Title: Positive and Negative Affectivity as Risk Factors for Heavy Drinking in The Second

Half of Life: A Prospective Cohort Study

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Running head: Affectivity and heavy drinking

Word count: 3478

Declarations of interest: None

Abstract

Aims: To estimate the prospective relations between levels of propensity to experience

positive affect (PA) and propensity to experience negative affect (NA) and risk of heavy

drinking in a cohort of Norwegians aged 40 to 80 years.

Design: Clustered sampling was used to draw Norwegians aged 40 to 79 years in 2002/2003

(t1). The relationship between PA and NA measured at t1 and heavy drinking measured in

2007/2008 (t2) was estimated with random-intercept logistic regression.

Setting: Norway

Participants: 2 142 (44.0% men) who consumed M = 3.07 (SD = 3.15) UK units of alcohol

on average per week and were intoxicated less than once per week at t1.

Measures: The Brief Measure of Positive and Negative Affect. Quantity-Frequency measure of alcohol use, and frequency of drinking to intoxication. Heavy drinking at t2 (> 14 units per week and/or intoxication ≥ once per week) was regressed on PA and NA at t1.

Findings: Controlling for alcohol consumption, gender, age, income, and level of education (at t1) and change in PA and NA, there was little evidence for an association between level of PA and heavy drinking (OR = 0.96, 95% CI: 0.71, 1.29, Bayes factor = 0.15). Level of NA at t1 was associated with greater risk of heavy drinking at t2, OR = 1.40 (95% CI: 1.02, 1.93).

Conclusion: There is little evidence for an association between the propensity to experience positive affect and heavy drinking among Norwegians aged 40 to 80 years. Norwegian adults in the second half of life with high propensity to experience negative affect are at greater risk of heavy drinking approximately five years later than those with low propensity to experience negative affect.

Positive and Negative Affectivity as risk factors for Heavy Drinking in the Second Half of Life: A Prospective Cohort Study

Alcohol consumption is an important risk factor for reduced disability-adjusted life years (DALYs) (1). According to the World Health Organization, the harmful use of alcohol leads to 2.5 million deaths every year globally (2). Alcohol use among adults and older people is a growing public health concern because they are drinking more than previous generations (3-5). Older age is associated with reduced alcohol tolerance, which can increase the likelihood of injury. Alcohol can also accelerate disease progression, and older adults are the biggest consumers of medications that interact negatively with alcohol (6, 7). For these

reasons, reduction in the harmful use of alcohol among adults and older people is important. While the most cost-effective reduction strategies at the population level may be to increase the price and restrict the availability of alcohol (8), an additional strategy can be to target interventions at individuals with high risk of harmful alcohol use. An important first step in that direction is to identify the risk factors.

Differences in positive affectivity (PA), the tendency to experience positive emotions, and negative affectivity (NA), the tendency to experience negative emotions, may partly determine differences in motivation to drink alcohol. PA and NA can be viewed as states when momentary emotions are considered, or as dispositional traits when the tendency to experience PA and NA over a longer period of time is considered (9). While they are different constructs, they are meaningfully linked (10), but in the following, the terms PA and NA are used to denote traits and not states. PA reflects an individual's zest for life, enthusiasm and excitement, versus feeling dull or drowsy, whereas NA reflects feeling distressed, nervous, or unpleasant, versus feeling calm or relaxed (11). Although trait PA and NA may appear to be opposite ends of the same dimension, studies have shown that they are low to moderately correlated independent dimensions (9, 11, 12).

The mechanisms by which PA and NA are linked to alcohol use have been thoroughly discussed by Cheetham, Allen, Yücel and Lubman (10). Individuals high in PA may be more likely to drink alcohol because they respond more strongly to its effects and gain more positive reinforcement from drinking alcohol. Also, risky behaviour such as substance use may be more likely for individuals who frequently experience strong positive emotional states. However, it could also be the case that individuals low in trait PA drink in order to enhance positive affect (13). Considerably less evidence is available for the PA-alcohol relationship than the NA-alcohol relationship. Accumulated evidence suggests that

individuals high in trait NA are more likely to drink alcohol because they wish to reduce negative emotions or to seek distraction from negative thoughts and emotions (10).

Most previous empirical studies that have investigated the relationship between affectivity and alcohol consumption have studied adolescents and university students. Several studies have found a moderate relationship between NA and alcohol consumption among adolescents (14-16), and among university students (17, 18). The relation between PA and alcohol use among young people appears unclear. Some studies have found a weak positive relationship between PA and alcohol use (15, 17, 19), while others have found a negative relationship (16).

