A Meta-analysis of Marijuana and Alcohol Use by Socio-economic Status in Adolescents Aged 10-15 Years

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ABSTRACT

Objectives: A majority of population-based studies suggest prevalence of drug and alcohol risk behaviour increases during late adolescence to early adulthood. The purpose of this systematic literature review is to clarify if socio-economic status (SES) is a determinant of marijuana and alcohol risk behaviour in adolescents between the ages of 10-15 years.

Methods: We performed a meta-analysis to identify published or unpublished papers between January 1, 1980 and February 9, 2007 that reviewed marijuana and alcohol risk behaviour by SES in adolescents aged 10-15 years.

Synthesis: We found nine studies that fulfilled our inclusion criteria and passed the methodological quality review. The prevalence of marijuana and alcohol risk behaviour was 22% higher (RR = 1.22; 95% CI 1.14-1.31) in adolescents with low SES in comparison to adolescents with higher SES. Stratification by country of origin revealed that American and New Zealand studies had statistically significant variability in the reported effects as compared to European and UK studies.

Discussion: The evidence suggests that low SES has an inverse association with the prevalence of marijuana and alcohol risk behaviour in adolescents between the ages of 10-15 years. Higher rates of marijuana and alcohol risk behaviour among lower SES adolescents may impact emotional development, limit future educational and occupational achievement, and increase the likelihood for adult marijuana and alcohol addiction.

Conclusion: Lower SES adolescents have higher rates of marijuana and alcohol risk behaviour than higher SES adolescents.

Key words: Alcohol-related disorders; alcohol drinking; drugs; marijuana; adolescents; smoking and socioeconomic factors

La traduction du résumé se trouve à la fin de l'article.

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Unhealthy behaviours, such as excessive consumption of alcohol, are one of the main determinants through which socio-economic status (SES) health differences develop.[1-7] Explanations for SES differences in unhealthy behaviour have mainly focused on adults, although lifestyle patterns are largely developed during adolescence.[8] Although the importance of individual lifestyle behaviours in promoting health and preventing disease has long been accepted, little is known about how SES affects the distribution of lifestyle behaviours among children and adolescents.[9-19]

Alcohol is the drug of choice among North American adolescents and it is used by more young people than tobacco or illicit drugs.[20-22] Alcohol plays a role in adverse health outcomes, including being the leading contributor to death from injuries.[23-27] For example, morbidity and mortality rates increase 200% from middle childhood to late adolescence/early adulthood.[28] This substantial rise is attributable in large part to the increase in risk taking, sensation seeking, and erratic behaviour that follows the onset of puberty.[29] Underage drinking is associated with academic failure, illicit drug use, tobacco use, and risky sexual behaviour, and increases the risk of physical and sexual assault.[30-34] Underage drinking can cause alterations in the structure and function of the developing brain and may have consequences reaching far beyond adolescence.[35-41] According to data from the 2005 National Survey on Drug Use and Health (NSDUH), 5.5% of youth between the ages of 12-17 years meet the diagnostic criteria for alcohol abuse or dependence.[20]

The prevalence of marijuana and alcohol risk behaviour among youth has been steadily increasing since the 1980s, with sharp inclines during the early 1990s.[42-52] A World Health Organization cross-national study suggests that for Canadian youth in the 15-year age group, prevalence of alcohol use is 25% for males and 19% for females.[45] Prevalence of alcohol use for the Canadian 11-13 year age group is 12% for males and 8% for females.[45] A review of American population-based studies suggests that drug and alcohol risk behaviours start at approximately age 10 years and peak between the ages of 14-15 years.[46,47] The prevalence of alcohol use is higher than drug use among adolescents.[53-56]

The objective of this meta-analysis was to determine the association between SES and marijuana and alcohol risk behaviour among adolescents aged 10-15 years.

