Collectivity of drinking behavior among adolescents: An analysis of the Norwegian ESPAD data 1995–2011

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ABSTRACT

AIMS – The aim of the current study was to test empirically two predictions from Skog's theory of collectivity of drinking behavior, using time series data from Norwegian adolescents. The two specific predictions were: 1) A change in mean alcohol consumption is positively associated with a change in the proportion of heavy drinkers, and 2) A change in mean alcohol consumption is positively associated with a change at all consumption levels. DATA & METHODS – The present analyses are based on ESPAD data collected from Norwegian adolescents (15–16 years) in 1995, 1999, 2003, 2007 and 2011. The relationship between mean consumption and the proportion of heavy drinkers was analyzed by regressing the proportions of heavy drinkers at each time point on the consumption means at each time point. In order to assess whether adolescents at all consumption levels, from light to heavy drinkers, changed collectively as mean consumption changed, we regressed log-transformed consumption means on the log-transformed percentile values (P25, P50, P75, P90 and P95). The analysis was restricted to adolescents who had consumed alcohol in the last 30 days (total $n = 7554$). RESULTS – The results showed a strong relationship between mean alcohol consumption and the proportion of heavy drinkers. An increase in mean consumption was also associated with an increase at all consumption levels, from light to heavy drinkers. CONCLUSION – The results of the current study are in line with the theory of collectivity of drinking behavior. The findings of this study suggest that by reducing the total consumption of alcohol among adolescents, consumption and risk of harm may be reduced in all consumer groups. KEYWORDS – heavy drinking, mean consumption, adolescents, collectivity, ESPAD, Norway

Introduction

The European School Survey Project on Alcohol and Other Drugs (ESPAD) does not only provide a unique opportunity to compare adolescent substance use across a large number of countries, but with its regular data collection every fourth year it has also provided important time series of such data. This study is based on the latter. In Norway, per capita alcohol sales increased by 50 per cent from 1993 to 2008, and thereafter a slight decrease was observed (Edland-Gryt, Bryhni, Skretting, Lund, & Bye, 2012). Among young people, however, the increase in consumption during the 1990s peaked around the first years of the new millennium, and thereafter it decreased (Bye, 2012; Vedøy & Skretting, 2009). Similar diverging trends in adult and youth drinking have been observed in Sweden (CAN, 2012) and the United Kingdom (Meier, 2010). These diverging trends in alcohol consumption may appear contradictory to Skog's theory of collectivity of drinking behaviour (Skog, 1985), but as

we shall see this is not necessarily the case. However, a recent study of Swedish youth (Hallgren, Leifman, & Andréasson, 2012) suggested that the observed decrease in youth drinking resulted in a polarization of youth drinkers. While consumption had decreased in most consumer groups, it had increased in the heaviest drinking groups, which is inconsistent with Skog's theory. In light of this, the current study investigated the applicability of Skog's theory to the recent trends in youth drinking in Norway.

According to Skog's theory of the distribution of alcohol consumption, drinking is a social behavior, and individual drinking tends to be modified by interaction with other individuals (Skog, 1985, 1991a, 1991b). Since the individuals in one's social network in turn interact with other individuals who interact with yet more individuals, there exists a complex network where each individual is tied to the drinking culture as a whole. The result is a collectivity of drinking behavior where all groups of consumers, ranging from light to heavy drinkers, tend to change in the same direction when total consumption changes, that is they move 'in concert up and down the scale of consumption'. The distribution of alcohol consumption is heavily skewed and the majority of drinkers consumes less than the population mean, while a minority of heavy drinkers consumes most of the alcohol (Skog, 1985, 1991a). Given that all drinking groups, from light drinkers to heavy drinkers, change with a change in the total consumption, one implication of this collectivity is that there must be a close relationship between the mean consumption and the proportion of heavy drinkers in the population. A further implication of Skog's theory for alcohol policy is that effective efforts to reduce the total consumption of alcohol will cause a reduction in heavy drinking and alcohol related harm.