Knowledge about the relationship between PA/NA and alcohol use among adolescents is not necessarily generalizable to the adult population. Young people seem to have greater expectations about the effect of drinking alcohol compared to older people (20). For younger people, positive and negative expectancies seem to predict alcohol use equally well (but in opposite directions) while for older people, negative expectancies predicts alcohol use more strongly than do positive expectancies (21). Since findings from studies of young people are both inconclusive and not necessarily generalizable to adults, it is important to investigate the relation between PA and NA and alcohol use among adults and older people. Knowledge about which sub-populations are at increased risk of developing a potentially dangerous drinking pattern is an important starting point for targeted prevention. If, for instance, older individuals with high NA are at greater risk of high alcohol intake, prevention may be targeted at this sub-group.

Longitudinal studies that explicitly study the relationship between PA, NA and alcohol use among adults and older people appear to be lacking from the literature. PA and NA are related to levels of depression and anxiety: Studies have shown that PA is strongly

negatively correlated with level of depression, and moderately negatively correlated with level of anxiety, whereas NA is strongly positively correlated with both depression and anxiety (12). This is in line with the Tripartite model, where trait NA (i.e. general distress) is common for anxiety and depression, whereas low PA (i.e. anhedonia) is more specific to depression, and physiological arousal is specific to anxiety (22). Two studies found support for a longitudinal association between level of depression and alcohol use among adults (23, 24). Also, sub-clinical anxiety disorder has been linked to increased risk of developing alcohol use disorder (25). Furthermore, a recent longitudinal study found that adults with a depressive disorder were more likely to develop alcohol dependence (26).

Western governments advise inhabitants to drink below certain levels (27, 28). For instance, the UK Department of Health advise adults to restrict their alcohol intake to a maximum of 14 units of alcohol per week (112 g of pure alcohol per week), and that the units are spread over at least three days to avoid episodic heavy drinking (27). It may therefore be informative to investigate whether factors such as high PA and NA are predictive of developing a drinking pattern that exceeds official recommendations (i.e. heavy drinking over time), rather than to estimate linear relationships between risk factors and continuous measures of drinking, or estimate risk of clinical diagnosis.

Finally, previous studies have found differences in both affectivity and alcohol use between different demographic groups (12, 29). Because they are potential moderators, it is necessary to make adjustment for demographic factors when estimating the relation between affectivity and heavy drinking (30). The aim of the current study was to estimate the prospective relation between 1) level of PA and risk of heavy drinking, and 2) level of NA and risk of heavy drinking in a cohort of Norwegians aged 40 to 80 years.

Methods

Design

In this prospective cohort study, initial non-heavy drinkers were followed over five years. PA and NA were measured at time 1 (t1), and transition into heavy drinking at time 2 (t2) was the outcome variable.

Data

The data was from the Norwegian Study on Life Course, Ageing and Generation (NorLAG), which was conducted by Norwegian Social Research and Statistics Norway[1]. Data was collected from the same participants at two time points, in 2002/2003 (t1) and 2007/2008 (t2). Twenty-four Norwegian municipalities and six districts in Oslo were selected from four geographic regions based on population size, population density, standard of living, age distribution, and level of income. From the municipalities and districts, the national population registry was used to draw at random 8 298 individuals aged 40 to 79 years. The data collection was conducted using two strategies. The first was a computer assisted telephone interview in which 5 559 individuals responded (response rate 67.0%). Those who responded in the telephone interviews were asked to complete a questionnaire at home to be returned by postal mail. The questionnaire consisted of questions more sensitive in nature, among which were questions about alcohol use, health, and personality. Out of those who received the questionnaire, questionnaires were returned by 74.7 percent (4 149 individuals).

At t2, 5 269 respondents from t1 were invited to take part in a second round of the study. A total of 3 774 took part only in the telephone interviews (71.6 %) whereas 2 984 respondents (50.7 %) took part in both the telephone interview and returned the postal questionnaire. The longitudinal sample consisted of 2 671 individuals who responded via telephone and postal mail at both time-points (32.2 percent of the gross sample). A previous study found that attrition between t1 and t2 in the NorLAG-study was predicted by high age, low level of education, low income and poor health (31). The data collection was approved by the Norwegian Social Science Data Service. See (32) for more details about the NorLAG study.

