



Alcohol consumption, life satisfaction and mental health among Norwegian college and university students



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ABSTRACT

Objective: High-level alcohol consumption is common in, and central to, the student community. Among adults, high-level alcohol consumption, and sometimes also low, has been associated with poorer social integration and mental health. We aimed to investigate how alcohol consumption relates to life satisfaction and mental health among students in higher education.

Methods: Data from the Norwegian study of students' health and well-being (SHoT, 2014, n = 9632) were used. Associations between alcohol consumption (AUDIT; abstainers, low risk, risky and hazardous consumption) and life satisfaction and mental health complaints, as well as number of close friends, and social and emotional loneliness were investigated using linear regression models. Crude models and models adjusted for age, gender and relationship status were conducted.

Results: Students reporting hazardous consumption reported lower life satisfaction, more mental health complaints, and more emotional and social loneliness than students with low risk consumption. Students reporting risky consumption reported slightly reduced life satisfaction and more mental health complaints, but more close friends and less social loneliness. Abstainers did not report reduced life satisfaction or more mental health complaints, despite reporting fewer close friends and more social loneliness.

Conclusion: High-level alcohol consumption among students might indicate increased risk of several problems in the future – but also currently. Our findings further imply that the quality of friendships might be more important for life satisfaction and mental health than the number of friends, but also that social integration in student communities might be more difficult for students who do not drink.

1. Introduction

It is well-established that prolonged heavy drinking is harmful for the individual's physical and mental health (Babor et al., 1994; Forouzanfar et al., 2015) (heavy drinking here used as an umbrella term for various forms of high and problematic alcohol use). In Norway and other high-income countries, alcohol consumption and alcohol related disorders greatly contribute to the burden of disease (Agarath et al., 2016; Forouzanfar et al., 2015; GBD 2016 DALYs and HALE Collaborators, 2017; Knudsen et al., 2017), and high-level consumption is associated with mental health problems (Jones et al., 2008; Knight et al., 2002; Rehm et al., 2010; Rodgers et al., 2000a; Rodgers et al., 2000b; Skogen et al., 2009) and psychosocial problems in adults

(Collins, Ellickson, & Klein, 2007; Rodgers et al., 2000b).

Mood enhancement (Cooper, 1994; Cooper et al., 1992), reduction of tension or increased coping (Cooper, 1994; Cooper et al., 1992), as well as social motives (making social gatherings more fun) (Cooper, 1994; Cooper et al., 1992; Kuntsche et al., 2005) and conformity (to fit in, to be liked) (Cooper, 1994) are commonly reported reasons to drink. During the transitional period from adolescence to adulthood social expectations, roles, and relationships undergo significant changes. Adolescents spend less time with family and more with peers (Larson & Richards, 1991), and adolescence has traditionally been viewed as a time of increasing peer and decreasing parental influence (Berndt, 1979). During late adolescence, many begin their college and university studies, and move away from their hometown to live on their own for

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the first time. New students report alcohol as central in getting to know each other (Lie & Kahlbom, 2011; Stålesen, 2015). Heavy drinking is by some students seen as integral to the college social life (Crawford & Novak, 2006). Intense partying is often expected (Lie & Kahlbom, 2011; Vaadal, 2014), and drinking and drinking to intoxication can give admittance to the emotional community (Stålesen, 2015; Vaadal, 2014). Perceived peer norms seem to strongly influence students' drinking behavior (Perkins, 2002a; Read et al., 2002), and not surprisingly, most young people and students report social motives for drinking (LaBrie, Hummer, & Pedersen, 2007; Wicki, Kuntsche, & Gmel, 2010).

Students often report that positive experiences related to alcohol - such as having fun/socializing, expressing oneself (Park, 2004), and social approval and acceptance by peers - outweigh potential negative experiences of alcohol (Dodd et al., 2010). On social networking sites, the positive aspects of alcohol use, such as enjoyment and social community, are most frequently shared (Erevik et al., 2017a). Further, the most socially integrated (Perkins, 2002a) and most popular students (high school) (Diego, Field, & Sanders, 2003) drink more, and greater alcohol use (greater quantity/frequency, more frequent intoxication, heavy episodic drinking) has been found to predict higher subjective well-being among students, both concurrently and prospectively (Molnar et al., 2009).

As such, alcohol consumption seems to be an important and positive aspect of student life. Severe psychological problems and chronic conditions associated with prolonged heavy drinking (for instance liver cirrhosis, cardio-vascular disorders, and alcohol dependency (Jones et al., 2008; Knight et al., 2002; Rehm et al., 2010)) take time to develop, and are therefore less likely to affect students than older adults. However, heavy drinking is also associated with more immediate adverse events, such as falls, injuries, traffic accidents, unwanted sexual encounters, or unprotected sex (Hingson et al., 2002; Wechsler et al., 1994; White & Hingson, 2014), reduced academic performance (Myrtveit et al., 2016; Perkins, 2002b; Porter & Pryor, 2007; Wechsler et al., 1994; Wechsler et al., 2000; Wolaver, 2002), hangovers and sickness, and saying or doing things one will later regret (Dodd et al., 2010; Park, 2004; Tefre, Amundsen, Nordlund, & Lund, 2007). Such events might influence life satisfaction, mental health and social relations, and alcohol related problems have indeed been found consistently associated with diminished life satisfaction among students (Molnar et al., 2009; Murphy et al., 2006; Murphy, McDevitt-Murphy, & Barnett, 2005). The association between alcohol use and adverse events might be explained either by the risk behavior hypothesis, suggesting that high alcohol use increases the likelihood of experiencing adverse events (Bountress et al., 2019), or if alcohol is used to cope with problems (Cooper, 1994; Cooper et al., 1992). Thirdly, some other variable (such as personality type) might precede both alcohol use and other risky behavior (Vollrath & Torgersen, 2002). These causal pathways are not necessarily exclusive (Stewart, 1996).

