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Alcohol in the second half of life: do usual quantity and frequency of drinking to intoxication increase with increased drinking frequency?

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Abstract

Aims: We investigated if increased drinking frequency among adults in the second half of life co-occurred with increased usual quantity, and increased intoxication frequency. Design: Two-wave panel study. Setting: Norway. Participants: Norwegian adults (1,017 women and 959 men) aged 40 to 79 years. Measurements: Drinking frequency, usual quantity, and intoxication frequency was measured by self-report in 2002/2003 and again in 2007/2008. Information about gender, age, and level of education was obtained from the public register. Health was collected by self-report. Findings: Because of a significant gender by change in drinking frequency interaction effect on change in intoxication frequency (b = 0.02, P = .013), women and men were analyzed separately. After adjusting for covariates, women who increase their drinking frequency showed a non-significant decrease in usual quantity (low initial usual quantity (LIUQ): ß = -.01, P = .879; high initial usual quantity (HIUQ): ß = -.06, P = .164), and a non-significant increase in intoxication frequency (LIUQ: ß = .04, P = .569; HIUQ: ß = .09, P = .251). Men who increased their drinking frequency showed a small decrease in usual quantity (LIUQ: ß = -.06, P = .049; HIUQ: ß = -.05, P = .002) and a small increase in intoxication frequency (LIUQ: ß = .05, P = .035; HIUQ: ß = .13, P = .004). Conclusion: Among Norwegian adults in the second half of life, increased drinking frequency appears to be associated with a small reduction in usual quantity, and a small increase in frequency of drinking to intoxication.

As populations in Western countries are aging, the use of alcohol can become a growing public health concern. When people grow older, health problems become more prevalent, and alcohol use may accelerate disease progression. Aging is also associated with lower alcohol tolerance due to reduced muscle mass and slower metabolism (1). In addition, older adults are the biggest consumers of medications that may be harmful when consumed in combination with alcohol (2). For these reasons, more knowledge about the nature of changes in alcohol use that take place among older adults is needed. Alcohol consumption has increased in Norway over the last two decades, especially in older age groups (3, 4). Survey data has suggested that the increase in alcohol consumption is more a result of increased drinking frequency than it is a result of people drinking larger amounts at each drinking occasion. Also, while the proportion of Norwegians who drink frequently has increased, there has not been an increase in the proportion who frequently drink to intoxication (5). This points to the possibility that individuals who start drinking more often do so mainly by adding more low-consumption, low-risk episodes to their drinking pattern, and that the recent increase in alcohol consumption in Norway does not represent a serious public health problem. Little evidence has been presented to support this possibility, and even less is known about this relationship in older people. Therefore, the current five year longitudinal study investigated if Norwegian adults in the second half of life who started drinking more often also increased the quantities they consumed, and if they started to drink to intoxication more often.

Alcohol consumption in a population can increase because people begin to drink more often, because they begin to drinking larger quantities per occasion, or both. However, the public health implications are likely to be dramatically different for these different scenarios. Whether individuals who start to drink more frequently also start to drink larger quantities per occasion is

a largely ignored question in the alcohol research literature. Some studies indicate that individuals with higher drinking frequency also usually drink larger quantities per drinking occasion (6, 7), which indicates that increase in drinking frequency has been accompanied by increased drinking quantities. However, other investigations have reached different conclusions. Lemmens and colleagues (8) compared different methods for measuring alcohol use in Dutch adults. They found that the more drinking occasions were reported during a week, the greater the quantity was per day when they used a 7-day diary method. However, when a past six months quantity-frequency measure was used, the relationship was absent. This was corroborated by results from a more recent cross-sectional study by Paradis and colleagues (9) who investigated if drinking frequency was associated with usual quantity and binge drinking in Canadian adults. They found that occasional drinkers were less likely to drink more than two drinks when drinking compared to weekly drinkers, but that there was no relationship between drinking frequency and usual quantity among weekly drinkers. This indicates that those who have increased their drinking frequency did not necessarily increase their usual quantities. As previous findings concerning the relationship between frequency and quantity have been inconsistent, further study is warranted. No previous studies have investigated this in adults in the second half of life. Also, there is dearth of longitudinal studies of the association between change in frequency and change in usual quantity.

