Northern, Western and central part of Europe (Austria, Denmark, Finland, Germany, Ireland, Netherlands, Norway, Portugal, Slovenia, Sweden, Switzerland, and UK) to more than 20 % in a range of South Eastern European and Mediterranean countries (Greece, Israel, Romania, Turkey (highest)). Tab. 1 also shows the substantial variation in the determinant FAS: In Norway and Iceland approximately 70 % of the students belong in the highest category. Countries where less than 20 % of the students belong to the highest FAS category are Bulgaria, Lithuania, Malta, Russia, Slovakia, The Former Yugoslav Republic of Macedonia (TFYR Macedonia), and Turkey.

Further, Tab. 1 shows large variations in the macro-economic indicators. GNP varies from less than 10 000 USD per capita in Bulgaria, Romania, TFYR Macedonia, Turkey, and Ukraine to more than 40,000 USD per capita in Luxembourg, Norway and the United States. The Gini coefficient varies from approximately 25 % in the Nordic countries (Denmark, Finland, Iceland, Norway, Sweden), Luxembourg, the Czech Republic and Slovakia to approximately 40 % in Israel, Russia, Turkey and USA.

FAS and health complaints

Tab. 2 shows the association between FAS and health complaints for each country. In the total study population, the OR (95 % CI) for at least two daily health complaints was 1.31 (1.27–1.36) in the medium FAS group and 2.07 (2.00–2.14) in the low FAS group. This pattern of a significant association appeared in 27 of the 37 countries. In the remaining ten countries there was no significant association. In four of these countries (Bulgaria, Ukraine, Croatia, Ireland) the association between FAS and health complaints was graded and significant when we applied the alternative categorisation with a smaller proportion in the low FAS group. In the remaining six countries (Malta, Poland, Russia, Slovakia, Slovenia, Turkey) there was no association between FAS and health complaints, regardless of which of the two categorisations we used. These patterns were confirmed by linear regression analyses (not shown in tables). Tab. 3 shows that there was a significant and graded increase in the prevalence of seven complaints with decreasing FAS. The association between FAS and the eighth complaint: difficulties in getting to sleep, was not graded but the prevalence was significantly higher in the lowest FAS-group.

Multilevel modelling

The empty model 1 (not shown in table) revealed a significant country variance in health complaints (0.189, $p = 0.004$) with an Intra Class Correlation of 0.0543 which means that 5.43 % of the variation in health complaints is attributable to differences between countries. After inclusion of country level and individual level data, the country variance was still significant (0.116, $p = 0.028$, ICC = 3.41 %).

Tab. 4 shows the result of the final multilevel multivariate logistic regression analyses. There was a graded and significant increase in health complaints with decreasing FAS, OR-values approximately 1.70 for high level of health complaints in the lowest FAS group. The gradient is less steep than for the total study population in Tab. 2 which suggests that the inclusion of macro level economic variables explain some of the association between FAS and health complaints at the individual level. Table 4 also shows a higher prevalence of health complaints among girls than boys, OR = 1.78 (1.73–1.83) and a higher prevalence of health complaints among 15-year-olds than 11-year-olds, OR = 1.14 (1.10–1.18).

Table 4. Multilevel multivariate logistic regression model showing age and sex adjusted OR (95 % CI) for 2+ daily symptoms by FAS and macroeconomic indicators.

Independent variable and covariates	OR (95 % CI)
Individual level variables	
High FAS	1
Medium FAS	**1.214 (1.173–1.257)**
Low FAS	**1.628 (1.565–1.694)**
11–year–olds	1
13–year–olds	**1.093 (1.056–1.130)**
15–year–olds	**1.141 (1.103–1.180)**
Boys	1
Girls	**1.780 (1.731–1.831)**
Macro level variables	
GNP per 1,000 USD	0.992 (0.982–1.001)
GINI per 10 %	**1.353 (1.081–1.694)**

Applied total study population, n = 194,353.
Figures in bold: Statistically significant, $p < 0.05$.

Tab. 4 also displays the association between the macro-economic indicators and health complaints. There was a significant association between Gini and health complaints, OR = 1.35 (1.08–1.69) per 10 % increase in Gini but no significant association between GNP and health complaints, OR per 1 000 USD = 0.992 (0.982–1.001).

Discussion

There are three main findings in these analyses. First, odds for high level of health complaints increased by decreasing FAS in the total study population with an OR of 2.07 (2.00–2.14) for at least two daily health complaints in the most exposed group (the lowest FAS group) as compared to the reference group of high FAS. The measure of multiple complaints include a mixture of complaints but all of these complaints are socially patterned, i. e. most prevalent in the lowest FAS group.