Heavy drinking might not only influence well-being for the consumer. The focus on alcohol in student communities might also make social integration problematic for students who cannot or do not want to take part in heavy drinking. More than half of Norwegian students of higher education report that too much alcohol is consumed in the student community (Myrtveit, Askeland, Knudsen, et al., 2016). Participating in student events without drinking can be experienced as difficult (Lie & Kahlbom, 2011; Rimstad et al., 2011) and some students report feeling excluded from important social arenas and missing out on opportunities for building relationships with other students (Rimstad et al., 2011). Nonparticipation in certain student events is associated with poorer social integration, and individuals who do not drink tend to participate less (Myrtveit, Askeland, Knapstad, Knudsen, & Skogen, 2016). Similarly, adults who do not drink in cultures where consumption is the norm, have been found to have lower social support (Rodgers et al., 2000b) and fewer close friends (Skogen et al., 2009), as well as lower social well-being, sociability and social participation (Peele & Brodsky, 2000). In general, social relationships and social support are

associated with better physical and mental health (Berkman et al., 2000; Melchior et al., 2003; Seeman, 1996), and indeed, studies have found poorer mental health among individuals who do not drink (Rodgers et al., 2000a; Rodgers et al., 2000b; Skogen et al., 2009). Investigating mental and social wellbeing among students who abstain from alcohol is therefore of particular importance.

Further, the complex association between alcohol consumption and well-being seems gender specific (Murphy et al., 2005; Murphy et al., 2006). In general, males drink more than females (Dodd et al., 2010; O'Malley & Johnston, 2002; Wechsler et al., 1995; Wicki et al., 2010), also among Norwegian students (Erevik et al., 2017b; Heradstveit et al., 2019; Myrtveit, Askeland, Knudsen, et al., 2016). Among males, heavy drinking/frequency of drinking seems associated with better social satisfaction/social belonging (Murphy et al., 2005; Murphy et al., 2006). Among female students, however, drinking (as opposed to abstaining) has been found associated with lower levels of general satisfaction with life (Murphy et al., 2005), while frequency of drinking has been found unassociated with social belonging (Murphy et al., 2006). Although perceived norms have been found to be a significant predictor of heavy drinking for both genders, the association is stronger among male students (Read et al., 2002). It further seems that male students may be more susceptible to peer influences than female with respect to alcohol use (Lo, 1995) and that alcohol might still be a more important aspect of the male role than the female. On the other hand, the gender gap in alcohol consumption is closing (O'Malley & Johnston, 2002), and little is known about how gender interacts with the association between alcohol consumption and life satisfaction and mental health among students in Norway today.

Based on the above considerations, we aimed to investigate how alcohol consumption is associated with life satisfaction and mental health among Norwegian college students in a cross-sectional sample. As the social aspects related to alcohol consumption seem of particular importance to students, we also aimed to investigate the association between alcohol consumption and number of friends and social and emotional loneliness, measures potentially influencing both life satisfaction and mental health.

2. Materials and methods

2.1. Data used

Data from the Norwegian study of students' health and well-being, SHoT ("Studentenes Helse- og Trivselsundersøkelse"), commissioned by the student welfare organizations in Bergen, Oslo and Trondheim and collected in February and March 2014, were used (TSN Gallup, 2015; Nedregård & Olsen, 2014). All full-time students below the age of 35 with a Norwegian citizenship made up the population of interest. Data was collected online. An email with a link to a questionnaire was sent to 47,514 randomly selected students from the 10 largest student welfare organizations in Norway. In total, 13,663 students (29%) responded (Nedregård & Olsen, 2014). At some of the smaller study institutions response rate was particularly low. Therefore, as in previous papers (Myrtveit, Askeland, Knapstad, et al., 2016; Myrtveit, Askeland, Knudsen, et al., 2016), only students from the universities and university colleges in Norway's traditional university cities, Bergen, Oslo, Trondheim and Tromsø, were eligible (9810; 72% of responders).

2.2. Socio-demographic variables

Participants reported their age (no missing), gender (no missing), relationship status and numbers of semesters studied. Relationship status was grouped as married/partner (coded as 1) cohabitant (2), boyfriend/girlfriend (3), single (4), and other (5). Level 1 and 2 were combined in the descriptive table, but all levels used categorically when included in the statistical models. In total, 12 (0.1%) individuals did not provide information on relationship status and 33 (0.3%) did not

provide information on number of semesters studied.

2.3. Alcohol consumption

Participants were asked how often they consumed alcohol, with response options “never”, “monthly or less”, “2–4 times a month”, “2–3 times a week”, and “4 times a week or more”. Individuals responding “never” were grouped as abstainers ($n = 736$) and did not receive further questions about alcohol use. Remaining participants were assessed using the Alcohol Use Disorder Identification Test (AUDIT) (Babor et al., 2001).