METHODS

An epidemiologist and a senior librarian performed a systematic literature review utilizing the databases PubMed, PsycINFO, CINAHL and EMBASE from January 1, 1980 to February 9, 2007. Subject descriptors included the MeSH terms: Ethanol, Alcohol Related Disorders, Alcohol Drinking, Alcohol Induced Disorders, Fetal Alcohol Syndrome, Alcoholism, Alcoholic Intoxication, Alcoholic Beverages, Socio-economic, Socioeconomic Factors, Social Class, Health Behaviour, Population Characteristics, Poverty, Educational Status, Occupations, Employment, Drugs, Non-Prescription, Street Drugs, Designer Drugs, Psychotropic Drugs, Physiological Effects of Drugs, Marijuana Smoking, Substance Use, Substance Related Disorders, Substance Abuse Detection, Behaviour, Addictive and Social Problems. Limits terms included: Child: 6-12 years, Adolescent: 13-18 years, Publication date 1980-2007, Clinical Trial, Meta-Analysis, Practice Guideline, Randomized Controlled Trial, Review Humans and English language.

We also sought information pertaining to governmental or non-published papers (grey literature). In total, 251 e-mail requests were sent out to all relevant health, mental health, social science and education department heads of Canadian universities, urban health regions, provincial and federal ministries, school boards, Canadian mental health associations, researchers involved in projects from the National Longitudinal Survey of Children and Youth and independent research agencies (i.e., Statistics Canada). Each of the contacts was asked to forward the e-mail request to any colleague who worked within the area of risk behaviour and adolescents. The original e-mails were sent out during the time period between November 22, 2006 and January 15, 2007. From this process, 13 responses were received.

Two epidemiologists independently screened titles and abstracts of published and unpublished literature for relevance. Inclusion and exclusion criteria were developed and used to assist in the selection of articles for inclusion in the meta-analysis (Table I). Articles were reviewed in full when criteria within the abstract did not provide enough detail to make a decision. Reference lists of articles were examined. Full articles were reviewed independently by a panel of three reviewers consisting of two epidemiologists and a medical health officer. The panel independently appraised the methodological quality of a study with pre-established criteria in two stages: 1) assess the presence of selection, information or confounding bias, and 2) review the study design, study population, variable definition, participation rate, sample size, measurement technique, and analysis strategy (Table II).[57] Except for major violations, a study required an overall score of at least 10 out of 15 to be accepted. The statistical basis for the meta-analysis was taken from Fleiss (1993).[58] Data analysis included the total number of studies found in comparison to a sample.[58] The sample sizes from each of the reviewed studies had the statistical assumption that they were large.[58] A computer program was built that utilized the following formulae:[58]

The fixed effects model was chosen with:

effect size

$$\bar{Y} = \frac{\Sigma W_c Y_c}{\Sigma W_c}$$

standard error

$$SE(\bar{Y}) = (\Sigma W_c)^{-1/2}$$

and 95% confidence interval (ψ)

$$Y - z_{\alpha/2} / \sqrt{\Sigma W_c} \leq \psi \leq + z_{\alpha/2} / \sqrt{\Sigma W_c}$$

The meta-analytic approach took a weighted average of each study result (slope or β). The study weight W was the inverse of the variance computed from the estimated standard error or $SE(\beta)$ as $1/SE(\beta)^2$ and where Y was the effect size. Weighted slopes were calculated by weighting each β as follows:

$$\beta_w = \Sigma[\beta * 1 / \text{var}(\beta)] / \Sigma 1 / \text{var}(\beta)$$

where $\text{var}(\beta) = SE(\beta)^2$

The pooled estimate of the $SE(\beta_w)$ was:

$$1/\sqrt{\Sigma W_i}$$

The pooled estimate of the 95% confidence interval of β_w was: $\beta_w \pm 1.96 * SE(\beta_w)$. Because the rate ratio (RR) is less prone to artificial appearance of inter-study heterogeneity, the adjusted RR is presented with 95% CIs.[58] The assumption of homogeneity of variance is given by: $\chi^2 = \Sigma W(\beta - \beta_w)^2$ which, if the studies are estimating the same value for the effect, has a chi-square distribution with degrees of freedom one less than the number of studies.[59]

