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Hazardous alcohol consumption among university students: a cross-sectional study

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Abstract

Objective

There is considerable anecdotal evidence of a cultural shift towards heavier alcohol consumption among university students, especially women. The aim of this study is to investigate the prevalence and correlates of hazardous alcohol consumption among university students with particular reference to gender and to compare different modes of data collection in this population.

Setting

A large Irish university

Design

A cross-sectional study using a classroom distributed paper questionnaire and a web-based survey

Participants

A total of 2,275 undergraduates completed the classroom survey, 84% of those in class and 51% of those registered for the relevant module. A total of 333 undergraduates responded to the web-based questionnaire yielding a response rate of 2.4%.

Main outcome measures

Prevalence of hazardous alcohol consumption (HAC) measured using the Alcohol Use Disorders Identification Test for Consumption (AUDIT-C) and the proportion of university students reporting one or more of thirteen adverse consequences linked to HAC.

Results

In the classroom based sample, 66.4% (95%CI 64.4-68.3) reported HAC (65.2% men and 67.3% women). In women, 57.4% met HAC thresholds for men. Similar patterns of adverse consequences were observed among men and women. Students with a HAC pattern were more likely to report smoking, illicit drug use and one or more sexual partners in their lifetime. Respondents to the web-based survey reported higher levels of both HAC (men 73.5%; women 75.3%) and alcohol related adverse consequences.

Conclusion

The findings highlight the high prevalence of hazardous alcohol consumption among university students. As alcohol consumption levels are unlikely to be lower in non-respondents who were absent from lectures on the day of sampling, the true prevalence of HAC in this population is likely to be higher. Web-based surveys provide an unacceptably low response rate in this population and results that are discordant with those in the classroom based sample.

Article Summary

Article Focus

- Problem alcohol use is an ongoing worldwide phenomenon of considerable concern. Binge drinking has been identified as the number one substance abuse problem during university life.
- A culture of hazardous alcohol consumption exists among university students. This consumption pattern is linked to wider risk taking behaviour among students such as smoking and illicit drug use.
- The aim of the current study was to investigate the prevalence of hazardous alcohol consumption and the adverse consequences associated with its use among university students in Ireland, with particular reference to gender differences, using both class room distributed and web based questionnaires.

Key Messages

- In the class room survey the prevalence of hazardous alcohol consumption was 66.4% (95%CI 64.4-68.3). In women, 57.4% of the sample met the current hazardous alcohol consumption thresholds for men.
- Controlling for age and stratifying by gender, multivariate regression found those who reported hazardous alcohol consumption were more likely to report smoking, drug use and one or more sexual partners in their lifetime.
- Similar patterns of adverse consequences, ranging from being in an accident to unplanned sexual behaviour, were observed among men and women.
- The findings from the web based survey suggested a higher prevalence of HAC (men 73.5%; women 75.3%) and higher levels of adverse consequences due to alcohol. However the response rate was low (2.4%)

Strengths & Limitations

- The current study employed standardised methods for the measurement of hazardous alcohol consumption and a rigorous probability proportion to size sampling strategy for the class room based survey.
- The study participants were representative of the university undergraduate student population with regard to gender and course of study.
- Although the response rate was low (51% of those registered for the relevant modules), it is similar to that achieved in major international studies of student alcohol consumption. It should also be noted that the majority of non-respondents were students absent from class during the survey. The latter group of students are unlikely to have a more favourable pattern of alcohol consumption than that observed in this study. Thus, the current study may be regarded as reporting the lower bound estimates of hazardous alcohol consumption in Irish university students.

What is already known on this subject?

Levels of alcohol consumption among younger age groups have increased in recent decades.

University students represent a unique subsection of society where a culture of hazardous alcohol

consumption exists. Recently, anecdotal evidence has suggested that male and female students are consuming similar amounts of alcohol. There is a need for reliable data on patterns of alcohol consumption in this population.

What does this study add?

The findings highlight the high prevalence of hazardous alcohol consumption, the substantial burden of adverse effects or consequences and the narrowing of the gender gap among students in a large Irish university. Approximately two thirds of students, (66.4%; 95%CI 64.4-68.3) reported hazardous alcohol consumption, (65.2% men and 67.3% women) and in women, 57.4% of the sample met the current hazardous alcohol consumption thresholds for men. Even higher levels of hazardous alcohol consumption were noted in a web based survey compared to the primary class room based survey but response rates for the web survey were unacceptably low.

Introduction

Problem alcohol use is an on-going, worldwide phenomenon of considerable concern [1-7]. Levels of harm caused by alcohol use have been found to be higher in younger age groups [8] with young adults aged between 18 and 25 reporting high levels of alcohol consumption, including binge drinking [7]. The university student population represent a unique sub-section of society within this population. In the university environment, there is a culture of hazardous alcohol consumption, defined as "a pattern of alcohol consumption that increases the risk of harmful consequences for the user or others"[9]. Binge drinking has been identified as the number one substance abuse problem during university life [10, 11].

Hazardous alcohol use is linked to wider risk taking behaviour among students. A comprehensive review of drinking habits in European universities found a range of studies suggesting that hazardous levels of alcohol consumption were associated with increased smoking and drug use [12]. Differences in the volume of alcohol consumed by women and men in universities have been reported in some studies [11-17]. In U.S. studies, approximately 44% of university students were classified as binge drinkers [7, 8] with Harrell and Karmin finding that male students reported significantly higher alcohol intakes than their female peers [15], a result mirrored in other studies [16, 17].

More recently however, a shift in norms has been observed with some studies of student alcohol consumption reporting similar patterns in men and women [18]. A systematic review investigating the consequences of alcohol misuse noted that gender differences in relation to the adverse consequences of alcohol consumption were decreasing [19]. Perkins noted that males were more likely to get involved in physical fights, have damaged property, report poor academic performance and inadvertent sexual activity than females. However, no differences were seen between men and women in relation to memory loss and injury to self [19]. Moreover, Hoeppner et al. found that females were more likely to exceed their recommended weekly alcohol allowance than their male counterparts [20].

The aim of this study was to investigate the prevalence of hazardous alcohol consumption and the adverse consequences associated with its use among university students in Ireland, with particular reference to gender differences, using both class room distributed and web based questionnaires. The class room based survey was carried out in one large Irish university whereas the web based survey targeted all Irish universities and Institutes of Technology. The focus of the current paper is on the single university from which data from both the class room and web based survey are available.

Methods and participants

Undergraduate students attending one large university in Ireland, University College Cork (UCC) were eligible for inclusion in the class room based study which was focused on health and lifestyle with particular reference to alcohol consumption. Students were sampled at degree programme level using probability proportional to size (PPS) sampling. We estimated the required sample size at 2,686 students, based on an undergraduate student population of 12,475, a required precision of 1.5% and an expected prevalence of hazardous alcohol consumption of 73%, based on an earlier unpublished masters dissertation [21]. Lecturers or module coordinators were contacted to request permission to distribute and collect questionnaires during fifteen minutes of lecture time on a date convenient to them between March 12th and March 23rd, 2012. Students were briefed orally and in writing (on the front sheet of the questionnaire) on the aims and objectives of the study including details of the confidential, anonymous and voluntary nature of the exercise. To enhance the response rate, the distribution of questionnaires was confined to mid week lectures, Tuesdays to Thursdays inclusive.

Of the lecturers/module coordinators approached to facilitate the study, 94.3% agreed to cooperate. A total, 2,332 students completed this face-to-face lecture theatre based survey; 57 students were subsequently identified as post-graduate students and were excluded from the analyses. Thus data are available on a total of 2,275 undergraduates with a response rate of 84% for those attending class on the day of survey and 51% of those registered for the specific modules. The gender and the degree programme profiles of the sample collected were broadly similar to those registered with the university; 63.1% of the sample were women versus 56% for the university, 39.7% were registered with the College of Arts, Celtic Studies & Social Sciences (university 33%), 20.1 % with Business & Law (university 21%), 24.6% with Science, Engineering & Food Science (university 27%) and 14.2% with Medicine & Health, (university 19%).

SurveyMonkey, the online survey tool, was used for the web-based survey [22]. Initially, a link to the questionnaire was e-mailed to all registered students at fourteen third-level education institutions in Ireland. The link was e-mailed on the 26th March 2012 and remained open for two

weeks. In the e-mail, students were advised of the aims and objectives of the research and invited to participate in the survey by following a link. The survey was a replica of the questionnaire distributed in lecture theatres. The average response rate across the institutions was 5% and the response rate for UCC was 2.4%, a total of 333 undergraduates.

As an incentive both in classroom and online participants were invited to enter a draw to win a tablet computer following survey completion. As completion was anonymous, each student was advised to send an e-mail with their name and e-mail address to enter the prize draw. Details of how to enter were included on their post-questionnaire information sheet which was handed out in the lecture theatre or included as the last page of the questionnaire on Survey Monkey. This post-questionnaire information sheet also included contact information to different websites and institutions offering help and advice on alcohol related issues.

Questionnaire

A total of 49 questions were included in the questionnaire which was based on previously validated instruments, including the Alcohol Use Disorders Identification Test for Consumption (AUDIT-C) [23], the Warwick Edinburgh Mental Well-being scale (WEMWBS) [24] and the International Physical Activity Questionnaire (IPAQ) [25]. In addition, questions on smoking status [26], drug use [27], sexual health [28], diet and self-reported height and weight [27] were taken from the national survey on health and lifestyle in Ireland [27] and previous university research [26, 28]. All of these instruments have previously shown reliability and validity among a student population [29, 30]. It took approximately twelve minutes to complete the paper-based questionnaire.

Hazardous alcohol consumption was estimated using the Alcohol Use Disorders Identification Test for Consumption (AUDIT-C) developed by the World Health Organisation [9] to identify hazardous patterns of alcohol consumption. The AUDIT-C takes the first three questions of the AUDIT questionnaire. These questions focus on the frequency of consumption, the number of units consumed and the number of binge drinking occasions. The guidelines on safe alcohol consumption in women are lower than those for men reflecting their increased vulnerability to alcohol related harm [31]. In the current study therefore, hazardous alcohol consumption was

defined as an AUDIT-C score of 6 or more among males and 5 or more among females. This instrument has demonstrated high sensitivity and specificity among a population of young adults aged between 18 and 20 years [23, 32, 33].

BMI was estimated from self-reported height and weight with normal weight, overweight and obesity defined as BMI of 20-24.99 Kg/M^2, 25-29.99 Kg/M^2 and ≥ 30 Kg/M^2, respectively. Physical activity was coded as low, moderate and high using the standard International Physical Activity Questionnaire (IPAQ) protocol [25]. WEMWBS scores were divided into categories of mental well-being as defined by Braunholtz et al [34]. Below average mental wellbeing was defined as a WEMWBS score of more than one standard deviation below the mean, average mental wellbeing was within one standard deviation of the mean and above average mental wellbeing was over one standard deviation above the mean [35].

The Clinical Research Ethics Committee, University College Cork, Ireland, granted ethical approval for this research.

Data management & Statistical analysis

The paper questionnaire data were scanned, checked and verified using TeleForm TM scanning processes. The estimated error rate for data entry was 0.06% based on manual checking of a 10% sample of all scanned questionnaires. The web based data were downloaded from SurveyMonkey into Excel. All data were analysed using *Stata Version* 12. Given the low response rate and small sample size for the web based survey, we have focused the primary analyses on the classroom based sample. In the data from the latter sample, univariate and multivariate logistic regression analyses were undertaken to investigate factors associated with hazardous alcohol consumption separately in men and women.

Results

Table 1 shows the profile of respondents and the main questionnaire findings on health and well-being by mode of data collection. Respondents to the web based survey were significantly older, in later years in college and they were less likely to live at home with their parents. There were no significant differences in the course of study between the two sample groups. The web respondents were less physically active and reported a higher number of sexual partners. The two sample groups were similar in self reported BMI, mental well-being, illicit drug use and smoking prevalence. However, the prevalence of hazardous alcohol consumption was significantly higher in the web based sample 74.8% (95% C.I. 70.0%-79.6%) versus 66.4% (95%CI 64.4-68.3) in the class room based sample.

Hazardous alcohol consumption in the class room study sample

In the classroom based sample, the prevalence of hazardous alcohol consumption (HAC) was similar in men and women, 65.2% men and 67.3% women. In women, 57.4% met HAC thresholds for men. Only 8.4% of men and 5.8% of women were non drinkers. Approximately, 17% of men and 5% of women had an audit C score of 10 or higher. This equates to consuming more than 6 units of alcohol (binge drinking) at least 4 times per week and in some cases daily. The prevalence of hazardous alcohol consumption by age, socio-demographic variables and lifestyle factors, are presented in **Table 2,** stratified by gender. Broadly similar trends were observed in univariate analyses in both men and women with higher prevalence of hazardous alcohol consumption associated with increasing age, later years in college, studying Business or Law, not owning a house, current smoking, illicit drug use and number of sexual partners. As previously reported [35], hazardous alcohol consumption was associated with above average mental well-being in men but not in women in these univariate analyses.

Multivariate analysis

Controlling for age only, males [OR=2.26 95%CI1.46-3.49; p<0.001] and females [OR=2.12 95%CI1.44-3.49; p<0.001] studying Law and Business were over twice as likely to report HAC, as their peers studying Science & Engineering. Among males, those in third year were 56% more likely to

report HAC [OR=1.56 95%CI1.02-2.41; p<0.001] while, among females, those in fourth year were 80% more likely to report HAC than their counterparts in first year [OR=1.80 95%CI 1.14-2.86]. Male smokers were more than twice as likely to report HAC while female smokers were more than three times as likely to report HAC compared to their non-smoking peers. In men and women, those reporting illicit drug use were over twice as likely to report hazardous alcohol consumption. Males reporting 1-3, 4-5 and 6+ lifetime sexual partner were 4, 6 and 7 times more likely to report HAC than those reporting no sexual partners. For females the OR's were increase 3 fold, 5 fold and 7 fold for the same categories.

In further analyses controlling for age, course of study, accommodation type and college year, males [OR=1.97 95%CI 1.34-2.88; p=0.001] and females [OR=1.88 95%CI 1.34-2.65; p<0.001] who reported illicit drug use were more likely to report HAC. Among females current smokers remained twice as likely to report HAC compared to their non-smoking female peers [OR=2.19 95%CI1.50-3.21; p<0.001]. However in these adjusted analyses, the association of smoking with HAC in males was attenuated. The associations between HAC and number of sexual partners was also somewhat attenuated in these adjusted analyses but remained highly significant, **Table 3**.

Adverse consequences

The pattern and frequency of adverse consequences of alcohol consumption was broadly similar in men and women. However, men were more likely to report getting into a fight (p=0.001) and having a one night stand (p<0.001) than women. No significant differences were found for other second-hand effects. **Figures 1a** shows the proportion of alcohol consumers reporting one or more of 13 adverse consequences of alcohol consumption, stratified by pattern, hazardous versus non hazardous in men. **Figure 1b** shows the same data for women. Over 70% of men and women with a hazardous alcohol consumption pattern reported regretting something they had said or done due to their alcohol consumption. Over 60% reported missing days from work or college due to their alcohol consumption, affecting academic performance and future prospects. In men, stark differences were observed between hazardous and non-hazardous alcohol consumers in relation to unintended (19.2% vs. 2.8) and unprotected sex (16.8% vs. 3.3%). Similarly in women the burden of

adverse consequences was substantially greater among hazardous drinkers than their non-hazardous peers, with 73% regretted something they said or did after drinking compared to 35.5% of their peers. Approximately 17% of female hazardous drinkers reported unintended sex while 13.8% reported unprotected sex because of their drinking compared to 3.5% and 3.8% respectively among their peers.

Discussion

These findings highlight the high prevalence of hazardous alcohol consumption, the burden of related adverse consequences and the narrowing of the gender gap among students in a large Irish university. Almost two thirds of respondents reported hazardous alcohol consumption, (65.2% men and 67.3% women) and in women, 57.4% of the sample meet the current hazardous alcohol consumption thresholds for men. Even higher levels of hazardous alcohol consumption were noted in a web based survey compared to the primary classroom based survey but response rates for the web survey were unacceptably low. It has been suggested that the threshold for hazardous drinking is too low. However it is based on the well defined biological and behavioural effects of alcohol. In the context of the present study, it should also be noted that within the large group of hazardous drinkers, over one quarter of hazardous drinkers were consuming more than 6 units of alcohol (binge drinking) at least 2-3 times per week and in some cases daily.

High, alcohol consumption is a significant public health issue in Ireland. The OECD ranks Ireland as 6th of 32 countries worldwide in relation to alcohol consumption in 2012. Irish alcohol consumption is significantly higher than the OECD average, the United States and the United Kingdom. In addition, the Eurobarometer study noted that Irish adults reported binge drinking more frequently than any other EU country [36]. Recently it was reported that 54.3% of Irish adults reported HAC using the same screening tool as the current study [37].

Alcohol consumption has been noted as the number one public health problem facing universities [38]. The current research suggests that the prevalence of alcohol consumption in Irish university students (based on self report) is broadly similar to levels observed in British students [39] but significantly higher than those observed in the US [40]. A large proportion of students (31.7%) felt their drinking harmed their work or studies. The latter findings are similar to those from the Harvard College Alcohol Study where one third of students had missed class during the last year due to their alcohol consumption [19]. In other studies of alcohol consumption in university students, adverse consequences from alcohol consumption range in severity from violence and physical harm [28] to unplanned and unintended sexual intercourse [41], broadly similar to those reported in the

current study.. In relation to the sexual health of university students, previous research reports that 70% are sexually active [42]. The current research found HAC was associated with an increasing number of sexual partners. Previously, the Harvard College Alcohol Study illustrated that the reporting of unplanned sexual activity increased from 8% among non-binge drinkers, 22% among occasional binge drinkers to 42% among frequent binge drinkers [43]. Those reporting unplanned sexual activity are also less likely to use protection [44]. Coupled with high rates of short term or casual sexual partnerships and reported low levels of sexual health knowledge, hazardous alcohol consumers are at higher risk of unintended pregnancy or contracting a sexually transmitted infection [45].

University students occupy new social environments where experimentation and risk-taking are recognised norms [46]. The prevalence of smoking is approximately 22% among the general population [47] but is in excess of 25% in the current study of university students. In addition, we found that hazardous alcohol consumers are more likely to report smoking, confirming previous research by Harrison et al who stated that smoking is associated with hazardous drinking in young adults [48]. As Ireland aims to become smoke free by 2025, a concentrated effort to reduce the smoking prevalence among university students is required.

Similarly, the literature shows a high prevalence of illicit drug use among university students. Previously, Chiauzzi reported over 20% of the student population were found to be part of a group categorised by high risk drinking and high prevalence of illicit drug use [49]. The current research complements these findings, highlighting the association between alcohol and a twelve month prevalence of illicit drug use and the growing need to tackle these issues concurrently.

Strengths & Weaknesses

This work can be readily replicated in other universities worldwide. We used a probability proportional to size sampling strategy to ensure that all students, regardless of degree course had an equal opportunity of being included in the study. The demographics of study participants were

similar to those of the wider institution in relation to course of study and gender. We used a standard, internationally recognised screening tool for hazardous alcohol consumption.

Although the response rate was low (51%), this is consistent with both national [28] and international research [50]. It should also be noted that the majority of non-respondents were students absent from class during the survey. While it falls short of the desired response rate of at least 70% in health and well-being surveys, it provides important policy relevant data. We have no reason to believe that the non-respondents to this survey, who were absent from class on the day of sampling, are drinking at less hazardous levels. We also have no reason to believe that this pattern of alcohol consumption is unique to this university which in recent years has developed a campus wide health promoting university initiative with a significant focus and dedicated resources centered on the problem of excessive alcohol consumption [51]. Thus the current study may be regarded as reporting the lower bound estimates of hazardous alcohol consumption in Irish university students.

Conclusion

Hazardous alcohol consumption is now a public health issue in Irish university students, both in terms of immediate adverse consequences and the long term risks to physical, mental and social health and wellbeing. Policies on the promotion and marketing of alcohol require urgent review. In particular the findings from this study highlight the need for public policy measures, including a minimum unit price for alcohol and a ban on sports sponsorship.

