

# Income inequality and alcohol use: a multilevel analysis of drinking and drunkenness in adolescents in 34 countries

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**Background:** Economic inequality has been hypothesized to be a health determinant, independent of poverty and household income. The goal of this study was to explore the contextual influences of income inequality on alcohol use and frequency of drunkenness in adolescents. **Methods:** The Health Behaviour in School-aged Children study surveyed 162 305 adolescents (ages 11, 13 and 15 years) in 34 countries, providing self-report data on family affluence, alcohol consumption and episodes of drunkenness. Country-level data on income inequality and overall wealth were retrieved from the United Nations Development Program. **Results:** Multilevel logistic regression revealed that 11- and 13-year-olds in countries of high income inequality consumed more alcohol than their counterparts in countries of low income inequality (after adjustment for sex, family affluence and country wealth). No such effect on alcohol consumption was found in 15-year-olds. Eleven-year-olds in countries of high income inequality reported more episodes of drunkenness than their counterparts in countries of low income inequality. No such effect of income inequality on drunkenness was found in 13- or 15-year-olds. **Conclusions:** Income inequality may have a contextual influence on the use of alcohol among younger adolescents. Findings suggest that economic policies that affect the distribution of wealth within societies may indirectly influence the use of alcohol during early and mid-adolescence.

**Keywords:** adolescents, alcohol, cross-national, Health Behaviour in School-aged Children, inequality, multilevel

The notion that the distribution of wealth and consumption within societies could be a health determinant has attracted a great deal of attention in public health research. Multilevel, epidemiological studies that have been carried out in the United States and in Europe indicate that a disparity between the rich and the poor, or 'income inequality', relates to both morbidity and mortality in the population above and beyond the effects of individual-level income.<sup>1–5</sup> A number of mechanisms have been proposed to explain this contextual influence on health. Wilkinson suggested that inequality in socioeconomic status elicits stress and thereby contributes to stress-relieving health behaviours such as smoking and drinking.<sup>5</sup> Other possible mechanisms include public investments in social goods such as education and health care, social cohesion and social capital in countries or regions of greater economic equality among its citizens.<sup>5,6</sup> Given that economic disparity contributes to relative deprivation within a society (either real or perceived), both economic and psychological factors may be involved in mediating the effects of income inequality on health and health behaviours.<sup>7,8</sup>

The issue of income distribution is relevant to public policy. Inequalities can be influenced by taxation and tax benefits, income transfers between regions, investment incentives and other economic policies. It is important to study the effects, if any, of income inequality within a society on the health of its citizens.<sup>1</sup> To date, research on income inequality and health

outcomes has focused almost exclusively on adult populations, whereas few studies have considered the health of young people. The paucity of research on income inequality and child health is particularly striking given the high level of public interest in child poverty. At an individual level, studies have shown that adolescents who report low family affluence or live in areas of high unemployment report poorer health status and poorer health behaviours (e.g. substance use) than their more affluent counterparts.<sup>9–12</sup> One study demonstrated a relation between state-level income inequality and alcohol problems among adults living in the United States.<sup>13</sup> Such a contextual influence of income inequality on alcohol use has not yet been established among adolescents. Given the effects of poverty and income inequality on alcohol use among adults, it could be expected that a similar contextual influence exists among adolescents. However, adolescents may not perceive social inequality as adults do, so the adult data may not generalize well to young people.

The aim of the present study was to study the contextual effects of income inequality on drinking behaviour among 11-, 13- and 15-year-olds in 34 industrialized countries. It was hypothesized that income inequality within countries would predict alcohol consumption and episodes of drunkenness in adolescents after accounting for sex, family affluence and country wealth.