Sensitivity analysis was reviewed by looking at the individual influence of a study and then repeating the analysis without studies with the largest weights. Where this produced change in inference (greater than 15% change in RR), it was determined that inclusion of the study in question warranted caution in the interpretation.[59] The point estimates of individual studies were plotted against the inverse of their variance or sample size in order to visualize a funnel shape scattered around the true value of the point estimate.[59] This funnel plot was used to assess publication bias.[59]

RESULTS

The selection of articles for the systematic literature review is summarized in Table III. PubMed, PsycINFO, CINAHL and EMBASE identified 8,897 titles, which were screened for relevance. The grey literature search resulted in 1 additional title. A further 490 titles were identified from reference sections in reviewed papers from the above databases. From the total of 9,388 titles screened for relevance, the overall search yielded 1,327 abstracts. Of these, 629 articles were selected for full review including reference sections; 9 of the 629 articles met the inclusion criteria and passed the methodological quality review. These 9 studies were forwarded for statistical pooling.

Of the 9 pooled studies, 3 were American, 5 were European and 1 international study included both of these geographic locations (Table IV).[8,11,60-66] Seven studies were national samples and 2 were provincial/state or regional. All studies used marijuana and/or alcohol risk behaviour as an outcome measure. Parental income was used as the socio-economic indicator in 5 studies, occupational classifi-

cation was used in 2 studies, parental education was used in 2 studies and 1 study also included parental education as a secondary SES indicator. Sample sizes varied from 1,000 to 162,305.

In total, the overall sample size used for the meta-analysis was 219,517 adolescents (Table IV). The statistical pooling of the 9 studies resulted in an overall RR of 1.22 with a 95% CI of 1.14-1.31. Six studies out of nine and seven results (additional stratifications by gender and age) reported an inverse association between SES and marijuana and alcohol risk behaviour. The rate ratios ranged from a low of 0.09 to a high of 1.85. Nine individual results out of 16 had lower confidence limits that crossed one. The result of the overall test of homogeneity of variance was $p<0.00$, suggesting highly significant heterogeneity between studies. Stratifications by study design, year of publication, scale to measure risk behaviour and construct used to measure parental SES did not significantly explain heterogeneity between studies. Stratification by gender on 2 studies revealed no statistically significant difference between male and female adolescents (Table IV).

Sensitivity analysis individually removed 1 study comprised of two results with relative weights of 0.25 and 0.31. With all studies included, the pooled RR was 1.22, (95% CI 1.14-1.31) in comparison to a pooled RR of 1.03 (95% CI 0.93-1.14) when 1 well-designed study with narrow confidence intervals was removed. The changes in the RR and 95% CI were statistically significant, therefore caution is recommended when interpreting the results. There were not enough studies accepted in order to visualize a funnel shape to the data to formally assess publication bias.

TABLE I

Inclusion and Exclusion Criteria

Inclusion Criteria:
1. Published or unpublished literature that examined risk behaviour (drug use once per month or more and/or one full alcohol drink per month or more) by SES in adolescents between the ages of 10 and 15 years. Studies were accepted if the age range crossed an age period that included, but was not exclusive to, adolescents between the ages of 10 to 15 years (e.g., 15 to 17 years).
2. Population-based cross-sectional surveys or cohort/longitudinal studies.
3. Defined SES as parental income, education, employment status or occupational classification.
4. Data from Canada, United States, Western Europe, Australia or New Zealand.
5. Articles published in English language.

Exclusion Criteria:
1. Opinion papers, letters to the Editor, case reports, case studies or natural experiments.
2. Randomized trials or clinical settings.
3. Any paper where the baseline data were not presented or available upon request.

