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## Socio-economic disadvantage is associated with heavier drinking in high but not middle-income countries participating in the International Alcohol Control Study

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### Abstract

**Introduction and Aims.** To investigate if socio-economic disadvantage, at the individual- and country-level, is associated with heavier drinking in some middle- and high-income countries. **Design and Methods.** Surveys of drinkers were undertaken in some high- and middle-income countries. Participating countries were Australia, England, New Zealand, Scotland (high-income) and Peru, Thailand and Vietnam (middle-income). Disadvantage at the country-level was defined as per World Bank (categorised as middle- or high-income); individual-level measures were (i) years of education and (ii) whether and individual was under or over the poverty line in each country. Measures of heavier drinking were (i) proportion of drinkers that consumed 8+ drinks and (ii) three drinking risk groups (lower, increasing and higher). Multi-level logistic regression models were used. **Results.** Individual-level measures of disadvantage, lower education and living in poverty, were associated with heavier drinking, consuming 8+ drinks on a typical occasion or drinking at the higher risk level, when all countries were considered together. Drinkers in the middle-income countries had a higher probability of consuming 8+ drinks on a typical occasion relative to drinkers in the high-income countries. Interactions between country-level income and individual-level disadvantage were undertaken: disadvantaged drinkers in the middle-income countries were less likely to be heavier drinkers relative to those with less disadvantage in the high-income countries. **Discussion and Conclusions.** Associations between socio-economic disadvantage and heavier drinking vary depending on country-level income. These findings highlight the value of exploring cross-country differences in heavier drinking and disadvantage and the importance of including country-level measurements to better elucidate relationships. [Huckle T, Romeo JS, Wall M, Callinan S, Holmes J, Meier P, Mackintosh A-M, Piazza M, Chaiyasong S, Pham CV, Casswell S. Socio-economic disadvantage is associated with heavier drinking in high but not middle-income countries participating in the International Alcohol Control Study. *Drug Alcohol Rev* 2018;37:S63–S71]

**Key words:** alcohol consumption, heavier drinking, socio-economic advantage, international alcohol control (IAC) study.

### Introduction

Several studies have been undertaken within countries to understand how socio-economic status is related to heavier alcohol consumption, for example, [1]. Although study methods and measures are continually

being refined, no clear picture has yet emerged. The most common pattern seen in high-income countries is that those of higher socio-economic status are more likely to consume alcohol more frequently than those of lower status, but those of lower status consume more alcohol in total (and more on a typical occasion)

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[1–3]. A recent study conducted in two countries; a high-income and an upper-middle income country, found no inequalities in heavy episodic drinking in Chile (upper-middle income), but in Finland heavy episodic drinking was more prevalent among those with lower education, however, women of higher education were also more likely to consume heavily [1]. There is some evidence that in middle-income countries (e.g. Brazil and Russia) high socio-economic status is associated with heavier consumption [4,5]. However, a different study from Russia found higher odds of hazardous drinking among those who were least educated and were not in employment [6]. One study assessed the impact of educational level in 15 countries, of which 13 were high-income and two were middle-income countries, and found within each of the two middle-income countries, those in the higher educated groups were more likely to consume alcohol in a risky manner [2]. These studies provide limited evidence that patterns of heavier drinking may differ by level of income in countries.

To the best of our knowledge, no studies have utilised multi-level modelling to measure how country-level factors may interact with individual-level measures of socio-economic status and heavier drinking. Grittner *et al.* [7], although not directly assessing drinking patterns, conducted a cross-country study of 25 countries comprised of high-, middle- and low-income to understand how social inequalities and gender differences affected the experience of self-reported alcohol-related problems. Multi-level modelling allowed for assessment of country-level indicators of inequality along with individual-level education measures. The findings showed men in lower income countries were more likely to report alcohol-related social problems [7]. This study suggests that taking account of country-level factors, along with individual-level variables, in understanding impacts of socio-economic status is important.