Despite widespread recognition of Skog's theory and its importance for public alcohol policies, as well as criticism of its empirical testability (Gmel & Rehm, 2000), surprisingly little research has been conducted that tests its predictions (Gmel & Rehm, 2000; Rossow & Clausen, 2013; Rossow, Mäkelä, & Kerr, 2014). The assumption that all drinkers 'move in concert' when mean consumption changes, has been tested by analyzing the association between the mean consumption and the consumption at various drinking levels (e.g. light, moderate and heavy drinkers). Skog's own empirical analyses of such collective changes were mainly based on regional variations, whereas the interpretation is usually related to temporal changes. Skog (1985) noted this as a weakness that needed to be addressed in future studies. Although such studies have been warranted also in the succeeding years (Gmel & Rehm, 2000; Rossow & Norström, 2013; Skog, 2001), they are still quite few. Very recent exceptions are studies of the adult population in a several countries. Two studies from Sweden demonstrated that consumption increased in all consumer groups between 1996/1997 and 2004/2005 (Tryggvesson, 2013) and that consumption in all consumer groups declined in the subsequent years (Raninen, Leifman, & Ramstedt, 2013). Correspondingly, a study from Finland, Norway and the USA also found empirical support for Skog's theory by demonstrating a close relationship between mean consumption

and the consumption at various drinking levels (Rossow et al., 2014).

Now, turning to the youth population, the observation that alcohol consumption among adolescents has declined, whereas the prevalence of heavy drinkers may have increased, has led several authors to suggest that a "polarization" between light and heavy drinkers has taken place (Bjarnason, 2006; Livingston, 2008; Meier, 2010), rather than collective changes. Two recent studies among Swedish youth that have examined changes in mean consumption and consumption among heavy drinkers over time have produced different findings; one apparently contradicting Skog's theory (Hallgren et al., 2012), whereas the other provided evidence that was in line with Skog's theory (Norström & Svensson, 2014).

The aim of the current study was to test empirically two predictions of collective changes from Skog's theory, using time series data for Norwegian adolescents. The two specific predictions were: 1) A change in mean alcohol consumption is positively associated with a change in the proportion of heavy drinkers, and 2) A change in mean alcohol consumption is positively associated with a change at all consumption levels.

Method

Samples

The present analyses are based on Norwegian data from the ESPAD study, which was conducted five times: In 1995, 1999, 2003, 2007 and in 2011. The population each year comprised students that turned 16 years of age during the year of data collection (Norwegian 10th grade students). School classes were selected at random after stratification by region and municipality type, and invited to take part in the survey. Anonymous self-report questionnaires were administered during school hours. Sample size and response rates for the different years were: 1995: $N = 4,020$, 92%; 1999: $N = 3,918$, 90%; 2003: $N = 3,935$, 87%; 2007: $N = 3,687$, 92 %; and 2011: $N = 3,196$, 73 %. See Hibell et al. (2012) for more details about the sampling procedures and data collection.

Measures

An estimate of past 30 days drinking frequency was obtained by using responses to the question "On how many occasions (if any) have you had any alcohol beverage to drink during the last 30 days?" The response alternatives were: "0", "1–2", "3–5", "6–9", "10–19", "20–39" and "40 or more". The responses were recoded to number of days per month (0, 1.5, 4, 7.5, 14.5, 30 and 30 respectively). The response category "40 or more" was coded 30 because it is the maximum possible number of days in a 30 day period.

Responses from five beverage specific questions were used to determine the amount of alcohol consumed at the last drinking occasion. The question was worded: "If you drank beer/wine/spirits/ alcopops/cider that last day you drank any alcohol, how much did you drink?" The response alternatives for beer, alcopops and cider were "I never drink beer/alcopops/cider" (coded 0), "I did not drink beer/alcopops/cider on the last day that I drank alcohol" (coded 0), "<50 cl" (coded 25), "50–100 cl" (coded 66), "101–200 cl" (coded 150), and ">200 cl" (coded 200).