TABLE II

Methodological Evaluation Criteria

1. Research question is well stated.
2. Source population is identified and appropriate.
3. Inclusion criteria are described and appropriate.
4. Exclusion criteria are described and appropriate.
5. Participation rate is reported and appropriate.
6. Sample size is preplanned and provides adequate statistical power.
7. Baseline comparability of various groups is reported.
8. Same data collection method is used for all respondents.
9. Important baseline variables are measured, valid, and reliable.
10. Outcome is defined and measurable.
11. Outcome measure is validated.
12. Outcome assessment was blind or free from bias.
13. Statistical analysis is appropriate.
14. Adjustment is made for important covariates.
15. The results are verifiable from the baseline data.

TABLE III

Flow Chart Describing the Systematic Literature Review and Selection of Articles

PubMed	PsycINFO	CINAHL	Embase	Grey Lit	Reference List	Total
2733 Titles	685 Titles	3660 Titles	1819 Titles	1 Titles	490 Titles	9388 Titles
Screen 1 - Review of Abstracts:						
327	225	254	256	1	264	1327
Screen 2 - Review of Full Articles:						
94	117	76	77	1	264	629
Screen 3 - Met Inclusion Criteria and Passed Methodological Review:						
0	2	0	1	0	6	9
Statistical Pooling of 9 papers.						

DISCUSSION

This meta-analysis found that adolescents with low SES are 22% more likely to engage in marijuana and alcohol risk behaviour than other adolescents with higher SES.

As reported, gender is not a likely explanation for heterogeneity in the estimate. This finding is relevant because gender differences in rates of marijuana and alcohol risk behaviour emerge around the age of 11 years and continue through to age 15 years or older.[66-70] Stratification by country of origin revealed that American and New Zealand studies (inverse association) had statistically significant variability in the reported effects as compared to European and UK studies (mostly no association). The differences between the cultural norms and expectations of these two geographical locations regarding marijuana and alcohol risk behaviour may, in part, explain the heterogeneity between results of studies included in the analysis.[65] Overall, the papers have contradictory and negative results, so publication bias is not suspected.

There are several limitations to discuss. First, the review of the grey literature is mainly influenced by contact with Canadian researchers. Second, there were two studies that included ages above the age range of 10-15 years. The authors were unable to separate age groupings. Third, the authors did not examine causation or selection. Fourth, measurement scales for marijuana and alcohol use vary between studies. Fifth, the results of the meta-analysis were highly influenced by one study.

The association between SES and drug and alcohol risk behaviour is well known for adult populations.[1,8] We found a correlation between SES and marijuana and alcohol risk behaviour for adolescents aged 10-15 years. Assumption is likely that pre-

TABLE IV

Summary of Results of Meta-analysis

Study	RR (95% CI)	ln (RR)	Relative Weight	Sample Size	Country of Origin	Study Design	Geographical Coverage	Outcome Measure	SES Indicator
Elgar F (2005)				162,305	34 countries	Cross-sectional	International	Alcohol	Income
M/F age 11									
Low vs. High	0.95 (0.43, 2.11)		0.01						
Low vs. Medium	2.01 (1.21, 3.33)								
M/F age 13									
Low vs. High	0.93 (0.54, 1.62)		0.01						
Low vs. Medium	1.59 (0.96, 2.65)								
M/F age 15									
Low vs. High	0.53 (0.31, 0.90)		0.02						
Low vs. Medium	0.74 (0.41, 1.35)								
Boys A (2003)				2624	UK	Cross-sectional	National	Drugs Alcohol	Income
M/F age 13-15									
Drugs									
Low vs. High	0.2 (0.28, 0.68)		0.00						
Alcohol									
Low vs. High	0.09 (0.05, 0.23)		0.00						
Low vs. Medium	0.54 (0.07, 1.09)								
Droomers M (2003)				1000	New Zealand	Longitudinal	Regional	Alcohol	Father's occupation
M/F age 11									
Low vs. High	1.85 (1.32, 2.60)		0.04						
Blenkinsop S (2001)				9000	UK	Cross-sectional	National	Alcohol	Income
Male age 11-15									
Low vs. High	0.62 (0.03, 1.20)		0.01						
Low vs. Mediumum	0.83 (0.60, 1.07)								
Female age 11-15									
Low vs. High	0.28 (0.37, 0.93)		0.00						
Low vs. Mediumum	0.44 (0.25, 1.13)								
Lintonen T (2000)				6321	Finland	Cross-sectional	National	Alcohol	Parental education
Male age 9-13									
Low vs. High	1.1 (0.9, 1.5)		0.05						
Wallace J (1999)				25,000	USA	Cohort	National	Alcohol	Education
Male age 13									
Low vs. High	0.98 (0.75, 1.27)		0.07						
Male age 15									
Low vs. High	1.08 (0.81, 1.44)		0.05						
Miller D (1997)				1725	USA	Cross-sectional	National	Drugs	Income
M/F age 11-17									
Low vs. High	1.72 (0.80, 3.70)		0.01						
Lowry R (1996)				6321	USA	Cross-sectional	National	Alcohol	Education Income
M/F age 12-17									
Income									
Low vs. High	1.35 (1.17, 1.52)		0.31						
Education									
Low vs. High	1.47 (1.25, 1.68)		0.25						
Donato F (1995)				5221	Italy	Cross-sectional	Regional	Alcohol	Occupational category
Males age 14	1.0 (0.8, 1.2)		0.13						
Females age 14	1.4 (1.0, 1.9)		0.05						
POOLED ESTIMATE	1. 22 (1.14, 1. 31)	0.20115	1.00						