Previous cross-country studies to date have tended to use years of education as a measure of socio-economic status [1,7]. Measures of education status have advantages in that they tend to represent the construct of socio-economic status quite well and are less likely to change over time relative to other measures such as income [8]. In the current study we use years of education grouped into low, medium and high. Income is used less often in relevant cross-country studies. Household income, while a more inclusive measure of socio-economic status than personal income, cannot be adequately determined as lower or higher unless equivalised to yield a representative income. In this current study, we use equivalised household income to first determine income and then to assign respondents to being above or below the

poverty line in their respective countries as a way to conceptualise those who are disadvantaged versus not disadvantaged. We also include at the country-level whether the country is classified as a middle- or high-income country [9] to conceptualise disadvantage at the country-level.

The countries included in the current study differ in terms of prevalence of alcohol use and estimated per capita levels of consumption (per capita higher in middle-income countries for drinkers [10]). High-income countries had higher prevalence levels (84% in Australia and UK, New Zealand 79.5%). A lower level of prevalence was apparent in the middle-income countries (Thailand 29.7%, Peru 55.4%, Vietnam 38.3% [11]). As previous studies, for example, Probst, Mantney and Rehm [12], have shown that lifetime abstinence is associated with lower country-level income relative to high-income and given the stark variation in abstinence rates, a country-level measure of abstinence for each country was included in the current study as a potential explanatory variable.

To the best of our knowledge, no cross-country study has assessed relationships between disadvantage and heavier drinking using both country-level and individual-level measures. This study will therefore assess if socio-economic disadvantage, at the individual-level and country-level, is associated with heavier drinking in some middle- and high-income countries.

## Methods

The following countries were included in the current study: Australia, England, Scotland, New Zealand (high-income), Peru, Thailand and Vietnam (middle-income). Inclusion in the study depended on the availability of household composition data to allow for equalisation of income.

Sampling methods were designed to obtain a random representative sample and each country utilised the sampling frame that was most appropriate in their context. Either multi-stage sampling of geographical units or telephone samples were used to represent the countries (although the samples in Vietnam and Peru were sub-national). For further details on sampling please see Huckle *et al.* 2018 [13]. Interviews were conducted via computer-assisted interviewing either over the phone or face-to-face using android tablets.

A screening interview established eligibility for participation (drinking in the last 6 months and age 16–65 years) and one respondent was selected at random from the household. Additional screening criteria for Australia meant that a larger proportion of risky drinkers, defined as consuming more than five drinks at least once a month, were included than would otherwise

**Table 1.** Characteristics of study participants: Socio-demographic and alcohol consumption measures across countries

	Australia <sup>a</sup>	England	Scotland	New Zealand	Thailand	Peru	Vietnam
<i>Gender, %</i>							
Female	48	48	49	50	33	56	9
Male	52	52	51	50	67	44	91
<i>Age group, %</i>							
18–24	13	10	12	7	14	22	4
25–34	21	24	24	18	26	24	16
35–44	27	24	24	29	26	19	30
45–54	20	24	23	24	23	20	30
55–65	19	18	17	21	11	15	20
<i>Education, %</i>							
Low	9	16	17	8	52	55	71
Med	25	19	16	42	19	20	13
High	66	64	67	50	29	25	16
<i>Poverty line, %</i>							
Below	9	11	12	14	9	10	5
Above	91	89	88	86	91	90	95
<i>Heavier drinking, %</i>							
<8 drinks <sup>b</sup>	88	91	86	92	84	89	84
>8 drinks	12	9	14	8	16	11	16
<i>Risk category, %</i>							
Low	51	43	37	62	54	74	54
Increased	25	32	35	23	26	24	23
Higher	24	25	28	15	20	2	23
<i>Total, n = 9862</i>	1098	1222	1178	1072	2208	1623	1461

<sup>a</sup>Countries are ordered in terms of gross domestic product purchasing power parity (current international \$)—highest to lowest.

<sup>b</sup>A drink is defined as 15 mL absolute alcohol.

be obtained in a random sample. This has been accounted for with weighting in the current paper.

Considerable effort was put into minimising participant refusals. The response rates obtained for the countries were as follows: Australia 38%, England 16%; Scotland 19%, New Zealand 60%; Thailand 93%, Peru 82% and Vietnam 99%.

Response rates were calculated using American Association for Public Opinion Research formula #3 (or more stringent formulas) [14].

The years in which data collection occurred in each country were: Australia (2013), England (2012–2013), Scotland (2012–2013), New Zealand (2011), Peru (2015), Thailand (2012) and Vietnam (2014).