A related question is whether older individuals who increase their drinking frequency also begin to drink to intoxication more often. This question is of particular concern to public health since intoxication is one of the main mechanisms by which alcohol can cause harm (10). Paradis et al. (9) found that drinking frequency was related to risk of binge drinking (drinking five drinks or more on one occasion). For instance, those who drank alcohol 5 to 7 days per week had greater

likelihood of binge drinking at least once per week compared to those who drank 1 or 2 days per week. This indicates that those who had increased their drinking frequency had also increased their intoxication frequency. The study did not, however, address directly whether change over time in drinking frequency was associated with change in frequency of drinking to intoxication, or how strong this relationship may be. To our knowledge, no previous investigations have addressed this question.

The current longitudinal study investigated change over five years in alcohol use in a cohort of Norwegians aged 40 to 79 years. We investigated if change in drinking frequency was associated with 1) change in usual quantity, and 2) change in frequency of drinking to intoxication. Change in usual quantity and change in intoxication frequency may be dependent on the baseline drinking pattern. For instance, the consequences of increased drinking frequency may be different for people who usually drink small quantities compared to people who usually drink larger quantities. To assess this issue we stratified the analysis so that those who usually consumed less than three drinks at the start of the study and those who usually consumed three drinks or more were analyzed separately. Also, since change in alcohol use may be dependent on gender, age, level of education and health, these factors were controlled for in the analysis.

Methods

Data

Two-wave panel data from the Norwegian study on life course, ageing and generation (NorLAG) conducted by Norwegian Social Research (NOVA) and Statistics Norway[1] was

[1] The NorLAG and LOGG surveys are financed by the Research Council of Norway (grant no. 149564 and 168373), Ministry of Health and Care Services, Ministry of Labour, Ministry of Children, Equality and Social Inclusion, Ministry of Local Government and Regional Development, Norwegian Social Research (NOVA) and Statistics

analyzed. At time point 1 in 2002/2003 (t1), 24 Norwegian municipalities and 6 districts in Oslo were selected from four geographic regions. The selection criteria were population size, population density, standard of living, age distribution, and income. The national population register was used to draw at random 8,298 individuals aged 40 to 79 years from within the municipalities and districts. The sample was invited to take part in a computer assisted telephone interview. A total of 5,559 individuals responded, yielding a response rate of 67.0 percent. Respondents were asked to also receive and complete a questionnaire at home, which contained questions about alcohol use as well as other questions deemed sensitive. Questionnaires were returned by 74.6 percent (4,149 individuals) of the respondents who took part in the telephone interviews.

At time point 2 in 2007/2008 (t2), 5,269 of the respondents from t1 were re-contacted and invited to take part in the second round of the study. The response rate was 79.1 percent (3,774 respondents). Out of those respondents, postal questionnaires were returned by 79.1 percent (2,984 respondents). In total, 2,672 individuals responded via telephone and postal mail at both time-points (32.2 percent of the gross sample at t1). The main predictors of attrition between t1 and t2 were high age, low education, low income and poor health (11). The data collection was approved by the Norwegian Social Science Data Service. See (12) for more details about the NorLAG study.

The analytical sample for the current study (n = 1,976; 51.5 % women) comprised individuals with non-missing responses to questions about alcohol use and covariates. Five

Norway. The NorLAG and LOGG datasets are part of the ACCESS Life Course infrastructure project funded by the National Financing Initiative for Research Infrastructure at the Research Council of Norway (grant no. 195403) and NOVA. The data are distributed by Norwegian Social Science Data Services. None of the above mentioned institutions are responsible for the data analysis or the interpretation of results in the current study.

respondents were excluded because they reported greater intoxication frequency than drinking frequency.

Measures

Responses from three questions about alcohol use included in the questionnaires at both t1 and t2 were used in the analysis. The first two questions concerned annual drinking frequency, and annual frequency of drinking to intoxication. The questions were worded: "Think about your alcohol use in the last 12 months. Approximately how often did you a) …drink alcohol? b) …drink so much that you felt intoxicated?" Responses were indicated using the following alternatives and coded as mid-point number of days per month: "daily or almost daily" (coded 30), "2-3 times per week" (coded 10), "once per week" (coded 4), "2-3 times per month" (coded 2.5), "once per month" (coded 1), "rarely" (coded 0.5), "not in the last 12 months", and "never drank alcohol" (both coded 0). The third question was used to measure typical drinking quantity, and read: "If you drank alcohol in the last year, how many "drinks" did you usually drink per occasion? (A "drink" is 0.5 liters of beer, one glass of wine, a small glass of fortified wine or 4 centiliters of spirits)". An open response field was provided in the questionnaire. Change in drinking frequency, change in usual quantity and change in intoxication frequency were calculated by subtracting the t1 value from the t2 value. The change scores were used as continuous variables in the analysis.