The overall pooled variance of the log of the Rate Ratios was 0.00114

vention or cessation strategies for youth that do not address SES as a component of intervention would be met with limited success. SES is one variable that should be further explored as a mediating or explanatory factor for increased marijuana and alcohol risk behaviour among adolescents. The identification of determinants, and how SES impacts risk behaviour status in adolescents, should become an important public health priority in Canada.

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Received: May 14, 2007
Accepted: October 31, 2007

RÉSUMÉ

Objectifs : Selon la majorité des études fondées sur des populations, la prévalence des comportements à risque liés à la drogue et à l'alcool augmente entre la fin de l'adolescence et le début de l'âge adulte. Dans cette enquête bibliographique systématique, nous avons voulu déterminer si le statut socioéconomique (SSE) est un déterminant des comportements à risque liés à la marijuana et à l'alcool chez les jeunes de 10 à 15 ans.

Méthode : Nous avons effectué une méta-analyse afin de répertorier les articles publiés ou inédits, pour la période du 1er janvier 1980 au 9 février 2007, portant sur les comportements à risque liés à la marijuana et à l'alcool selon le SSE chez les jeunes de 10 à 15 ans.

Synthèse : Neuf études répondaient à nos critères d'inclusion et de qualité méthodologique. La prévalence des comportements à risque liés à la marijuana et à l'alcool était plus élevée de 22 % (ratio des taux [RT] = 1,22; IC de 95 % = 1,14-1,31) chez les jeunes de faible SSE comparés aux jeunes de SSE supérieur. Une stratification par pays d'origine a montré que les études américaines et néo-zélandaises présentaient des écarts significatifs dans les effets indiqués, comparées aux études menées en Europe et au Royaume-Uni.

Discussion : Selon ces données, il existerait une corrélation inverse entre un faible SSE et la prévalence de comportements à risque liés à la marijuana et à l'alcool chez les jeunes de 10 à 15 ans. Or, les taux plus élevés de ces comportements chez les jeunes de faible SSE peuvent avoir des répercussions sur leur développement affectif, limiter leurs horizons pédagogiques et professionnels et accroître la probabilité qu'ils soient dépendants de la marijuana et de l'alcool à l'âge adulte.

Conclusion : Les taux de comportements à risque liés à la marijuana et à l'alcool sont plus élevés chez les jeunes de faible SSE que chez les jeunes de SSE supérieur.

Mots clés : troubles liés à l'alcool; consommation d'alcool; drogue; marijuana; jeunes; tabagisme et facteurs socioéconomiques