Table 1: Characteristics of undergraduate students sampled in the classroom and via the web based survey

Gender	Classroom (N=2275)	Web (N=333)	p-value
Male	830 (36.9%)	110 (33%)	P=0.17
Age			
≤18	297 (13.3%)	3 (0.9%)	**p <0.001**
19	697 (31.3%)	43 (13.2%)	
20	467 (21.0%)	89 (27.3%)	
21	314 (14.1%)	95 (29.1%)	
≥22	451 (20.3%)	96 (29.4%)	
Course of Study			
Science/Engineering/ Food Science	554 (24.6%)	90 (27.1%)	p=0.16
Arts/Celtic Studies/Social Science	894 (39.7%)	124 (37.3%)	
Law & Business	453 (20.1%)	60 (18.1%)	
Medicine & Health	319 (14.2%)	57 (17.2%)	
Other	34 (1.5%)	1 (0.3%)	
Year in college			
First	1065 (46.8%)	14 (4.2%)	**p<0.001**
Second	327 (27.6%)	132 (39.6%)	
Third	408 (17.9%)	109 (32.7%)	
Fourth	175 (7.7%)	78 (23.4%)	
Accommodation			
House Owner	100 (4.4%)	8 (2.4%)	**p=0.001**
Parents' House	972 (43.0%)	113 (34.2%)	
Rented House/Apartment	909 (40.2%)	186 (56.4%)	
Campus Accommodation	280 (12.4%)	23 (7%)	
BMI			
Underweight	142 (7.4%)	17 (6.3%)	p=0.39
Normal weight	1354 (70.3%)	181 (67%)	
Overweight	329 (17.1%)	57 (21.1%)	
Obese	100 (5.2%)	15 (5.6%)	
Physical Activity (IPAQ)			
Low	699 (31.3%)	33 (36.7%)	**p=0.03**
Moderate	935 (41.9%)	44 (48.9%)	
High	600 (26.9%)	13 (14.4%)	
Mental Well-being (WEMWBS)			
Below average wellbeing	408 (17.9%)	40 (14.5%)	p=0.12
Average wellbeing	1551 (68.2%)	186 (69.6%)	
Above average wellbeing	316 (13.9%)	49 (17.8%)	
No. of sexual partners			
None	438 (20.6%)	46 (16.8%)	p=0.06
1-3	1038 (48.9%)	123 (44.9%)	
4-5	281 (13.2%)	46 (16.8%)	
6 or more	366 (17.2%)	21.5% (59)	
Substance misuse			
Hazardous alcohol consumer	1497 (66.4%)	237 (74.8%)	**p=0.003**
Illicit drug user	717 (31.5%)	120 (36%)	p=0.1
Smoker	590 (26.6%)	84 (29.2%)	p=0.35

Table 2: Prevalence of hazardous alcohol consumption by gender, age, sociodemographic and lifestyle factors

		Men [N=830 (36.9%)]	p-value	Women [N=1420 (63.1%)]	p-value
All		541 (65.2%)		956 (67.3%)	
Age	*<=18*	72 (67.9%)	**0.003**	138 (74.2%)	**0.04**
	19	190 (70.1%)		290 (69.2%)	
	20	101 (66.9%)		214 (68.6%)	
	21	71 (70.3%)		139 (66.5%)	
	22+	100 (53.5%)		159 (60.9%)	
	Missing	7 (50%)		16 (48.5%)	
Course of study	*Science/Engineering/ Food Science*	159 (62.6%)	**0.001**	192 (65.1%)	**<0.001**
	Arts/Social			367 (63.4%)	
	Science/Education	182 (59.5%)			
	Law & Business	145 (77.5%)		204 (79.4%)	
	Medicine & Health	38 (61.3%)		175 (68.4%)	
	Other	11 (78.6%)		13 (65%)	
	Missing	6 (85.7%)		5 (38.5%)	
Year in college	*First*	286 (65.0%)	**0.03**	402 (65.6%)	**0.046**
	Second	112 (58.0%)		299 (70.0%)	
	Third	104 (72.7%)		165 (63.2%)	
	Fourth	39 (72.2%)		90 (75.6%)	
	Missing	0 (0%)		0 (0%)	
Accommodation	*Campus Accommodation*	49 (70.0%)	**0.005**	140 (67.6%)	**<0.001**
	Rented House/Flat	209 (67.0%)		410 (70.1%)	
	Parents' House	256 (65.6%)		381 (67.0%)	
	House Owner	20 (41.7%)		19 (38.0%)	
	Missing	4 (80%)		6 (66.7%)	
BMI	*Normal Weight*	355 (65.7%)	0.97	630 (66.7%)	0.96
	Overweight/Obese	145 (65.9%)		135 (66.5%)	
	Missing	41 (58.6%)		191 (70.2%)	
Physical Activity	*Low*	162 (66.1%)	0.83	295 (65.7%)	0.07
	Moderate	230 (65.7%)		374 (65.4%)	
	High	140 (63.6%)		269 (72.1%)	
	Missing	9 (60%)		18 (69.2%)	
Mental Well-being (WEMWBS)	*Below average wellbeing*	79 (57.7%)	**0.02**	169 (65.3%)	0.64
	Average wellbeing	372 (65.0%)		660 (68.1%)	
	Above average wellbeing	90 (74.4%)		127 (66.1%)	
	Missing	0 (0%)		0 (0%)	
No. of sexual partners	*None*	72 (41.6%)	**<0.001**	120 (45.8%)	**<0.001**
	1-3	246 (72.4%)		479 (69.8%)	
	4-5	67 (76.1%)		146 (76.8%)	
	6+	121 (68.4%)		147 (79.9%)	
	Missing	35 (67.3%)		64 (65.3%)	
Smoker	*Yes*	163 (73.4%)	**0.002**	292 (81.3%)	**<0.001**
	No	361 (61.8%)		647 (62.7%)	
	Missing	17 (70.8%)		17 (58.6%)	
Illicit drug user	*Yes*	251 (76.3%)	**<0.001**	302 (81.6%)	**<0.001**
	No	290 (57.9%)		654 (62.3%)	
	Missing	0 (0%)		0 (0%)	

Table 3: Multivariate Logistic Regression: Risk factors associated with male and female hazardous alcohol consumption

	Male				Female			
	Age adjusted		Multivariate analysis**		Age adjusted		Multivariate analysis**	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Course of study								
Science/Engineering/ Food Science	1.00		1.00		1.00		1.00	
Arts/Social Science/Education	1.07	0.75-1.53	0.75	0.49-1.15	1.03	0.76-1.39	0.87	0.62-1.23
Law & Business	**2.26**	**1.46-3.49**	**2.81**	**1.70-4.63**	**2.12**	**1.44-3.14**	**2.17**	**1.37-3.42**
Medicine & Health	1.14	0.63-2.06	1.01	0.52-1.96	1.20	0.84-1.73	1.22	0.81-1.84
Other	2.49	0.66-9.36	1.46	0.34-6.23	1.09	0.42-2.85	0.99	0.36-2.71
Year in college								
First	1.00		1.00		1.00		1.00	
Second	0.86	0.60-1.24	0.71	0.46-1.09	1.28	0.98-1.69	0.94	0.68-1.30
Third	**1.56**	**1.02-2.41**	1.53	0.89-2.61	0.95	0.70-1.30	0.91	0.62-1.34
Fourth	1.57	0.83-2.98	0.73	0.35-1.50	**1.80**	**1.14-2.86**	1.35	0.75-2.42
Accommodation								
Campus Accommodation	1.00		1.00		1.00		1.00	
Rented House/Apartment	1.47	0.53-4.08	0.71	0.36-1.42	1.32	0.93-1.88	1.02	0.67-1.55
Parents' House	0.91	0.52-1.59	0.58	0.30-1.12	1.06	0.75-1.50	0.84	0.56-1.26
House Owner	1.12	0.63-1.99	1.06	0.32-3.53	0.83	0.35-1.97	1.09	0.38-3.09
BMI								
Normal Weight	1.00				1.00			
Overweight/Obese	1.30	0.91-1.87			1.10	0.78-1.54		
Physical Activity								
Low	1.00				1.00		1.00	
Moderate	0.94	0.66-1.34			0.99	0.76-1.30	0.78	0.55-1.12
High	0.91	0.61-1.34			**1.12**	**1.04-1.93**	0.70	0.51-0.98
No. of sexual partners								
None	1.00		1.00		1.00		1.00	
1-3	**4.12**	**2.78-6.08**	**3.88**	**2.53-5.94**	**3.09**	**2.28-4.15**	**2.67**	**1.93-3.70**
4-5	**5.70**	**3.13-10.36**	**5.10**	**2.64-9.83**	**5.36**	**3.45-8.35**	**3.91**	**2.40-6.39**
6 or more	**6.90**	**1.04-11.77**	**5.76**	**3.14-10.55**	**7.40**	**4.58-12.0**	**4.28**	**2.52-7.26**
Smoker								
No	1.00		1.00		1.00		1.00	
Yes	**2.70**	**1.81-4.04**	1.34	0.83-2.18	**3.38**	**2.44-4.68**	**2.19**	**1.50-3.21**
Illicit drug user								
No	1.00		1.00		1.00		1.00	
Yes	**2.33**	**1.70-3.21**	**1.97**	**1.34-2.88**	**2.59**	**1.93-3.47**	**1.88**	**1.34-2.65**

** Adjusted for age, course of study, accommodation type and college year

Figure 1 a: The adverse consequences of hazardous alcohol consumption among male students

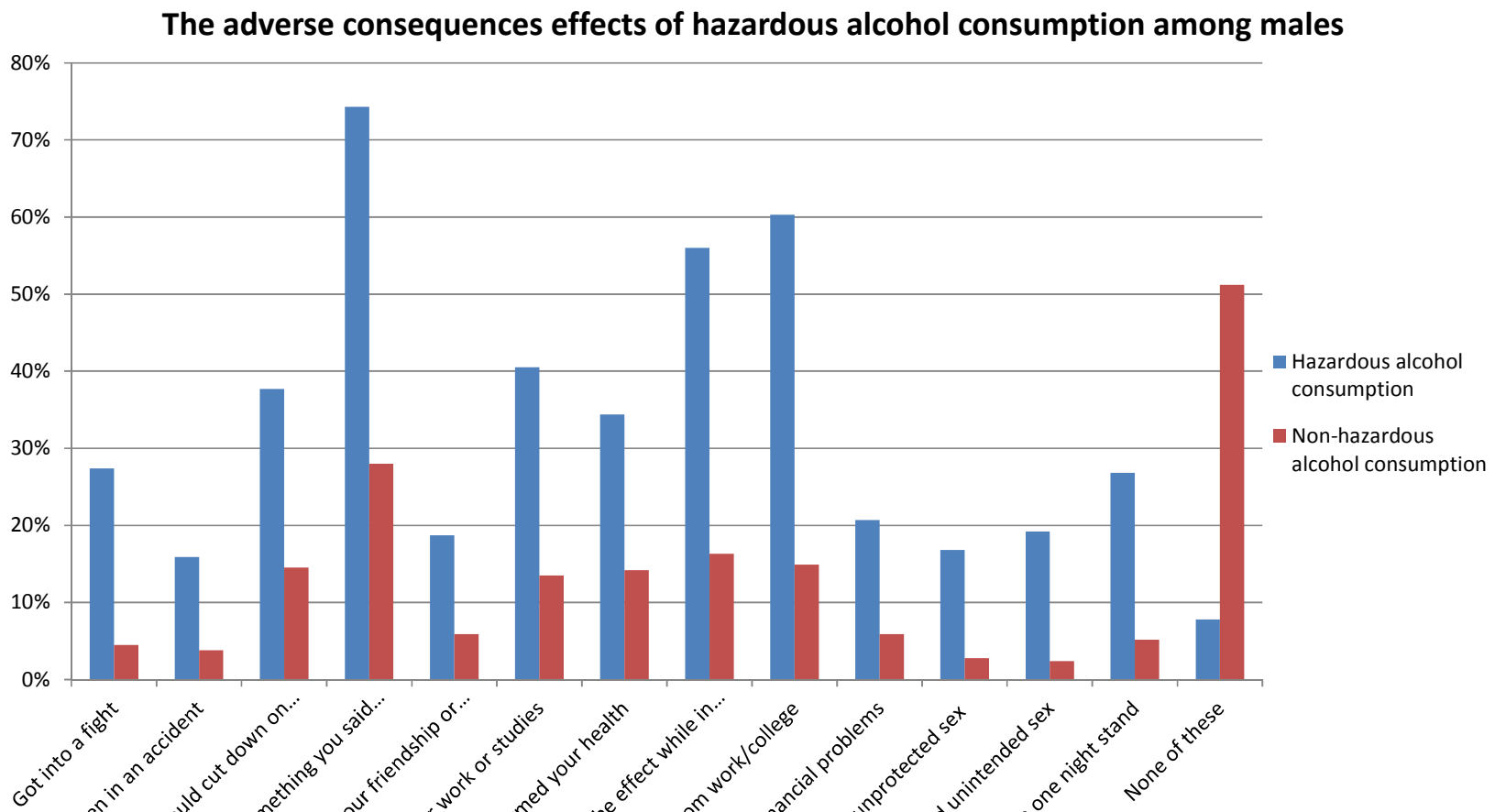
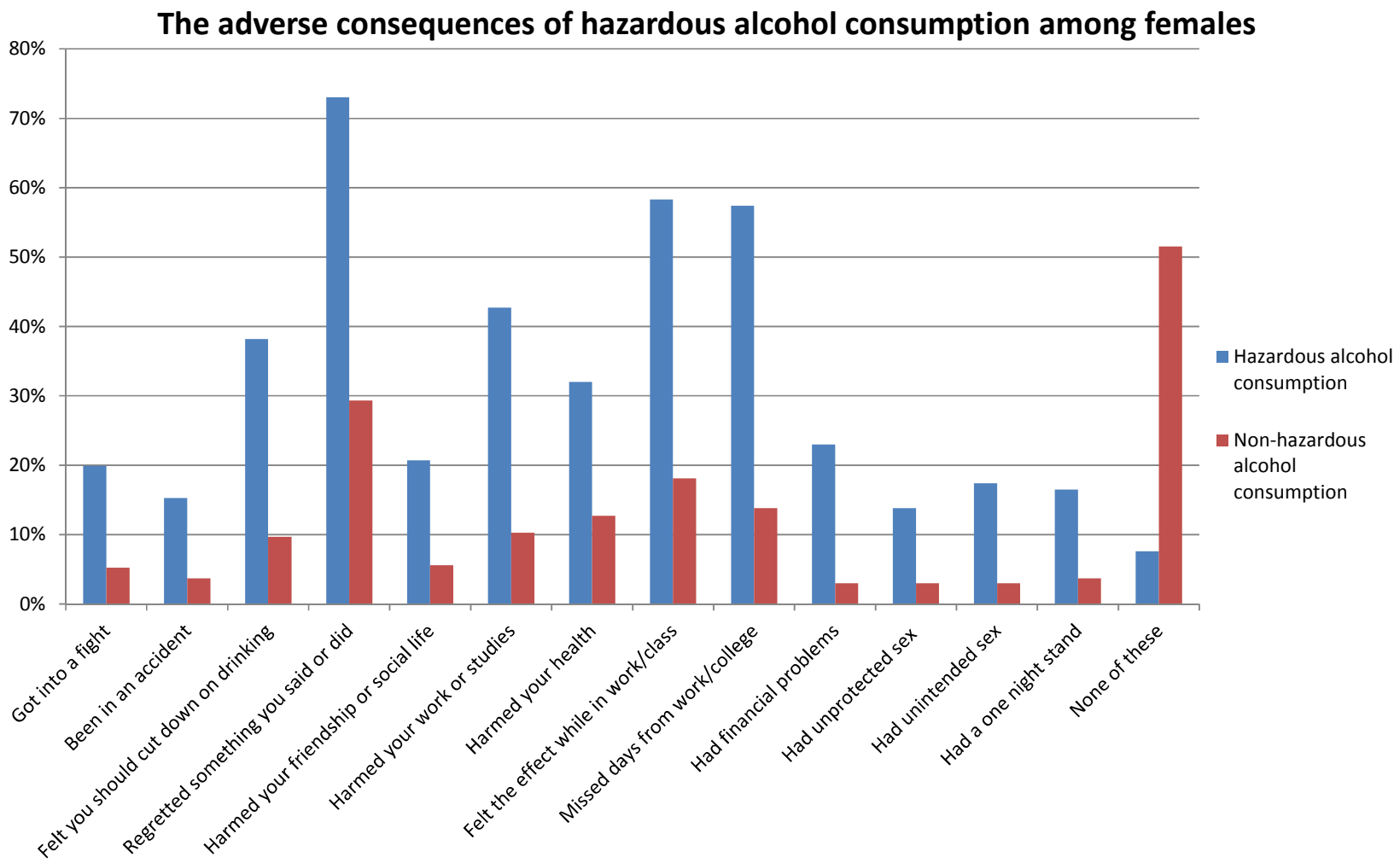


Figure 1 b: The adverse consequences of hazardous alcohol consumption among female students



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Details of contributors

MPD – Design of study, analysed the data, drafted and edited the manuscript

FS – Design and conception, statistical support, draft and editing of manuscript

MB – Design and conception of study, drafting and editing of manuscript

IJP – Design and conception of study, statistical support, drafting and editing of manuscript, overall supervision of project

*All authors gave full approval of the version to be published

Competing interests

All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work

Ethical Approval

The Clinical Research Ethics Committee, University College Cork, Ireland, granted ethical approval for this research.

Transparency declaration

The lead author affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

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Data Sharing Statement

No additional data available

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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	✓
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	✓
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	✓
Objectives	3	State specific objectives, including any prespecified hypotheses	✓
Methods			
Study design	4	Present key elements of study design early in the paper	✓
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	✓
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	✓
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	✓
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	✓
Bias	9	Describe any efforts to address potential sources of bias	✓
Study size	10	Explain how the study size was arrived at	✓
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	✓
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	✓
		(*b*) Describe any methods used to examine subgroups and interactions	
		(*c*) Explain how missing data were addressed	
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	✓
		(*e*) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	✓
		(b) Give reasons for non-participation at each stage	✓
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	✓
		(b) Indicate number of participants with missing data for each variable of interest	✓
Outcome data	15*	Report numbers of outcome events or summary measures	✓
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	✓

		(*b*) Report category boundaries when continuous variables were categorized	
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	✓
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	✓
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	✓
Generalisability	21	Discuss the generalisability (external validity) of the study results	✓
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	✓

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Hazardous alcohol consumption among university students in Ireland: a cross-sectional study

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Hazardous alcohol consumption among university students in Ireland: a cross-sectional study

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What is already known on this subject?

Internationally, levels of alcohol consumption among younger age groups have increased in recent decades. University students represent a unique subsection of society where a culture of hazardous alcohol consumption exists. Recently, evidence has suggested that male and female students are consuming similar amounts of alcohol. There is a need for reliable data on patterns of alcohol consumption in this population.

What does this study add?

The findings highlight the high prevalence of hazardous alcohol consumption relative to the general population, the substantial burden of adverse consequences and the narrowing of the gender gap among students in a large Irish university. Approximately two thirds of students, (66.4%; 95%CI 64.4-68.3) reported hazardous alcohol consumption, (65.2% men and 67.3% women) and in women, 57.4% of the sample met the current hazardous alcohol consumption thresholds for men. Even higher levels of hazardous alcohol consumption were noted in a web based survey compared to the primary class room based survey but response rates for the web survey were unacceptably low.

Abstract

Objective

There is considerable evidence of a cultural shift towards heavier alcohol consumption among university students, especially women. The aim of this study is to investigate the prevalence and correlates of hazardous alcohol consumption among university students with particular reference to gender and to compare different modes of data collection in this population.

Setting

A large Irish university

Design

A cross-sectional study using a classroom distributed paper questionnaire and a web-based survey

Participants

A total of 2,275 undergraduates completed the classroom survey, 84% of those in class and 51% of those registered for the relevant module. A total of 333 undergraduates responded to the web-based questionnaire yielding a response rate of 2.4%.

Main outcome measures

Prevalence of hazardous alcohol consumption (HAC) measured using the Alcohol Use Disorders Identification Test for Consumption (AUDIT-C) and the proportion of university students reporting one or more of thirteen adverse consequences linked to HAC. HAC was defined as an AUDIT-C score of 6 or more among males and 5 or more among females.

Results

In the classroom sample, 66.4% (95%CI 64.4-68.3) reported HAC (65.2% men and 67.3% women). In women, 57.4% met HAC thresholds for men. Similar patterns of adverse consequences were observed among men and women. Students with a hazardous consumption pattern were more likely to report smoking, illicit drug use and being sexually active. Respondents to the web-based survey reported higher levels HAC (men 73.5%; women 75.3%) and alcohol related adverse consequences.

Conclusion

Web-based surveys provide an unacceptably low response rate in this population and results that are discordant with the classroom based sample. The findings highlight the high prevalence of hazardous alcohol consumption among university students relative to the general population. Public policy measures require review to tackle the short and long term risks to physical, mental and social health and wellbeing.

Article Summary

Strengths & Limitations

- The current study employed standardised methods for the measurement of hazardous alcohol consumption and a rigorous probability proportion to size sampling strategy for the class room based survey.
- In regard to gender and course of study, the study participants were representative of the university undergraduate student population from which they were sampled.
- The overall response rate, defined in terms of students registered for specific modules was 51%. However, the response rate for those in attendance at lectures was 84%. There was over-representation of first year and under-representation of fourth year students in the sample.
- Although the response rate was low, it is similar to that achieved in major international studies of student alcohol consumption. It should also be noted that the majority of non-respondents were students absent from class during the survey. The latter group of students are unlikely to have a more favourable pattern of alcohol consumption than that observed in this study. Thus, the current study may be regarded as reporting the lower bound estimates of hazardous alcohol consumption in Irish university students.

Introduction

Problem alcohol use is an on-going, worldwide phenomenon of considerable concern [1-4] . Ireland displays a unique relationship with alcohol with significantly higher intakes [5] than many European and American states [5-7]. In Ireland, levels of harm caused by alcohol use have been found to be higher in younger age groups [4] with young adults aged between 18 and 25 reporting high levels of alcohol consumption [8, 9]. University students represent a unique sub-section of society among those aged 18-25. In the university environment, there is a culture of hazardous alcohol consumption [9], defined as "a pattern of alcohol consumption that increases the risk of harmful consequences for the user or others" [10]. Previous research has reported lower levels of consumption among non university peers (36%) [11] and the general population (54%) [12].

In a number of countries, hazardous drinking has been identified as the number one substance abuse problem during university life [9, 13-15]. A comprehensive review of drinking habits in European universities found a range of studies suggesting that hazardous levels of alcohol consumption were associated with increased levels of smoking and drug use [16]. In Ireland, the College, Lifestyle, Attitudinal National survey in Ireland noted high levels of alcohol consumption and other risk taking behaviours among students [9]. However, these data were collected over 10 years ago and there is a clear need for contemporary Irish data on this issue.

Differences in the volume of alcohol consumed by women and men in universities have been reported in some studies [1, 9, 14, 16-20]. Harrell and Karmin found male students reported significantly higher alcohol intakes than their female peers [18], a result mirrored in other studies [19, 20]. More recently, international research has noted a shift in alcohol consumption among university students with some studies reporting similar patterns of hazardous drinking in men and women [21]. A review investigating the consequences of alcohol misuse noted that gender differences in relation to the adverse consequences of alcohol consumption were also beginning to decrease [22]. For instance, Hoeppner et al. found that females were more likely to exceed their recommended weekly alcohol allowance than their male counterparts [23]. Much of this research has employed either self-administered in classroom or web-based surveys.

Web-based data collection provides an attractive alternative to many universities for monitoring trends in hazardous alcohol consumption among students. Universities issue students with a university e-mail address upon registration [24] as a medium for knowledge transfer between the institution and student. This along with increased internet access has led to a surge in web-based student questionnaires over the last decade. However, conflicting results across classroom based and web-based data collection procedures are observed [24-30].

The aim of this study was to investigate the prevalence of hazardous alcohol consumption and the adverse consequences associated with its use among university students in Ireland, with particular reference to gender differences, using both class room distributed and web based questionnaires. The class room based survey was carried out in one large Irish university whereas the web based survey targeted all Irish universities and Institutes of Technology. The focus of the current paper is on the single university from which data from both the class room and web based survey are available.

Methods and participants

Undergraduate students attending one large university in Ireland, University College Cork (UCC), were eligible for inclusion in the class room based study which was focused on health and lifestyle with particular reference to alcohol consumption. Students were sampled at degree programme level using probability proportional to size (PPS) sampling. We estimated the required sample size at 2,686 students, based on an undergraduate student population of 12,475, a required precision of 1.5% and an expected prevalence of hazardous alcohol consumption of 73%, based on an earlier unpublished masters dissertation [31]. Lecturers or module coordinators were contacted to request permission to distribute and collect questionnaires during fifteen minutes of lecture time on a date convenient to them between March 12th and March 23rd, 2012. Students were briefed orally and in writing (on the front sheet of the questionnaire) on the aims and objectives of the study including details of the confidential, anonymous and voluntary nature of the exercise. Participating in the research was presumed to imply consent. To enhance the response rate, the distribution of questionnaires was avoided on Mondays and Fridays due to Irish student social and recreational patterns.

Of the lecturers/module coordinators approached to facilitate the study, 94.3% agreed to cooperate. A total, 2,332 students completed this face-to-face lecture theatre based survey; 57 students were subsequently identified as post-graduate students and were excluded from the analyses. Thus data are available on a total of 2,275 undergraduates with a response rate of 84% for those attending class on the day of survey and 51% of those registered for the specific modules. The gender and the degree programme profiles of the sample collected were broadly similar to those registered with the university; 63.1% of the sample were women versus 56% for the university, 39.7% were registered with the College of Arts, Celtic Studies & Social Sciences (university 33%), 20.1 % with Business & Law (university 21%), 24.6% with Science, Engineering & Food Science (university 27%) and 14.2% with Medicine & Health, (university 19%). However, with regard to year in college there was over sampling of first years (46.8% vs. 32.1%) and under sampling of fourth years (7.7% vs. 16.7%).