The AUDIT consists of 10 items with response options that can be scored from 0 to 4. Examples of AUDIT questions are how many units the respondents consume on a typical day of drinking, how often they consume six or more units of alcohol, and whether they themselves or someone else have been injured because of their drinking. The number of individuals with missing on AUDIT items ranged from 251 (2.6%) to 301 (3.1%).

Based on the information from individuals who had responded to all AUDIT items, a sum score ranging from 0 to 40 was created. Individuals who reported to never consume alcohol were given total AUDIT score 0. Based on the sum score, a 4-level variable was created; abstainers (AUDIT = 0), low risk consumption, risky consumption and hazardous consumption. As recommended, risky alcohol consumption was indicated by a total score of at least 8 and < 18 (Babor et al., 2001), while a score of 18 or above indicated hazardous alcohol consumption.

2.4. Dependent variables

2.4.1. Life satisfaction

Life satisfaction was measured using a Norwegian version of the Satisfaction with Life Scale (Diener et al., 1985). The scale shows favorable psychometric properties, including high internal consistency, and scale scores correspond moderately to highly with other measures of subjective well-being (Diener et al., 1985; Diener, Ingelhart, & Tay, 2013). Life satisfaction scale has also been found to negatively correlate with measures of psychological distress (Diener, 2009).

The scale consists of five statements measuring satisfaction with life overall. Participants could indicate their agreement with each statement on a 7-point scale, where 1 indicated “strongly disagree” and 7 “strongly agree”. Example statements are “I am satisfied with my life”, and “So far in life I have gotten the important things that I wish for”. The sum score ranging from 5 to 35 was used, higher scores indicating being more satisfied with life. The number of individuals with missing on each the life satisfaction items ranged from 238 (2.4%) to 255 (2.6%).

2.4.2. Mental health complaints

The 25 item Hopkins Symptoms Check List (Derogatis et al., 1974; Müller et al., 2010) (HSCL-25) was used. The scale consists of 25 statements regarding symptoms as experienced during the past two weeks, each with response options ranging from 1 (not bothered) to 4 (extremely bothered). The factor structure of the instrument has been investigated in the SHoT data, and a uni-dimensional model is recommended (Skogen et al., 2017). We therefore investigated the sum score of the scale (potentially ranging from 25 to 100), with higher scores indicating higher symptom load. As higher scores were positive for all other outcome variables, the z-scored version of the HSCL-variable was reversed in the analyses, so that higher scores indicated less mental health complaints. The number of individuals with missing on each of the HSCL items ranged from 105 (1.1%) to 145 (1.5%).

2.4.3. Number of close friends

Students were asked “How many friends with whom you can confide in/talk about various problems with do you have?”. As phrased, the question may also measure access to emotional support. The response

options were “no friends”, “one friend”, “two to three friends”, “four to nine friends” or “ten or more friends”, and 141 (1.4%) did not respond to this item. Individuals who reported not to know how many friends they had were excluded ($n = 178$, 1.8%), giving a final sample of $n = 9632$.

2.4.4. Loneliness

Loneliness can be defined as the aversive state experienced when there is a discrepancy between the interpersonal relationships one wishes to have, and those that one currently perceives to have (Peplau et al., 1982). One often distinguishes between emotional and social loneliness, with attachment predicting emotional loneliness (the lack of intimate contact with other people), and social integration predicting social loneliness (the experience of being alone or lacking a social network) (DiTommaso & Spinner, 1997; Russell et al., 1984).

As in previous research based on the SHoT data (Myrtveit, Askeland, Knapstad, et al., 2016), loneliness was measured using Wittenberg's emotional and social loneliness scale (Wittenberg, 1986), an unpublished extension of the Russell et al. two item scale (Russell et al., 1984; Shaver & Brennan, 1991). Participants were asked to indicate their agreement with ten statements on a five-point Likert scale, from “never” to “very often”. Five of the items measure social loneliness and five measure emotional loneliness. The two subscales (social and emotional loneliness) thus range from 5 to 25, with higher scores indicating less loneliness. The Wittenberg's scale alpha values have been found to be 0.78 for the emotional loneliness dimension, and 0.76 for the social loneliness dimension (Shaver & Brennan, 1991). The scale yields acceptable correlation coefficients of 0.81 for social loneliness and 0.59 for emotional loneliness when compared to the UCLA Loneliness scale (Shaver & Brennan, 1991). The number of individuals with missing on each of the loneliness items ranged from 207 (2.1%) to 424 (4.3%).

2.5. Statistical analyses

As detailed above, not all students taking part in the survey responded to all questions of interest. In total, 1912 (19.5%) students had missing information on at least one measure. Assuming missing at random, analyses based on multiple imputed data sets can produce less biased estimates than complete case analyses (Sterne et al., 2009). We created 10 missing imputed data sets using Stata. To enable investigating of an interaction effect between alcohol consumption and gender, the imputations were conducted stratified by gender. As our data did not allow for gender-stratified imputation of all relevant variables at the item level, relevant sum score variables were created before the imputation. Ordered factor variables were imputed using ordered logistic regression (relationship status and number of friends), truncated continuous variables using truncated regression (numbers of semesters studied, AUDIT sum score, HSCL-25 sum score), and continuous variables that should be restrained to the observed range, using predictive mean matching (social and emotional loneliness sum scores and life satisfaction sum score). Analyses were subsequently conducted on all datasets, and estimates were pooled, using the estimation approach for multiple imputations native to Stata.