## Methods

### Sample

Self-report data were collected from 162 305 adolescents in the 2001–2002 World Health Organization collaborative Health Behaviour in School-aged Children (HBSC) study.<sup>14</sup> The purpose of the HBSC study was to identify behaviours and social factors that influence physical and psychosocial health in adolescents. Cluster samples of 11-, 13- and 15-year-olds were recruited through schools using a common protocol in 31 European countries, Canada, the United States and Israel

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**Table 1** Sample details

Country	HBSC study data collection	<i>n</i>	Gini index	GDP per capita (US dollars, 2001)
Low income inequality				
Hungary	April to May 2002	4164	0.244	\$12 340
Denmark	March 2002	4672	0.247	\$29 000
Belgium <sup>a</sup>	March to June 2002	10 612	0.250	\$25 520
Sweden	December 2001	3926	0.250	\$24 180
Czech Republic	June 2002	5012	0.254	\$14 720
Finland	March to May 2002	5388	0.256	\$26 730
Norway	December 2001	5023	0.258	\$29 620
Macedonia	March 2002	4161	0.282	\$6110
Slovenia	March 2002	3956	0.284	\$17 130
Medium income inequality				
Croatia	February 2002	4397	0.290	\$9170
Ukraine	February 2002	4090	0.290	\$4350
Austria	October 2001	4472	0.305	\$26 730
Canada	February to June 2002	4361	0.315	\$27 130
Poland	February to March 2002	6383	0.316	\$9450
Latvia	November to December 2001	3481	0.324	\$7730
Spain	May 2002	5827	0.325	\$20 150
The Netherlands	December 2001 to January 2002	4268	0.326	\$27 190
France	March to June 2002	8185	0.327	\$23 990
Switzerland	May 2002	4679	0.331	\$28 100
Greece	October 2002	3807	0.354	\$17 440
High income inequality				
Israel	June 2002	5661	0.355	\$19 790
Ireland	April to June 2002	2875	0.359	\$32 410
Italy	April to May 2002	4386	0.360	\$24 670
UK <sup>b</sup>	February to May 2002	14 372	0.360	\$24 160
Lithuania	March to April 2002	5645	0.363	\$8430
Estonia	November 2001	3979	0.376	\$10 170
Germany	February to June 2002	5650	0.382	\$25 350
Portugal	March 2002	2940	0.385	\$18 150
USA	December 2001 to January 2002	5025	0.408	\$34 320
Russia	February 2002	8037	0.456	\$7100
Greenland <sup>c</sup>	April 2002	891	NA	\$20 000
Malta <sup>c</sup>	January 2002	1980	NA	\$13 160

a: French and Flemish samples combined.

b: Scottish, Welsh and English samples combined.

c: Not included in analysis.

NA: not available.

(Table 1). Schools and classes were selected to be representative by age and geography and all national samples were selected to be self-weighting, with the exception of England and Ukraine. For the present study, data from Flemish- and French-speaking samples in Belgium were combined, as were Welsh, Scottish and English samples in the UK, to correspond to available macro-level data. Mean ages of the three age groups were 11.6 years

(SD 0.4), 13.6 years (SD 0.4) and 15.6 years (SD 0.4). The mean age of the entire sample was 13.5 years (SD 1.7; range 9.8–17.3).

### Measures

Individual material wealth, a proxy measure of family income, was measured using the HBSC Family Affluence Scale (FAS).<sup>10</sup>

The FAS is comprised of three items: 'Does your family have a car or a van?' (0 = no, 1 = yes, 2 = yes, two or more), 'Do you have your own bedroom?' (0 = no, 1 = yes) and 'During the past year, how many times did you travel away on holiday (vacation) with your family?' (0 = not at all, 1 = once, 2 = twice, 3 = more than twice). These items produced a score ranging from 0 (lowest affluence) to 6 (highest affluence). The FAS has been shown to have good criterion validity and to be less subject to non-response bias than other measures such as parental occupational status.<sup>10</sup> In a study of material deprivation using 1998 HBSC data, the FAS showed a three-fold increase in the likelihood of adolescents' poor self-rated health attributed to socioeconomic status.<sup>15</sup>