Following the classroom based survey, SurveyMonkey the online survey tool, was used for the web-based survey [32]. Initially, a link to the questionnaire was e-mailed to all registered students at fourteen third-level education institutions (universities and institutes of technology) in Ireland. The link was e-mailed on the 26th March 2012 (after the lecture theatre survey) and remained open for two weeks. In the e-mail, students were advised of the aims and objectives of the research and invited to participate in the survey by following a link. The survey was a replica of the questionnaire distributed in lecture theatres. The average response rate across the institutions was 5% and the response rate for UCC was 2.4%, a total of 333 undergraduates. Students completing the web-based survey were advised not to return the questionnaire if they had previously completed the campus based survey.

As an incentive both in classroom and online participants were invited to enter a draw to win a tablet computer following survey completion. As completion was anonymous, each student was advised to send an e-mail with their name and e-mail address to enter the prize draw. Details of how to enter were included on their post-questionnaire information sheet which was handed out in the lecture theatre or included as the last page of the questionnaire on Survey Monkey. This post-questionnaire information sheet also included contact information to different websites and institutions offering help and advice on alcohol related issues.

Questionnaire

A total of 49 questions were included in the questionnaire which was based on previously validated instruments, including the Alcohol Use Disorders Identification Test for Consumption (AUDIT-C) [33], the Warwick Edinburgh Mental Well-being scale (WEMWBS) [34] and the International Physical Activity Questionnaire (IPAQ) [35]. In addition, questions on smoking status [36], drug use [37], sexual health [9], diet and self-reported height and weight [37] were taken from the national survey on health and lifestyle in Ireland [37] and previous university research [9, 36]. All of these instruments have previously shown reliability and validity among a student population [3, 38]. It took approximately twelve minutes to complete the paper-based questionnaire.

Hazardous alcohol consumption was estimated using the Alcohol Use Disorders Identification Test for Consumption (AUDIT-C) developed by the World Health Organisation [10] to identify hazardous patterns of alcohol consumption. The AUDIT-C takes the first three questions of the AUDIT questionnaire. These questions focus on the frequency of consumption, the number of units consumed and the number of binge drinking occasions. The guidelines on safe alcohol consumption in women are lower than those for men reflecting their increased vulnerability to alcohol related harm [39]. In the current study therefore, hazardous alcohol consumption was defined as an AUDIT-C score of 6 or more among males and 5 or more among females. This instrument has demonstrated high sensitivity and specificity among a population of young adults aged between 18 and 20 years [33, 40, 41].

BMI was estimated from self-reported height and weight with normal weight, overweight and obesity defined as BMI of 20-24.99 Kg/M^2, 25-29.99 Kg/M^2 and ≥ 30 Kg/M^2, respectively. Physical activity was coded as low, moderate and high using the standard International Physical Activity Questionnaire (IPAQ) protocol [35]. WEMWBS scores were divided into categories of mental well-being as defined by Braunholtz et al [42]. Below average mental wellbeing was defined as a WEMWBS score of more than one standard deviation below the mean, average mental wellbeing was within one standard deviation of the mean and above average mental wellbeing was over one standard deviation above the mean [43].

The Clinical Research Ethics Committee, University College Cork, Ireland, granted ethical approval for this research.

Data management & Statistical analysis

The paper questionnaire data were scanned, checked and verified using TeleForm TM scanning processes. The estimated error rate for data entry was 0.06% based on manual checking of a 10% sample of all scanned questionnaires. The web based data were downloaded from SurveyMonkey into Excel. All data were analysed using *IBM SPSS Statistics Version* 20. Given the low response rate and small sample size for the web based survey, we have focused the primary analyses on the

classroom based sample. In the data from the latter sample, univariate and multivariate logistic regression analyses were undertaken to investigate factors associated with hazardous alcohol consumption separately in men and women.

Results

Table 1 shows the profile of respondents and the main questionnaire findings on health and well-being by mode of data collection. Respondents to the web based survey were significantly older, in later years in college and were less likely to live at home with their parents. There were no significant differences in the course of study between the two sample groups. The web respondents were less physically active and reported a higher number of sexual partners. The two sample groups were similar in self reported BMI, mental well-being, illicit drug use and smoking prevalence. However, the prevalence of hazardous alcohol consumption was significantly higher in the web based sample 74.8% (95% C.I. 70.0%-79.6%) versus 66.4% (95%CI 64.4-68.3) in the class room based sample. In further analysis comparing the classroom and web-based survey data stratified by age, the prevalence of HAC was similar in the two surveys among students aged 19 or less (70.1% vs. 71.1%) where as in students aged 20 or more the prevalence of HAC was lower in the classroom based survey (64.1% vs. 74.8%).**Hazardous alcohol consumption in the class room study sample**

In the classroom based sample, the prevalence of hazardous alcohol consumption (HAC) was similar in men (65.2%) and women (67.3%). In women, 57.4% met HAC thresholds for men. Only 8.4% of men and 5.8% of women were non drinkers. Approximately, 17% of men and 5% of women had an audit C score of 10 or higher. This equates to consuming more than 6 units of alcohol at least 4 times per week and in some cases daily. The prevalence of hazardous alcohol consumption by age, socio-demographic variables and lifestyle factors, are presented in **Table 2,** stratified by gender. Broadly similar trends were observed in univariate analyses in both men and women with higher prevalence of hazardous alcohol consumption associated with later years in college, studying Business or Law, not owning a house, current smoking, illicit drug use and being sexually active. Hazardous alcohol consumption was associated with above average mental well-being in men but not in women in these univariate analyses.

Multivariate analysis

Controlling for age only, males [OR=2.26 95%CI1.46-3.49; p<0.001] and females [OR=2.12 95%CI1.44-3.14; p<0.001] studying Law and Business were over twice as likely to report HAC, as their

peers studying Science & Engineering. Among males, those in third year were 56% more likely to report HAC [OR=1.56 95%CI1.02-2.41; p<0.001] while, among females, those in fourth year were 80% more likely to report HAC than their counterparts in first year [OR=1.80 95%CI 1.14-2.86]. Male smokers were more than twice as likely to report HAC while female smokers were more than three times as likely to report HAC compared to their non-smoking peers. In men and women, those reporting illicit drug use were over twice as likely to report hazardous alcohol consumption. Males reporting 1-3, 4-5 and 6+ lifetime sexual partner were 4, 5 and 6 times more likely to report HAC than those reporting no sexual partners. For females the OR's were increase 3 fold, 5 fold and 7 fold for the same categories.

In further analyses controlling for age, course of study, accommodation type and college year, males [OR=2.33 95%CI 1.52-3.26; p=0.001] and females [OR=2.11 95%CI 1.51-2.96; p<0.001] who reported illicit drug use were more likely to report HAC. Among females current smokers were almost twice as likely to report HAC compared to their non-smoking female peers [OR=1.95 95%CI1.36-2.81; p<0.001]. However in these adjusted analyses, the association of smoking with HAC in males was attenuated. The associations between HAC and number of sexual partners was also somewhat attenuated in these adjusted analyses but remained highly significant.

The final model was adjusted for other significant factors from the age adjusted model. The model observes that being a house owner is negatively associated with HAC for both males and females while being in second year is negatively associated for males. In contrast, studying Law and Business was positively associated with HAC. Males and females reporting one or more sexual partner or illicit drug use were also positively associated with hazardous alcohol consumption as were females who reported smoking. These results are shown in **Table 3**.

Adverse consequences

The pattern and frequency of adverse consequences of alcohol consumption was broadly similar in men and women. However, men were more likely to report getting into a fight (p=0.001) and having a one night stand (p<0.001) than women. No significant differences were found for other second-

hand effects. **Table 4** shows the proportion of students reporting one or more of 13 adverse consequences of alcohol consumption. Over 70% of men with a hazardous alcohol consumption pattern reported regretting something they had said or done due to their alcohol consumption. Over 60% reported missing days from work or college due to their alcohol consumption, affecting academic performance and future prospects. In men, stark differences were observed between hazardous and non-hazardous alcohol consumers in relation to unintended (19.2% vs. 2.8) and unprotected sex (16.8% vs. 3.3%). Similarly in women the burden of adverse consequences was substantially greater among hazardous drinkers than their non-hazardous peers, with 73% regretted something they said or did after drinking compared to 35.5% of their peers. Approximately 17% of female hazardous drinkers reported unintended sex while 13.8% reported unprotected sex because of their drinking compared to 3.5% and 3.8% respectively among their peers.

Discussion

These findings highlight the high prevalence of hazardous alcohol consumption (66.4%) relative to the general population, the burden of related adverse consequences and the narrowing of the gender gap among students in a large Irish university [31]. Almost two thirds of respondents reported hazardous alcohol consumption, (65.2% men and 67.3% women) and in women, 57.4% of the sample meet the current hazardous alcohol consumption thresholds for men. Even higher levels of hazardous alcohol consumption were noted in a web based survey compared to the primary classroom based survey but response rates for the web survey were unacceptably low. It has been suggested that the threshold for hazardous drinking is too low [44]. However it is based on the well defined biological and behavioural effects of alcohol [10]. In the context of the present study, it should also be noted that within the large group of hazardous drinkers, over one quarter of hazardous drinkers were consuming more than 6 units of alcohol (binge drinking) at least 2-3 times per week and in some cases daily.

Alcohol consumption is a significant public health issue in Ireland. The OECD ranks Ireland as 6th of 32 countries worldwide in relation to alcohol consumption in 2012. Irish alcohol consumption is significantly higher than the OECD average [5], the United States [6] and the United Kingdom [7]. In addition, the Eurobarometer study noted that Irish adults reported hazardous drinking more frequently than any other EU country [2]. Recently it was reported that 54% of Irish adults reported HAC using the same screening tool as the current study [12].

Alcohol consumption has been noted as the number one public health problem facing universities [45]. Previously, significant differences were observed among male and female students in the CLAN survey [9]. In a more recent study from University College Cork using the same screening tool this discrepancy between males (82%) and females (71%) was observed [31]. The current research suggests that the prevalence of alcohol consumption in Irish university students (based on self report) is broadly similar to levels observed in British students using the AUDIT scale [7] but significantly higher than those observed in the US [6]. A large proportion of students (31.7%) felt their drinking harmed their work or studies. The latter findings are similar to those from the Harvard

College Alcohol Study where one third of students had missed class during the last year due to their alcohol consumption [22]. In other studies of alcohol consumption in university students, adverse consequences from alcohol consumption range in severity from violence and physical harm [9] to unplanned and unintended sexual intercourse [46], broadly similar to those reported in the current study.

The current research found HAC was associated with smoking, an increasing number of sexual partners and illicit drug use. The current study confirms previous research by Harrison et al who stated that smoking is associated with hazardous drinking in young adults [47]. In relation to the sexual health of university students, previous research reports that 70% are sexually active [48]. Previously, the Harvard College Alcohol Study illustrated that the reporting of unplanned sexual activity increased from 8% among non-binge drinkers, 22% among occasional binge drinkers (six or more standard drinks in one drinking occasion) to 42% among frequent binge drinkers [49]. Those reporting unplanned sexual activity are also less likely to use protection [50]. Coupled with high rates of short term or casual sexual partnerships and reported low levels of sexual health knowledge, hazardous alcohol consumers are at higher risk of unintended pregnancy or contracting a sexually transmitted infection [51]. Similarly, the literature shows a high prevalence of illicit drug use among university students. Previously, Chiauzzi reported over 20% of the student population were found to be part of a group categorised by high risk drinking and high prevalence of illicit drug use [52]. The current research complements these findings, highlighting the association between alcohol and a twelve month prevalence of illicit drug use and the growing need to tackle these issues concurrently.

Strengths & Weaknesses

This work can be readily replicated in other universities worldwide. We used a standard, internationally recognised screening tool for hazardous alcohol consumption. Probability proportional to size sampling strategy was employed to ensure that all students, regardless of degree course had an equal opportunity of being included in the study. The demographics of study

participants were broadly similar to those of the wider institution in relation to course of study and gender.

The overall response rate, defined in terms of students registered for specific modules was 51%. Although the response rate was low, it is similar to that achieved in major national [9] and international research [53] of student alcohol consumption. While this falls short of the desired rate of at least 70% in health and well-being surveys, the study provides important policy relevant data. We have no reason to believe that the non-respondents to this survey, who were absent from class on the day of sampling, are drinking at less hazardous levels. There was over-representation of first years and under-representation of fourth years. As the prevalence of HAC was higher in fourth year students than first years this imbalance in sampling is likely to have lead to an underestimation of overall prevalence of HAC. Thus the current study may be regarded as reporting the lower bound estimates of hazardous alcohol consumption in Irish university students. This pattern of alcohol consumption is not unique to this university which in recent years has developed a campus wide health promoting university initiative with a significant focus and dedicated resources centered on the problem of excessive alcohol consumption [54].

Conclusion

Hazardous alcohol consumption continues to be a public health issue in Irish university students, both in terms of immediate adverse consequences and long term risks to physical, mental and social health and wellbeing. Currently the Irish state is at a decision point with regard to policies on the promotion and marketing of alcohol. The findings from this study highlight the need for effective public policy measures in response to this issue such as a minimum unit price for alcohol and a ban on sports sponsorship.

Table 1: Characteristics of undergraduate students sampled in the classroom and via the web based survey

Gender	Classroom (N=2275)	Web (N=333)	p-value
Male	830 (36.9%)	110 (33%)	P=0.17
Age			
≤18	297 (13.3%)	3 (0.9%)	**p <0.001**
19	697 (31.3%)	43 (13.2%)	
20	467 (21.0%)	89 (27.3%)	
21	314 (14.1%)	95 (29.1%)	
≥22	451 (20.3%)	96 (29.4%)	
Course of Study			
Science/Engineering/ Food Science	554 (24.6%)	90 (27.1%)	p=0.16
Arts/Celtic Studies/Social Science	894 (39.7%)	124 (37.3%)	
Law & Business	453 (20.1%)	60 (18.1%)	
Medicine & Health	319 (14.2%)	57 (17.2%)	
Other	34 (1.5%)	1 (0.3%)	
Year in college			
First	1065 (46.8%)	14 (4.2%)	**p<0.001**
Second	327 (27.6%)	132 (39.6%)	
Third	408 (17.9%)	109 (32.7%)	
Fourth	175 (7.7%)	78 (23.4%)	
Accommodation			
House Owner	100 (4.4%)	8 (2.4%)	**p=0.001**
Parents' House	972 (43.0%)	113 (34.2%)	
Rented House/Apartment	909 (40.2%)	186 (56.4%)	
Campus Accommodation	280 (12.4%)	23 (7%)	
BMI			
Underweight	142 (7.4%)	17 (6.3%)	p=0.39
Normal weight	1354 (70.3%)	181 (67%)	
Overweight	329 (17.1%)	57 (21.1%)	
Obese	100 (5.2%)	15 (5.6%)	
Physical Activity (IPAQ)			
Low	699 (31.3%)	33 (36.7%)	**p=0.03**
Moderate	935 (41.9%)	44 (48.9%)	
High	600 (26.9%)	13 (14.4%)	
Mental Well-being (WEMWBS)			
Below average wellbeing	408 (17.9%)	40 (14.5%)	p=0.12
Average wellbeing	1551 (68.2%)	186 (69.6%)	
Above average wellbeing	316 (13.9%)	49 (17.8%)	
No. of sexual partners			
None	438 (20.6%)	46 (16.8%)	p=0.06
1-3	1038 (48.9%)	123 (44.9%)	
4-5	281 (13.2%)	46 (16.8%)	
6 or more	366 (17.2%)	21.5% (59)	
Substance misuse			
Hazardous alcohol consumer	1497 (66.4%)	237 (74.8%)	**p=0.003**
Illicit drug user	717 (31.5%)	120 (36%)	p=0.1
Smoker	590 (26.6%)	84 (29.2%)	p=0.35

Table 2: Prevalence of hazardous alcohol consumption by gender, age, sociodemographic and lifestyle factors

		Men [N=830 (36.9%)]	p-value	Women [N=1420 (63.1%)]	p-value
All		541 (65.2%)		956 (67.3%)	
Age	*<=18*	72 (67.9%)	**0.003**	138 (74.2%)	**0.04**
	19	190 (70.1%)		290 (69.2%)	
	20	101 (66.9%)		214 (68.6%)	
	21	71 (70.3%)		139 (66.5%)	
	22+	100 (53.5%)		159 (60.9%)	
Course of study	*Science/Engineering/ Food Science*	159 (62.6%)	**0.001**	192 (65.1%)	**<0.001**
	Arts/Social			367 (63.4%)	
	Science/Education	182 (59.5%)			
	Law & Business	145 (77.5%)		204 (79.4%)	
	Medicine & Health	38 (61.3%)		175 (68.4%)	
	Other	11 (78.6%)		13 (65%)	
Year in college	*First*	286 (65.0%)	**0.03**	402 (65.6%)	**0.046**
	Second	112 (58.0%)		299 (70.0%)	
	Third	104 (72.7%)		165 (63.2%)	
	Fourth	39 (72.2%)		90 (75.6%)	
Accommodation	*Campus Accommodation*	49 (70.0%)	**0.005**	140 (67.6%)	**<0.001**
	Rented House/Flat	209 (67.0%)		410 (70.1%)	
	Parents' House	256 (65.6%)		381 (67.0%)	
	House Owner	20 (41.7%)		19 (38.0%)	
BMI	*Normal Weight*	355 (65.7%)	0.97	630 (66.7%)	0.96
	Overweight/Obese	145 (65.9%)		135 (66.5%)	
Physical Activity	*Low*	162 (66.1%)	0.83	295 (65.7%)	0.07
	Moderate	230 (65.7%)		374 (65.4%)	
	High	140 (63.6%)		269 (72.1%)	
Mental Well-being (WEMWBS)	*Below average wellbeing*	79 (57.7%)	**0.02**	169 (65.3%)	0.64
	Average wellbeing	372 (65.0%)		660 (68.1%)	
	Above average wellbeing	90 (74.4%)		127 (66.1%)	
No. of sexual partners	*None*	72 (41.6%)	**<0.001**	120 (45.8%)	**<0.001**
	1-3	246 (72.4%)		479 (69.8%)	
	4-5	67 (76.1%)		146 (76.8%)	
	6+	121 (68.4%)		147 (79.9%)	
Smoker	*Yes*	163 (73.4%)	**0.002**	292 (81.3%)	**<0.001**
	No	361 (61.8%)		647 (62.7%)	
Illicit drug user	*Yes*	251 (76.3%)	**<0.001**	302 (81.6%)	**<0.001**
	No	290 (57.9%)		654 (62.3%)	

Table 3: Multivariate Logistic Regression: Risk factors associated with male and female hazardous alcohol consumption

	Male						Female					
	Age adjusted		Multivariate analysis**		Multivariate analysis***		Age adjusted		Multivariate analysis**		Multivariate analysis***	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI		
Course of study												
Science/Engineering/ Food Science	1.00		1.00		1.00		1.00		1.00		1.00	
Arts/Social Science/Education	1.07	0.75-1.53	0.62	0.41-0.94	0.75	0.49-1.15	1.03	0.76-1.39	0.82	0.59-1.15	0.87	0.62-1.23
Law & Business	**2.26**	**1.46-3.49**	**2.52**	**1.54-4.11**	**2.81**	**1.70-4.63**	**2.12**	**1.44-3.14**	**2.18**	**1.39-3.42**	**2.17**	**1.37-3.42**
Medicine & Health	1.14	0.63-2.06	1.01	0.52-1.95	1.01	0.52-1.96	1.20	0.84-1.73	1.18	0.79-1.77	1.22	0.81-1.84
Other	2.49	0.66-9.36	1.15	0.29-4.68	1.46	0.34-6.23	1.09	0.42-2.85	0.85	0.31-2.33	0.99	0.36-2.71
Year in college												
First	1.00		1.00		1.00		1.00		1.00		1.00	
Second	0.86	0.60-1.24	**0.54**	**0.35-0.82**	**0.55**	**0.35-0.85**	1.28	0.98-1.69	0.91	0.66-1.25	0.94	0.68-1.30
Third	**1.56**	**1.02-2.41**	1.24	0.73-2.11	1.21	0.07-2.10	0.95	0.70-1.30	0.82	0.56-1.19	0.91	0.62-1.34
Fourth	1.57	0.83-2.98	0.66	0.32-1.36	0.67	0.31-1.45	**1.80**	**1.14-2.86**	1.07	0.60-1.88	1.35	0.75-2.42
Accommodation												
Campus Accommodation	1.00		1.00		1.00		1.00				1.00	
Rented House/Apartment	1.47	0.53-4.08	0.60	0.30-1.19	0.57	0.28-1.19	1.32	0.93-1.88	0.86	0.57-1.30	1.02	0.67-1.55
Parents' House	0.91	0.52-1.59	0.52	0.27-1.01	0.50	0.25-1.00	1.06	0.75-1.50	0.78	0.53-1.17	0.84	0.56-1.26
House Owner	1.47	0.47-4.08	0.17	0.07-0.43	0.16	0.06-0.43	**0.95**	**0.92-0.98**	**0.19**	**0.09-0.40**	**0.23**	**0.11-0.51**
BMI												
Normal Weight	1.00		1.00		1.00		1.00		1.00		1.00	
Overweight/Obese	1.30	0.91-1.87	1.12	0.76-1.66	1.08	0.73-1.59	1.10	0.78-1.54	1.07	0.74-1.53	1.05	0.73-1.51
Physical Activity												
Low	1.00		1.00		1.00		1.00		1.00		1.00	
Moderate	0.94	0.66-1.34	1.25	0.79-1.98	1.18	0.72-1.92	0.99	0.76-1.30	0.88	0.65-1.20	0.88	0.63-1.24
High	0.91	0.61-1.34	1.05	0.70-1.59	0.92	0.60-1.42	1.12	1.04-1.93	1.23	0.87-1.74	1.36	0.93-1.99
No. of sexual partners												
None	1.00		1.00				1.00		1.00		1.00	
1-3	**4.12**	**2.78-6.08**	**3.58**	**2.39-5.49**	**3.53**	**2.26-5.53**	**3.09**	**2.28-4.15**	**2.58**	**1.87-3.55**	**2.67**	**1.87-3.81**

4-5	**5.70**	**3.13-10.36**	**4.25**	**2.22-8.16**	**4.39**	**2.14-8.71**	**5.36**	**3.45-8.35**	**3.21**	**2.00-5.13**	**3.08**	**1.83-5.19**
6 or more	**6.90**	**1.04-11.77**	**3.83**	**2.18-6.73**	**3.88**	**2.14-7.01**	**7.40**	**4.58-12.0**	**3.14**	**1.91-5.17**	**3.35**	**1.97-5.72**
Smoker												
No	1.00		1.00		1.00		1.00		1.00		1.00	
Yes	**2.70**	**1.81-4.04**	1.06	0.68-1.66	0.86	0.54-1.37	**3.38**	**2.44-4.68**	**1.95**	**1.36-2.81**	**1.99**	**1.35-2.93**
Illicit drug user												
No	1.00		1.00		1.00		1.00		1.00		1.00	
Yes	**2.33**	**1.70-3.21**	**2.23**	**1.52-3.26**	**2.43**	**1.63-3.63**	**2.59**	**1.93-3.47**	**2.11**	**1.51-2.96**	**1.90**	**1.33-2.71**

** Adjusted for university level effects of course of study, accommodation type and college year

*** Adjusted for university level effects and other significant factors in the age adjusted model

Table 4: Adverse consequences associated with harmful alcohol consumption among male and female students

		Male 830 [36.9%]		Females 1420 [63.1%]	
		Hazardous alcohol consumption	Non-hazardous alcohol consumption	Hazardous alcohol consumption	Non-hazardous alcohol consumption
Got into a fight when you had been drinking	*Yes*	148 (27.36%)	13 (4.5%)	190 (19.87%)	24 (5.17%)
Been in an accident after drinking	*Yes*	86 (15.9%)	11 (3.81%)	146 (15.27%)	17 (3.66%)
Felt you should cut down on your drinking	*Yes*	204 (37.71%)	42 (14.53%)	365 (38.18%)	45 (9.7%)
Regretted something you said or did after drinking	*Yes*	402 (74.31%)	81 (28.03%)	698 (73.01%)	136 (29.31%)
Felt drinking harmed your friendship or social life	*Yes*	101 (18.67%)	17 (5.88%)	198 (20.71%)	26 (5.6%)
Felt drinking harmed your work or studies	*Yes*	219 (40.48%)	39 (13.49%)	408 (42.68%)	48 (10.34%)
Felt drinking harmed your health	*Yes*	186 (34.38%)	41 (14.19%)	306 (32.01%)	59 (12.72%)
Felt the effect of alcohol while in work or class	*Yes*	303 (56.01%)	47 (16.26%)	557 (58.26%)	84 (18.1%)
Missed days from work/college due to a hangover/too much alcohol	*Yes*	326 (60.26%)	43 (14.88%)	549 (57.43%)	64 (13.79%)
Had financial problems as a result of your drinking	*Yes*	112 (20.7%)	17 (5.88%)	220 (23.01%)	14 (3.02%)
Had unprotected sex as a result of your drinking	*Yes*	91 (16.82%)	8 (2.77%)	132 (13.81%)	14 (3.02%)
Had unintended sex as a result of your drinking	*Yes*	104 (19.22%)	7 (2.42%)	166 (17.36%)	14 (3.02%)
Had a one night stand	*Yes*	145 (26.8%)	15 (5.19%)	158 (16.53%)	17 (3.66%)
None of these	*Yes*	42 (7.76%)	148 (51.21%)	73 (7.64%)	239 (51.51%)

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MPD – Design of study, analysed the data, drafted and edited the manuscript

FS – Design and conception, statistical support, draft and editing of manuscript

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*All authors gave full approval of the version to be published

Competing interests

All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work

Ethical Approval

The Clinical Research Ethics Committee, University College Cork, Ireland, granted ethical approval for this research.