Based on the imputed data sets, the distribution of relationship status, age, number of semesters studied, and alcohol consumption (grouped as abstainers, low risk, risky or hazardous consumption) were evaluated stratified by gender using descriptive statistics (percentages). The mean AUDIT score was also presented, with 95% confidence intervals.

The association between alcohol consumption and life satisfaction, mental health complaints, number of friends, and social and emotional loneliness, was investigated. All dependent variables were standardized to yield variables with a mean of zero and a standard deviation of one. Linear regression models were computed for each of the dependent variables, with alcohol consumption as the independent, ordinal variable (base; low risk consumption). Crude and adjusted (age, gender and

relationship status) analyses were conducted. The standardized mean differences (SMD) and p-values were reported. To better enable comparison of the strengths of association between alcohol consumption and the dependent measures collectively, a multivariate multiple regression model (adjusted for age, gender and relationship status) was fitted.

The likelihood ratio test was used to investigate whether including an interaction term between gender and alcohol consumption could significantly improve the fit of models investigating the association with number of friends, social and emotional loneliness, life satisfaction and mental health complaints. The likelihood ratio test can in Stata not be correctly estimated on imputed datasets. As results based on imputed datasets did not differ substantially from results based on the dataset where listwise deletion had been used (data not shown), the likelihood ratio tests were conducted on the listwise deleted data set. For models where inclusion of the interaction term led to a statistically significantly improved model fit ($p < 0.05$), stratified analyses were conducted on the imputed data sets. As predictive margins also cannot be well estimated on imputed data, predictive margins plots were created based on the listwise deleted data.

All analyses were conducted using Stata 15 (StataCorp, 2017).

2.6. Ethics

The SHoT study was evaluated and approved by the Norwegian Centre for Research Data (NSD) (NSD, N.C.f.R.D., n.d.).

3. Results

3.1. Background information

In our sample of 9632 students, 67% were female and 53% were between 23 and 28 years of age. About half of the population reported to be single, one in five had a boyfriend or girlfriend, and one in three were married or cohabiting. Overall, 7% abstained from alcohol, 52% reported low risk consumption, 38% reported risky consumption and 3% reported hazardous consumption as defined by AUDIT. See Table 1 for details stratified by gender. The AUDIT sum score reported was higher among men than women.

Table 1
Background information and alcohol consumption (N = 9632).

	Women n = 6426 66.7%	Men n = 3206 33.3%	p-Value for difference between gender	Total n = 9632
	(Column %)	(Column %)		(Column %)
Relationship status			< 0.001	
Single	44.7%	51.6%		47.0%
Boyfriend/girlfriend	19.8%	17.7%		19.1%
Married/partner/cohabitant	34.4%	29.5%		32.8%
Other	1.0%	1.2%		1.1%
Age			< 0.001	
18–22	39.5%	32.7%		37.3%
23–28	51.9%	56.0%		53.2%
29–34	8.6%	11.3%		9.5%
In first or second year of studying	46.7%	44.2%	0.103	45.9%
Alcohol consumption			< 0.001	
Abstainers (AUDIT = 0)	7.5%	7.3%		7.4%
Low risk consumption ($0 < \text{AUDIT} < 8$)	55.6%	43.1%		51.5%
Risky consumption ($8 \leq \text{AUDIT} < 18$)	35.2%	45.0%		38.4%
Hazardous consumption ($\text{AUDIT} \geq 18$)	1.7%	4.5%		2.6%
Mean AUDIT score (95% CI) ^a	6.44 (6.33–6.54)	7.92 (7.74–8.10)	< 0.001	6.93 (6.84–7.02)

Percentages estimated based on imputed data sets. p-values estimated based on list wise deleted data (chi²-test for relationship status, age, in first or second year of studying and alcohol consumption, t-test for mean AUDIT score).

^a Mean AUDIT score; individuals reporting to never consume alcohol were given AUDIT score = 0.

3.2. Association between dependent variables studied and the relative importance of AUDIT on each

Satisfaction with life and mental health complaints were found to be strongly correlated ($R^2 = 0.58\%$). In turn, both factors were associated, but weaker, with number of friends and social loneliness and emotional loneliness (R^2 for the association between social loneliness and satisfaction with life and number of friends were 0.53 and 0.52 respectively, while all other associations were between 0.21 and 0.44 (correlations based on listwise deleted data)).

In the multivariate multiple regression models, the largest SMDs were found for life satisfaction and mental health complaints (-0.50 and -0.72 , respectively, among students reporting hazardous consumption compared to low risk consumption). All other SMDs were below 0.30. Together, this supports a hierarchy, with life satisfaction and mental health complaints as the main constructs, with sub-factors number of close friends, emotional and social loneliness correlated with both.

3.3. Gender differences

The models investigating the association between alcohol consumption and number of friends and emotional loneliness were statistically significantly better when an interaction term between alcohol consumption and gender was included ($p = 0.008$ and $p < 0.001$, respectively). Results from stratified analyses and predictive margin plots for these models are presented below, together with results from non-stratified analyses for all outcomes.

3.4. Life satisfaction

As detailed in Table 2, individuals with a risky (-0.06 SMD) or hazardous (-0.51 SMD) consumption reported lower life satisfaction than individuals with low risk consumption, and the tendency seemed stronger for those with hazardous consumption. Reported life satisfaction did not differ between abstainers and individuals with low risk consumption in fully adjusted models.

3.5. Mental health complaints

Individuals reporting risky (-0.11 SMD) or hazardous

Table 2

The association between alcohol consumption and life satisfaction, mental health complaints, number of friends, and social and emotional loneliness (N = 9632).