Measures

PA and NA were measured at t1 and t2. Twelve of the original 20-items in the Brief Measure of Positive and Negative Affect (the PANAS scales) (9) were used. Study of the psychometric properties of this the Norwegian version has not been undertaken, however, the full English version was found to be measurement equivalent (invariant) across demographic subgroups (12). Respondents were asked to indicate to what extent they had experienced six positive types of affect (interested, excited, alert, inspired, determined and attentive) and six negative types of affect (distressed, upset, scared, irritable, nervous and afraid) during the last two weeks on a five-item response scale ranging from 1 = "very slightly or not at all", to 5 = "extremely". Internal consistency (Cronbach's alpha) was 0.83 for the PA items and 0.80 for the NA items. The average of the positively and negatively worded items constituted the PA and NA scores respectively. Change from t1 to t2 in PA and NA were computed by subtracting the t1 scores from the t2 scores.

Alcohol use was measured at t1 and t2. Respondents were asked to indicate how often they had consumed alcohol in the last 12 months, and how often they had been drinking to

intoxication. Responses were "daily/almost daily", "2-3 times per week", "once a week", "2-3 times a month", "once a month", "more rarely", "not in the last 12 months", and "never". The responses were coded into number of days per year (350, 130, 52, 30, 12, 6 and 0 respectively). Respondents were also asked to indicate how many drinks (number of half-litre glasses of beer, glasses of wine, or glasses of spirits containing 4 cl) they would usually have per occasion. This was multiplied by 1.5 in order to convert glasses into UK units of alcohol (1 UK unit of alcohol = 10 ml/8 g of pure alcohol). The number of alcohol units on average per week was calculated by multiplying yearly drinking frequency with the units of alcohol per occasion and dividing by 52. The cut-off for heavy drinking was set at > 14 units of alcohol per week and/or drinking to intoxication once a week or more often, which is in line with official UK drinking guidelines (27).

Information about gender and age was obtained from the Norwegian population registry. Level of education was obtained from the National Education Registry, which records the highest completed level of education. Level of education was coded 1 for tertiary level of education and 0 for less than tertiary level of education. Annual income after taxes was obtained from the Norwegian National Insurance Administration registry (FD-trygd).

Sample characteristics and descriptive statistics for the study variables are shown in Table 1.

Analysis

Respondents who were heavy drinkers at t1 (n = 299) were excluded from the analysis because the outcome variable was change from non-heavy drinking status at t1 to heavy drinking status at t2. Respondents with missing information about heavy drinking at t2 (n = 230) were also dropped from the analysis, yielding an analytical sample of 2142 individuals (44.0% men). Multiple imputation was used to handle missing data (see (33) for details).

Briefly, ten datasets with imputed values were generated using linear regression imputation based on all variables included in the final regression model. The analysis was performed on each dataset separately, and the results were pooled to a single multiple imputation result using the "mi estimate" command in Stata version 14 (34).

The sample was not drawn at random from the population, but from selected municipalities. Correction to the standard errors for clustered sampling was achieved by applying random-intercept logistic regression modelling with municipality as the cluster variable (the "xtlogit" command in Stata).

First, heavy drinking status at t2 was regressed on PA and NA at t1 (Model 1). Secondly, the change in PA and NA from t1 to t2, and the number of units of alcohol consumed on average per week at t1 were added (Model 2). Change in PA and NA were added to account for instability in PA and NA over time, and alcohol consumption at t1 was added because initial drinking level is strongly associated with developing a heavy drinking pattern, and may be associated with PA and NA. Thirdly, gender, age, income and higher education measured at t1 were added to the model to account for demographic heterogeneity in affect and heavy drinking (Model 3). The natural logarithm of income was used because the income distribution was heavily skewed to the right.

Bayes factor was calculated using Dienes' on-line calculator (35). A non-uniform distribution was chosen. The log of the odds-ratio estimate and its standard error was entered. The population mean was set to 0, the SD of P was set to 1, and a two-tailed distribution was specified.

Results

Sample characteristics and pairwise Spearman correlation coefficients for the study variables are presented in Table 1. At t2, 7.3 percent (95% CI: 6.3, 8.5) of the cohort (157

individuals) had become heavy drinkers (i.e. drinking > 14 units of alcohol per week and/or drinking to intoxication ≥ once a week). Heavy drinking (t2) was weakly positively correlated with PA and NA (t1). Heavy drinking (t2) was more common among those with higher education (t1), it was positively correlated with income (t1), and the number of alcohol units on average per week (t1), but weakly negatively correlated with age (t1).