Transparency declaration

The lead author affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

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Data Sharing Statement

No additional data available

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Hazardous alcohol consumption among university students in Ireland: a cross-sectional study

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What is already known on this subject?

Internationally, ~~L~~levels of alcohol consumption among younger age groups have increased in recent decades. University students represent a unique subsection of society where a culture of hazardous alcohol consumption exists. Recently, ~~anecdotal~~ evidence has suggested that male and female students are consuming similar amounts of alcohol. There is a need for reliable data on patterns of alcohol consumption in this population.

What does this study add?

The findings highlight the high prevalence of hazardous alcohol consumption relative to the general population, the substantial burden of adverse ~~effects or~~ consequences and the narrowing of the gender gap among students in a large Irish university. Approximately two thirds of students, (66.4%; 95%CI 64.4-68.3) reported hazardous alcohol consumption, (65.2% men and 67.3% women) and in women, 57.4% of the sample met the current hazardous alcohol consumption thresholds for men. Even higher levels of hazardous alcohol consumption were noted in a web based survey compared to the primary class room based survey but response rates for the web survey were unacceptably low.

Abstract

~~Background &~~ Objective

There is considerable ~~anecdotal~~ evidence of a cultural shift towards heavier alcohol consumption among university students, especially women. The aim of this study is to investigate the prevalence and correlates of hazardous alcohol consumption among university students with particular reference to gender and to compare different modes of data collection in this population.

Setting

A large Irish university

Design

A cross-sectional study using a classroom distributed paper questionnaire and a web-based survey

Participants

A total of 2,275 undergraduates completed the classroom survey, 84% of those in class and 51% of those registered for the relevant module. A total of 333 undergraduates responded to the web-based questionnaire yielding a response rate of 2.4%.

Main outcome measures

Prevalence of hazardous alcohol consumption (HAC) measured using the Alcohol Use Disorders Identification Test for Consumption (AUDIT-C) and the proportion of university students reporting one or more of thirteen adverse consequences linked to HAC. HAC was defined as an AUDIT-C score of 6 or more among males and 5 or more among females.

Results

In the classroom ~~based~~ sample, 66.4% (95%CI 64.4-68.3) reported HAC (65.2% men and 67.3% women). In women, 57.4% met HAC thresholds for men. Similar patterns of adverse consequences were observed among men and women. Students with a ~~HAC~~ hazardous consumption pattern were more likely to report smoking, illicit drug use and ~~one or more sexual partners in their lifetime~~being sexually active. Respondents to the web-based survey reported higher levels ~~of both~~ HAC (men 73.5%; women 75.3%) and alcohol related adverse consequences.

Conclusion

Web-based surveys provide an unacceptably low response rate in this population and results that are discordant with ~~those in~~ the classroom based sample. The findings highlight the high prevalence of hazardous alcohol consumption among university students relative to the general population. Public policy measures require review to tackle the short and long term risks to physical, mental and social health and wellbeing. ~~As alcohol consumption levels are unlikely to be lower in non-respondents who were absent from lectures on the day of sampling, the true prevalence of HAC in~~

~~this population is likely to be higher.~~ ~~Web-based surveys provide an unacceptably low response rate in this population and results that are discordant with those in the classroom-based sample.~~

Article Summary

~~**Article Focus**~~

- ~~Problem alcohol use is an ongoing worldwide phenomenon of considerable concern. Binge drinking has been identified as the number one substance abuse problem during university life.~~
- ~~A culture of hazardous alcohol consumption exists among university students. This consumption pattern is linked to wider risk taking behaviour among students such as smoking and illicit drug use.~~
- ~~The aim of the current study was to investigate the prevalence of hazardous alcohol consumption and the adverse consequences associated with its use among university students in Ireland, with particular reference to gender differences, using both class room distributed and web based questionnaires.~~

~~**Key Messages**~~

- ~~In the class room survey the prevalence of hazardous alcohol consumption was 66.4% (95%CI 64.4-68.3). In women, 57.4% of the sample met the current hazardous alcohol consumption thresholds for men.~~
- ~~Controlling for age and stratifying by gender, multivariate regression found those who reported hazardous alcohol consumption were more likely to report smoking, drug use and one or more sexual partners in their lifetime.~~
- ~~Similar patterns of adverse consequences, ranging from being in an accident to unplanned sexual behaviour, were observed among men and women.~~
- ~~The findings from the web based survey suggested a higher prevalence of HAC (men 73.5%; women 75.3%) and higher levels of adverse consequences due to alcohol. However the response rate was low (2.4%)~~

Strengths & Limitations

- The current study employed standardised methods for the measurement of hazardous alcohol consumption and a rigorous probability proportion to size sampling strategy for the class room based survey.
- In regard to gender and course of study, ~~T~~the study participants were representative of the university undergraduate student population from which they were sampled.~~with regard to gender and course of study.~~
- The overall response rate, defined in terms of students registered for specific modules was 51%. However, the response rate for those in attendance at lectures was 84%. There was over-representation of first year and under-representation of fourth year students in the sample.
- Although the response rate was low ~~(51% of those registered for the relevant modules)~~, it is similar to that achieved in major international studies of student alcohol consumption. It should also be noted that the majority of non-respondents were students absent from class during the survey. The latter group of students are unlikely to have a more favourable pattern of alcohol consumption than that observed in this study. Thus, the current study may be regarded as reporting the lower bound estimates of hazardous alcohol consumption in Irish university students.

Introduction

Problem alcohol use is an on-going, worldwide phenomenon of considerable concern [1-4] . Ireland displays a unique relationship with alcohol with significantly higher intakes [5] than many European and American states [5-7]. In Ireland, ~~L~~levels of harm caused by alcohol use have been found to be higher in younger age groups [4] with young adults aged between 18 and 25 reporting high levels of alcohol consumption~~, including binge drinking~~ [8, 9]. ~~The u~~University student~~s population~~ represent a unique sub-section of society ~~within this population~~among those aged 18-25. In the university environment, there is a culture of hazardous alcohol consumption [9], defined as "a pattern of alcohol consumption that increases the risk of harmful consequences for the user or others" [10]. Previous research has reported lower levels of consumption among non university peers (36%) [11] and the general population (54%) [12].

In a number of countries, ~~Binge~~hazardous drinking has been identified as the number one substance abuse problem during university life [9, 13-15]. ~~Hazardous alcohol use is linked to wider risk taking behaviour among students[9].~~ A comprehensive review of drinking habits in European universities found a range of studies suggesting that hazardous levels of alcohol consumption were associated with increased levels of smoking and drug use [16]. In Ireland, the College, Lifestyle, Attitudinal National survey in Ireland noted high levels of alcohol consumption and other risk taking behaviours among students [9]. However, these data were collected over 10 years ago and there is a clear need for contemporary Irish data on this issue.

Differences in the volume of alcohol consumed by women and men in universities have been reported in some studies [1, 9, 14, 16-20]. ~~In U.S. studies, approximately 44% of university students were classified as binge drinkers [4, 8] with~~ Harrell and Karmin ~~finding that~~found male students reported significantly higher alcohol intakes than their female peers [18], a result mirrored in other studies [19, 20].

More recently ~~however~~, international research has noted a shift in alcohol consumption among university students with some studies reporting similar patterns of hazardous drinking in men and women ~~norms has been observed with some studies of student alcohol consumption~~

~~reporting similar patterns in men and women~~ [21]. A ~~systematic~~ review investigating the consequences of alcohol misuse noted that gender differences in relation to the adverse consequences of alcohol consumption were also beginning to decrease~~ing~~ [22]. ~~Perkins noted that males were more likely to get involved in physical fights, have damaged property, report poor academic performance and inadvertent sexual activity than females. However, no differences were seen between men and women in relation to memory loss and injury to self~~ [22]~~. Moreover~~For instance, Hoeppner et al. found that females were more likely to exceed their recommended weekly alcohol allowance than their male counterparts [23]. Much of this research has employed either self-administered in classroom or web-based surveys.

Web-based data collection provides an attractive alternative to many universities for monitoring trends in hazardous alcohol consumption among students. Universities issue students with a university e-mail address upon registration [24] as a medium for knowledge transfer between the institution and student. This along with increased internet access has led to a surge in web-based student questionnaires over the last decade. However, conflicting results across classroom based and web-based data collection procedures are observed [24-30].

The aim of this study was to investigate the prevalence of hazardous alcohol consumption and the adverse consequences associated with its use among university students in Ireland, with particular reference to gender differences, using both class room distributed and web based questionnaires. The class room based survey was carried out in one large Irish university whereas the web based survey targeted all Irish universities and Institutes of Technology. The focus of the current paper is on the single university from which data from both the class room and web based survey are available.

Methods and participants

Undergraduate students attending one large university in Ireland, University College Cork (UCC), were eligible for inclusion in the class room based study which was focused on health and lifestyle with particular reference to alcohol consumption. Students were sampled at degree programme level using probability proportional to size (PPS) sampling. We estimated the required sample size at 2,686 students, based on an undergraduate student population of 12,475, a required precision of 1.5% and an expected prevalence of hazardous alcohol consumption of 73%, based on an earlier unpublished masters dissertation [31]. Lecturers or module coordinators were contacted to request permission to distribute and collect questionnaires during fifteen minutes of lecture time on a date convenient to them between March 12th and March 23rd, 2012. Students were briefed orally and in writing (on the front sheet of the questionnaire) on the aims and objectives of the study including details of the confidential, anonymous and voluntary nature of the exercise. Participating in the research was presumed to imply consent. To enhance the response rate, the distribution of questionnaires was avoided on Mondays and Fridays due to Irish student social and recreational patterns.~~confined to mid-week lectures, Tuesdays to Thursdays inclusive.~~

Of the lecturers/module coordinators approached to facilitate the study, 94.3% agreed to cooperate. A total, 2,332 students completed this face-to-face lecture theatre based survey; 57 students were subsequently identified as post-graduate students and were excluded from the analyses. Thus data are available on a total of 2,275 undergraduates with a response rate of 84% for those attending class on the day of survey and 51% of those registered for the specific modules. The gender and the degree programme profiles of the sample collected were broadly similar to those registered with the university; 63.1% of the sample were women versus 56% for the university, 39.7% were registered with the College of Arts, Celtic Studies & Social Sciences (university 33%), 20.1 % with Business & Law (university 21%), 24.6% with Science, Engineering & Food Science (university 27%) and 14.2% with Medicine & Health, (university 19%). However, with regard to year in college there was over sampling of first years (46.8% vs. 32.1%) and under sampling of fourth years (7.7% vs. 16.7%).

Following the classroom based survey, SurveyMonkey~~,~~ the online survey tool, was used for the web-based survey [32]. Initially, a link to the questionnaire was e-mailed to all registered students at fourteen third-level education institutions (universities and institutes of technology) in Ireland. The link was e-mailed on the 26th March 2012 (after the lecture theatre survey) and remained open for two weeks. In the e-mail, students were advised of the aims and objectives of the research and invited to participate in the survey by following a link. The survey was a replica of the questionnaire distributed in lecture theatres. The average response rate across the institutions was 5% and the response rate for UCC was 2.4%, a total of 333 undergraduates. Students completing the web-based survey were advised not to return the questionnaire if they had previously completed the campus based survey.

As an incentive both in classroom and online participants were invited to enter a draw to win a tablet computer following survey completion. As completion was anonymous, each student was advised to send an e-mail with their name and e-mail address to enter the prize draw. Details of how to enter were included on their post-questionnaire information sheet which was handed out in the lecture theatre or included as the last page of the questionnaire on Survey Monkey. This post-questionnaire information sheet also included contact information to different websites and institutions offering help and advice on alcohol related issues.

Questionnaire

A total of 49 questions were included in the questionnaire which was based on previously validated instruments, including the Alcohol Use Disorders Identification Test for Consumption (AUDIT-C) [33], the Warwick Edinburgh Mental Well-being scale (WEMWBS) [34] and the International Physical Activity Questionnaire (IPAQ) [35]. In addition, questions on smoking status [36], drug use [37], sexual health [9], diet and self-reported height and weight [37] were taken from the national survey on health and lifestyle in Ireland [37] and previous university research [9, 36]. All of these instruments have previously shown reliability and validity among a student population [3, 38]. It took approximately twelve minutes to complete the paper-based questionnaire.

Hazardous alcohol consumption was estimated using the Alcohol Use Disorders Identification Test for Consumption (AUDIT-C) developed by the World Health Organisation [10] to identify hazardous patterns of alcohol consumption. The AUDIT-C takes the first three questions of the AUDIT questionnaire. These questions focus on the frequency of consumption, the number of units consumed and the number of binge drinking occasions. The guidelines on safe alcohol consumption in women are lower than those for men reflecting their increased vulnerability to alcohol related harm [39]. In the current study therefore, hazardous alcohol consumption was defined as an AUDIT-C score of 6 or more among males and 5 or more among females. This instrument has demonstrated high sensitivity and specificity among a population of young adults aged between 18 and 20 years [33, 40, 41].

BMI was estimated from self-reported height and weight with normal weight, overweight and obesity defined as BMI of 20-24.99 Kg/M^2, 25-29.99 Kg/M^2 and ≥ 30 Kg/M^2, respectively. Physical activity was coded as low, moderate and high using the standard International Physical Activity Questionnaire (IPAQ) protocol [35]. WEMWBS scores were divided into categories of mental well-being as defined by Braunholtz et al [42]. Below average mental wellbeing was defined as a WEMWBS score of more than one standard deviation below the mean, average mental wellbeing was within one standard deviation of the mean and above average mental wellbeing was over one standard deviation above the mean [43].

The Clinical Research Ethics Committee, University College Cork, Ireland, granted ethical approval for this research.

Data management & Statistical analysis

The paper questionnaire data were scanned, checked and verified using TeleForm TM scanning processes. The estimated error rate for data entry was 0.06% based on manual checking of a 10% sample of all scanned questionnaires. The web based data were downloaded from SurveyMonkey into Excel. All data were analysed using *IBM SPSS Statistics Version* 20. Given the low response rate and small sample size for the web based survey, we have focused the primary analyses on the

classroom based sample. In the data from the latter sample, univariate and multivariate logistic regression analyses were undertaken to investigate factors associated with hazardous alcohol consumption separately in men and women.

Results

Table 1 shows the profile of respondents and the main questionnaire findings on health and well-being by mode of data collection. Respondents to the web based survey were significantly older, in later years in college and ~~they~~ were less likely to live at home with their parents. There were no significant differences in the course of study between the two sample groups. The web respondents were less physically active and reported a higher number of sexual partners. The two sample groups were similar in self reported BMI, mental well-being, illicit drug use and smoking prevalence. However, the prevalence of hazardous alcohol consumption was significantly higher in the web based sample 74.8% (95% C.I. 70.0%-79.6%) versus 66.4% (95%CI 64.4-68.3) in the class room based sample. In further analysis comparing the classroom and web-based survey data stratified by age, the prevalence of HAC was similar in the two surveys among students aged 19 or less (70.1% vs. 71.1%) where as in students aged 20 or more the prevalence of HAC was lower in the classroom based survey (64.1% vs. 74.8%).

Hazardous alcohol consumption in the class room study sample

In the classroom based sample, the prevalence of hazardous alcohol consumption (HAC) was similar in men (65.2%) and women (67.3%)~~, 65.2% men and 67.3% women~~. In women, 57.4% met HAC thresholds for men. Only 8.4% of men and 5.8% of women were non drinkers. Approximately, 17% of men and 5% of women had an audit C score of 10 or higher. This equates to consuming more than 6 units of alcohol at least 4 times per week and in some cases daily. The prevalence of hazardous alcohol consumption by age, socio-demographic variables and lifestyle factors, are presented in **Table 2,** stratified by gender. Broadly similar trends were observed in univariate analyses in both men and women with higher prevalence of hazardous alcohol consumption associated with ~~increasing age,~~ later years in college, studying Business or Law, not owning a house, current smoking, illicit drug use and ~~number of sexual partners~~being sexually active. ~~As previously reported [43], h~~Hazardous alcohol consumption was associated with above average mental well-being in men but not in women in these univariate analyses.

Multivariate analysis

Controlling for age only, males [OR=2.26 95%CI1.46-3.49; p<0.001] and females [OR=2.12 95%CI1.44-3.14; p<0.001] studying Law and Business were over twice as likely to report HAC, as their peers studying Science & Engineering. Among males, those in third year were 56% more likely to report HAC [OR=1.56 95%CI1.02-2.41; p<0.001] while, among females, those in fourth year were 80% more likely to report HAC than their counterparts in first year [OR=1.80 95%CI 1.14-2.86]. Male smokers were more than twice as likely to report HAC while female smokers were more than three times as likely to report HAC compared to their non-smoking peers. In men and women, those reporting illicit drug use were over twice as likely to report hazardous alcohol consumption. Males reporting 1-3, 4-5 and 6+ lifetime sexual partner were 4, 5 and 6 times more likely to report HAC than those reporting no sexual partners. For females the OR's were increase 3 fold, 5 fold and 7 fold for the same categories.

In further analyses controlling for age, course of study, accommodation type and college year, males [OR=2.33 95%CI 1.52-3.26; p=0.001] and females [OR=2.11 95%CI 1.51-2.96; p<0.001] who reported illicit drug use were more likely to report HAC. Among females current smokers were almost twice as likely to report HAC compared to their non-smoking female peers [OR=1.95 95%CI1.36-2.81; p<0.001]. However in these adjusted analyses, the association of smoking with HAC in males was attenuated. The associations between HAC and number of sexual partners was also somewhat attenuated in these adjusted analyses but remained highly significant.

The final model was adjusted for other significant factors from the age adjusted model. The model observes that being a house owner is negatively associated with HAC for both males and females while being in second year is negatively associated for males. In contrast, studying Law and Business was positively associated with HAC. Males and females reporting one or more sexual partner or illicit drug use were also positively associated with hazardous alcohol consumption as were females who reported smoking. These results are shown in **Table 3**.

Adverse consequences

The pattern and frequency of adverse consequences of alcohol consumption was broadly similar in men and women. However, men were more likely to report getting into a fight (p=0.001) and having a one night stand (p<0.001) than women. No significant differences were found for other second-hand effects. ~~Figures 1a~~Table 4 shows the proportion of ~~alcohol consumers~~students reporting one or more of 13 adverse consequences of alcohol consumption~~, stratified by pattern, hazardous versus non-hazardous in men. Figure 1b shows the same data for women~~. Over 70% of men ~~and women~~ with a hazardous alcohol consumption pattern reported regretting something they had said or done due to their alcohol consumption. Over 60% reported missing days from work or college due to their alcohol consumption, affecting academic performance and future prospects. In men, stark differences were observed between hazardous and non-hazardous alcohol consumers in relation to unintended (19.2% vs. 2.8) and unprotected sex (16.8% vs. 3.3%). Similarly in women the burden of adverse consequences was substantially greater among hazardous drinkers than their non-hazardous peers, with 73% regretted something they said or did after drinking compared to 35.5% of their peers. Approximately 17% of female hazardous drinkers reported unintended sex while 13.8% reported unprotected sex because of their drinking compared to 3.5% and 3.8% respectively among their peers.

Discussion

These findings highlight the high prevalence of hazardous alcohol consumption (66.4%) relative to the general population, the burden of related adverse consequences and the narrowing of the gender gap among students in a large Irish university [31]. Almost two thirds of respondents reported hazardous alcohol consumption, (65.2% men and 67.3% women) and in women, 57.4% of the sample meet the current hazardous alcohol consumption thresholds for men. Even higher levels of hazardous alcohol consumption were noted in a web based survey compared to the primary classroom based survey but response rates for the web survey were unacceptably low. It has been suggested that the threshold for hazardous drinking is too low [44]. However it is based on the well defined biological and behavioural effects of alcohol [10]. In the context of the present study, it should also be noted that within the large group of hazardous drinkers, over one quarter of hazardous drinkers were consuming more than 6 units of alcohol (binge drinking) at least 2-3 times per week and in some cases daily.