Second, the association between FAS and health complaints appeared in 31 of the 37 countries in the study. There was no significant interaction between GNP and FAS on multiple complaints but nevertheless the findings suggest that GNP may modify the association between FAS and health complaints: There was an association between FAS and health complaints in 23 of the 25 countries with GNP-values over 16 000 USD per capita but there was no association between FAS and health complaints in 4 of 12 countries with GNP-values below 16 000 USD per capita per year.

Third, the inclusion of macro level indicators in the multilevel models reduced the age adjusted OR for at least two daily health complaints in low FAS groups from approximately 2.0 to 1.62 which suggest that macro level indicators may explain some of the socioeconomic variation in health complaints at the individual level. Especially income distribution had an influence, in such a way that in countries with a high income inequality the relationship between high level of health complaints and low FAS was stronger. There was no association between country affluence as measured by GNP but a significant association between high income inequality and high level of health complaints.

The first observation of a relatively consistent social gradient in health complaints is similar to findings in many other studies[13–16,44–47] and was also observed for other HBSC health indicators[48]. The gradient is rather steep in many countries with OR-values of 2 or more and in this way the analyses do not lend much support to the hypothesis of equalisation in health in youth.

It is however important to pay attention to the second finding, i. e. that the association was not consistent across countries. The six countries with no association between FAS and health complaints are not just exceptions from a general finding but rather cases for a more in-depth analysis and for learning more about socioeconomic inequalities in health. It is noteworthy that most of these countries are characterised by a relatively low GNP. The lack of socioeconomic variations in health complaints in these countries could be a result of the distribution of the population in FAS-groups: If the distribution leaves a large part of the study population in the most exposed group (for instance if it is the norm to belong to the low FAS group), then the contrast between the participants in high and low FAS may be too small to produce significant OR-estimates. We examined this hypothesis by changing the cut-point between the medium and low FAS groups but this re-analysis did not change the results and there were still no socioeconomic variation in health complaints in these countries. Further, relatively low GNP is not a sufficient condition for avoiding socioeconomic variations in health complaints because other countries with relatively low GNP (Estonia, Lithuania and Romania) have substantial socioeconomic variations in health complaints. However, the prevalences of high level of health complaints vary widely, from Turkey being highest and Slovenia being tied for 2nd lowest.

In general, the OR for at least two daily health complaints in the lowest FAS group was highest in the affluent countries in northern, central and western Europe and North America. Again, this finding could be an artefact for the distribution of the population into FAS groups. If the most exposed group (low FAS) is very small like in Norway, then it is likely that it includes only very poor families with an overall high burden of daily symptoms. We examined this hypothesis, again by changing the cut-point between the midium and low FAS

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groups but this change did not change the OR-estimates substantially.

The role of the macro level economic factors is very similar to what have been reported in other studies. The classical observation of a close association between national affluence and health status of the population is not valid any more, at least not in countries in which the population is not very poor.[29] The protective effect of a relatively equal distribution of income is also in accordance with several recent studies[30,33,49].

The association between FAS and health complaints at the individual level attenuated somewhat after inclusion of macro economic factors into the model and Gini caused most attenuation, i. e. the more unequal the income distribution, the more socioeconomic variation in health complaints.

The findings are important also in relation to the studies which suggest that social inequality in health in adolescence tend to track into adulthood[51–54].

This study has important strengths and limitations that we have to take into consideration in assessing the results.

a) Comparability: The study includes comparable study populations and data from a large number of countries.
b) Selection bias: Although most countries had high participation rates, there were variations in participation rate varied across countries. Therefore, the study may be hampered by selection bias, e. g. non-participation of students with many health problems and low FAS. Further, the probability of missing data regarding complaints was highest among students from low FAS families. These potential selection biases will most likely result in an underestimation of the association between FAS and multiple health complaints. Further, the proportion of adolescents not attending school may be highest in the least affluent families in the least affluent countries. In this case, a school-based sample is not ideal for the study of health inequalities. School-based samples might lead to underestimation of the social inequality in health, which is a potential explanation for the finding of no association between FAS and health complaints in four countries with relatively low GNP.
c) Validity of the outcome measure: The available studies suggest that the data on health complaints have an acceptable reliability and validity[36–39]. Ravens-Sieberer et al.[38] conducted Rasch analysis and analyses for Differential Item Functioning (DIF) to study the construct validity of HBSC-SCL. Seven of the eight items showed no DIF and the Rasch model revealed acceptable item fit. Haugland & Wold[36] reported high test-retest reliability of the eight items and qualitative analyses showed acceptable reliability. In previous confirmatory factor analyses, Hetland et al.[39] demonstrated that HBSC-SCL reflects two correlated sub-factors, subsuming psychological and somatic complaints. However, the high correlation between the factors supports the validity of one general factor underlying the health complaints in the scale. The chosen indicator (two or more daily complaints) mixes complaints for quite heterogeneous troubles. We believe that this potential bias is less important because all eight complaints are more prevalent in low FAS groups.
d) Validity of the exposure variable: There are several studies of FAS which suggest acceptable validity[43]. Andersen et al.[55] showed high agreement between 11-year old schoolchildren's responses to the four FAS items and their parents' reports. Boyce et al.[56] showed that FAS aggregated at the country level correlated strongly with the national wealth indicator Gross Domestic Product and Molcho et al.[57] showed high correlations between children's reports on FAS and parents' occupational social class.