Sample sizes of drinkers included for the analyses for each country can be found in Table 1.

Drinkers who were not within the age range 18–65 years or had missing income data were excluded from the samples.

## Measures

### Country-level measures

*High- and middle-income.* Countries were categorised into high- or middle-income based on World Bank

categories. During the period of the current study high-income countries had a gross national income per capita > US\$12 615 (approximately, the thresholds differ by year) and middle-income countries had a gross national income per capita below this but above US\$1025. For the purposes of this analysis, the upper- and lower middle-income were grouped as middle-income [9,15].

### Country-level prevalence of alcohol consumption.

Abstinence rates in the past 12 months for each country were obtained from the Global Information System on Alcohol and Health 2010 [16], as the IAC study samples included in this study comprised drinkers only.

### Individual-level measures

All individual-level survey measures had a reference period of the past 6 months.

*Alcohol consumption outcome measures.* Consumption data were collected using a beverage- and location-specific measure. Respondents reported on their drinking in a number of specified locations plus any additional locations they drank at. For each place, they

were asked how often they drank there and what they would drink on a typical occasion at that location [17]. The locations asked about in each country were adapted to the context and reflected the full range of drinking locations in that context as were the beverages that also included unrecorded beverages. This information was then used to calculate the typical occasion quantity and frequency of drinking (please see Huckle *et al.* [13] for further details).

Measures for analysis were then derived as:

1. Heavier drinking: the proportion of respondents consuming 8+ drinks on a typical occasion within the previous 6 months versus not (a drink was defined as 15 mL absolute alcohol in each country).
2. Risk categories: The risk categories we used in analysis were designed to reflect the evidence presented in Refs. [18,19], i.e. in Rehm *et al.* [18].
  - *Low risk*: Up to four drinks on an occasion OR 4–6 drinks on an occasion less than once a week.
  - *Increased risk*: 4–6 drinks on an occasion at least once a week OR 6+ drinks on an occasion less than once a week.
  - *Higher risk*: 6+ drinks on an occasion at least once a week.

*Disadvantage measures.* Education: Education in years for each respondent was grouped as <10 years (Low); 11–12 years (Medium); 13+ years (High) [as per 7]. Poverty line: Respondents were categorised in each country to be either below of above the poverty line (based on equivalised household income).

## Analysis

### *Equivalised household income*

In order to determine which drinkers in each country were below or above the poverty line we firstly 'equivalised' household income to account for the fact that households contain a different number of individuals. The number and ages of individuals in each household was available in a separate survey question for countries. In New Zealand, household composition data were not complete. Some data were used from the 2013 follow-up IAC survey and for missing data, imputation was used to assign average number of adults and children in that household based on 2013 census data (according to the number of eligible adults between 16 and 65 years of age living in the household in 2011). Seventeen percent of respondents had missing income data after this process.

Household income was then equivalised by dividing total household income by the square root of the total number of household members. This is a method used by the Organisation for Economic Co-operation and Development for comparing income across countries [20].

Determining respondents who were above and below the poverty line was performed by obtaining the poverty line in each country, from different sources, and with the assistance of the participating countries. The poverty line was expressed as the income required to keep an adult out of poverty (for the high-income countries poverty is defined relatively whereas for the low-income countries this is usually expressed as the cost of a basket of essential goods). Where the poverty line referred to a year other than the survey year it was adjusted for the local rate of consumer price inflation. A respondent was assigned as being below the poverty line if they belonged to a household whose income once equivalised was less than the hurdle income. Therefore, poverty was measured in absolute poverty within their respective countries.

The missing income data ranged across countries: Australia 33%, England 27%, Scotland 29%, New Zealand 33% (with the addition of 17% of respondents for which household size could not be determined this meant that 50% of the data were missing for income), Thailand 3%, Peru 7%, Vietnam 23%.

### *Statistical modelling*

SAS 9.3 was used both to compute descriptive statistics and to fit multi-level logistic regression models.

For the country-grouped data, two different models were fitted.

The heavier drinking dichotomous outcome was analysed considering Bernoulli distribution with logit link function. Here the probability of being a heavier drinker depends on gender, age, level of education, poverty line and high- or medium-income country-level. Level of education and gender were considered as random effects.