~~High, a~~Alcohol consumption is a significant public health issue in Ireland. The OECD ranks Ireland as 6th of 32 countries worldwide in relation to alcohol consumption in 2012. Irish alcohol consumption is significantly higher than the OECD average [5], the United States [6] and the United Kingdom [7]. In addition, the Eurobarometer study noted that Irish adults reported ~~binge~~hazardous drinking more frequently than any other EU country [2]. Recently it was reported that 54~~.3~~% of Irish adults reported HAC using the same screening tool as the current study [12].

Alcohol consumption has been noted as the number one public health problem facing universities [45]. Previously, significant differences were observed among male and female students in the CLAN survey [9]. In a more recent study from University College Cork using the same screening tool this discrepancy between males (82%) and females (71%) was observed [31]. The current research suggests that the prevalence of alcohol consumption in Irish university students (based on self report) is broadly similar to levels observed in British students using the AUDIT scale [7] but significantly higher than those observed in the US [6]. A large proportion of students (31.7%) felt their drinking harmed their work or studies. The latter findings are similar to those from the Harvard

College Alcohol Study where one third of students had missed class during the last year due to their alcohol consumption [22]. In other studies of alcohol consumption in university students, adverse consequences from alcohol consumption range in severity from violence and physical harm [9] to unplanned and unintended sexual intercourse [46], broadly similar to those reported in the current study.

The current research found HAC was associated with smoking, an increasing number of sexual partners and illicit drug use. The current study confirms previous research by Harrison et al who stated that smoking is associated with hazardous drinking in young adults [47]. In relation to the sexual health of university students, previous research reports that 70% are sexually active [48]. Previously, the Harvard College Alcohol Study illustrated that the reporting of unplanned sexual activity increased from 8% among non-binge drinkers, 22% among occasional binge drinkers (six or more standard drinks in one drinking occasion) to 42% among frequent binge drinkers [49]. Those reporting unplanned sexual activity are also less likely to use protection [50]. Coupled with high rates of short term or casual sexual partnerships and reported low levels of sexual health knowledge, hazardous alcohol consumers are at higher risk of unintended pregnancy or contracting a sexually transmitted infection [51]. Similarly, the literature shows a high prevalence of illicit drug use among university students. Previously, Chiauzzi reported over 20% of the student population were found to be part of a group categorised by high risk drinking and high prevalence of illicit drug use [52]. The current research complements these findings, highlighting the association between alcohol and a twelve month prevalence of illicit drug use and the growing need to tackle these issues concurrently.

~~In relation to the sexual health of university students, previous research reports that 70% are sexually active [48]. The current research found HAC was associated with an increasing number of sexual partners. Previously, the Harvard College Alcohol Study illustrated that the reporting of unplanned sexual activity increased from 8% among non-binge drinkers, 22% among occasional binge drinkers to 42% among frequent binge drinkers [49]. Those reporting unplanned sexual activity are also less likely to use protection [50]. Coupled with high rates of short term or casual sexual~~

partnerships and reported low levels of sexual health knowledge, hazardous alcohol consumers are at higher risk of unintended pregnancy or contracting a sexually transmitted infection [51].

University students occupy new social environments where experimentation and risk-taking are recognised norms [53]. The prevalence of smoking is approximately 22% among the general population [4] but is in excess of 25% in the current study of university students. In addition, we found that hazardous alcohol consumers are more likely to report smoking, confirming previous research by Harrison et al who stated that smoking is associated with hazardous drinking in young adults [47]. As Ireland aims to become smoke free by 2025, a concentrated effort to reduce the smoking prevalence among university students is required.

Similarly, the literature shows a high prevalence of illicit drug use among university students. Previously, Chiauzzi reported over 20% of the student population were found to be part of a group categorised by high risk drinking and high prevalence of illicit drug use [52]. The current research complements these findings, highlighting the association between alcohol and a twelve month prevalence of illicit drug use and the growing need to tackle these issues concurrently.

Strengths & Weaknesses

This work can be readily replicated in other universities worldwide. We used a standard, internationally recognised screening tool for hazardous alcohol consumption. We used a pProbability proportional to size sampling strategy was employed to ensure that all students, regardless of degree course had an equal opportunity of being included in the study. The demographics of study participants were broadly similar to those of the wider institution in relation to course of study and gender. We used a standard, internationally recognised screening tool for hazardous alcohol consumption.

The overall response rate, defined in terms of students registered for specific modules was 51%. Although the response rate was low, it is similar to that achieved in major national [9] and international research [54] of student alcohol consumption. While ithist falls short of the desired response rate of at least 70% in health and well-being surveys, ithe study provides important policy

relevant data. We have no reason to believe that the non-respondents to this survey, who were absent from class on the day of sampling, are drinking at less hazardous levels. There was over-representation of first years and under-representation of fourth years. As the prevalence of HAC was higher in fourth year students than first years this imbalance in sampling is likely to have lead to an underestimation of overall prevalence of HAC. Thus the current study may be regarded as reporting the lower bound estimates of hazardous alcohol consumption in Irish university students. ~~with both national [9] and international research [54]. It should also be noted that the majority of non-respondents were students absent from class during the survey. While it falls short of the desired response rate of at least 70% in health and well-being surveys, it provides important policy relevant data. We have no reason to believe that the non-respondents to this survey, who were absent from class on the day of sampling, are drinking at less hazardous levels. We also have no reason to believe that T~~this pattern of alcohol consumption is not unique to this university which in recent years has developed a campus wide health promoting university initiative with a significant focus and dedicated resources centered on the problem of excessive alcohol consumption [55]. ~~Thus the current study may be regarded as reporting the lower bound estimates of hazardous alcohol consumption in Irish university students.~~

Conclusion

Hazardous alcohol consumption ~~is now~~continues to be a public health issue in Irish university students, both in terms of immediate adverse consequences and ~~the~~ long term risks to physical, mental and social health and wellbeing. Currently the Irish state is at a decision point with regard to ~~P~~policies on the promotion and marketing of alcohol ~~require urgent review~~. ~~In particular t~~The findings from this study highlight the need for effective public policy measures~~, including~~ in response to this issue such as a minimum unit price for alcohol and a ban on sports sponsorship.

Table 1: Characteristics of undergraduate students sampled in the classroom and via the web based survey

Gender	Classroom (N=2275)	Web (N=333)	p-value
Male	830 (36.9%)	110 (33%)	P=0.17
Age			
≤18	297 (13.3%)	3 (0.9%)	**p <0.001**
19	697 (31.3%)	43 (13.2%)	
20	467 (21.0%)	89 (27.3%)	
21	314 (14.1%)	95 (29.1%)	
≥22	451 (20.3%)	96 (29.4%)	
Course of Study			
Science/Engineering/ Food Science	554 (24.6%)	90 (27.1%)	p=0.16
Arts/Celtic Studies/Social Science	894 (39.7%)	124 (37.3%)	
Law & Business	453 (20.1%)	60 (18.1%)	
Medicine & Health	319 (14.2%)	57 (17.2%)	
Other	34 (1.5%)	1 (0.3%)	
Year in college			
First	1065 (46.8%)	14 (4.2%)	**p<0.001**
Second	327 (27.6%)	132 (39.6%)	
Third	408 (17.9%)	109 (32.7%)	
Fourth	175 (7.7%)	78 (23.4%)	
Accommodation			
House Owner	100 (4.4%)	8 (2.4%)	**p=0.001**
Parents' House	972 (43.0%)	113 (34.2%)	
Rented House/Apartment	909 (40.2%)	186 (56.4%)	
Campus Accommodation	280 (12.4%)	23 (7%)	
BMI			
Underweight	142 (7.4%)	17 (6.3%)	p=0.39
Normal weight	1354 (70.3%)	181 (67%)	
Overweight	329 (17.1%)	57 (21.1%)	
Obese	100 (5.2%)	15 (5.6%)	
Physical Activity (IPAQ)			
Low	699 (31.3%)	33 (36.7%)	**p=0.03**
Moderate	935 (41.9%)	44 (48.9%)	
High	600 (26.9%)	13 (14.4%)	
Mental Well-being (WEMWBS)			
Below average wellbeing	408 (17.9%)	40 (14.5%)	p=0.12
Average wellbeing	1551 (68.2%)	186 (69.6%)	
Above average wellbeing	316 (13.9%)	49 (17.8%)	
No. of sexual partners			
None	438 (20.6%)	46 (16.8%)	p=0.06
1-3	1038 (48.9%)	123 (44.9%)	
4-5	281 (13.2%)	46 (16.8%)	
6 or more	366 (17.2%)	21.5% (59)	
Substance misuse			
Hazardous alcohol consumer	1497 (66.4%)	237 (74.8%)	**p=0.003**
Illicit drug user	717 (31.5%)	120 (36%)	p=0.1
Smoker	590 (26.6%)	84 (29.2%)	p=0.35

Table 2: Prevalence of hazardous alcohol consumption by gender, age, sociodemographic and lifestyle factors

		Men [N=830 (36.9%)]	p-value	Women [N=1420 (63.1%)]	p-value
All		541 (65.2%)		956 (67.3%)	
Age	*<=18*	72 (67.9%)	**0.003**	138 (74.2%)	**0.04**
	19	190 (70.1%)		290 (69.2%)	
	20	101 (66.9%)		214 (68.6%)	
	21	71 (70.3%)		139 (66.5%)	
	22+	100 (53.5%)		159 (60.9%)	
	~~*Missing*~~	~~7 (50%)~~		~~16 (48.5%)~~	
Course of study	*Science/Engineering/ Food Science*	159 (62.6%)	**0.001**	192 (65.1%)	**<0.001**
	Arts/Social			367 (63.4%)	
	Science/Education	182 (59.5%)			
	Law & Business	145 (77.5%)		204 (79.4%)	
	Medicine & Health	38 (61.3%)		175 (68.4%)	
	Other	11 (78.6%)		13 (65%)	
	~~*Missing*~~	~~6 (85.7%)~~		~~5 (38.5%)~~	
Year in college	*First*	286 (65.0%)	**0.03**	402 (65.6%)	**0.046**
	Second	112 (58.0%)		299 (70.0%)	
	Third	104 (72.7%)		165 (63.2%)	
	Fourth	39 (72.2%)		90 (75.6%)	
	~~*Missing*~~	~~0 (0%)~~		~~0 (0%)~~	
Accommodation	*Campus Accommodation*	49 (70.0%)	**0.005**	140 (67.6%)	**<0.001**
	Rented House/Flat	209 (67.0%)		410 (70.1%)	
	Parents' House	256 (65.6%)		381 (67.0%)	
	House Owner	20 (41.7%)		19 (38.0%)	
	~~*Missing*~~	~~4 (80%)~~		~~6 (66.7%)~~	
BMI	*Normal Weight*	355 (65.7%)	0.97	630 (66.7%)	0.96
	Overweight/Obese	145 (65.9%)		135 (66.5%)	
	~~*Missing*~~	~~41 (58.6%)~~		~~191 (70.2%)~~	
Physical Activity	*Low*	162 (66.1%)	0.83	295 (65.7%)	0.07
	Moderate	230 (65.7%)		374 (65.4%)	
	High	140 (63.6%)		269 (72.1%)	
	~~*Missing*~~	~~9 (60%)~~		~~18 (69.2%)~~	
Mental Well-being (WEMWBS)	*Below average wellbeing*	79 (57.7%)	**0.02**	169 (65.3%)	0.64
	Average wellbeing	372 (65.0%)		660 (68.1%)	
	Above average wellbeing	90 (74.4%)		127 (66.1%)	
	~~*Missing*~~	~~0 (0%)~~		~~0 (0%)~~	
No. of sexual partners	*None*	72 (41.6%)	**<0.001**	120 (45.8%)	**<0.001**
	1-3	246 (72.4%)		479 (69.8%)	
	4-5	67 (76.1%)		146 (76.8%)	
	6+	121 (68.4%)		147 (79.9%)	
	~~*Missing*~~	~~35 (67.3%)~~		~~64 (65.3%)~~	
Smoker	*Yes*	163 (73.4%)	**0.002**	292 (81.3%)	**<0.001**
	No	361 (61.8%)		647 (62.7%)	
	~~*Missing*~~	~~17 (70.8%)~~		~~17 (58.6%)~~	
Illicit drug user	*Yes*	251 (76.3%)	**<0.001**	302 (81.6%)	**<0.001**
	No	290 (57.9%)		654 (62.3%)	
	~~*Missing*~~	~~0 (0%)~~		~~0 (0%)~~	

Table 3: Multivariate Logistic Regression: Risk factors associated with male and female hazardous alcohol consumption

	Male						Female					
	Age adjusted		Multivariate analysis**		Multivariate analysis***		Age adjusted		Multivariate analysis**		Multivariate analysis***	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI		
Course of study												
Science/Engineering/ Food Science	1.00		1.00		1.00		1.00		1.00		1.00	
Arts/Social Science/Education	1.07	0.75-1.53	0.62	0.41-0.94	0.75	0.49-1.15	1.03	0.76-1.39	0.82	0.59-1.15	0.87	0.62-1.23
Law & Business	**2.26**	**1.46-3.49**	**2.52**	**1.54-4.11**	**2.81**	**1.70-4.63**	**2.12**	**1.44-3.14**	**2.18**	**1.39-3.42**	**2.17**	**1.37-3.42**
Medicine & Health	1.14	0.63-2.06	1.01	0.52-1.95	1.01	0.52-1.96	1.20	0.84-1.73	1.18	0.79-1.77	1.22	0.81-1.84
Other	2.49	0.66-9.36	1.15	0.29-4.68	1.46	0.34-6.23	1.09	0.42-2.85	0.85	0.31-2.33	0.99	0.36-2.71
Year in college												
First	1.00		1.00		1.00		1.00		1.00		1.00	
Second	0.86	0.60-1.24	**0.54**	**0.35-0.82**	**0.55**	**0.35-0.85**	1.28	0.98-1.69	0.91	0.66-1.25	0.94	0.68-1.30
Third	**1.56**	**1.02-2.41**	1.24	0.73-2.11	1.21	0.07-2.10	0.95	0.70-1.30	0.82	0.56-1.19	0.91	0.62-1.34
Fourth	1.57	0.83-2.98	0.66	0.32-1.36	0.67	0.31-1.45	**1.80**	**1.14-2.86**	1.07	0.60-1.88	1.35	0.75-2.42
Accommodation												
Campus Accommodation	1.00		1.00		1.00		1.00				1.00	
Rented House/Apartment	1.47	0.53-4.08	0.60	0.30-1.19	0.57	0.28-1.19	1.32	0.93-1.88	0.86	0.57-1.30	1.02	0.67-1.55
Parents' House	0.91	0.52-1.59	0.52	0.27-1.01	0.50	0.25-1.00	1.06	0.75-1.50	0.78	0.53-1.17	0.84	0.56-1.26
House Owner	1.47	0.47-4.08	0.17	0.07-0.43	0.16	0.06-0.43	**0.95**	**0.92-0.98**	**0.19**	**0.09-0.40**	**0.23**	**0.11-0.51**
BMI												
Normal Weight	1.00		1.00		1.00		1.00		1.00		1.00	
Overweight/Obese	1.30	0.91-1.87	1.12	0.76-1.66	1.08	0.73-1.59	1.10	0.78-1.54	1.07	0.74-1.53	1.05	0.73-1.51
Physical Activity												
Low	1.00		1.00		1.00		1.00		1.00		1.00	
Moderate	0.94	0.66-1.34	1.25	0.79-1.98	1.18	0.72-1.92	0.99	0.76-1.30	0.88	0.65-1.20	0.88	0.63-1.24
High	0.91	0.61-1.34	1.05	0.70-1.59	0.92	0.60-1.42	1.12	1.04-1.93	1.23	0.87-1.74	1.36	0.93-1.99
No. of sexual partners												
None	1.00		1.00				1.00		1.00		1.00	
1-3	**4.12**	**2.78-6.08**	**3.58**	**2.39-5.49**	**3.53**	**2.26-5.53**	**3.09**	**2.28-4.15**	**2.58**	**1.87-3.55**	**2.67**	**1.87-3.81**

4-5	**5.70**	**3.13-10.36**	**4.25**	**2.22-8.16**	**4.39**	**2.14-8.71**	**5.36**	**3.45-8.35**	**3.21**	**2.00-5.13**	**3.08**	**1.83-5.19**
6 or more	**6.90**	**1.04-11.77**	**3.83**	**2.18-6.73**	**3.88**	**2.14-7.01**	**7.40**	**4.58-12.0**	**3.14**	**1.91-5.17**	**3.35**	**1.97-5.72**
Smoker												
No	1.00		1.00		1.00		1.00		1.00		1.00	
Yes	**2.70**	**1.81-4.04**	1.06	0.68-1.66	0.86	0.54-1.37	**3.38**	**2.44-4.68**	**1.95**	**1.36-2.81**	**1.99**	**1.35-2.93**
Illicit drug user												
No	1.00		1.00		1.00		1.00		1.00		1.00	
Yes	**2.33**	**1.70-3.21**	**2.23**	**1.52-3.26**	**2.43**	**1.63-3.63**	**2.59**	**1.93-3.47**	**2.11**	**1.51-2.96**	**1.90**	**1.33-2.71**

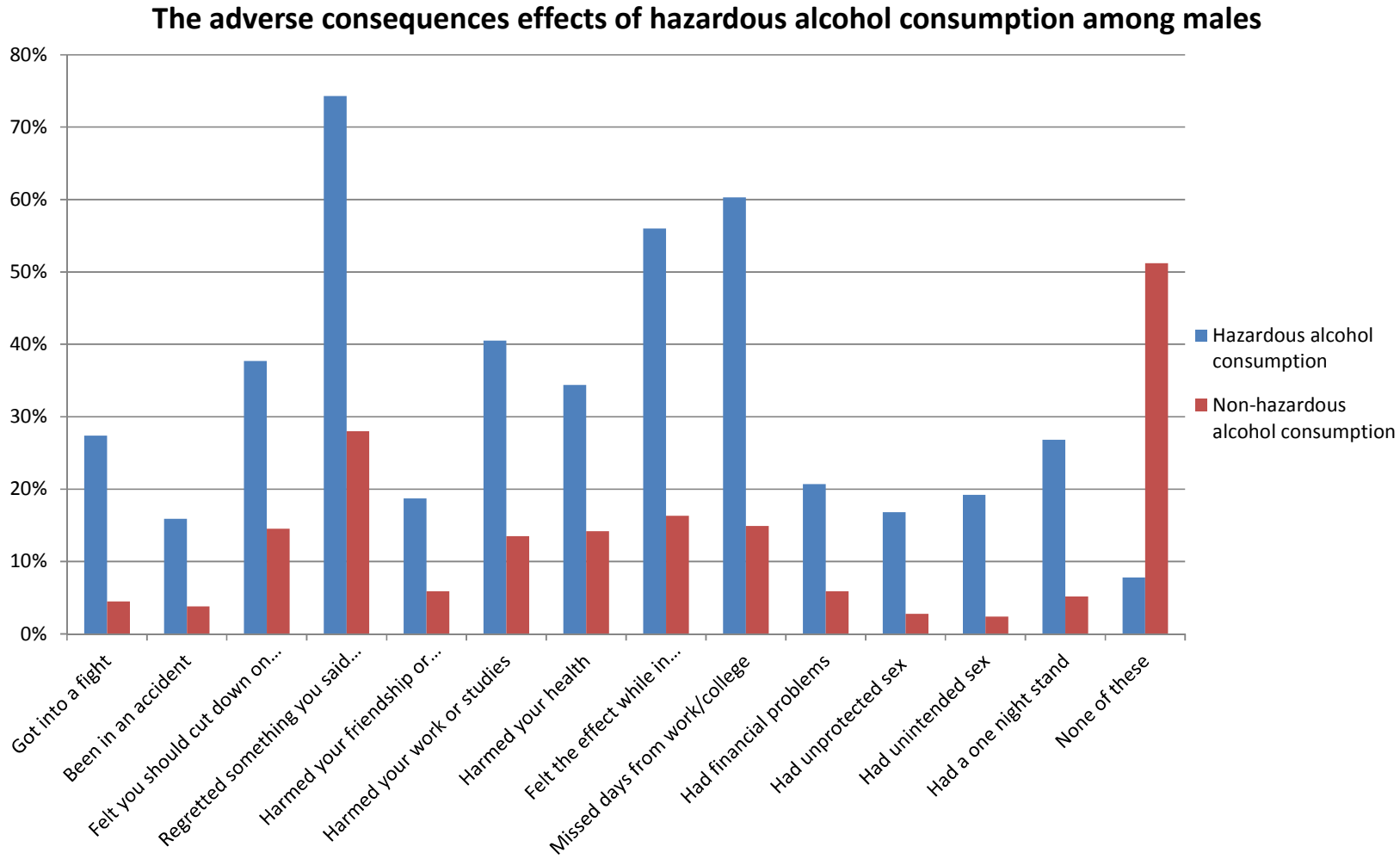
** Adjusted for university level effects of course of study, accommodation type and college year

*** Adjusted for university level effects and other significant factors in the age adjusted model

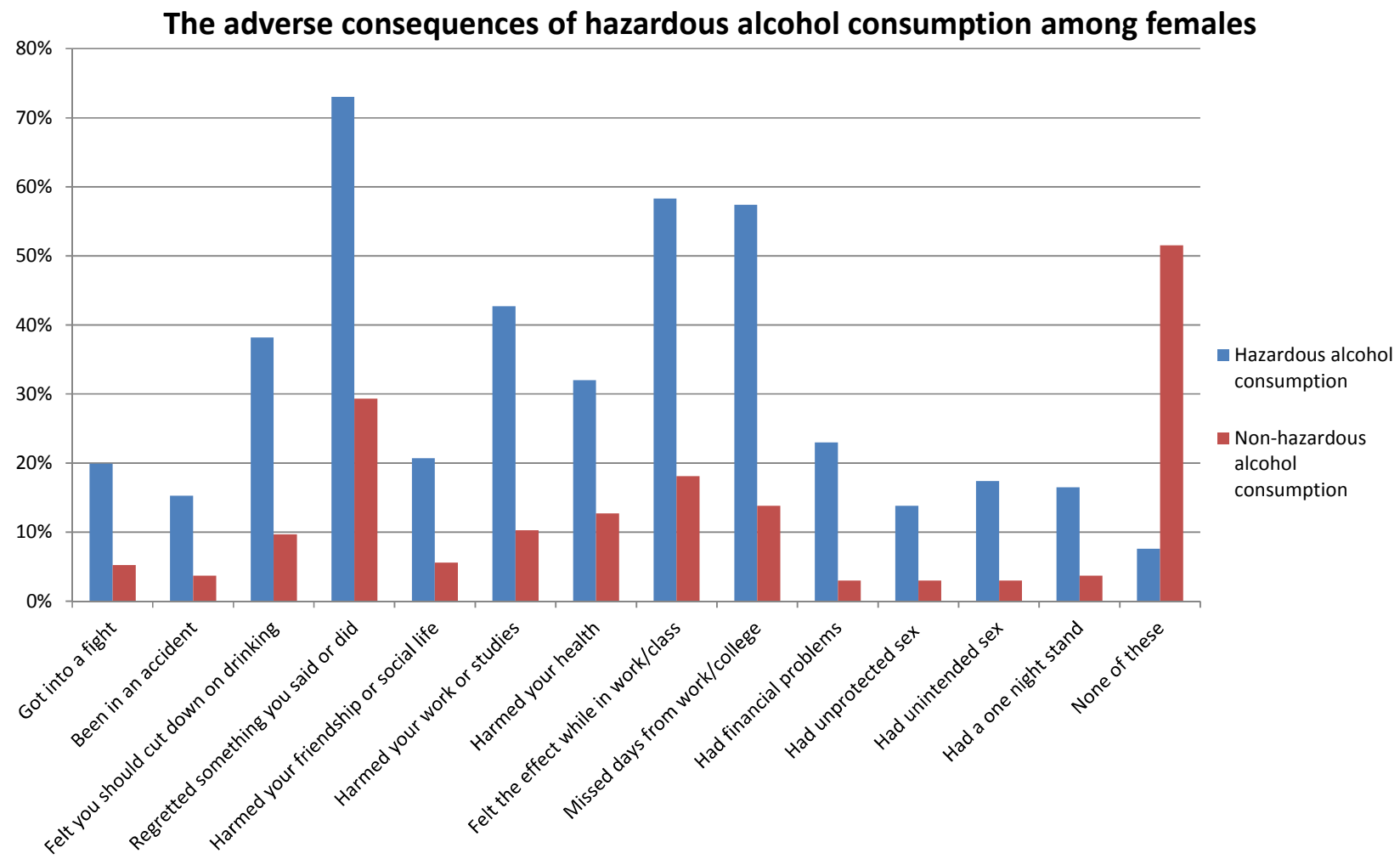
Table 4: Adverse consequences associated with harmful alcohol consumption among male and female students