The ordered categorical responses in the FAS were riddit transformed to cumulative probabilities yielding a continuous material deprivation score ranging between 0 and 1, with a whole-sample mean of 0.5.<sup>10</sup>

The HBSC questionnaire measured alcohol consumption with an ordinal scale item 'How often do you drink anything alcoholic, such as beer, wine or spirits?' (1 = never, 2 = less than once a week, 3 = once a week, 4 = 2–4 days a week, 5 = 5–6 days a week, 6 = once a day, 7 = more than once a day). Episodes of drunkenness were measured with the item 'Have you ever had so much alcohol that you were really drunk?' (1 = never, 2 = once, 3 = 2–3 times, 4 = 4–10 times, 5 = more than 10 times). The HBSC questionnaire is available online at [www.hbsc.org](http://www.hbsc.org).

### Procedure

Individual data were collected in classroom settings by teachers or trained interviewers in accordance with a standardized protocol.<sup>14</sup> Pupils were instructed not to write their names or any identifying information on the assessment materials. Pupils were informed that participation was voluntary and that all

responses would be studied anonymously. Completion of the survey took students ~45 min.

### Country data

Data on country wealth [gross domestic product (GDP) per capita] and income inequality in HBSC countries were retrieved from the 2003 United Nations Human Development Report.<sup>16</sup> These data are shown in Table 1. The Gini index represents the distribution of income or consumption 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. The greater the income disparity, the greater the bowing of the curve away from the diagonal line. The Gini index ranges theoretically from 0 (perfect equality) to 1 (perfect inequality). To facilitate logistic regression analysis, countries were grouped into approximate thirds of low, medium and high income inequality based on Gini indices, as shown in Table 1.

### Data analysis

SPSS 12.0.1 (Chicago, IL, USA) was used to compute descriptive statistics. MlwiN version 2.00 (Institute of Education, London, UK) was used to test multilevel logistic regression models of the effects of medium and high income inequality (versus low income inequality) on alcohol use and drunkenness.<sup>17</sup> These regression models tested eight dichotomous outcomes: drinking once a week or more, twice a week or more, five times a week or more and every day (versus never been drinking), and having been drunk at least once, two or more times, four or more times and 10 or more times (versus never been drunk). Forty-eight models were used to test the effect of income inequality on each outcome separately for each age group and with and without adjustment for sex, family affluence and country GDP per

**Table 2** Percentage of adolescents reporting alcohol consumption and drunkenness

	Income inequality		
	Low ( <i>n</i> = 55 401) (%)	Medium ( <i>n</i> = 41 656) (%)	High ( <i>n</i> = 58 570) (%)
Alcohol consumption			
Never	64.2	69.5	63.3
Less than once a week	22.2	17.2	19.9
Once a week	8.4	7.5	9.5
Two to four days a week	3.0	3.3	4.1
Five to six days a week	0.7	0.7	1.0
Every day	0.6	0.5	0.7
Every day, more than once	0.8	1.2	1.5
Drunkenness			
Never	71.9	76.3	67.1
Once	11.3	11.2	14.2
Two to three times	8.3	7.0	9.9
Four to 10 times	4.1	2.9	4.3
More than 10 times	4.3	2.5	4.5

Low income inequality group includes Hungary, Denmark, Belgium, Sweden, Czech Republic, Finland, Norway, Macedonia and Slovenia. Medium income inequality group includes Croatia, Ukraine, Austria, Canada, Poland, Latvia, Spain, The Netherlands, France, Switzerland and Greece. High income inequality group includes Israel, Ireland, Italy, UK, Lithuania, Estonia, Germany, Portugal, USA and Russia. All data, including English and Ukraine samples, were unweighted.