The three-level drinking risk groups outcome was analysed by fitting a multinomial distribution with logit link function and the same covariates specification. In particular, a polytomous logistic regression model was considered since the proportional odds test for ordinal logistic regression was rejected. We included gender as a random effect. Age was centred about the mean to allow interpretation against the intercept.

In the multi-level models, the inclusion of varying-intercept and varying-slopes was considered for all the covariates, for example, gender, age. After observing

the statistical significance of the variance associated with the specific random effect, the models that were reported were 'the best'—model assumptions and potential outliers were checked and Wald and Likelihood ratio tests were used jointly with standard model selection criteria (likelihood-based measures, for example, Akaike Information Criteria, Bayesian Information Criterion) for discriminating among models.

We also considered the country-level measure of abstinence in the modelling, however, it was removed since it was positively correlated with the country-level income variable.

Interactions between country-level and individual-level variables were also tested in both models.

Given the number of countries was small, we also fitted the same models using a Bayesian framework. We considered non-informative prior distributions for the parameters. The estimates obtained were very similar reflecting no influence of the priors chosen on the posterior distribution and leading to the same inferential conclusions and as such is not reported here [21,22].

Analyses presented were run on individuals with complete data only. While missing data for most variables were minimal, there was considerable missing income data in some countries. As such the heavier drinking model (8+ drinks) was first run excluding individual-level poverty line (based on income), which provided a more complete dataset, then with individual-level poverty line included. The addition of poverty line did not change the findings (not reported here).

## Results

In the high-income countries, the proportions of male and females were roughly equal. In two of the middle-income countries, males comprised the majority of drinkers (Thailand and Vietnam). In Peru, it was observed that more drinkers were female.

The most populated age groups for drinkers as documented by the surveys were 25–34, 35–44 and 45–54 years in all countries except for Peru where 18–24, 24–34 and 45–54 years were most populated. In Vietnam, the age group 55–65 was among the groups most populated (Table 1).

The percentage of those with low education varied across countries. The countries that had the greatest percentages of drinkers with low education were Peru (55%), Thailand (52%) and Vietnam (71%). In Australia, England and Scotland the majority of drinkers were highly educated (Table 1).

**Table 2.** Estimated parameters from the multi-level logistic model for country-grouped International Alcohol Control Study data: 8+ drinks on a typical occasion

Effect	8+ drinks on a typical occasion		
	Beta	SE	P value
Intercept	−3.55	0.22	<0.0001
Age centred	−0.04	0.00	<0.0001
<i>Education</i>			
Low education	1.34	0.29	0.0004
Medium education	0.68	0.28	0.0285
High education <sup>a</sup>	—	.	.
<i>Gender</i>			
Male	1.18	0.13	<0.0001
Female <sup>a</sup>	—	.	.
<i>Poverty line</i>			
Under poverty line	0.67	0.14	<0.0001
Over poverty line <sup>a</sup>	—	.	.
<i>Country income level</i>			
Middle-income	0.68	0.32	0.0334
High-income <sup>a</sup>	—	.	.
<i>Education<sup>a</sup> country income level</i>			
Low education <sup>a</sup> middle-income	−1.25	0.43	0.0034
<i>Country income level<sup>a</sup> poverty line</i>			
Middle-income <sup>a</sup> under poverty line	−1.24	0.23	<0.0001

<sup>a</sup>Ref. category. Multi-level logistic regression model, *n* countries = 7, *n* individuals = 9862. SE, standard error.

The percentage of drinkers living below the poverty line ranged from 5% in Vietnam to 14% in New Zealand (Table 1).

The percentage of drinkers consuming eight or more drinks on a typical occasion ranged from 8% in New Zealand to 16% in Thailand and Vietnam (Table 1).

The percentage of drinkers consuming in the higher risk group ranged from 2% in Peru (due to lower frequency of drinking) to 28% in Scotland (Table 1).

## Multi-level models

### 8+ drinks on a typical occasion

Table 2 shows the results for the multi-level model assessing consumption of 8+ drinks on a typical occasion including all countries. Being of lower age and male were associated with a greater likelihood of consuming 8+ drinks on a typical occasion (compared to being female) (Table 2).