	Abstainers		Low risk consumption (Ref. group point estimate)	Risky consumption		Hazardous consumption	
	SMD	p-Value		SMD	p-Value	SMD	p-Value
Life satisfaction	-0.07	0.082	(0.06)	-0.10	< 0.001	-0.60	< 0.001
Adj. for age, gender, rel. status	-0.07	0.062		-0.06	0.006	-0.51	< 0.001
Mental health complaints ^a	0.00	0.950	(-0.04)	-0.07	0.004	-0.59	< 0.001
Adj. for age, gender, rel. status	-0.04	0.323		-0.11	< 0.001	-0.72	< 0.001
Number of friends	-0.26	< 0.001	(-0.05)	0.19	< 0.001	0.03	0.624
Adj. for age, gender, rel. status	-0.27	< 0.001		0.19	< 0.001	0.06	0.315
Social loneliness	-0.24	< 0.001	(-0.04)	0.17	< 0.001	-0.22	0.001
Adj. for age, gender, rel. status	-0.25	< 0.001		0.17	< 0.001	-0.18	0.006
Emotional loneliness	-0.29	< 0.001	(0.13)	-0.23	< 0.001	-0.70	< 0.001
Adj. for age, gender, rel. status	-0.07	0.014		0.02	0.340	-0.19	< 0.001

Note. Regression analyses with alcohol consumption as indicator variable, all outcome variables standardized. SMD: standardized mean difference. For all dependent variables, higher scores are positive (more friends, less loneliness, less mental health complaints).

Bold: p-values < 0.05

^a Mental health complaints measured using the HSCL-25. Scale reversed, so that higher scores indicate less complaints.

(-0.72 SMD) consumption also reported more mental health complaints than those with low risk consumption. Again, the tendency seemed stronger for individual with hazardous consumption. Mental health complaints did not differ significantly between abstainers and individuals with low risk consumption.

3.6. Number of close friends

Individuals who reported risky consumption (0.19 SMD) had more close friends than individuals with low risk consumption while abstainers had fewer (-0.27 SMD). There was no difference in number of close friends between individuals with low risk and individuals with hazardous consumption.

Stratified analyses showed that, in both genders, those with risky consumption had more close friends than those with low risk consumption, and abstainers had fewer (Fig. 1 and Table 3). Men reporting hazardous consumption also had more friends than those reporting low risk consumption, but this was not the case among women. Overall, women reported more friends than men (Fig. 1).

3.7. Social loneliness

Individuals with risky consumption experienced less social loneliness than individuals with low risk consumption (0.17 SMD) (Table 2). Abstainers (-0.25 SMD) and individuals who reported hazardous

consumption (-0.18 SMD) experienced more social loneliness than individuals with low risk consumption.

3.8. Emotional loneliness

Abstainers and individuals who reported risky or hazardous consumption all reported more emotional loneliness than individuals with a low risk consumption in crude models, with the strongest association among individuals with hazardous consumption (-0.70 SMD). When adjusting for age, gender and relationship status, the strength of the association was greatly reduced in all groups, but remained statistically significant among abstainers (-0.07 SMD) and individuals with hazardous consumption (-0.19 SMD) (Table 2).

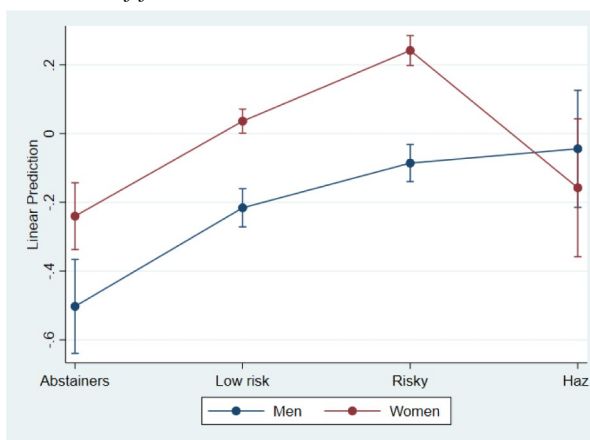
As detailed in Table 3 and Fig. 1, men who abstained from alcohol and women who reported hazardous consumption reported more emotional loneliness than those with low risk consumption also after adjustments.

4. Discussion

4.1. Summary of main findings

This study shows, as previously reported (Myrtveit, Askeland, Knudsen, et al., 2016), that risky alcohol consumption is common among Norwegian college and university students. Individuals who

Number of friends



Emotional loneliness

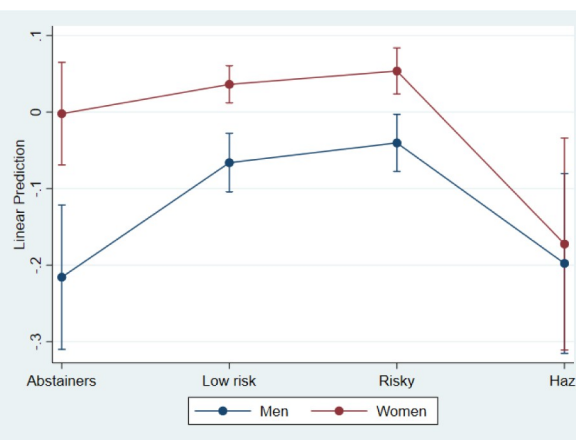


Fig. 1. Predictive margins for men and women for the association between alcohol consumption and number of friends and emotional loneliness. Note. Friends and emotional loneliness: higher scores are positive (more friends, less loneliness). Adjusted for age and relationship status.