capita. Because individuals were clustered within schools within countries, three-level models with variances at the level of individual, school and country were used. Multilevel analysis thereby accounted for the clustered structure of the data and produced accurate estimates of individual standard errors. Equal weights were used for all units within each level. Statistical significance was tested using Walds  $\chi^2$  and second-order penalized quasi-likelihood (PQL2) estimation. Compared with marginalized first-order estimation, PQL2 estimation provides more accurate variance estimates when the ratio of low level units (e.g. number of individuals) to high level units (e.g. number of countries) is high, as was the case in the HBSC study.<sup>17</sup>

## Results

A majority of adolescents in the sample indicated that they never drink alcohol (65.3%) and have never been drunk (71.4%). Drinking less than once a week was reported by 19.9% of the sample, once a week 8.6% and two or more days a week by 6.2%. One episode of drunkenness was reported by 12.3% of the sample, two or three episodes were reported by 8.5% and four or more episodes were reported by 7.7%. Frequencies of alcohol use and drunkenness across groups of countries with low, medium and high levels of income inequality are shown in Table 2.

Logistic regression analyses showed an increase in the likelihood of alcohol use between groups of low and high income inequality after adjustment for sex, individual-level family affluence and country-level GDP per capita (Table 3). However, this effect was statistically significant only among the 11- and 13-year-olds, and not among the 15-year-olds. Among 11-year-olds, individuals in high income inequality countries, compared with those in low income inequality countries, were

85% more likely to drink two to four times a week or more, 82% more likely to drink five to six times a week or more and 78% more likely to drink every day. Similarly, among 13-year-olds, individuals in high income inequality countries, compared with those in low income inequality countries, were 96% more likely to drink two to four times a week or more, 123% more likely to drink five to six times a week or more and 136% more likely to drink every day. These upward trends in drinking attributed to income inequality were only marginally significant owing to large confidence intervals. Individuals in medium inequality countries did not differ significantly from individuals in low or high inequality countries with regard to drinking frequency.

Income inequality was also associated with drunkenness, but these relations were most clearly shown among 11-year-olds and not among 13- and 15-year-olds. As shown in Table 4, 11-year-olds in high income inequality countries were 69% more likely to have been drunk two or more times, 89% more likely to have been drunk four or more times, and 101% more likely to have been drunk 10 or more times compared with 11-year-olds in low income inequality countries. Again, large confidence intervals affected the precision of these odds ratios and, for the most part, individuals in medium income inequality countries did not differ significantly from those in either low or high income inequality countries in terms of episodes of drunkenness. However, the 15-year-olds in the medium income inequality countries were *less* likely than 15-year-olds in the low income inequality countries to have been drunk four or more times (adjusted odds ratio 0.61) and to have been drunk 10 or more times (adjusted odds ratio 0.53).

## Discussion

The aim of this study was to explore whether country-level income inequality is associated with drinking and drunkenness