Drinkers with low education had a greater likelihood of consuming 8+ drinks on a typical occasion

**Table 3.** Estimated parameters from the multi-level logistic model for country-grouped International Alcohol Control Study data: Drinking risk categories

Effect	Risk category			
	Risk category Ref category: Lower risk	Beta	Standard Error	P value
Intercept		-1.12	0.19	<0.0001
Intercept		-2.04	0.40	<0.0001
<i>Age centred</i>				
Age	Increased risk	-0.03	0.00	<0.0001
Age	Higher risk	-0.04	0.00	<0.0001
<i>Education</i>				
Low education	Increased risk	0.14	0.12	0.2568
Low education	Higher risk	0.56	0.13	<0.0001
Medium education	Increased risk	0.34	0.09	0.0003
Medium education	Higher risk	0.66	0.10	<0.0001
High education <sup>a</sup>				
<i>Gender</i>				
Male	Increased risk	0.98	0.23	0.0003
Male	Higher risk	1.78	0.49	0.0014
Female <sup>a</sup>				
<i>Poverty line</i>				
Under poverty line	Increased risk	-0.01	0.12	0.9137
Under poverty line	Higher risk	0.27	0.13	0.0322
Over poverty line <sup>a</sup>				
<i>Country income level</i>				
Middle-income	Increased risk	-0.73	0.24	0.0023
Middle-income	Higher risk	-1.35	0.50	0.0072
High-income <sup>a</sup>				
<i>Education<sup>a</sup> country income level</i>				
Low education <sup>a</sup> middle-income	Higher risk	-0.67	0.16	<0.0001
Middle education <sup>a</sup> middle-income	Higher risk	-0.76	0.17	<0.0001
<i>Country income level<sup>a</sup> poverty line</i>				
Middle-income <sup>a</sup> under poverty line	Higher risk	-1.07	0.25	<0.0001

<sup>a</sup>Ref. category. Multi-level logistic regression model,  $n$  countries = 7,  $n$  individuals = 9862.

compared to drinkers with high education; the same result was found for drinkers of medium education, however, the magnitude of the effect was smaller (Table 2).

Drinkers living under the poverty line had a greater likelihood of consuming 8+ drinks on a typical occasion compared to drinkers above the poverty line (Table 2).

A significant interaction was found between country-level income and education. The probability of being a heavier drinker was lower for drinkers with low education living in the middle-income countries compared to drinkers with high education level in the high-income countries (Table 2).

A significant interaction was also found between country-level income and poverty line. The probability of being a heavier drinker was lower for drinkers living under the poverty line in the middle-income countries compared to drinkers above the poverty line in the high-income countries (Table 2).

#### *Risk categories (low, increased and higher)*

Table 3 shows the results for the multi-level model assessing risk categories including all countries. Drinkers of a lower age were more likely to be in the increased and higher risk categories than those of older age (Table 3).

The probability of being in the increased risk group compared to the low risk group was higher for male drinkers compared to female drinkers. The same result was found for the higher risk group but the magnitude of the effect was larger (Table 3).

The probability of those with low education being in the higher risk group compared to low risk group was higher relative to those with high education. For medium level of education, the probability of being in the increased and higher risk groups compared to low risk was higher (compared to those with high education) (Table 3).

The likelihood of being in the increased or higher risk groups compared to lower risk was lower for

drinkers in the middle-income countries compared to the high-income countries (Table 3).

A significant interaction was found for education and country-level income. The probability of higher risk group membership (compared to low risk) was lower for drinkers living in the middle-income countries with low education compared to drinkers with high education level in the high-income countries. The same interaction effect was found for medium education (Table 3).

A significant interaction was found for country-level income and poverty line. The higher likelihood of higher risk group membership (compared to low risk) was lower for drinkers living in the middle-income countries and under the poverty line compared to drinkers above the poverty line in the high-income countries (Table 3).