   The use of FAS does not comply with the usual choice of indicators for SEP (occupation, education, income) but rather reflects what the families have bought or consumed. Although FAS is not an ideal measurement of SEP, it has demonstrated its usefulness in many prior studies of socioeconomic variations[43], not least because it is easy for the respondents to answer the four items and there is no need for the fairly complicated supplementary coding of educational level or occupational social class.
e) Comparability of FAS across countries: FAS may not be fully comparable across countries. Both Schnohr et al.[58] and Batista-Foguet et al.[59] have shown that FAS is not completely comparable across countries because the individual items have different importance in different countries. The distribution of the study populations across the three FAS groups, high, medium and low, also varies across countries. In some countries there are few in the low FAS group and many in the high FAS group and in other countries it is quite the contrary. Therefore, the relative size of the most exposed group (low FAS) vis-a-vis the reference group (high FAS) varies and also influences the OR-estimates. We conducted alternative analyses with another cut-point between low and medium FAS. These analyses did not change the observed socioeconomic gradient very much.
f) Validity of the statistical model: The multilevel modeling provides an opportunity to deal with individual level and country level data in the same statistical models. We decided to conduct a two level model with individual and country but without class and school as an additional level of analysis. This decision for at more parsimonious model takes into account the results of a previous HBSC-paper which showed that only 3–6 % of the random effects on self-rated health were accounted for by the class level[6].

Previous research also suggests that subjective health outcomes differs little across schools and that any bias due to not modeling a random school-level intercept variance would be relatively small[60].

The observation of a high risk of health complaints for adolescents from poor families and in countries with a high level of income inequality is an important public health issue. It is likely that adverse socioeconomic conditions in childhood predicts a high level of health problems in adult life[51,52,60–65]. It is also likely that social inequalities in health in childhood and adolescence is a precursor of social inequalities in health in adulthood[27,28,54,67]. The findings therefore suggest that social inequalities in health will be present for many years in many of the participating countries. The findings suggest that the strive to reduce social inequalities in health may need substantial efforts and still suffer from poor chances of succes.

We do suggest that researchers focus on the processes by which poor socioeconomic circumstances influence health. There are several important contributions from the HBSC study. One example is the analyses which suggest that poor social relations between students, parents and the school may account for a considerable part of the social inequality in health[13] or that the confident relations with adults play a role[68]. Another example is the study by Zambon et al.[69] which shows that self esteem and self-efficacy may mediate the association between socioeconomic position and health. Another study by Zambon et al.[70] showed that welfare policies with genuine re-distribution of wealth were protective to social inequalities in health. A combination of such studies about the processes which produce social inequalities in health and careful intervention studies may provide the insights and instruments we need to procede towards a more fair distribution of health.

Insight into the factors that mediate the effect of low SEP on health may be important from a public health point of view: It is not easy to change the socioeconomic circumstances of children, but it may be easier to change the mediators. For example the relationship between SEP and BMI is mediated by lack of physical activity[71] and according to Moore and his co-workers[31] quality of sleep can be also a potential mediator between low SEP and poor health. Low SEP may associate with unhealthy physical environment, may undermine optimism and personal control[72], may increase reactive responding[73] and increase the level of perceived stress[74]. For example in families with low income those children and youth who have high self-esteem and good emotion regulation skills, have parents with high parental control[75], so high parental control may modify the relationship between SEP and health, it is a protective factor.

Similarly, early attachment and parenting also affect the physical and mental health of children[76,77] through shaping of stress systems' (e. g. HPA-axis) condition and the ability to regulate emotions[76], so early prevention seems to be essential.

These examples suggest that efforts to change the above mentioned mediators may be an appropriate way to start reducing social inequalities in health in adolescence.

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