Table 3

The association between alcohol consumption and number of friends and emotional loneliness stratified by gender.

	Abstainers		Low risk consumption (Reference group point estimate)	Risky consumption		Hazardous consumption	
	SMD	p-Value		SMD	p-Value	SMD	p-Value
<i>Men</i>							
Number of friends	-0.27	< 0.001	(-0.23)	0.15	< 0.001	0.25	0.010
Adj. for age and relationship status	-0.30	< 0.001		0.13	0.001	0.22	0.023
Emotional loneliness	-0.36	< 0.001	(-0.05)	-0.10	0.012	-0.55	< 0.001
Adj. for age and relationship status	-0.14	0.009		0.02	0.381	-0.10	0.119
<i>Women</i>							
Number of friends	-0.23	< 0.001	(0.01)	0.26	< 0.001	-0.09	0.332
Adj. for age and relationship status	-0.26	< 0.001		0.22	< 0.001	-0.15	0.108
Emotional loneliness	-0.23	< 0.001	(0.20)	-0.27	< 0.001	-0.74	< 0.001
Adj. for age and relationship status	-0.04	0.235		0.00	0.930	-0.29	< 0.001

Note. Regression analyses with alcohol consumption as indicator variable, all outcome variables standardized. SMD: Standardized mean difference. Friends and emotional loneliness: higher scores are positive (more friends, less loneliness). Bold: p-values < 0.05

reported risky consumption experienced slightly more mental health complaints and reduced life satisfaction compared to individuals with low risk consumption, despite having more friends and experiencing less social loneliness. Reporting hazardous alcohol consumption was altogether associated with negative outcomes, namely lower life satisfaction, more mental health complaints, and more emotional and social loneliness. Mental health and life satisfaction did not differ between abstainers and individuals with low risk consumption, but abstainers had fewer close friends and experienced more social loneliness and slightly more emotional loneliness.

Gender stratified analyzed showed that men who reported hazardous consumption had more friends than men reporting low risk consumption, while this was not true for women. Men who abstained from alcohol and women who reported hazardous consumption experienced more emotional loneliness. Both men and women who abstained from alcohol had fewer close friends.

4.2. Interpretation of findings

Even though heavy drinking was found to be common in the present sample, as in other college and university student samples (Davoren et al., 2015; Dodd et al., 2010; Erevik et al., 2017b; Knight et al., 2002; O'Malley & Johnston, 2002; Wechsler et al., 1994; Wechsler et al., 1995), students who reported risky or hazardous alcohol consumption experienced lower life satisfaction and more mental health complaints than individuals with low risk consumption. Individuals reporting hazardous consumption further emerged as a clear risk group as they also experienced more emotional and social loneliness. This is in line with findings among adults, where heavy drinking is associated with reduced social support (Rodgers et al., 2000b) and more mental health problems (Jones et al., 2008; Knight et al., 2002; Rehm et al., 2010; Rodgers et al., 2000a; Rodgers et al., 2000b; Skogen et al., 2009). A wide variety of factors such as low education, unemployment, financial hardship, negative life events and trauma, separations or divorce, and childhood adversity seem to account for some of the association between heavy drinking and mental health problems (Rodgers et al., 2000b; Stewart, 1996) – and some of these factors could also be relevant for the associations observed among students.

As mentioned in the introduction, immediate adverse events related to alcohol, such as falls, injuries, traffic accidents, unwanted sexual encounters or unprotected sex (Hingson et al., 2002; Wechsler et al., 1994; White & Hingson, 2014), reduced academic performance (Myrtveit, Askeland, Knudsen, et al., 2016; Perkins, 2002b; Porter & Pryor, 2007; Wechsler et al., 1994; Wechsler et al., 2000; Wolaver, 2002), hangovers and sickness, and saying or doing things one will later regret (Dodd et al., 2010; Park, 2004; Tefre et al., 2007), might be of particular importance to student well-being. Studies have shown that

greater alcohol use (Molnar et al., 2009) (Erevik et al., 2018) during the university introductory week) and frequent binge (Wechsler et al., 2000) is associated with more adverse alcohol-related consequences, and that alcohol related problems in turn are associated with lower life satisfaction (Molnar et al., 2009; Murphy et al., 2005; Murphy et al., 2006). This can, at least in part explain the reduced life satisfaction and increased mental health complaints found among students reporting risky and hazardous alcohol consumption in our study. However, whether alcohol consumption increases the likelihood of experiencing adverse events (Bountress et al., 2019), is used to cope with problems (Cooper, 1994; Cooper et al., 1992), or if both alcohol use and other risk behavior is preceded by some third factor (Vollrath & Torgersen, 2002) cannot be determined in this cross-sectional study.

Students reporting hazardous consumption also reported more emotional and social loneliness. Research has shown that social relationships might be directly affected by frequent intoxication. Students who frequently binge are for instance more likely to argue with friends (Wechsler et al., 2000), while students who do not binge, but reside at schools with many binge drinkers, report being bothered by drinking-related behaviors such as being pushed, hit, assaulted, experiencing unwanted sexual advances or having studies or sleep interrupted (Wechsler et al., 1994; Wechsler et al., 2000). As such, social factors might be of particular importance to well-being among students with hazardous consumption, and might be driving some of the association with diminished life satisfaction and increased mental health complaints seen in this group.