**Table 3** Odds ratios of drinking frequency by high, medium and low income inequality

	11-year-olds (n = 54 857)		13-year-olds (n = 55 539)		15-year-olds (n = 50 580)	
	Crude model [OR (95% CI)]	Adjusted model [OR (95% CI)]	Crude model [OR (95% CI)]	Adjusted model [OR (95% CI)]	Crude model [OR (95% CI)]	Adjusted model [OR (95% CI)]
Drink once a week						
High	1.44 (0.86–2.40)	1.49 (0.88–2.52)	1.60 (1.09–2.35)	1.62 (1.09–2.40)	0.94 (0.60–1.49)	0.91 (0.58–1.43)
Medium	1.05 (0.66–1.35)	0.89 (0.62–1.27)	1.13 (0.77–1.67)	1.09 (0.69–1.71)	1.04 (0.65–1.66)	0.97 (0.61–1.57)
Low	1.00	1.00	1.00	1.00	1.00	1.00
Drink 2–4 times a week						
High	1.69 (0.97–2.95)	1.85 (1.07–3.21)	1.89 (1.37–2.60)	1.96 (1.40–2.74)	1.13 (0.70–1.81)	1.07 (0.68–1.63)
Medium	1.11 (0.78–1.59)	1.11 (0.82–1.50)	1.29 (0.95–1.76)	1.24 (0.88–1.76)	1.13 (0.72–1.77)	1.06 (0.68–1.68)
Low	1.00	1.00	1.00	1.00	1.00	1.00
Drink 5–6 times a week						
High	1.58 (0.86–2.89)	1.82 (1.01–3.29)	2.07 (1.45–2.97)	2.23 (1.53–3.24)	1.37 (0.85–2.21)	1.38 (0.84–2.26)
Medium	1.13 (0.76–1.70)	1.14 (0.79–1.63)	1.29 (0.89–1.85)	1.26 (0.86–1.83)	1.00 (0.68–1.46)	0.97 (0.64–1.47)
Low	1.00	1.00	1.00	1.00	1.00	1.00
Drink every day						
High	1.54 (0.85–2.82)	1.78 (1.00–3.19)	2.12 (1.46–3.07)	2.36 (1.59–3.49)	1.47 (0.89–2.43)	1.54 (0.91–2.63)
Medium	1.11 (0.68–1.80)	1.12 (0.69–1.84)	1.36 (0.86–2.15)	1.32 (0.83–2.11)	1.04 (0.69–1.57)	1.05 (0.67–1.65)
Low	1.00	1.00	1.00	1.00	1.00	1.00

The reference group in all logistic regression models was adolescents who had never consumed alcohol. These models were adjusted for sex, family affluence and GDP per capita.

**Table 4** Odds ratios of drunkenness by high, medium and low income inequality

	11-year-olds (n = 54 857)		13-year-olds (n = 55 539)		15-year-olds (n = 50 580)	
	Crude model [OR (95% CI)]	Adjusted model [OR (95% CI)]	Crude model [OR (95% CI)]	Adjusted model [OR (95% CI)]	Crude model [OR (95% CI)]	Adjusted model [OR (95% CI)]
Drunk at least once						
High	1.41 (0.89–2.23)	1.45 (0.90–2.35)	1.36 (0.88–2.08)	1.39 (0.92–2.11)	0.88 (0.54–1.45)	0.90 (0.57–1.40)
Medium	0.89 (0.57–1.40)	0.88 (0.54–1.42)	0.90 (0.61–1.32)	0.90 (0.60–1.37)	0.76 (0.51–1.13)	0.79 (0.48–1.29)
Low	1.00	1.00	1.00	1.00	1.00	1.00
Drunk two or more times						
High	1.59 (0.97–2.61)	1.69 (1.03–2.78)	1.29 (0.78–2.13)	1.29 (0.77–2.15)	0.82 (0.48–1.38)	0.81 (0.47–1.39)
Medium	0.80 (0.49–1.32)	0.82 (0.49–1.38)	0.78 (0.49–1.24)	0.81 (0.48–1.37)	0.65 (0.41–1.01)	0.68 (0.43–1.07)
Low	1.00	1.00	1.00	1.00	1.00	1.00
Drunk four or more times						
High	1.77 (1.07–2.92)	1.89 (1.12–3.18)	1.25 (0.73–2.15)	1.23 (0.70–2.17)	0.75 (0.43–1.31)	0.75 (0.42–1.33)
Medium	0.82 (0.43–1.57)	0.77 (0.38–1.56)	0.69 (0.41–1.17)	0.73 (0.41–1.30)	0.57 (0.33–0.97)	0.61 (0.37–0.97)
Low	1.00	1.00	1.00	1.00	1.00	1.00
Drunk 10 or more times						
High	1.83 (1.10–3.07)	2.01 (1.21–3.33)	1.56 (0.96–2.57)	1.59 (0.96–2.65)	0.73 (0.41–1.32)	0.74 (0.41–1.35)
Medium	0.95 (0.47–1.91)	0.95 (0.43–2.11)	0.86 (0.52–1.45)	0.93 (0.54–1.62)	0.49 (0.28–0.87)	0.53 (0.31–0.90)
Low	1.00	1.00	1.00	1.00	1.00	1.00

The reference group in all logistic regression models was adolescents who had never been drunk. These models were adjusted for sex, family affluence and GDP per capita. Income inequality and alcohol use

among adolescents. Multilevel regression analyses indicated that income inequality was associated with drinking frequency among 11- and 13-year olds and drunkenness among 11-year-olds. There were few differences between unadjusted and adjusted models, indicating that neither sex, family affluence nor country wealth affected the relationship between income inequality and drinking behaviour.