		Male 830 [36.9%]		Females 1420 [63.1%]	
		Hazardous alcohol consumption	Non-hazardous alcohol consumption	Hazardous alcohol consumption	Non-hazardous alcohol consumption
Got into a fight when you had been drinking	*Yes*	148 (27.36%)	13 (4.5%)	190 (19.87%)	24 (5.17%)
Been in an accident after drinking	*Yes*	86 (15.9%)	11 (3.81%)	146 (15.27%)	17 (3.66%)
Felt you should cut down on your drinking	*Yes*	204 (37.71%)	42 (14.53%)	365 (38.18%)	45 (9.7%)
Regretted something you said or did after drinking	*Yes*	402 (74.31%)	81 (28.03%)	698 (73.01%)	136 (29.31%)
Felt drinking harmed your friendship or social life	*Yes*	101 (18.67%)	17 (5.88%)	198 (20.71%)	26 (5.6%)
Felt drinking harmed your work or studies	*Yes*	219 (40.48%)	39 (13.49%)	408 (42.68%)	48 (10.34%)
Felt drinking harmed your health	*Yes*	186 (34.38%)	41 (14.19%)	306 (32.01%)	59 (12.72%)
Felt the effect of alcohol while in work or class	*Yes*	303 (56.01%)	47 (16.26%)	557 (58.26%)	84 (18.1%)
Missed days from work/college due to a hangover/too much alcohol	*Yes*	326 (60.26%)	43 (14.88%)	549 (57.43%)	64 (13.79%)
Had financial problems as a result of your drinking	*Yes*	112 (20.7%)	17 (5.88%)	220 (23.01%)	14 (3.02%)
Had unprotected sex as a result of your drinking	*Yes*	91 (16.82%)	8 (2.77%)	132 (13.81%)	14 (3.02%)
Had unintended sex as a result of your drinking	*Yes*	104 (19.22%)	7 (2.42%)	166 (17.36%)	14 (3.02%)
Had a one night stand	*Yes*	145 (26.8%)	15 (5.19%)	158 (16.53%)	17 (3.66%)
None of these	*Yes*	42 (7.76%)	148 (51.21%)	73 (7.64%)	239 (51.51%)

~~Figure 1 a:~~ ~~The adverse consequences of hazardous alcohol consumption among male students~~



~~Figure 1 b:~~ ~~The adverse consequences of hazardous alcohol consumption among female students~~



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Details of contributors

MPD – Design of study, analysed the data, drafted and edited the manuscript

FS – Design and conception, statistical support, draft and editing of manuscript

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Competing interests

All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work

Ethical Approval

The Clinical Research Ethics Committee, University College Cork, Ireland, granted ethical approval for this research.

Transparency declaration

The lead author affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

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Data Sharing Statement

There is no additional data available

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Hazardous alcohol consumption among university students in Ireland: a cross-sectional study

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What is already known on this subject?

Internationally, levels of alcohol consumption among younger age groups have increased in recent decades. University students represent a unique subsection of society where a culture of hazardous alcohol consumption exists. Recently, evidence has suggested that male and female students are consuming similar amounts of alcohol. There is a need for reliable data on patterns of alcohol consumption in this population.

What does this study add?

The findings highlight the high prevalence of hazardous alcohol consumption relative to the general population, the substantial burden of adverse consequences and the narrowing of the gender gap among students in a large Irish university. Approximately two thirds of students, (66.4%; 95%CI 64.4-68.3) reported hazardous alcohol consumption, (65.2% men and 67.3% women) and in women, 57.4% of the sample met the current hazardous alcohol consumption thresholds for men.

Abstract

Objective

There is considerable evidence of a cultural shift towards heavier alcohol consumption among university students, especially women. The aim of this study is to investigate the prevalence and correlates of hazardous alcohol consumption among university students with particular reference to gender and to compare different modes of data collection in this population.

Setting

A large Irish university

Design

A cross-sectional study using a classroom distributed paper questionnaire

Participants

A total of 2,275 undergraduates completed the classroom survey, 84% of those in class and 51% of those registered for the relevant module.

Main outcome measures

Prevalence of hazardous alcohol consumption (HAC) measured using the Alcohol Use Disorders Identification Test for Consumption (AUDIT-C) and the proportion of university students reporting one or more of thirteen adverse consequences linked to HAC. HAC was defined as an AUDIT-C score of 6 or more among males and 5 or more among females.

Results

In the classroom sample, 66.4% (95%CI 64.4-68.3) reported HAC (65.2% men and 67.3% women). In women, 57.4% met HAC thresholds for men. Similar patterns of adverse consequences were observed among men and women. Students with a hazardous consumption pattern were more likely to report smoking, illicit drug use and being sexually active.

Conclusion

The findings highlight the high prevalence of hazardous alcohol consumption among university students relative to the general population. Public policy measures require review to tackle the short and long term risks to physical, mental and social health and wellbeing.

Article Summary

Strengths & Limitations

- The current study employed standardised methods for the measurement of hazardous alcohol consumption and a rigorous probability proportion to size sampling strategy for the class room based survey.
- In regard to gender and course of study, the study participants were representative of the university undergraduate student population from which they were sampled.
- The overall response rate, defined in terms of students registered for specific modules was 51%. However, the response rate for those in attendance at lectures was 84%. There was over-representation of first year and under-representation of fourth year students in the sample.
- Although the response rate was low, it is similar to that achieved in major international studies of student alcohol consumption. It should also be noted that the majority of non-respondents were students absent from class during the survey. The latter group of students are unlikely to have a more favourable pattern of alcohol consumption than that observed in this study. Thus, the current study may be regarded as reporting the lower bound estimates of hazardous alcohol consumption in Irish university students.

Introduction

Problem alcohol use is an on-going, worldwide phenomenon of considerable concern [1-4] . Ireland displays a unique relationship with alcohol with significantly higher intakes than the OECD average [5], the United States [6] and the United Kingdom [7]. In addition, the Eurobarometer study notes that Irish adults report hazardous drinking more frequently than any other EU country [2]. Recently it was reported that 54% of Irish adults reported hazardous alcohol consumption [8]. University students represent a unique subsection of society. [9] In this environment, there is a culture of hazardous alcohol consumption [10], defined as "a pattern of alcohol consumption that increases the risk of harmful consequences for the user or others" [11]. The findings from the 2002-03 College Lifestyle Attitudinal National Survey in Ireland indicated that at least 60 in every 100 drinking occasions among students involved hazardous alcohol consumption [10]. This suggests hazardous alcohol consumption is a cultural norm among university students in Ireland. Previous research using the AUDIT-C scale has reported lower levels of hazardous consumption among non university peers (36%) [12] and the general population (54%) [8].

In a number of countries, hazardous drinking has been identified as the number one substance abuse problem during university life [10, 13-15]. A comprehensive review of drinking habits in European universities found a range of studies suggesting that hazardous levels of alcohol consumption were associated with increased levels of smoking and drug use [16]. In Ireland, the College Lifestyle Attitudinal National survey in Ireland noted high levels of alcohol consumption and other risk taking behaviours among students [10]. However, these data were collected over 10 years ago and there is a clear need for contemporary Irish data to guide public policy response to this issue.

Differences in the volume of alcohol consumed by women and men in universities have been reported in some studies [1, 10, 14, 16-20]. Harrell and Karmin found male students reported significantly higher alcohol intakes than their female peers [18], a result mirrored in other studies [19, 20]. More recently, international research has noted a shift in alcohol consumption among university students with some studies reporting similar patterns of hazardous drinking in men and

women [21]. A review investigating the consequences of alcohol misuse noted that gender differences in relation to the adverse consequences of alcohol consumption were also beginning to decrease [22]. For instance, Hoeppner et al. found that females were more likely to exceed their recommended weekly alcohol allowance than their male counterparts [23].

Thus, the aim of this study was to investigate the prevalence of hazardous alcohol consumption and the adverse consequences associated with its use among university students in Ireland, with particular reference to gender differences.

Methods and participants

Undergraduate students attending one large university in Ireland, University College Cork (UCC), were eligible for inclusion in the class room based study which was focused on health and lifestyle with particular reference to alcohol consumption. Students were sampled at degree programme level using probability proportional to size (PPS) sampling. We estimated the required sample size at 2,686 students, based on an undergraduate student population of 12,475, a required precision of 1.5% and an expected prevalence of hazardous alcohol consumption of 73%, based on an earlier unpublished masters dissertation [31]. Lecturers or module coordinators were contacted to request permission to distribute and collect questionnaires during fifteen minutes of lecture time on a date convenient to them between March 12th and March 23rd, 2012. Students were briefed orally and in writing (on the front sheet of the questionnaire) on the aims and objectives of the study including details of the confidential, anonymous and voluntary nature of the exercise. Participating in the research was presumed to imply consent. To enhance the response rate, the distribution of questionnaires was avoided on Mondays and Fridays due to Irish student social and recreational patterns.

Of the lecturers/module coordinators approached to facilitate the study, 94.3% agreed to cooperate. A total, 2,332 students completed this face-to-face lecture theatre based survey; 57 students were subsequently identified as post-graduate students and were excluded from the analyses. Thus data are available on a total of 2,275 undergraduates with a response rate of 84% for those attending class on the day of survey and 51% of those registered for the specific modules. The gender and the degree programme profiles of the sample collected were broadly similar to those registered with the university; 63.1% of the sample were women versus 56% for the university, 39.7% were registered with the College of Arts, Celtic Studies & Social Sciences (university 33%), 20.1 % with Business & Law (university 21%), 24.6% with Science, Engineering & Food Science (university 27%) and 14.2% with Medicine & Health, (university 19%). However, with regard to year in college there was over sampling of first years (46.8% vs. 32.1%) and under sampling of fourth years (7.7% vs. 16.7%).

As an incentive, participants were invited to enter a draw to win a tablet computer following survey completion. As completion was anonymous, each student was advised to send an e-mail with their name and e-mail address to enter the prize draw. Details of how to enter were included on their post-questionnaire information sheet which was handed out in the lecture theatre. This post-questionnaire information sheet also included contact information to different websites and institutions offering help and advice on alcohol related issues.

Questionnaire

A total of 49 questions were included in the questionnaire which was based on previously validated instruments, including the Alcohol Use Disorders Identification Test for Consumption (AUDIT-C) [33], the Warwick Edinburgh Mental Well-being scale (WEMWBS) [34] and the International Physical Activity Questionnaire (IPAQ) [35]. In addition, questions on smoking status [36], drug use [37], sexual practice and activity [10], diet and self-reported height and weight [37] were taken from the national survey on health and lifestyle in Ireland [37] and previous university research [10, 36]. All of these instruments have previously shown reliability and validity among a student population [3, 38]. It took approximately twelve minutes to complete the paper-based questionnaire.

Hazardous alcohol consumption was estimated using the Alcohol Use Disorders Identification Test for Consumption (AUDIT-C) developed by the World Health Organisation [11] to identify hazardous patterns of alcohol consumption. The AUDIT-C takes the first three questions of the AUDIT questionnaire. These questions focus on the frequency of consumption, the number of units consumed and the number of binge drinking occasions. The guidelines on safe alcohol consumption in women are lower than those for men reflecting their increased vulnerability to alcohol related harm [39]. In the current study therefore, hazardous alcohol consumption was defined as an AUDIT-C score of 6 or more among males and 5 or more among females. This instrument has demonstrated high sensitivity and specificity among a population of young adults aged between 18 and 20 years [33, 40, 41].

BMI was estimated from self-reported height and weight with normal weight, overweight and obesity defined as BMI of 20-24.99 Kg/M^2, 25-29.99 Kg/M^2 and ≥ 30 Kg/M^2, respectively.

Physical activity was coded as low, moderate and high using the standard International Physical Activity Questionnaire (IPAQ) protocol [35]. WEMWBS scores were divided into categories of mental well-being as defined by Braunholtz et al [42]. Below average mental wellbeing was defined as a WEMWBS score of more than one standard deviation below the mean, average mental wellbeing was within one standard deviation of the mean and above average mental wellbeing was over one standard deviation above the mean [43].

The Clinical Research Ethics Committee, University College Cork, Ireland, granted ethical approval for this research.

Data management & Statistical analysis

The questionnaire data were scanned, checked and verified using TeleForm TM scanning processes. The estimated error rate for data entry was 0.06% based on manual checking of a 10% sample of all scanned questionnaires. All data were analysed using *IBM SPSS Statistics Version* 20. Univariate and multivariate logistic regression analyses were undertaken to investigate factors associated with hazardous alcohol consumption separately in men and women.

Results

Hazardous alcohol consumption in the class room study sample

The prevalence of hazardous alcohol consumption (HAC) was similar in men (65.2%) and women (67.3%). In women, 57.4% met HAC thresholds for men. Only 8.4% of men and 5.8% of women were non drinkers. Approximately, 17% of men and 5% of women had an AUDIT-C score of 10 or higher. This equates to consuming more than 6 units of alcohol at least 4 times per week and in some cases daily. The prevalence of hazardous alcohol consumption by age, socio-demographic variables and lifestyle factors, are presented in **Table 1,** stratified by gender. Broadly similar trends were observed in univariate analyses in both men and women with higher prevalence of hazardous alcohol consumption associated with later years in college, studying Business or Law, not owning a house, current smoking, illicit drug use and being sexually active. Hazardous alcohol consumption was associated with above average mental well-being in men but not in women in these univariate analyses.

Multivariate analysis

Controlling for age only, males [OR=2.26 95%CI1.46-3.49; p<0.001] and females [OR=2.12 95%CI1.44-3.14; p<0.001] studying Law and Business were over twice as likely to report HAC, as their peers studying Science & Engineering. Among males, those in third year were 56% more likely to report HAC [OR=1.56 95%CI1.02-2.41; p<0.001] while, among females, those in fourth year were 80% more likely to report HAC than their counterparts in first year [OR=1.80 95%CI 1.14-2.86]. Male smokers were more than twice as likely to report HAC while female smokers were more than three times as likely to report HAC compared to their non-smoking peers. In men and women, those reporting illicit drug use were over twice as likely to report hazardous alcohol consumption. Males reporting 1-3, 4-5 and 6+ lifetime sexual partner were 4, 5 and 6 times more likely to report HAC than those reporting no sexual partners. For females the OR's were increase 3 fold, 5 fold and 7 fold for the same categories.

In further analyses controlling for age, course of study, accommodation type and college year, males [OR=2.33 95%CI 1.52-3.26; p=0.001] and females [OR=2.11 95%CI 1.51-2.96; p<0.001]

who reported illicit drug use were more likely to report HAC. Among females current smokers were almost twice as likely to report HAC compared to their non-smoking female peers [OR=1.95 95%CI1.36-2.81; p<0.001]. However in these adjusted analyses, the association of smoking with HAC in males was attenuated. The associations between HAC and number of sexual partners was also somewhat attenuated in these adjusted analyses but remained highly significant.

The final model was adjusted for other significant factors from the age adjusted model. The model observes that being a house owner is negatively associated with HAC for both males and females while being in second year is negatively associated for males. In contrast, studying Law and Business was positively associated with HAC. Males and females reporting one or more sexual partner or illicit drug use were also positively associated with hazardous alcohol consumption as were females who reported smoking. These results are shown in **Table 2**.

Adverse consequences

The pattern and frequency of adverse consequences of alcohol consumption was broadly similar in men and women. However, men were more likely to report getting into a fight (p=0.001) and having a one night stand (p<0.001) than women. No significant differences were found for other second-hand effects. **Table 3** shows the proportion of students reporting one or more of 13 adverse consequences of alcohol consumption. Over 70% of men with a hazardous alcohol consumption pattern reported regretting something they had said or done due to their alcohol consumption. Over 60% reported missing days from work or college due to their alcohol consumption, affecting academic performance and future prospects. In men, stark differences were observed between hazardous and non-hazardous alcohol consumers in relation to unintended (19.2% vs. 2.8) and unprotected sex (16.8% vs. 3.3%). Similarly in women the burden of adverse consequences was substantially greater among hazardous drinkers than their non-hazardous peers, with 73% regretted something they said or did after drinking compared to 35.5% of their peers. Approximately 17% of female hazardous drinkers reported unintended sex while 13.8% reported unprotected sex because of their drinking compared to 3.5% and 3.8% respectively among their peers.

Discussion

These findings highlight the extremely high prevalence of hazardous alcohol consumption (66.4%) relative to the general population, the burden of related adverse consequences and the narrowing of the gender gap among students in a large Irish university [31]. Almost two thirds of respondents reported hazardous alcohol consumption, (65.2% men and 67.3% women) and in women, 57.4% of the sample meet the current hazardous alcohol consumption thresholds for men. It has been suggested that the threshold for hazardous drinking is too low [44]. However it is based on the well defined biological and behavioural effects of alcohol [11]. In the context of the present study, it should also be noted that within the large group of hazardous drinkers, over one quarter of hazardous drinkers were consuming more than 6 units of alcohol (binge drinking) at least 2-3 times per week and in some cases daily.

Alcohol consumption has been noted as the number one public health problem facing universities [45]. Previously, significant differences were observed among male and female students in the CLAN survey [10]. In a more recent study from University College Cork using the same screening tool this discrepancy between males (82%) and females (71%) was observed [31]. Thus, the current findings of no gender gap in the prevalence of hazardous alcohol consumption is noteworthy and of particular concern given women's increased innate susceptibility to the harmful effects of alcohol. It is unclear whether this narrowing of the gender gap reflects changing cultural norms or has arisen as a direct consequence of alcohol marketing targeting young women.

The current research suggests that the prevalence of alcohol consumption in Irish university students (based on self report) is broadly similar to levels observed in British students using the AUDIT scale [7] but significantly higher than those observed in the US [6]. A large proportion of students (31.7%) felt their drinking harmed their work or studies. The latter findings are similar to those from the Harvard College Alcohol Study where one third of students had missed class during the last year due to their alcohol consumption [22]. In other studies of alcohol consumption in university students, adverse consequences from alcohol consumption range in severity from

violence and physical harm [10] to unplanned and unintended sexual intercourse [46], broadly similar to those reported in the current study.

The current research found HAC was associated with smoking, an increasing number of sexual partners and illicit drug use. The current study confirms previous research by Harrison et al who stated that smoking is associated with hazardous drinking in young adults [47]. In relation to the sexual health of university students, previous research reports that 70% are sexually active [48]. Previously, the Harvard College Alcohol Study illustrated that the reporting of unplanned sexual activity increased from 8% among non-binge drinkers, 22% among occasional binge drinkers (six or more standard drinks in one drinking occasion) to 42% among frequent binge drinkers [49]. Those reporting unplanned sexual activity are also less likely to use protection [50]. Coupled with high rates of short term or casual sexual partnerships and reported low levels of sexual health knowledge, hazardous alcohol consumers are at higher risk of unintended pregnancy or contracting a sexually transmitted infection [51]. Similarly, the literature shows a high prevalence of illicit drug use among university students. Previously, Chiauzzi reported over 20% of the student population were found to be part of a group categorised by high risk drinking and high prevalence of illicit drug use [52]. The current research complements these findings, highlighting the association between alcohol and a twelve month prevalence of illicit drug use and the growing need to tackle these issues concurrently.

Strengths & Weaknesses

This work can be readily replicated in other universities worldwide. We used a standard, internationally recognised screening tool for hazardous alcohol consumption. Probability proportional to size sampling strategy was employed to ensure that all students, regardless of degree course had an equal opportunity of being included in the study. The demographics of study participants were broadly similar to those of the wider institution in relation to course of study and gender.

The overall response rate, defined in terms of students registered for specific modules was 51%. Although the response rate was low, it is similar to that achieved in major national [10] and

international research [53] of student alcohol consumption. While this falls short of the desired rate of at least 70% in health and well-being surveys, the study provides important policy relevant data. We have no reason to believe that the non-respondents to this survey, who were absent from class on the day of sampling, are drinking at less hazardous levels. There was over-representation of first years and under-representation of fourth years. As the prevalence of HAC was higher in fourth year students than first years this imbalance in sampling is likely to have lead to an underestimation of overall prevalence of HAC. Thus the current study may be regarded as reporting the lower bound estimates of hazardous alcohol consumption in Irish university students. This pattern of alcohol consumption is not unique to this university which in recent years has developed a campus wide health promoting university initiative with a significant focus and dedicated resources centered on the problem of excessive alcohol consumption [54].

Conclusion

Hazardous alcohol consumption continues to be a public health issue in Irish university students, both in terms of immediate adverse consequences and long term risks to physical, mental and social health and wellbeing. Currently the Irish state is at a decision point with regard to policies on the promotion and marketing of alcohol. The findings from this study highlight the need for effective public policy measures in response to this issue such as a minimum unit price for alcohol and a ban on sports sponsorship.