Information about gender, age and education level (coded 0 = less than high school, 1 = high school, 2 = bachelor's degree, 3 = master's degree/PhD) was obtained from the population register. Health status was measured by self-report using one question item: "Would you say that

your health now is mostly…". The response categories were "poor", "satisfactory", "good", "very good", and "excellent" (coded 1, 2, 3, 4 and 5 respectively).

Analysis

The analysis was conducted using STATA version 13. To test the relationships between change in drinking frequency and change in usual quantity and intoxication frequency, OLS regression models were computed separately for respondents with low usual quantity (< 3 drinks) and respondents with high usual quantity (≥ 3 drinks). In preliminary analysis, change in intoxication frequency was regressed on change in drinking frequency, gender and the gender by change in drinking frequency interaction term. The result showed a significant gender by change in drinking frequency interaction (b = 0.02, P = .013), therefore women and men were analyzed separately.

Change in usual quantity was firstly regressed only on change in drinking frequency (unadjusted models). In subsequent adjusted models, age, education and health measured at t1 were also included as covariates. Change in intoxication frequency was regressed on change in drinking frequency (unadjusted models). Subsequently, change in usual quantity, age, education and health (at t1) were also included in the models (adjusted models).

The sample was not drawn randomly from the population, but rather from within a selection of municipalities selected within regions. Such clustered sampling may lead to invalid estimates of standard errors, confidence intervals and *P*-values (13). To correct for the effects of the complex sampling scheme in our analysis, we used the survey estimation command available in STATA, which uses the linearized variance estimator to compute standard errors (14). Also, inverse probability weights were applied in the analyses to reduce the effect of selective attrition.

Results

Distributions for drinking frequency, usual quantity, and intoxication frequency at t1 and t2, and change from t1 to t2 are presented in Table 1. Overall, the mean drinking frequency increased by a little less than one time per month from t1 to t2. The mean usual quantity and the mean intoxication frequency changed very little, and the changes were not statistically significant. The means and changes were different for women and men. Men had higher mean drinking frequency, higher mean usual quantity and higher mean intoxication frequency compared to women. For women, the mean drinking frequency increased by 0.96 times per month, and the mean usual quantity increased by 0.14 drinks, which was small but statistically significant. The change in mean intoxication frequency was small and not statistically significant. For men, the mean drinking frequency increased by 0.82 times per month, but the changes in usual quantity and intoxication frequency were not statistically significant.

The results from regression models for change in usual quantity are shown in Table 2. For the women, the relationship between change in drinking frequency and change in usual quantity was weak, both in the unadjusted and adjusted models, and they were not statistically significant. This was the case both for those with low and those with high usual quantity at t1. For the men, the relationship between change in drinking frequency and change in usual quantity was negative, statistically significant, but weak for those with low usual quantity (standardized regression coefficient ($ß$) = -.06) and those with high usual quantity ($ß$ = -.05) at t1, both in the unadjusted and adjusted models.

The relationships between the covariates in the adjusted models and change in usual quantity were mostly negligible, but with some exceptions. For women with low usual quantity,

there was a significant negative relationship between health at t1 and change in usual quantity. For the women with high usual quantity, there was a significant negative relationship between age at t1 and change in usual quantity. For the men with low usual quantity, there was a significant negative relationship between level of education at t1 and change in usual quantity.

The results from regression models for change in intoxication frequency are presented in Table 3. For women, there was no significant relationship between change in drinking frequency and change in intoxication frequency both for those with low and high usual quantity. For men, the relationship between change in drinking frequency and change in intoxication frequency was positive and significant, but stronger for those with high usual quantity ($ß$ = .13) than for those with low usual quantity ($ß$ = .05). The only covariate that reached statistical significance was age at t1, which was weakly associated with change in intoxication frequency for the men with low usual quantity ($ß$ = -.05).

Discussion

This was the first longitudinal investigation of the relationship between change in drinking frequency, change in usual quantity, and change in intoxication frequency for adults in the second half of life. For both women and men, change in drinking frequency was not associated with substantial increase in usual quantity; we actually observed a small decrease in usual quantity. This was in line with previous cross sectional studies, which have shown a weak relationship between how often people drink and how much they usually drink (8, 9).