Previous research has identified several mechanisms that may explain this ecological correlate of adolescent drinking. Feelings of relative deprivation may contribute to stress among young people, for which alcohol is used to cope.<sup>5</sup> Adolescents, like adults, may drink as a means to cope with feelings of deprivation and social disadvantage. Income inequality may also relate to consistency in government spending on public health services and public education, thereby affecting the amount of exposure adolescents may have had to health promotion campaigns.<sup>6</sup> Links between income inequality and adolescent drinking may also involve parental drinking, which models the behaviour to adolescents and affects parental monitoring and discipline.<sup>13</sup> Elucidating these mechanisms is a fruitful area for further research and may shed light on how socioeconomic factors influence adolescents' use of alcohol.

Unexpectedly, income inequality was associated with drinking and drunkenness among younger adolescents and not among older adolescents. This age difference is attributable to two factors: motives to use alcohol and age differences in socioeconomic influences on health. First, while some adolescents drink as a means to cope with negative feelings, older adolescents tend to report stronger social motivations to use alcohol than younger adolescents.<sup>18</sup> If income inequality is, in fact, indirectly related to adolescent stress then younger adolescents may be more susceptible to stress-related drinking and drunkenness than older adolescents. Alternatively,

socioeconomic inequalities in health are less pronounced in late adolescence than in early adolescence and adulthood.<sup>19</sup> Such 'equalization in health' among the older participants in the HBSC study may have attenuated any contextual influences of income inequality on drinking.

Weaknesses in the study design include the exclusive reliance on self-report data on drinking behaviour and lacking economic data on variations in income inequality within larger countries (e.g. USA, Russia). Additional data collected from other informants and more economic regions may have produced more accurate results. Indeed, our analyses showed modest increases in odds ratios and wide confidence intervals. Also, given the cross-sectional design of the study, it would be useful to replicate these findings using longitudinal data.

While gradients in drinking frequency were observed across groups of low, medium and high income inequality, such was not the case for drunkenness. In fact, the 15-year-olds in medium income inequality countries were *less* likely to report four or more episodes of drunkenness than 15-year-olds in low and high income inequality countries. Given the large number of models tested, replication of this potentially spurious effect is warranted, but it is possible that alcohol consumption in some regions is unrelated to heavy drinking. There were certainly cultural differences in attitudes towards social drinking among the countries represented in this study. Previous HBSC studies have shown that societies in which alcohol is traditionally an accepted and morally neutral element of everyday life, such as Southern European cultures of Italy, Spain, France and Greece, have lower rates of drunkenness among young people than societies with a more ambiguous, uneasy relationship with alcohol, such as Scandinavia, Britain and North America.<sup>20</sup>

In all, the study provided unique findings in a growing evidence base on income inequality and health. Its focus on adolescents sets it apart from studies of income inequality



and adult morbidity. Moreover, income inequality was studied between countries rather than within countries, lending further credibility to the notion that income inequality may influence health outcomes independently of their cultural and political contexts. From a global health perspective, long-term strategies to curb alcohol-related morbidity should target youth in areas where inequalities between the rich and the poor are high.

### Key points

- This study explored whether disparity between the rich and the poor relates to alcohol use by adolescents.
- Survey data from adolescents in 34 countries were merged with data on the distribution of wealth in these countries.
- Income inequality was related to drinking and drunkenness among young adolescents.
- The distribution of wealth in a society may indirectly influence health behaviours among young people.