Table 1: Prevalence of hazardous alcohol consumption by gender, age, sociodemographic and lifestyle factors

		Men [N=830 (36.9%)]	p-value	Women [N=1420 (63.1%)]	p-value
All		541 (65.2%)		956 (67.3%)	
Age	*<=18*	72 (67.9%)	**0.003**	138 (74.2%)	**0.04**
	19	190 (70.1%)		290 (69.2%)	
	20	101 (66.9%)		214 (68.6%)	
	21	71 (70.3%)		139 (66.5%)	
	22+	100 (53.5%)		159 (60.9%)	
Course of study	*Science/Engineering/ Food Science*	159 (62.6%)	**0.001**	192 (65.1%)	**<0.001**
	Arts/Social			367 (63.4%)	
	Science/Education	182 (59.5%)			
	Law & Business	145 (77.5%)		204 (79.4%)	
	Medicine & Health	38 (61.3%)		175 (68.4%)	
	Other	11 (78.6%)		13 (65%)	
Year in college	*First*	286 (65.0%)	**0.03**	402 (65.6%)	**0.046**
	Second	112 (58.0%)		299 (70.0%)	
	Third	104 (72.7%)		165 (63.2%)	
	Fourth	39 (72.2%)		90 (75.6%)	
Accommodation	*Campus Accommodation*	49 (70.0%)	**0.005**	140 (67.6%)	**<0.001**
	Rented House/Flat	209 (67.0%)		410 (70.1%)	
	Parents' House	256 (65.6%)		381 (67.0%)	
	House Owner	20 (41.7%)		19 (38.0%)	
BMI	*Normal Weight*	355 (65.7%)	0.97	630 (66.7%)	0.96
	Overweight/Obese	145 (65.9%)		135 (66.5%)	
Physical Activity	*Low*	162 (66.1%)	0.83	295 (65.7%)	0.07
	Moderate	230 (65.7%)		374 (65.4%)	
	High	140 (63.6%)		269 (72.1%)	
Mental Well-being (WEMWBS)	*Below average wellbeing*	79 (57.7%)	**0.02**	169 (65.3%)	0.64
	Average wellbeing	372 (65.0%)		660 (68.1%)	
	Above average wellbeing	90 (74.4%)		127 (66.1%)	
No. of sexual partners	*None*	72 (41.6%)	**<0.001**	120 (45.8%)	**<0.001**
	1-3	246 (72.4%)		479 (69.8%)	
	4-5	67 (76.1%)		146 (76.8%)	
	6+	121 (68.4%)		147 (79.9%)	
Smoker	*Yes*	163 (73.4%)	**0.002**	292 (81.3%)	**<0.001**
	No	361 (61.8%)		647 (62.7%)	
Illicit drug user	*Yes*	251 (76.3%)	**<0.001**	302 (81.6%)	**<0.001**
	No	290 (57.9%)		654 (62.3%)	

Table 2: Multivariate Logistic Regression: Risk factors associated with male and female hazardous alcohol consumption

	Male						Female					
	Age adjusted		Multivariate analysis**		Multivariate analysis***		Age adjusted		Multivariate analysis**		Multivariate analysis***	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI		
Course of study												
Science/Engineering/ Food Science	1.00		1.00		1.00		1.00		1.00		1.00	
Arts/Social Science/Education	1.07	0.75-1.53	0.62	0.41-0.94	0.75	0.49-1.15	1.03	0.76-1.39	0.82	0.59-1.15	0.87	0.62-1.23
Law & Business	**2.26**	**1.46-3.49**	**2.52**	**1.54-4.11**	**2.81**	**1.70-4.63**	**2.12**	**1.44-3.14**	**2.18**	**1.39-3.42**	**2.17**	**1.37-3.42**
Medicine & Health	1.14	0.63-2.06	1.01	0.52-1.95	1.01	0.52-1.96	1.20	0.84-1.73	1.18	0.79-1.77	1.22	0.81-1.84
Other	2.49	0.66-9.36	1.15	0.29-4.68	1.46	0.34-6.23	1.09	0.42-2.85	0.85	0.31-2.33	0.99	0.36-2.71
Year in college												
First	1.00		1.00		1.00		1.00		1.00		1.00	
Second	0.86	0.60-1.24	**0.54**	**0.35-0.82**	**0.55**	**0.35-0.85**	1.28	0.98-1.69	0.91	0.66-1.25	0.94	0.68-1.30
Third	**1.56**	**1.02-2.41**	1.24	0.73-2.11	1.21	0.07-2.10	0.95	0.70-1.30	0.82	0.56-1.19	0.91	0.62-1.34
Fourth	1.57	0.83-2.98	0.66	0.32-1.36	0.67	0.31-1.45	**1.80**	**1.14-2.86**	1.07	0.60-1.88	1.35	0.75-2.42
Accommodation												
Campus Accommodation	1.00		1.00		1.00		1.00				1.00	
Rented House/Apartment	1.47	0.53-4.08	0.60	0.30-1.19	0.57	0.28-1.19	1.32	0.93-1.88	0.86	0.57-1.30	1.02	0.67-1.55
Parents' House	0.91	0.52-1.59	0.52	0.27-1.01	0.50	0.25-1.00	1.06	0.75-1.50	0.78	0.53-1.17	0.84	0.56-1.26
House Owner	1.47	0.47-4.08	0.17	0.07-0.43	0.16	0.06-0.43	**0.95**	**0.92-0.98**	**0.19**	**0.09-0.40**	**0.23**	**0.11-0.51**
BMI												
Normal Weight	1.00		1.00		1.00		1.00		1.00		1.00	
Overweight/Obese	1.30	0.91-1.87	1.12	0.76-1.66	1.08	0.73-1.59	1.10	0.78-1.54	1.07	0.74-1.53	1.05	0.73-1.51
Physical Activity												
Low	1.00		1.00		1.00		1.00		1.00		1.00	
Moderate	0.94	0.66-1.34	1.25	0.79-1.98	1.18	0.72-1.92	0.99	0.76-1.30	0.88	0.65-1.20	0.88	0.63-1.24
High	0.91	0.61-1.34	1.05	0.70-1.59	0.92	0.60-1.42	1.12	1.04-1.93	1.23	0.87-1.74	1.36	0.93-1.99
No. of sexual partners												
None	1.00		1.00				1.00		1.00		1.00	
1-3	**4.12**	**2.78-6.08**	**3.58**	**2.39-5.49**	**3.53**	**2.26-5.53**	**3.09**	**2.28-4.15**	**2.58**	**1.87-3.55**	**2.67**	**1.87-3.81**

4-5	**5.70**	**3.13-10.36**	**4.25**	**2.22-8.16**	**4.39**	**2.14-8.71**	**5.36**	**3.45-8.35**	**3.21**	**2.00-5.13**	**3.08**	**1.83-5.19**
6 or more	**6.90**	**1.04-11.77**	**3.83**	**2.18-6.73**	**3.88**	**2.14-7.01**	**7.40**	**4.58-12.0**	**3.14**	**1.91-5.17**	**3.35**	**1.97-5.72**
Smoker												
No	1.00		1.00		1.00		1.00		1.00		1.00	
Yes	**2.70**	**1.81-4.04**	1.06	0.68-1.66	0.86	0.54-1.37	**3.38**	**2.44-4.68**	**1.95**	**1.36-2.81**	**1.99**	**1.35-2.93**
Illicit drug user												
No	1.00		1.00		1.00		1.00		1.00		1.00	
Yes	**2.33**	**1.70-3.21**	**2.23**	**1.52-3.26**	**2.43**	**1.63-3.63**	**2.59**	**1.93-3.47**	**2.11**	**1.51-2.96**	**1.90**	**1.33-2.71**

** Adjusted for university level effects of course of study, accommodation type and college year

*** Adjusted for university level effects and other significant factors in the age adjusted model

Table 3: Adverse consequences associated with harmful alcohol consumption among male and female students

		Male 830 [36.9%]		Females 1420 [63.1%]	
		Hazardous alcohol consumption	Non-hazardous alcohol consumption	Hazardous alcohol consumption	Non-hazardous alcohol consumption
Got into a fight when you had been drinking	*Yes*	148 (27.36%)	13 (4.5%)	190 (19.87%)	24 (5.17%)
Been in an accident after drinking	*Yes*	86 (15.9%)	11 (3.81%)	146 (15.27%)	17 (3.66%)
Felt you should cut down on your drinking	*Yes*	204 (37.71%)	42 (14.53%)	365 (38.18%)	45 (9.7%)
Regretted something you said or did after drinking	*Yes*	402 (74.31%)	81 (28.03%)	698 (73.01%)	136 (29.31%)
Felt drinking harmed your friendship or social life	*Yes*	101 (18.67%)	17 (5.88%)	198 (20.71%)	26 (5.6%)
Felt drinking harmed your work or studies	*Yes*	219 (40.48%)	39 (13.49%)	408 (42.68%)	48 (10.34%)
Felt drinking harmed your health	*Yes*	186 (34.38%)	41 (14.19%)	306 (32.01%)	59 (12.72%)
Felt the effect of alcohol while in work or class	*Yes*	303 (56.01%)	47 (16.26%)	557 (58.26%)	84 (18.1%)
Missed days from work/college due to a hangover/too much alcohol	*Yes*	326 (60.26%)	43 (14.88%)	549 (57.43%)	64 (13.79%)
Had financial problems as a result of your drinking	*Yes*	112 (20.7%)	17 (5.88%)	220 (23.01%)	14 (3.02%)
Had unprotected sex as a result of your drinking	*Yes*	91 (16.82%)	8 (2.77%)	132 (13.81%)	14 (3.02%)
Had unintended sex as a result of your drinking	*Yes*	104 (19.22%)	7 (2.42%)	166 (17.36%)	14 (3.02%)
Had a one night stand	*Yes*	145 (26.8%)	15 (5.19%)	158 (16.53%)	17 (3.66%)
None of these	*Yes*	42 (7.76%)	148 (51.21%)	73 (7.64%)	239 (51.51%)

Details of contributors

MPD – Design of study, analysed the data, drafted and edited the manuscript

FS – Design and conception, statistical support, draft and editing of manuscript

MB – Design and conception of study, drafting and editing of manuscript

IJP – Design and conception of study, statistical support, drafting and editing of manuscript, overall supervision of project

*All authors gave full approval of the version to be published

Competing interests

All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work

Ethical Approval

The Clinical Research Ethics Committee, University College Cork, Ireland, granted ethical approval for this research.

Transparency declaration

The lead author affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

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Data Sharing Statement

There is no additional data available

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Hazardous alcohol consumption among university students in Ireland: a cross-sectional study

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What is already known on this subject?

Internationally, levels of alcohol consumption among younger age groups have increased in recent decades. University students represent a unique subsection of society where a culture of hazardous alcohol consumption exists. Recently, evidence has suggested that male and female students are consuming similar amounts of alcohol. There is a need for reliable data on patterns of alcohol consumption in this population.

What does this study add?

The findings highlight the high prevalence of hazardous alcohol consumption relative to the general population, the substantial burden of adverse consequences and the narrowing of the gender gap among students in a large Irish university. Approximately two thirds of students, (66.4%; 95%CI 64.4-68.3) reported hazardous alcohol consumption, (65.2% men and 67.3% women) and in women, 57.4% of the sample met the current hazardous alcohol consumption thresholds for men. ~~Even higher levels of hazardous alcohol consumption were noted in a web based survey compared to the primary class room based survey but response rates for the web survey were unacceptably low.~~

Abstract

Objective

There is considerable evidence of a cultural shift towards heavier alcohol consumption among university students, especially women. The aim of this study is to investigate the prevalence and correlates of hazardous alcohol consumption among university students with particular reference to gender and to compare different modes of data collection in this population.

Setting

A large Irish university

Design

A cross-sectional study using a classroom distributed paper questionnaire ~~and a web based survey~~

Participants

A total of 2,275 undergraduates completed the classroom survey, 84% of those in class and 51% of those registered for the relevant module. ~~A total of 333 undergraduates responded to the web-based questionnaire yielding a response rate of 2.4%.~~

Main outcome measures

Prevalence of hazardous alcohol consumption (HAC) measured using the Alcohol Use Disorders Identification Test for Consumption (AUDIT-C) and the proportion of university students reporting one or more of thirteen adverse consequences linked to HAC. HAC was defined as an AUDIT-C score of 6 or more among males and 5 or more among females.

Results

In the classroom sample, 66.4% (95%CI 64.4-68.3) reported HAC (65.2% men and 67.3% women). In women, 57.4% met HAC thresholds for men. Similar patterns of adverse consequences were observed among men and women. Students with a hazardous consumption pattern were more likely to report smoking, illicit drug use and being sexually active. ~~Respondents to the web based survey reported higher levels HAC (men 73.5%; women 75.3%) and alcohol related adverse consequences.~~

Conclusion

~~Web-based surveys provide an unacceptably low response rate in this population and results that are discordant with the classroom based sample.~~ The findings highlight the high prevalence of hazardous alcohol consumption among university students relative to the general population. Public policy measures require review to tackle the short and long term risks to physical, mental and social health and wellbeing.

Article Summary

Strengths & Limitations

- The current study employed standardised methods for the measurement of hazardous alcohol consumption and a rigorous probability proportion to size sampling strategy for the class room based survey.
- In regard to gender and course of study, the study participants were representative of the university undergraduate student population from which they were sampled.
- The overall response rate, defined in terms of students registered for specific modules was 51%. However, the response rate for those in attendance at lectures was 84%. There was over-representation of first year and under-representation of fourth year students in the sample.
- Although the response rate was low, it is similar to that achieved in major international studies of student alcohol consumption. It should also be noted that the majority of non-respondents were students absent from class during the survey. The latter group of students are unlikely to have a more favourable pattern of alcohol consumption than that observed in this study. Thus, the current study may be regarded as reporting the lower bound estimates of hazardous alcohol consumption in Irish university students.

Introduction

Problem alcohol use is an on-going, worldwide phenomenon of considerable concern [1-4] . Ireland displays a unique relationship with alcohol with significantly higher intakes ~~[5] than many European and American states [5-7]. The OECD ranks Ireland as 6th of 32 countries worldwide in relation to alcohol consumption in 2012. Irish alcohol consumption is significantly higher~~ than the OECD average [5], the United States [6] and the United Kingdom [7]. In addition, the Eurobarometer study ~~noted~~ notes that Irish adults ~~reported~~ report hazardous drinking more frequently than any other EU country [2]. Recently it was reported that 54% of Irish adults reported ~~HAC~~ hazardous alcohol consumption ~~using the same screening tool as the current study~~ [8]. ~~Alcohol consumption is a significant public health issue in Ireland. In Ireland, levels of harm caused by alcohol use have been found to be higher in younger age groups~~ University students represent a unique subsection of society. [9] In ~~the university~~this environment, there is a culture of hazardous alcohol consumption [10], defined as "a pattern of alcohol consumption that increases the risk of harmful consequences for the user or others" [11]. ~~with young adults aged between 18 and 25 reporting high levels of alcohol consumption~~The findings from the 2002-03 College Lifestyle Attitudinal National Survey in Ireland indicated that at least 60 in every 100 drinking occasions among students involved hazardous alcohol consumption ~~-~~[10]. This suggests hazardous alcohol consumption is a cultural norm among university students in Ireland. ~~University students represent a unique sub-section of society among those aged 18-25. In the university environment, there is a culture of hazardous alcohol consumption [10], defined as "a pattern of alcohol consumption that increases the risk of harmful consequences for the user or others" [11].~~ Previous research using the AUDIT-C scale has reported lower levels of hazardous consumption among non university peers (36%) [12] and the general population (54%) [8].

In a number of countries, hazardous drinking has been identified as the number one substance abuse problem during university life [10, 13-15]. A comprehensive review of drinking habits in European universities found a range of studies suggesting that hazardous levels of alcohol consumption were associated with increased levels of smoking and drug use [16]. In Ireland, the

College, Lifestyle, Attitudinal National survey in Ireland noted high levels of alcohol consumption and other risk taking behaviours among students [10]. However, these data were collected over 10 years ago and there is a clear need for contemporary Irish data ~~on~~ to guide public policy response to this issue.

Differences in the volume of alcohol consumed by women and men in universities have been reported in some studies [1, 10, 14, 16-20]. Harrell and Karmin found male students reported significantly higher alcohol intakes than their female peers [18], a result mirrored in other studies [19, 20]. More recently, international research has noted a shift in alcohol consumption among university students with some studies reporting similar patterns of hazardous drinking in men and women [21]. A review investigating the consequences of alcohol misuse noted that gender differences in relation to the adverse consequences of alcohol consumption were also beginning to decrease [22]. For instance, Hoeppner et al. found that females were more likely to exceed their recommended weekly alcohol allowance than their male counterparts [23]. ~~Much of this research has employed either self-administered in classroom or web-based surveys.~~

~~Web-based data collection provides an attractive alternative to many universities for monitoring trends in hazardous alcohol consumption among students. Universities issue students with a university e-mail address upon registration~~ [24] ~~as a medium for knowledge transfer between the institution and student. This along with increased internet access has led to a surge in web-based student questionnaires over the last decade. However, conflicting results across classroom based and web-based data collection procedures are observed~~ [24-30].

~~———~~Thus, the aim of this study was to investigate the prevalence of hazardous alcohol consumption and the adverse consequences associated with its use among university students in Ireland, with particular reference to gender differences~~, using both class room distributed and web based questionnaires~~. ~~The class room based survey was carried out in one large Irish university whereas the web based survey targeted all Irish universities and Institutes of Technology. The focus of the current paper is on the single university from which data from both the class room and web based survey are available.~~

Methods and participants

Undergraduate students attending one large university in Ireland, University College Cork (UCC), were eligible for inclusion in the class room based study which was focused on health and lifestyle with particular reference to alcohol consumption. Students were sampled at degree programme level using probability proportional to size (PPS) sampling. We estimated the required sample size at 2,686 students, based on an undergraduate student population of 12,475, a required precision of 1.5% and an expected prevalence of hazardous alcohol consumption of 73%, based on an earlier unpublished masters dissertation [31]. Lecturers or module coordinators were contacted to request permission to distribute and collect questionnaires during fifteen minutes of lecture time on a date convenient to them between March 12th and March 23rd, 2012. Students were briefed orally and in writing (on the front sheet of the questionnaire) on the aims and objectives of the study including details of the confidential, anonymous and voluntary nature of the exercise. Participating in the research was presumed to imply consent. To enhance the response rate, the distribution of questionnaires was avoided on Mondays and Fridays due to Irish student social and recreational patterns.

Of the lecturers/module coordinators approached to facilitate the study, 94.3% agreed to cooperate. A total, 2,332 students completed this face-to-face lecture theatre based survey; 57 students were subsequently identified as post-graduate students and were excluded from the analyses. Thus data are available on a total of 2,275 undergraduates with a response rate of 84% for those attending class on the day of survey and 51% of those registered for the specific modules. The gender and the degree programme profiles of the sample collected were broadly similar to those registered with the university; 63.1% of the sample were women versus 56% for the university, 39.7% were registered with the College of Arts, Celtic Studies & Social Sciences (university 33%), 20.1 % with Business & Law (university 21%), 24.6% with Science, Engineering & Food Science (university 27%) and 14.2% with Medicine & Health, (university 19%). However, with regard to year in college there was over sampling of first years (46.8% vs. 32.1%) and under sampling of fourth years (7.7% vs. 16.7%).

~~Following the classroom based survey, SurveyMonkey the online survey tool, was used for the web based survey~~ [32]~~. Initially, a link to the questionnaire was e-mailed to all registered students at fourteen third-level education institutions (universities and institutes of technology) in Ireland. The link was e-mailed on the 26th March 2012 (after the lecture theatre survey) and remained open for two weeks. In the e-mail, students were advised of the aims and objectives of the research and invited to participate in the survey by following a link. The survey was a replica of the questionnaire distributed in lecture theatres. The average response rate across the institutions was 5% and the response rate for UCC was 2.4%, a total of 333 undergraduates. Students completing the web-based survey were advised not to return the questionnaire if they had previously completed the campus based survey.~~

As an incentive~~, both in classroom and online~~ participants were invited to enter a draw to win a tablet computer following survey completion. As completion was anonymous, each student was advised to send an e-mail with their name and e-mail address to enter the prize draw. Details of how to enter were included on their post-questionnaire information sheet which was handed out in the lecture theatre~~ or included as the last page of the questionnaire on Survey Monkey~~. This post-questionnaire information sheet also included contact information to different websites and institutions offering help and advice on alcohol related issues.

Questionnaire

A total of 49 questions were included in the questionnaire which was based on previously validated instruments, including the Alcohol Use Disorders Identification Test for Consumption (AUDIT-C) [33], the Warwick Edinburgh Mental Well-being scale (WEMWBS) [34] and the International Physical Activity Questionnaire (IPAQ) [35]. In addition, questions on smoking status [36], drug use [37], ~~sexual health~~sexual practice and activity [10], diet and self-reported height and weight [37] were taken from the national survey on health and lifestyle in Ireland [37] and previous university research [10, 36]. All of these instruments have previously shown reliability and validity among a student population [3, 38]. It took approximately twelve minutes to complete the paper-based questionnaire.

Hazardous alcohol consumption was estimated using the Alcohol Use Disorders Identification Test for Consumption (AUDIT-C) developed by the World Health Organisation [11] to identify hazardous patterns of alcohol consumption. The AUDIT-C takes the first three questions of the AUDIT questionnaire. These questions focus on the frequency of consumption, the number of units consumed and the number of binge drinking occasions. The guidelines on safe alcohol consumption in women are lower than those for men reflecting their increased vulnerability to alcohol related harm [39]. In the current study therefore, hazardous alcohol consumption was defined as an AUDIT-C score of 6 or more among males and 5 or more among females. This instrument has demonstrated high sensitivity and specificity among a population of young adults aged between 18 and 20 years [33, 40, 41].

BMI was estimated from self-reported height and weight with normal weight, overweight and obesity defined as BMI of 20-24.99 Kg/M^2, 25-29.99 Kg/M^2 and ≥ 30 Kg/M^2, respectively. Physical activity was coded as low, moderate and high using the standard International Physical Activity Questionnaire (IPAQ) protocol [35]. WEMWBS scores were divided into categories of mental well-being as defined by Braunholtz et al [42]. Below average mental wellbeing was defined as a WEMWBS score of more than one standard deviation below the mean, average mental wellbeing was within one standard deviation of the mean and above average mental wellbeing was over one standard deviation above the mean [43].

The Clinical Research Ethics Committee, University College Cork, Ireland, granted ethical approval for this research.

Data management & Statistical analysis

The paper questionnaire data were scanned, checked and verified using TeleForm TM scanning processes. The estimated error rate for data entry was 0.06% based on manual checking of a 10% sample of all scanned questionnaires. ~~The web based data were downloaded from SurveyMonkey into Excel.~~ All data were analysed using *IBM SPSS Statistics Version* 20. ~~Given the low response rate and small sample size for the web based survey, we have focused the primary analyses on the~~

~~classroom based sample. In the data from the latter sample, u~~Univariate and multivariate logistic regression analyses were undertaken to investigate factors associated with hazardous alcohol consumption separately in men and women.