In contrast to individuals with hazardous consumption, individuals with risky consumption reported more friends and less social loneliness than individuals with low risk consumption. As new students report alcohol as central in getting to know each other (Lie & Kahlbom, 2011; Stålesen, 2015), and as partying and heavy alcohol consumption seem to be an expected and important part of social college life (Crawford & Novak, 2006; Lie & Kahlbom, 2011; Vaadal, 2014), individuals adopting to this pattern might more easily make friends. Indeed, other research has shown that the most socially integrated students tend to drink more (Perkins, 2002a). Despite being better socially integrated, individuals with risky consumption in our study reported slightly more mental health complaints and slightly reduced life satisfaction compared to individuals with low risk consumption. These negative aspects of risky drinking are important to highlight, as they apply to a large proportion of the student population.

When investigating men and women separately, men who reported hazardous consumption had more close friends than the men who reported low risk consumption. Also previous research has shown that among male students, heavy drinking/frequency of drinking seems associated with better social satisfaction/social belonging (Murphy et al., 2005; Murphy et al., 2006). In contrast, women who reported

hazardous consumption did not have more close friends than women with low risk consumption, but experienced more emotional loneliness. Both men and women abstaining from alcohol had fewer close friends, but only men reported more emotional loneliness. These differences might indicate that hazardous drinking is not as expected or accepted among women compared to men. In general, men drink more than women (Dodd et al., 2010; Heradstveit et al., 2019; Myrtveit, Askeland, Knudsen, et al., 2016; O'Malley & Johnston, 2002; Wechsler et al., 1995; Wicki et al., 2010), and perceived norms and peer influence concerning alcohol seem to affect male students more than females (Lo, 1995; Read et al., 2002). Also, female students tend to rate visible intoxication as less acceptable than males (Fjær et al., 2016). High-level alcohol consumption might further be more important for social relations among men. Among US adolescents, boys are socially rewarded for keeping up with their peer's drinking and for getting drunk, while girls are rewarded for drinking per se, but not necessarily for keeping up (Balsa et al., 2011). Self-reported hazardous drinking among female students could potentially be a marker of social or other problems, but this speculation needs to be investigated further in future studies.

In contrast to individuals with risky consumption, abstainers had fewer close friends and experienced more social loneliness (and slightly more emotional loneliness, primarily driven by men) – but did not experience reduced life satisfaction or more mental health problems compared to students with low risk consumption. In accordance with our findings, research among Norwegian adolescents show that individuals with moderate and heavy alcohol consumption seem more sociable, while abstainers and light drinkers appear emotionally healthier (Hoel et al., 2004). Indeed, among Norwegian adolescents, depressive symptoms are associated with earlier onset of alcohol use, more frequent consumption and intoxication, also among students with mild to moderate symptoms (Johannessen et al., 2017).

One reason why number of close friends and social loneliness vary independently from life satisfaction and mental health complaints might be that the former measures do not succeed in capturing the nature of the social relationships people engage in. Simply having social bonds does not seem to be enough (Baumeister & Leary, 1995). While total number of friends does not vary between lonely and non-lonely people (Williams & Solano, 1983), lonely people experience less intimacy in their relationships (Hamid, 1989; Williams & Solano, 1983). Further, non-lonely people may engage in more interactions with family and close friends, while lonely people may engage in fewer interactions with intimates, and more interactions with strangers and acquaintances (Jones, 1981), the latter being people less likely to satisfy the need to belong. In line with this, student cultures characterized by heavy drinking might provide plenty of acquaintances and parties to go to, while intimate and close relationships might be rarer.

The finding that abstainers did not experience lower life satisfaction nor had more mental health complaints than those with low risk consumption contrasts research showing elevated risk of anxiety and depression among adult abstainers (Rodgers et al., 2000a; Rodgers et al., 2000b; Skogen et al., 2009). This relationship has been much discussed, and research investigating Norwegian adolescents found no evidence of a J- or U-shaped association between alcohol use and mental health problems (Skogen et al., 2014). Others have found the risk of mental health problems to be increased only among men that drink little or not at all, and not among women (Caldwell et al., 2002). This might be related to the differences in drinking norms between genders discussed above. Further, it has been argued that low status occupations, poor education, current financial hardship, poor social support and recent stressful life events, as well as lower scores on extraversion, fun-seeking and drive can account for substantial parts of elevated mental health problems sometimes found among abstainers (Rodgers et al., 2000b).

The conflicting findings on mental health among abstainers could also be related to the group of abstainers being highly diverse, and potentially differing between studies. Among young adults, having a long-standing debilitating illness increases the odds of not drinking for

both men and women (Ng Fat & Shelton, 2012). Also, belonging to the lowest income quintile or having no qualifications is associated with being a non-drinker, indicating that the social gradient in alcohol consumption begins at an early age (Ng Fat & Shelton, 2012). One might further imagine that some students choose not to drink, as they are highly involved in sports. However, student athletes seem to view alcohol consumption as more normative than others (Ford, 2007a), and both at college and university, students involved in sports tend to drink more (Leichliter et al., 1998; Lisha & Sussman, 2010; Lorente et al., 2004). Still, alcohol consumption seems to differ with type of sport (Ford, 2007b), and probably also by level (professional or colloquial sports).