At t1, PA was positively correlated with income, higher education, and the number of alcohol units per week, but negatively correlated with age. NA was higher for women compared to men, and negatively correlated with age. PA and NA were weakly negatively correlated.

Estimates from the random-intercept logistic regression models are shown in Table 2. In Model 1, higher level of PA and NA at t1 was associated with greater risk of heavy drinking at t2, but only the estimate for PA was statistically significant. In Model 2, higher level of NA at t1 was associated with greater risk of heavy drinking at t2. Level of PA at t1 was very weakly associated with risk of heavy drinking at t2. Change in PA was weakly associated with greater risk of heavy drinking at t2, as was change in NA. Alcohol consumption at t1 was, however, strongly positively associated with greater risk of heavy drinking at t2.

After adding gender, age, income and higher education (Model 3), the estimates for PA and NA remained similar to the estimates in Model 2. Higher level of PA at t1 was weakly associated with risk of heavy drinking at t2. The Bayes factor for the estimate was 0.15, hence there is moderate evidence for a null association (36). Most importantly, an increase of one unit on the NA scale at t1 was associated with upwards of 40 percent greater risk of heavy drinking at t2. Gender, income and age were weakly associated with risk of

heavy drinking at t2, but higher education at t1 was associated with greater risk of heavy drinking at t2.

For all three models, the estimated residual intraclass correlations were small (37), which suggests little dependency between individuals residing in the same municipality.

Discussion

The current study followed a cohort of Norwegians aged 40 to 80 years over five years. None were heavy drinkers at the start of the study, but about five years later, 7.3 percent of the cohort had become heavy drinkers. An inverse relationship between level of PA at t1 and heavy drinking at t2 might have been expected because level of PA is moderately inversely related to level of depression (9, 12, 22), which in turn is positively related to alcohol use (23-26). However, the current study offers little evidence to support that low level of PA is associated with greater risk of heavy drinking.

High level of NA at the start of the study was associated with much greater risk of heavy drinking five years later. This is in line with previous studies that investigated the longitudinal relationship between NA related traits (depression and anxiety) and alcohol use among adults (23-26). The results are consistent with the theoretical assumption that individuals high in NA have greater risk of becoming heavy drinkers because they drink to cope with negative emotions (10, 13). The results are also consistent with previous longitudinal studies of adolescents and young adults (14-19). This suggests that both young and older people may drink alcohol to reduce negative emotions or to cope with negative thoughts and emotions (10). Gender, age, income, and level of education were included in the analysis because they may be moderating factors. However, the estimated relationships

between PA, NA and heavy drinking did not change substantially after adjusting for these variables.

An important implication of the current study is that prevention efforts may benefit from targeting adults and older individuals with high NA, since they may be at greater risk of heavy drinking. Research indicates that this is true also for young people. Persons of all ages may use alcohol as a strategy to cope with unpleasant emotions. Teaching such individuals healthier coping strategies could result in better quality of life and lower the risk of injury and disease. Targeted prevention efforts aimed specifically at adults and older individuals with high PA seems unwarranted. This may also be true for younger age groups. Finally, the results indicate that adults with higher education have greater risk of becoming heavy drinkers. Perhaps prevention efforts should be targeted at highly educated persons with high NA to reduce the harmful use of alcohol.

Designing effective targeted prevention efforts is an important task for future research, as the effectiveness of such efforts has been called into question (8). Evaluation of the effectiveness of prevention efforts targeted at individuals with high NA would also be a welcome addition to the field. Treatment professionals who counsel adult and older clients may benefit from knowledge that treatment of emotional problems can help prevent heavy drinking, which would be an unwelcome added burden for emotionally vulnerable individuals. Also, treating underlying emotional problems will probably improve the prognosis for people in treatment for alcohol problems.

Limitations

The use of self-report data can affect results because of social desirability bias. NA and alcohol consumption may have been underreported, whereas PA may have been

exaggerated. Future studies may benefit from more objective measurement, especially of alcohol consumption, which is often underreported (38, 39). It is difficult to ascertain the direction of bias that may have arisen by use of self-reported data.

Attrition between t1 and t2 was predicted by high age, low level of education, low income and poor health. These factors have been associated with alcohol consumption (3, 29, 40-42), and may have biased the current estimates. However, age, level of education, and income were included as covariates in the regression model, hence the effect of selective attrition may be small. Still, future longitudinal studies should ensure that non-random attrition is minimized to avoid selection bias.