The results also showed that those who increased their drinking frequency only increased their intoxication frequency to a small extent. This was true for both women and men, and for those with low and high usual quantities at the start of the study. The strongest association was

found for men with high usual quantity, but was quite weak even for this group. Our finding is consistent with Paradis et al. (9) who found that the more often people drink, the more often they drink to intoxication. But in our study, the relationship was quite weak, which suggests that disproportionally more non-intoxication occasions than intoxication occasion were added to the drinking pattern. For example, the strongest effect we found (b = 0.05 among men with high initial consumption) suggested that for every twenty added drinking occasions per month, on average only one was characterized by drinking to intoxication. In other words, those who started drinking more often increased the number of low-consumption situations, such as drinking mid-week with a meal, disproportionally much more than the number of high-consumption situations, such as celebrations, parties and festivals. Conversely, our findings suggest that individuals who reduce their drinking frequency start to concentrate their drinking around occasions associated with drinking to intoxication.

Our results have several implications. They suggest that the increase in alcohol consumption among Norwegians in the second half of life are due to increased drinking frequency, not increased quantities, and that it has not resulted in much greater intoxication frequency. This is line with previous research, which showed that most of the increase in drinking occasions in Norway over the last two decades are non-intoxication situations (5). This has implications for public health, as there may not be much reason to expect that increase in drinking frequency among adults in the second half of life will be accompanied by a dramatic increase in harm and injury caused by drinking to intoxication (10). However, there is still reason to expect that individuals who usually consume quantities large enough to result in intoxication will start to drink to intoxication more often if they start to drink more often.

The questions addressed in this study are not specific to individuals in the second half of life, but our findings may not be generalized to younger age groups. Future studies should investigate whether our findings also apply to people under 40 years of age. Future studies should also aim at identifying different trajectories for drinking frequency, and frequency of drinking to intoxication over the course of adulthood and old age, and investigate whether individuals who take different trajectories differ in terms of injury, morbidity and mortality in old age.

The current study has some limitations. Attrition was greater among individuals high in age, with low education, with low income and with poor health, which are factors that are associated with lower alcohol consumption (15-17). This selective attrition may have biased our estimates, but we believe that the bias is small as we included age, education and health as covariates in our analyses, and because the data was weighted to adjust for the selective attrition. The measurement of drinking frequency and intoxication frequency was crude, and it was not possible to assess the effect of small changes. Also, the term "intoxication" may be interpreted differently by different individuals, which can cause measurement error. Estimates of alcohol consumption based on self-report are usually biased downward, therefore our estimates are likely to be deflated. Finally, we are unable to make claims about the direction of the observed relationships because we cannot pinpoint the temporal order of the changes.

In conclusion, the current study presents evidence that increased drinking frequency among Norwegian adults in the second half of life is not associated with large increase in usual drinking quantity, or with large increase in the frequency of drinking to intoxication. Disproportionally more non-intoxication than intoxication episodes are added to the drinking pattern if drinking frequency increases.

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Table 1. Mean (95% CI) drinking frequency, usual quantity and intoxication frequency, and change from t1 to t2.

	Mean drinking frequency	Mean usual quantity	Mean intoxication frequency
Total (*N* = 1976)			
Mean t1	5.92 (4.05, 7.79)	2.69 (2.54, 2.83)	0.81 (0.75, 0.88)
Mean t2	6.81 (4.67, 8.95)	2.74 (2.63, 2.85)	0.78 (0.71, 0.86)
Mean change	0.89 (0.58, 1.21)	0.05 (-0.11, 0.22)	-0.03 (-0.08, 0.02)
t	5.86	0.68	-1.32
P	.000	.504	.201
Women (*N* = 1017)			
Mean t1	5.55 (3.71, 7.40)	2.35 (2.26, 2.45)	0.53 (0.49, 0.57)
Mean t2	6.51 (4.41, 8.62)	2.49 (2.34, 2.64)	0.56 (0.48, 0.63)
Mean change	0.96 (0.57, 1.35)	0.14 (0.00, 0.27)	0.02 (-0.04, 0.09)
t	5.07	2.10	0.80
P	.000	.048	.433
Men (*N* = 959)			
Mean t1	6.31 (4.36, 8.25)	3.04 (2.73, 3.36)	1.12 (1.00, 1.24)
Mean t2	7.13 (4.90, 9.36)	3.00 (2.81, 3.20)	1.02 (0.92, 1.13)
Mean change	0.82 (0.48, 1.16)	-0.04 (-0.28, 0.20)	-0.09 (-0.19, 0.00)
t	5.05	-0.33	-2.02
P	.000	.745	.058