Further, in Norway religious students have been found to be less likely to report problematic drinking (Erevik et al., 2017b). Being Christian is associated with more restrictive alcohol related norms (Fjær et al., 2016) and religious affiliation is a common reason to abstain from alcohol (Akvardar et al., 2004). Though fewer associate themselves with the established Christian church in Norway (Holberg & Brottveit, 2014; Statistics Norway), the prevalence of Islam and other religions is increasing (Statistics Norway). Membership in religious groups can provide considerable social support (Frankel & Hewitt, 1994), and students who are not greatly integrated in the student community might still get their needs for friendships and belonging fulfilled through religious community.

4.3. Limitations and strengths

As discussed above, the study is cross-sectional, which precludes causal inferences. For instance, the association between risky drinking and number of friends could be explained either if individuals with risky consumption are more likely to take part in social student activities, and thus more likely to develop friendships over time, or if students with more social relations are more exposed to situations where drinking is expected, and adhere to this. Also, some other factor, like personality, could precede both level of consumption and sociability.

Further, the response rate was notably low (27%). Details about the delivery method and measures taken to increase response rate has been discussed in a previous publication (Myrtveit, Askeland, Knapstad, et al., 2016). Over the last decades, participation in population-based studies (Krokstad et al., 2013; Tolonen et al., 2006) and e-mail surveys (Sheehan, 2001) have declined. In general, individuals who participate in studies are healthier than non-participants (Knudsen et al., 2010), thus healthier students might have been more likely to participate. Selection bias in SHoT has been discussed in previous publications (Myrtveit, Askeland, Knapstad, et al., 2016; Myrtveit, Askeland, Knudsen, et al., 2016). Despite the low response rate, it has been argued that the risk of biased results is larger for prevalence estimates of exposures and outcomes than for exposure-outcome associations (Nilssen et al., 2009) and that the generalizability of associations often is sufficient even when distribution of measurements in the study population is different from the general population (Manolio & Collins, 2010).

Drinking motives are significant predictors of heavy drinking and problem drinking (Cooper, 1994; Cooper et al., 1992). Unfortunately, in the SHoT study participants were not asked why they consumed the amount of alcohol reported, so we were unable to include this information in our analyses. We also do not have information on religious affiliation. Research based on other material should investigate how religious affiliation and reasons for drinking or not drinking affects the investigated associations.

Finally, as many other studies in this field, this study is purely quantitative. Important insight into the mechanisms underlying drinking choices can be efficiently explored using qualitative research. Recent studies have for instance investigated students' perceptions about alcohol policies on campus (Larsen et al., 2016) and why young people today seem to drink less than earlier (Törrönen et al., 2019) using qualitative designs. Such studies can provide new hypothesis that

later can be tested in quantitative studies.

Despite the abovementioned limitations, this is a large study able to undertake detailed investigations of alcohol consumption in relation to number of close friends, loneliness, life satisfaction, and mental health complaints among students. The population includes students from several cities, decreasing the likelihood that the associations found are specific to a particular university. The results might also be of value in wider context, for instance when evaluating whether and how to address drinking culture among students of higher education both in Norway and in other countries.

4.4. Implications and conclusion

Humans are inherently social beings with a fundamental need to belong (Baumeister & Leary, 1995). When failing to satisfy this need, loneliness can arise and may have severe consequences for mental health and wellbeing (Heinrich & Gullone, 2006). In general, social relationships and social support are associated with better physical and mental health (Berkman et al., 2000; Melchior et al., 2003; Seeman, 1996), and even reduced mortality risk (Holt-Lunstad, Smith, & Layton, 2010). Among students, social integration and friends seems to influence student retention (Wilcox, Winn, & Fyvie-Gauld, 2005), and there is also a positive association between quality of new friendships and academic adjustment to university among first-year students (Buote et al., 2007).

Our findings indicate that hazardous alcohol consumption is associated with loneliness, reduced life satisfaction and mental health complaints. Whichever the direction of causality, hazardous alcohol consumption should indicate to peers, parents, teachers or health care personnel that the student might be in need of help, and at risk of both current and long-term alcohol-related or other problems. Further, students with risky consumption had more close friends and experienced less social loneliness, but reported more mental health complaints and lower life satisfaction than individuals with low risk consumption. Contrasting this, abstainers had fewer friends and experienced more loneliness, but did not experience more mental health complaints or reduced life satisfaction compared to students with low risk consumption. These findings might indicate that the quality of friendships is more important than the number of friends for mental health, but also that the focus on alcohol in college and university student cultures might be making social integration difficult for students that do not drink.

Finally, the beliefs students hold about alcohol use are of great importance, as students' drinking behavior is affected by perceived peer norms (Perkins, 2002a; Read et al., 2002). Students seem to overestimate peers' alcohol consumption (Kypri & Langley, 2003; Perkins, 2002a), and believe that their peers are, on average, more permissive in personal drinking attitudes than what is actually the case (Perkins, 2002a). A tendency to conform to these misperceived norms might thus have significant negative effects by promoting and exacerbating problem drinking in the student community. The negative aspects of hazardous, but also risky, consumption found in our study are of importance, as they could contribute to adjust students' overly positive beliefs about and attitudes toward alcohol consumption.

Contributors

SMMS, MK, KGA and JCS conceived of the study. SMMS conducted the analyses in close cooperation with JCS. All authors contributed in interpretation of the findings. SMMS drafted the paper and all authors contributed in critical revisions of important intellectual content. All authors have approved the manuscript for submission.

Declaration of competing interest

None.

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