Results

~~**Table 1** shows the profile of respondents and the main questionnaire findings on health and well-being by mode of data collection. Respondents to the web based survey were significantly older, in later years in college and were less likely to live at home with their parents. There were no significant differences in the course of study between the two sample groups. The web respondents were less physically active and reported a higher number of sexual partners. The two sample groups were similar in self reported BMI, mental well-being, illicit drug use and smoking prevalence. However, the prevalence of hazardous alcohol consumption was significantly higher in the web based sample 74.8% (95% C.I. 70.0%-79.6%) versus 66.4% (95%CI 64.4-68.3) in the class room based sample. In further analysis comparing the classroom and web-based survey data stratified by age, the prevalence of HAC was similar in the two surveys among students aged 19 or less (70.1% vs. 71.1%) where as in students aged 20 or more the prevalence of HAC was lower in the classroom based survey (64.1% vs. 74.8%).~~

Hazardous alcohol consumption in the class room study sample

~~In the classroom based sample, t~~The prevalence of hazardous alcohol consumption (HAC) was similar in men (65.2%) and women (67.3%). In women, 57.4% met HAC thresholds for men. Only 8.4% of men and 5.8% of women were non drinkers. Approximately, 17% of men and 5% of women had an ~~audit~~ AUDIT-C score of 10 or higher. This equates to consuming more than 6 units of alcohol at least 4 times per week and in some cases daily. The prevalence of hazardous alcohol consumption by age, socio-demographic variables and lifestyle factors, are presented in **Table ~~2~~1,** stratified by gender. Broadly similar trends were observed in univariate analyses in both men and women with higher prevalence of hazardous alcohol consumption associated with later years in college, studying Business or Law, not owning a house, current smoking, illicit drug use and being sexually active. Hazardous alcohol consumption was associated with above average mental well-being in men but not in women in these univariate analyses.

Multivariate analysis

Controlling for age only, males [OR=2.26 95%CI1.46-3.49; p<0.001] and females [OR=2.12 95%CI1.44-3.14; p<0.001] studying Law and Business were over twice as likely to report HAC, as their peers studying Science & Engineering. Among males, those in third year were 56% more likely to report HAC [OR=1.56 95%CI1.02-2.41; p<0.001] while, among females, those in fourth year were 80% more likely to report HAC than their counterparts in first year [OR=1.80 95%CI 1.14-2.86]. Male smokers were more than twice as likely to report HAC while female smokers were more than three times as likely to report HAC compared to their non-smoking peers. In men and women, those reporting illicit drug use were over twice as likely to report hazardous alcohol consumption. Males reporting 1-3, 4-5 and 6+ lifetime sexual partner were 4, 5 and 6 times more likely to report HAC than those reporting no sexual partners. For females the OR's were increase 3 fold, 5 fold and 7 fold for the same categories.

In further analyses controlling for age, course of study, accommodation type and college year, males [OR=2.33 95%CI 1.52-3.26; p=0.001] and females [OR=2.11 95%CI 1.51-2.96; p<0.001] who reported illicit drug use were more likely to report HAC. Among females current smokers were almost twice as likely to report HAC compared to their non-smoking female peers [OR=1.95 95%CI1.36-2.81; p<0.001]. However in these adjusted analyses, the association of smoking with HAC in males was attenuated. The associations between HAC and number of sexual partners was also somewhat attenuated in these adjusted analyses but remained highly significant.

The final model was adjusted for other significant factors from the age adjusted model. The model observes that being a house owner is negatively associated with HAC for both males and females while being in second year is negatively associated for males. In contrast, studying Law and Business was positively associated with HAC. Males and females reporting one or more sexual partner or illicit drug use were also positively associated with hazardous alcohol consumption as were females who reported smoking. These results are shown in **Table ~~3~~2**.

Adverse consequences

The pattern and frequency of adverse consequences of alcohol consumption was broadly similar in men and women. However, men were more likely to report getting into a fight (p=0.001) and having a one night stand (p<0.001) than women. No significant differences were found for other second-hand effects. **Table ~~4~~ 3** shows the proportion of students reporting one or more of 13 adverse consequences of alcohol consumption. Over 70% of men with a hazardous alcohol consumption pattern reported regretting something they had said or done due to their alcohol consumption. Over 60% reported missing days from work or college due to their alcohol consumption, affecting academic performance and future prospects. In men, stark differences were observed between hazardous and non-hazardous alcohol consumers in relation to unintended (19.2% vs. 2.8) and unprotected sex (16.8% vs. 3.3%). Similarly in women the burden of adverse consequences was substantially greater among hazardous drinkers than their non-hazardous peers, with 73% regretted something they said or did after drinking compared to 35.5% of their peers. Approximately 17% of female hazardous drinkers reported unintended sex while 13.8% reported unprotected sex because of their drinking compared to 3.5% and 3.8% respectively among their peers.

Discussion

These findings highlight the extremely high prevalence of hazardous alcohol consumption (66.4%) relative to the general population, the burden of related adverse consequences and the narrowing of the gender gap among students in a large Irish university [31]. Almost two thirds of respondents reported hazardous alcohol consumption, (65.2% men and 67.3% women) and in women, 57.4% of the sample meet the current hazardous alcohol consumption thresholds for men. ~~Even higher levels of hazardous alcohol consumption were noted in a web based survey compared to the primary classroom based survey but response rates for the web survey were unacceptably low.~~ It has been suggested that the threshold for hazardous drinking is too low [44]. However it is based on the well defined biological and behavioural effects of alcohol [11]. In the context of the present study, it should also be noted that within the large group of hazardous drinkers, over one quarter of hazardous drinkers were consuming more than 6 units of alcohol (binge drinking) at least 2-3 times per week and in some cases daily.

Alcohol consumption has been noted as the number one public health problem facing universities [45]. Previously, significant differences were observed among male and female students in the CLAN survey [10]. In a more recent study from University College Cork using the same screening tool this discrepancy between males (82%) and females (71%) was observed [31]. Thus, the current findings of no gender gap in the prevalence of hazardous alcohol consumption is noteworthy and of particular concern given women's increased innate susceptibility to the harmful effects of alcohol. It is unclear whether this narrowing of the gender gap reflects changing cultural norms or has arisen as a direct consequence of alcohol marketing targeting young women.

The current research suggests that the prevalence of alcohol consumption in Irish university students (based on self report) is broadly similar to levels observed in British students using the AUDIT scale [7] but significantly higher than those observed in the US [6]. A large proportion of students (31.7%) felt their drinking harmed their work or studies. The latter findings are similar to those from the Harvard College Alcohol Study where one third of students had missed class during the last year due to their alcohol consumption [22]. In other studies of alcohol consumption in

university students, adverse consequences from alcohol consumption range in severity from violence and physical harm [10] to unplanned and unintended sexual intercourse [46], broadly similar to those reported in the current study.

The current research found HAC was associated with smoking, an increasing number of sexual partners and illicit drug use. The current study confirms previous research by Harrison et al who stated that smoking is associated with hazardous drinking in young adults [47]. In relation to the sexual health of university students, previous research reports that 70% are sexually active [48]. Previously, the Harvard College Alcohol Study illustrated that the reporting of unplanned sexual activity increased from 8% among non-binge drinkers, 22% among occasional binge drinkers (six or more standard drinks in one drinking occasion) to 42% among frequent binge drinkers [49]. Those reporting unplanned sexual activity are also less likely to use protection [50]. Coupled with high rates of short term or casual sexual partnerships and reported low levels of sexual health knowledge, hazardous alcohol consumers are at higher risk of unintended pregnancy or contracting a sexually transmitted infection [51]. Similarly, the literature shows a high prevalence of illicit drug use among university students. Previously, Chiauzzi reported over 20% of the student population were found to be part of a group categorised by high risk drinking and high prevalence of illicit drug use [52]. The current research complements these findings, highlighting the association between alcohol and a twelve month prevalence of illicit drug use and the growing need to tackle these issues concurrently.

Strengths & Weaknesses

This work can be readily replicated in other universities worldwide. We used a standard, internationally recognised screening tool for hazardous alcohol consumption. Probability proportional to size sampling strategy was employed to ensure that all students, regardless of degree course had an equal opportunity of being included in the study. The demographics of study participants were broadly similar to those of the wider institution in relation to course of study and gender.

The overall response rate, defined in terms of students registered for specific modules was 51%. Although the response rate was low, it is similar to that achieved in major national [10] and international research [53] of student alcohol consumption. While this falls short of the desired rate of at least 70% in health and well-being surveys, the study provides important policy relevant data. We have no reason to believe that the non-respondents to this survey, who were absent from class on the day of sampling, are drinking at less hazardous levels. There was over-representation of first years and under-representation of fourth years. As the prevalence of HAC was higher in fourth year students than first years this imbalance in sampling is likely to have lead to an underestimation of overall prevalence of HAC. Thus the current study may be regarded as reporting the lower bound estimates of hazardous alcohol consumption in Irish university students. This pattern of alcohol consumption is not unique to this university which in recent years has developed a campus wide health promoting university initiative with a significant focus and dedicated resources centered on the problem of excessive alcohol consumption [54].

Conclusion

Hazardous alcohol consumption continues to be a public health issue in Irish university students, both in terms of immediate adverse consequences and long term risks to physical, mental and social health and wellbeing. Currently the Irish state is at a decision point with regard to policies on the promotion and marketing of alcohol. The findings from this study highlight the need for effective public policy measures in response to this issue such as a minimum unit price for alcohol and a ban on sports sponsorship.

Table 1: Characteristics of undergraduate students sampled in the classroom and via the web based survey

Gender	Classroom (N=2275)	Web (N=333)	p-value
Male	830 (36.9%)	110 (33%)	P=0.17
Age			
≤18	297 (13.3%)	3 (0.9%)	**p <0.001**
19	697 (31.3%)	43 (13.2%)	
20	467 (21.0%)	89 (27.3%)	
21	314 (14.1%)	95 (29.1%)	
≥22	451 (20.3%)	96 (29.4%)	
Course of Study			
Science/Engineering/ Food Science	554 (24.6%)	90 (27.1%)	p=0.16
Arts/Celtic Studies/Social Science	894 (39.7%)	124 (37.3%)	
Law & Business	453 (20.1%)	60 (18.1%)	
Medicine & Health	319 (14.2%)	57 (17.2%)	
Other	34 (1.5%)	1 (0.3%)	
Year in college			
First	1065 (46.8%)	14 (4.2%)	**p<0.001**
Second	327 (27.6%)	132 (39.6%)	
Third	408 (17.9%)	109 (32.7%)	
Fourth	175 (7.7%)	78 (23.4%)	
Accommodation			
House Owner	100 (4.4%)	8 (2.4%)	**p=0.001**
Parents' House	972 (43.0%)	113 (34.2%)	
Rented House/Apartment	909 (40.2%)	186 (56.4%)	
Campus Accommodation	280 (12.4%)	23 (7%)	
BMI			
Underweight	142 (7.4%)	17 (6.3%)	p=0.39
Normal weight	1354 (70.3%)	181 (67%)	
Overweight	329 (17.1%)	57 (21.1%)	
Obese	100 (5.2%)	15 (5.6%)	
Physical Activity (IPAQ)			
Low	699 (31.3%)	33 (36.7%)	**p=0.03**
Moderate	935 (41.9%)	44 (48.9%)	
High	600 (26.9%)	13 (14.4%)	
Mental Well-being (WEMWBS)			
Below average wellbeing	408 (17.9%)	40 (14.5%)	p=0.12
Average wellbeing	1551 (68.2%)	186 (69.6%)	
Above average wellbeing	316 (13.9%)	49 (17.8%)	
No. of sexual partners			
None	438 (20.6%)	46 (16.8%)	p=0.06
1-3	1038 (48.9%)	123 (44.9%)	
4-5	281 (13.2%)	46 (16.8%)	
6 or more	366 (17.2%)	21.5% (59)	
Substance misuse			
Hazardous alcohol consumer	1497 (66.4%)	237 (74.8%)	**p=0.003**
Illicit drug user	717 (31.5%)	120 (36%)	p=0.1
Smoker	590 (26.6%)	84 (29.2%)	p=0.35

Table ~~2~~1: Prevalence of hazardous alcohol consumption by gender, age, sociodemographic and lifestyle factors

		Men [N=830 (36.9%)]	p-value	Women [N=1420 (63.1%)]	p-value
All		541 (65.2%)		956 (67.3%)	
Age	*<=18*	72 (67.9%)	**0.003**	138 (74.2%)	**0.04**
	19	190 (70.1%)		290 (69.2%)	
	20	101 (66.9%)		214 (68.6%)	
	21	71 (70.3%)		139 (66.5%)	
	22+	100 (53.5%)		159 (60.9%)	
Course of study	*Science/Engineering/ Food Science*	159 (62.6%)	**0.001**	192 (65.1%)	**<0.001**
	Arts/Social			367 (63.4%)	
	Science/Education	182 (59.5%)			
	Law & Business	145 (77.5%)		204 (79.4%)	
	Medicine & Health	38 (61.3%)		175 (68.4%)	
	Other	11 (78.6%)		13 (65%)	
Year in college	*First*	286 (65.0%)	**0.03**	402 (65.6%)	**0.046**
	Second	112 (58.0%)		299 (70.0%)	
	Third	104 (72.7%)		165 (63.2%)	
	Fourth	39 (72.2%)		90 (75.6%)	
Accommodation	*Campus Accommodation*	49 (70.0%)	**0.005**	140 (67.6%)	**<0.001**
	Rented House/Flat	209 (67.0%)		410 (70.1%)	
	Parents' House	256 (65.6%)		381 (67.0%)	
	House Owner	20 (41.7%)		19 (38.0%)	
BMI	*Normal Weight*	355 (65.7%)	0.97	630 (66.7%)	0.96
	Overweight/Obese	145 (65.9%)		135 (66.5%)	
Physical Activity	*Low*	162 (66.1%)	0.83	295 (65.7%)	0.07
	Moderate	230 (65.7%)		374 (65.4%)	
	High	140 (63.6%)		269 (72.1%)	
Mental Well-being (WEMWBS)	*Below average wellbeing*	79 (57.7%)	**0.02**	169 (65.3%)	0.64
	Average wellbeing	372 (65.0%)		660 (68.1%)	
	Above average wellbeing	90 (74.4%)		127 (66.1%)	
No. of sexual partners	*None*	72 (41.6%)	**<0.001**	120 (45.8%)	**<0.001**
	1-3	246 (72.4%)		479 (69.8%)	
	4-5	67 (76.1%)		146 (76.8%)	
	6+	121 (68.4%)		147 (79.9%)	
Smoker	*Yes*	163 (73.4%)	**0.002**	292 (81.3%)	**<0.001**
	No	361 (61.8%)		647 (62.7%)	
Illicit drug user	*Yes*	251 (76.3%)	**<0.001**	302 (81.6%)	**<0.001**
	No	290 (57.9%)		654 (62.3%)	

Table ~~3~~2: Multivariate Logistic Regression: Risk factors associated with male and female hazardous alcohol consumption

	Male						Female					
	Age adjusted		Multivariate analysis**		Multivariate analysis***		Age adjusted		Multivariate analysis**		Multivariate analysis***	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI		
Course of study												
Science/Engineering/ Food Science	1.00		1.00		1.00		1.00		1.00		1.00	
Arts/Social Science/Education	1.07	0.75-1.53	0.62	0.41-0.94	0.75	0.49-1.15	1.03	0.76-1.39	0.82	0.59-1.15	0.87	0.62-1.23
Law & Business	**2.26**	**1.46-3.49**	**2.52**	**1.54-4.11**	**2.81**	**1.70-4.63**	**2.12**	**1.44-3.14**	**2.18**	**1.39-3.42**	**2.17**	**1.37-3.42**
Medicine & Health	1.14	0.63-2.06	1.01	0.52-1.95	1.01	0.52-1.96	1.20	0.84-1.73	1.18	0.79-1.77	1.22	0.81-1.84
Other	2.49	0.66-9.36	1.15	0.29-4.68	1.46	0.34-6.23	1.09	0.42-2.85	0.85	0.31-2.33	0.99	0.36-2.71
Year in college												
First	1.00		1.00		1.00		1.00		1.00		1.00	
Second	0.86	0.60-1.24	**0.54**	**0.35-0.82**	**0.55**	**0.35-0.85**	1.28	0.98-1.69	0.91	0.66-1.25	0.94	0.68-1.30
Third	**1.56**	**1.02-2.41**	1.24	0.73-2.11	1.21	0.07-2.10	0.95	0.70-1.30	0.82	0.56-1.19	0.91	0.62-1.34
Fourth	1.57	0.83-2.98	0.66	0.32-1.36	0.67	0.31-1.45	**1.80**	**1.14-2.86**	1.07	0.60-1.88	1.35	0.75-2.42
Accommodation												
Campus Accommodation	1.00		1.00		1.00		1.00				1.00	
Rented House/Apartment	1.47	0.53-4.08	0.60	0.30-1.19	0.57	0.28-1.19	1.32	0.93-1.88	0.86	0.57-1.30	1.02	0.67-1.55
Parents' House	0.91	0.52-1.59	0.52	0.27-1.01	0.50	0.25-1.00	1.06	0.75-1.50	0.78	0.53-1.17	0.84	0.56-1.26
House Owner	1.47	0.47-4.08	0.17	0.07-0.43	0.16	0.06-0.43	**0.95**	**0.92-0.98**	**0.19**	**0.09-0.40**	**0.23**	**0.11-0.51**
BMI												
Normal Weight	1.00		1.00		1.00		1.00		1.00		1.00	
Overweight/Obese	1.30	0.91-1.87	1.12	0.76-1.66	1.08	0.73-1.59	1.10	0.78-1.54	1.07	0.74-1.53	1.05	0.73-1.51
Physical Activity												
Low	1.00		1.00		1.00		1.00		1.00		1.00	
Moderate	0.94	0.66-1.34	1.25	0.79-1.98	1.18	0.72-1.92	0.99	0.76-1.30	0.88	0.65-1.20	0.88	0.63-1.24
High	0.91	0.61-1.34	1.05	0.70-1.59	0.92	0.60-1.42	1.12	1.04-1.93	1.23	0.87-1.74	1.36	0.93-1.99
No. of sexual partners												
None	1.00		1.00				1.00		1.00		1.00	
1-3	**4.12**	**2.78-6.08**	**3.58**	**2.39-5.49**	**3.53**	**2.26-5.53**	**3.09**	**2.28-4.15**	**2.58**	**1.87-3.55**	**2.67**	**1.87-3.81**

4-5	**5.70**	**3.13-10.36**	**4.25**	**2.22-8.16**	**4.39**	**2.14-8.71**	**5.36**	**3.45-8.35**	**3.21**	**2.00-5.13**	**3.08**	**1.83-5.19**
6 or more	**6.90**	**1.04-11.77**	**3.83**	**2.18-6.73**	**3.88**	**2.14-7.01**	**7.40**	**4.58-12.0**	**3.14**	**1.91-5.17**	**3.35**	**1.97-5.72**
Smoker												
No	1.00		1.00		1.00		1.00		1.00		1.00	
Yes	**2.70**	**1.81-4.04**	1.06	0.68-1.66	0.86	0.54-1.37	**3.38**	**2.44-4.68**	**1.95**	**1.36-2.81**	**1.99**	**1.35-2.93**
Illicit drug user												
No	1.00		1.00		1.00		1.00		1.00		1.00	
Yes	**2.33**	**1.70-3.21**	**2.23**	**1.52-3.26**	**2.43**	**1.63-3.63**	**2.59**	**1.93-3.47**	**2.11**	**1.51-2.96**	**1.90**	**1.33-2.71**

** Adjusted for university level effects of course of study, accommodation type and college year

*** Adjusted for university level effects and other significant factors in the age adjusted model

Table 43: Adverse consequences associated with harmful alcohol consumption among male and female students

		Male 830 [36.9%]		Females 1420 [63.1%]	
		Hazardous alcohol consumption	Non-hazardous alcohol consumption	Hazardous alcohol consumption	Non-hazardous alcohol consumption
Got into a fight when you had been drinking	*Yes*	148 (27.36%)	13 (4.5%)	190 (19.87%)	24 (5.17%)
Been in an accident after drinking	*Yes*	86 (15.9%)	11 (3.81%)	146 (15.27%)	17 (3.66%)
Felt you should cut down on your drinking	*Yes*	204 (37.71%)	42 (14.53%)	365 (38.18%)	45 (9.7%)
Regretted something you said or did after drinking	*Yes*	402 (74.31%)	81 (28.03%)	698 (73.01%)	136 (29.31%)
Felt drinking harmed your friendship or social life	*Yes*	101 (18.67%)	17 (5.88%)	198 (20.71%)	26 (5.6%)
Felt drinking harmed your work or studies	*Yes*	219 (40.48%)	39 (13.49%)	408 (42.68%)	48 (10.34%)
Felt drinking harmed your health	*Yes*	186 (34.38%)	41 (14.19%)	306 (32.01%)	59 (12.72%)
Felt the effect of alcohol while in work or class	*Yes*	303 (56.01%)	47 (16.26%)	557 (58.26%)	84 (18.1%)
Missed days from work/college due to a hangover/too much alcohol	*Yes*	326 (60.26%)	43 (14.88%)	549 (57.43%)	64 (13.79%)
Had financial problems as a result of your drinking	*Yes*	112 (20.7%)	17 (5.88%)	220 (23.01%)	14 (3.02%)
Had unprotected sex as a result of your drinking	*Yes*	91 (16.82%)	8 (2.77%)	132 (13.81%)	14 (3.02%)
Had unintended sex as a result of your drinking	*Yes*	104 (19.22%)	7 (2.42%)	166 (17.36%)	14 (3.02%)
Had a one night stand	*Yes*	145 (26.8%)	15 (5.19%)	158 (16.53%)	17 (3.66%)
None of these	*Yes*	42 (7.76%)	148 (51.21%)	73 (7.64%)	239 (51.51%)

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Details of contributors

MPD – Design of study, analysed the data, drafted and edited the manuscript

FS – Design and conception, statistical support, draft and editing of manuscript

MB – Design and conception of study, drafting and editing of manuscript

IJP – Design and conception of study, statistical support, drafting and editing of manuscript, overall supervision of project

*All authors gave full approval of the version to be published

Competing interests

All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work

Ethical Approval

The Clinical Research Ethics Committee, University College Cork, Ireland, granted ethical approval for this research.

Transparency declaration

The lead author affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

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Data Sharing Statement

There is no additional data available

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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation		Page No.
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	✓	Title page
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	✓	2
Introduction				
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	✓	3
Objectives	3	State specific objectives, including any prespecified hypotheses	✓	3
Methods				
Study design	4	Present key elements of study design early in the paper	✓	4-5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	✓	4
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	✓	4
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	✓	5
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	✓	4-5
Bias	9	Describe any efforts to address potential sources of bias	✓	5
Study size	10	Explain how the study size was arrived at	✓	4
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	✓	5
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	✓	5
		(*b*) Describe any methods used to examine subgroups and interactions		
		(*c*) Explain how missing data were addressed		
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	✓	5
		(*e*) Describe any sensitivity analyses		
Results				
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	✓	6
		(b) Give reasons for non-participation at each stage		
		(c) Consider use of a flow diagram		
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	✓	6,8,15
		(b) Indicate number of participants with missing data for each variable of interest		

Outcome data	15*	Report numbers of outcome events or summary measures	✓	6,8,15
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	✓	7,16,17
		(*b*) Report category boundaries when continuous variables were categorized		
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period		
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses		
Discussion				
Key results	18	Summarise key results with reference to study objectives	✓	9
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	✓	10-11
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	✓	11
Generalisability	21	Discuss the generalisability (external validity) of the study results	✓	9-11
Other information				
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based		

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.