The current study used only one time lag, which was five years in duration. Previous studies of the relationship between depression and alcohol use have used several time lags and found different results for different time lags (23, 24). Therefore, the results from the current study would have been more robust if the NA-heavy drinking relationship was evident for shorter and longer time lags.

Finally, it is not impossible that the estimates were affected by unobserved heterogeneity. Future studies with several time lags could employ fixed effects modelling in order to minimize effects of omitted time invariant factors.

Conclusion

The results from this prospective cohort study of adults in the second half of life indicate that individuals with high NA are at greater risk of heavy drinking. However, the study provides little evidence that PA is a risk factor for heavy drinking. Knowledge of the risk factors for heavy drinking is important for designing targeted prevention efforts to reduce alcohol related injury and burden of disease.

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Table 1. Sample characteristics: Descriptive statistics and pairwise Spearman rank order correlations.

Study variables	Valid (N)	Range	%/Mean (SD)	Skewness	Kurtosis	1	2	3	4	5	6	7	8	9
1. Heavy drinking at t2	2142	0 - 1	7.3	-	-	-								
2. Positive affectivity t1	2124	1 - 5	3.14 (0.76)	-0.06	2.86	.05*	-							
3. Negative affectivity t1	2123	1 - 5	1.85 (0.61)	1.25	5.03	.04	-.04*	-						
4. Change in positive affectivity (t2-t1)	2105	-2.83 - 3	0.14 (0.68)	-0.14	4.04	.01	-.46*	.02	-					
5. Change in negative affectivity (t2-t1)	2103	-3 - 3.17	0.02 (0.64)	0.20	5.30	.00	-.06*	-.42*	.02	-				
6. Units of alcohol on average per week t1	1989	0 - 12.98	3.07 (3.15)	1.15	3.40	.29*	.17*	-.00	-.03	-.01	-			
7. Male gender t1	2142	0 - 1	44.0	-	-	.03	.00	-.11*	-.04	-.02	.15*	-		
8. Age t1	2142	40 - 80	55.95 (9.62)	0.28	2.14	-.04	-.17*	-.10*	-.06*	.03	-.17*	.07*	-	
9. Income (ln) t1	2130	8.52 - 15.20	12.21 (0.52)	-1.69	15.36	.11*	.21*	-.01	.01	-.05*	.33*	.31*	-.29*	-
10. Higher education t1	2136	0 - 1	33.2	-	-	.11*	.21*	.03	.03	-.03	.19*	-.01	-.10*	.38*

Note: Heavy drinking = > 14 units of alcohol per week and/or drinking to intoxication ≥ once a week. * indicates P < 0.05

Table 2. Estimates from random intercept logistic regression: Heavy drinking at t2 regressed on positive and negative affectivity a t1

	Model 1 Heavy drinking (t2)		Model 1 Heavy drinking (t2)		Model 2 Heavy drinking (t2)	
	OR (95% CI)	P	OR (95% CI)	P	OR (95% CI)	P
Fixed effects estimates:						
Positive affectivity (t1)	1.27 (1.01, 1.58)	0.037	1.06 (0.80, 1.41)	0.662	0.96 (0.71, 1.29)	0.790
Negative affectivity (t1)	1.14 (0.88, 1.48)	0.323	1.39 (1.01, 1.90)	0.042	1.40 (1.02, 1.93)	0.039
Change in positive affectivity (t2-t1)			1.12 (0.83, 1.52)	0.457	1.04 (0.76, 1.43)	0.792
Change in negative affectivity (t2-t1)			1.28 (0.94, 1.74)	0.114	1.30 (0.95, 1.77)	0.101
Units of alcohol on average per week (t1)			1.38 (1.31, 1.46)	<0.001	1.38 (1.31, 1.45)	<0.001
Male gender (t1)					1.21 (0.83, 1.78)	0.327
Age (t1)					0.99 (0.97, 1.01)	0.437
Income (ln) (t1)					1.01 (0.67, 1.52)	0.970
Higher education (t1)					1.58 (1.06, 2.35)	0.023
Random intercept estimates:						
Estimated residual variance (SD)	0.48		0.20		0.07	
Estimated residual intraclass correlations	0.06		0.01		0.00	

Note: Heavy drinking = > 14 units of alcohol per week and/or drinking to intoxication ≥ once a week.