## Discussion

### *Individual-level measures: education and poverty line*

Several key findings emerged from this study, the first that individual-level disadvantage as measured by education was associated with heavier drinking. Drinkers of low or medium education were more likely to be heavier consumers of alcohol (8+ drinks) with the magnitude of the effect being larger for drinkers with low education. When frequency was considered along with higher typical occasion quantity as measured by the drinking risk groups, low education was related to higher risk group membership as was medium education. These individual-level education findings confirm what is commonly known from the literature with respect to high-income countries - that lower education is generally associated with heavier drinking e.g. greater quantity, heavy episodic drinking [1–3].

We also found that drinkers living below the poverty line across countries had a greater probability of consuming 8+ drinks on a typical occasion or of being in the higher risk group (over and above the effect of education). This suggests that the burden of heavier alcohol consumption is falling on drinkers at the most vulnerable end of the socio-economic gradient. Those living in poverty are likely to experience compounding associations such as exposure to more adverse environmental settings related to alcohol e.g. with higher density of alcohol outlets found in areas of high deprivation (e.g. [23,24]) likely also resulting in exposure to more advertising via shop fronts and including exposure to adverse household-level conditions of stress [25,26]. It is also likely those living in poverty have fewer resources to protect against the adverse impacts of alcohol consumption [26].

### *Country-level income*

Country-level income had independent associations with heavier drinking patterns. Drinkers in the middle-income countries had a higher probability of consuming 8+ drinks on a typical occasion relative to drinkers in the high-income countries. However, for the risk groups based on both quantity and frequency, the likelihood of being in the increased or higher risk groups was higher for drinkers in the high-income countries. This could be because higher frequency of drinking is more common in the participating high-income countries [27].

### *Interactions between country-level income and individual-level disadvantage measures*

An important part of the current study was to assess how including country-level income affected the relationship between the individual-level measures of disadvantage and alcohol consumption. Interactions between country-level income (middle vs. high) and measures of disadvantage (low education and under the poverty line) revealed that drinkers with greater disadvantage in the middle-income countries were less likely to be a heavier drinker relative to those with fewer disadvantages in high-income countries. In other words, this analysis shows that if you have two people both with a low level of education, the person in the high-income country has a higher probability of being a heavier drinker than the person in the middle-income country. This was found for both outcome measures, 8+ drinks on a typical drinking occasion and the drinking risk groups. This is similar to findings from limited previous studies that have found that higher socio-economic status is associated with heavier drinking in some middle-income countries [2,4,5]. It also suggests that differences in country-level factors could be contributing to mixed findings in the literature about how socio-economic status relates to heavier consumption.

The result in our middle-income countries may relate to the affordability of alcohol, with alcohol being less affordable in several of the participating middle-income countries relative to the high-income countries [29]. There may also be different cultural factors contributing, for example, in Vietnam, higher education is associated with consuming more alcohol as people with higher education tend to have more prominent roles in society and are susceptible to the social norms encouraging drinking among this group [30]. In addition, commercial alcohol is more expensive in Vietnam, and is more related to heavier drinking than informal alcohol [31].



## Limitations

Missing income data is common in alcohol surveys and could have biased the results. In all the high-income countries, around one third of income data were missing and a higher proportion was missing for New Zealand due to the additional 17% missing household size data (needed to calculate equivalised income). However, adding income (in this case as it related to the poverty line) as the last variable in a step-wise process in the modelling did not change the findings. This not only provides confidence in the results but also suggests that education by itself can likely do a suitable job in cross-country analysis in the future given both the complexities of generating comparable income data across countries and because the magnitude of effect that the individual-level income data contributed over and above education and country-level income variables was relatively small.

In some countries, districts or municipalities were sampled, rather than nationwide and needs to be taken into account when interpreting the results. Response rates were high in all countries except Australia, England and Scotland (although the Australian response rate was in the normal range of response rates for telephone surveys in Australia) [32]. Post stratification weights were calculated and applied in these countries to correct for response bias (to the extent it could be). However, given the low response rates, heavier drinking and other measurements such as people in the low socio-economic category may have been underestimated.

## Conclusions

Disadvantaged drinkers in the participating middle-income countries were less likely to be heavier drinkers than less disadvantaged drinkers in the high-income countries. This suggests that socio-economic disadvantage operates differently in relation to heavier drinking patterns depending on country-level income. This study highlights the value of exploring cross-country differences in relation to socio-economic disadvantage and heavier drinking and the importance of including country-level factors to better elucidate relationships.

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