### References

- Kahn RS, Wise PH, Kennedy BP, Kawachi I. State income inequality, household income, and maternal mental and physical health: cross sectional national survey. *BMJ* 2000;321:1311–5.
- Kennedy BP, Kawachi I, Glass R, Prothrow-Stith D. Income distribution, socioeconomic status, and self rated health in the United States: multilevel analysis. *BMJ* 1998;317:917–21.
- Torsheim T, Currie C, Boyce W, et al. Material deprivation and self-rated health: a multilevel study of adolescents from 22 European and North American countries. *Soc Sci Med* 2004;59:1–12.
- Wilkinson RG. Income distribution and life expectancy. *BMJ* 1992;304:165–8.
- Wilkinson RG. *Unhealthy societies: the afflictions of inequality*. London: Routledge, 1996.
- Kawachi I, Kennedy BP, Lochner K, Prothrow-Stith D. Social capital, income inequality, and mortality. *Am J Public Health* 1997;87:1491–8.
- Aberg Yngwe M, Fritzell J, Lundberg O, et al. Exploring relative deprivation: is social comparison a mechanism in the relation between income and health? *Soc Sci Med* 2003;57:1463–73.
- Lynch J, Smith GD, Hillemeier M, et al. Income inequality, the psychosocial environment, and health: comparisons of wealthy nations. *Lancet* 2001;358:194–200.
- Karvonen S, Rimpela A. Socio-regional context as a determinant of adolescents' health behaviour in Finland. *Soc Sci Med* 1996;43:1467–74.
- Torsheim T, Currie C, Boyce W, et al. Material deprivation and self-rated health: a multilevel study of adolescents from 22 European and North American countries. *Soc Sci Med* 2004;59:1–12.
- Resnick MD, Bearman PS, Blum RW, et al. Protecting adolescents from harm. *Findings from the National Longitudinal Study on Adolescent Health*. *JAMA* 1997;278:823–32.
- Spooner C, Mattick RP, Noffs W. A study of the patterns and correlates of substance use among adolescents applying for drug treatment. *Aust N Z J Public Health* 2000;24:492–502.
- Henderson C, Liu X, Diez Roux AV, et al. The effects of US state income inequality and alcohol policies on symptoms of depression and alcohol dependence. *Soc Sci Med* 2004;58:565–75.
- Currie C, Samdal O, Boyce W, Smith B. Health Behaviour in School-Aged Children: a World Health Organization cross-national study. *Research protocol for the 2001/02 survey*. Edinburgh, Scotland: Child and Adolescent Health Research Unit, University of Edinburgh, 2001.
- Currie CE, Elton RA, Todd J, Platt S. Indicators of socioeconomic status for adolescents: the WHO Health Behaviour in School-aged Children survey. *Health Educ Res* 1997;12:385–97.
- Human Development Report 2003. Database on Internet. New York: United Nations Human Development Program. c2003, updated 8 July 2003. Available online at: <http://hdr.undp.org/reports/global/2003/> (1 April 2005, date last accessed).
- Rasbash J, Browne W, Goldstein H, et al. *A user's guide to MLwiN version 2.1*. London: University of London, 2000.
- Cooper ML. Motivations for alcohol use among adolescents: Development and validation of a four-factor model. *Psychol Assess* 1994;6:117–28.
- West P, Sweeting H. Evidence on equalisation in health in youth from the West of Scotland. *Soc Sci Med* 2004;59:13–27.
- Schmid H, Nic Gabhainn S. Alcohol use. In Currie C, Roberts C, Morgan A, et al., editors. *Young people's health in context. Health Behaviour in School-aged Children (HBSC) study: international report from the 2001/2002 survey* (Health Policy for Children and Adolescents, No.4). WHO Regional Office for Europe, 2004: 73–83.

Received 1 September 2004, accepted 1 March 2005