Table 2. Change in usual quantity regressed on change in drinking frequency.

	b (95% CI)	*ß*	*P*
Low usual quantity women (N = 709)			
Unajusted model			
Change in drinking frequency	-0.00 (-0.03, 0.03)	-.01	.903
Adjusted model			
Change in drinking frequency	-0.00 (-0.03, 0.03)	-.01	.879
Age at t1	-0.00 (-0.03, 0.02)	-.01	.748
Education level at t1	0.10 (-0.08, 0.28)	-.03	.271
Health at t1	-0.12 (-0.23, -0.02)	-.06	.024
High usual quantity women (N = 308)			
Unajusted model			
Change in drinking frequency	-0.04 (-0.09, 0.01)	-.06	.109
Adjusted model			
Change in drinking frequency	-0.04 (-0.10, 0.02)	-.06	.164
Age at t1	-0.05 (-0.10, -0.01)	-.12	.014
Education level at t1	0.23 (-.022, 0.68)	.06	.302
Health at t1	-0.38 (-0.77, 0.01)	-.12	.054
Low usual quantity men (N = 482)			
Unajusted model			
Change in drinking frequency	-0.02 (-0.04, -0.00)	-.06	.047
Adjusted model			
Change in drinking frequency	-0.02 (-0.04, -0.00)	-.06	.049
Age at t1	-0.00 (-0.04, 0.03)	-.03	.785
Education level at t1	-0.27 (-0.38, -0.15)	-.14	.000
Health at t1	0.12 (-0.03, 0.27)	.06	.116
High usual quantity men (N = 477)			
Unajusted model			
Change in drinking frequency	-0.02 (-0.04, -0.01)	-.05	.008
Adjusted model			
Change in drinking frequency	-0.03 (-0.04, -0.01)	-.05	.002
Age at t1	0.00 (-0.03, 0.03)	.01	.966
Education level at t1	-0.04 (-0.29, 0.20)	-.02	.718
Health at t1	0.16 (-0.16, 0.47)	.07	.308

Note: *ß* denotes standardized regression coefficient.

Table 3. Change in intoxication frequency regressed on change in drinking frequency.

	b (95% CI)	*ß*	*P*
Low usual quantity women (N = 709)			
Unajusted model			
Change in drinking frequency	0.00 (-0.01, 0.02)	.04	.577
Adjusted model			
Change in drinking frequency	0.00 (-0.01, 0.02)	.04	.569
Change in usual quantity	0.01 (-0.00, 0.02)	.04	.161
Age at t1	-0.00 (-0.01, 0.01)	-.01	.886
Education level at t1	0.03 (-0.02, 0.07)	.04	.193
Health at t1	0.06 (-0.02, 0.03)	.01	.650
High usual quantity women (N = 308)			
Unajusted model			
Change in drinking frequency	0.02 (-0.01, 0.05)	.09	.251
Adjusted model			
Change in drinking frequency	0.02 (-0.01, 0.05)	.10	.188
Change in usual quantity	0.01 (-0.03, 0.04)	.03	.616
Age at t1	-0.01 (-0.03, 0.01)	-.07	.387
Education level at t1	0.08 (-0.07, 0.22)	.07	.281
Health at t1	0.04 (-0.08, 0.15)	.03	.527
Low usual quantity men (N = 482)			
Unajusted model			
Change in drinking frequency	0.01 (0.00, 0.02)	.05	.042
Adjusted model			
Change in drinking frequency	0.01 (0.00, 0.02)	.05	.035
Change in usual quantity	0.02 (-0.01, 0.06)	.04	.199
Age at t1	-0.01 (-0.01, -0.00)	-.05	.002
Education level at t1	0.10 (-0.05, 0.24)	.09	.167
Health at t1	0.03 (-0.11, 0.17)	.02	.665
High usual quantity men (N = 477)			
Unajusted model			
Change in drinking frequency	0.05 (0.02, 0.08)	.13	.003
Adjusted model			
Change in drinking frequency	0.05 (0.02, 0.08)	.13	.004
Change in usual quantity	0.02 (-0.03, 0.07)	.04	.403
Age at t1	-0.00 (-0.02, 0.01)	-.02	.609
Education level at t1	0.05 (-0.14, 0.24)	.03	.562
Health at t1	0.05 (-0.12, 0.23)	.02	.525

Note: ß denotes standardized regression coefficient.