The response alternatives for wine in 1995 and 1999 were different from the

response alternatives in 2003, 2007 and 2011. In 1995 and 1999 the response alternatives were "I never drink wine" (coded 0), "I did not drink wine on the last day that I drank alcohol" (coded 0), "Less than a glass (<10 cl)" (coded 5), "1–2 glasses (10–20 cl)" (coded 15), "Half a bottle (37 cl)" (coded 37), "A bottle or more (≥75 cl)" (coded 75). In 2003, 2007 and 2011, the response alternatives were "I never drink wine" (coded 0), "I did not drink wine on the last day that I drank alcohol" (coded 0), "<20 cl" (coded 10), "20–40 cl (coded 30), ""41–74 cl" (coded 58), and ">74 cl" (coded 75).

The response alternatives for spirits in 1995 and 1999 were also different from the response alternatives in 2003, 2007 and 2011. In 1995 and 1999 the response alternatives were "I never drink spirits" (coded 0), "I did not drink spirits on my last drinking occasion" (coded 0), "Less than one drink (<5 cl) (coded 2.5), "1–2 drinks (5–10 cl)" (coded 7.5), "3–5 drinks (11–25 cl)" (coded 18), "6 drinks or more (≥30 cl)" (coded 30). In 2003, 2007 and 2011, the response alternatives were "I never drink spirits" (coded 0), "I did not drink spirits on the last day that I drank alcohol" (coded 0), "<8 cl" (coded 4), "8–15 cl" (coded 11.5), "16–24 cl" (coded 20), and ">24 cl" (coded 25).

Past 30 days alcohol consumption was determined by multiplying the past 30 day drinking frequency by the sum of all alcohol (converted to centiliters of 100% alcohol) consumed at the last drinking occasion.

Analysis
The analysis was restricted to adolescents who had consumed alcohol in the last 30 days ($n = 7554$). A cut-off point for heavy drinking was set at 1 liter of 100% alcohol, which was approximately the 90th percentile score for alcohol consumption in the total sample.

Aggregate level analysis was conducted by constructing a dataset ($N = 10$) consisting of aggregate estimates for girls and boys at each time point. The dataset included the following variables: mean alcohol consumption, proportion of heavy drinkers, the percentile values for P25, P50, P75, P90 and P95, as well as log-transformations of these variables. Using this aggregate level dataset, the relationship between mean consumption and the proportion of heavy drinkers was analyzed by regressing the logged proportions of heavy drinkers on the logged consumption means. This was done for girls and boys separately in order to increase statistical power (by doubling the number of observations). Pooled regression coefficients were the average of the estimates for girls and boys, and the pooled standard error was obtained by dividing the square root of the sum of the squared standard errors by two.

To obtain results comparable to previous research, we investigated whether change in mean alcohol consumption was associated with change at all consumption levels by applying the same method as Skog (1985). He used the percentile values, which are distribution measures, to illustrate categories of consumption levels. A person drinking the amount of the 25 percentile value (i.e. barely more than the 25 per cent of the drinkers who drink the least and less than the remaining 75%), was called a light drinker. Persons drinking the amount of the 50, 75, 90, and 95 percentile values, were called

Table 1. Mean (95% CI) past 30 day alcohol consumption and proportion of heavy drinkers (95% CI) for Norwegian adolescents aged 15 and 16 years from 1995 to 2011.

Year	n	Mean alcohol consumption[1]	Proportion of heavy drinkers[2] (%)
1995			
Girls	757	26.03 (22.01, 30.05)	3.96 (2.57, 5.36)
Boys	717	40.85 (34.38, 47.33)	6.56 (4.74, 8.37)
Total	1474	33.24 (29.46, 37.02)	5.22 (4.09, 6.36)
1999			
Girls	968	35.08 (30.19, 39.97)	5.17 (3.77, 6.56)
Boys	940	53.14 (46.17, 60.12)	9.68 (7.79, 11.57)
Total	1908	43.98 (39.72, 48.23)	7.39 (6.22, 8.56)
2003			
Girls	915	48.15 (41.73, 54.57)	10.49 (8.50, 12.48)
Boys	839	70.00 (59.51, 80.50)	15.85 (13.38, 18.33)
Total	1754	58.60 (52.56, 64.65)	13.06 (11.48, 14.63)
2007			
Girls	747	42.34 (35.85, 48.83)	8.26 (6.29, 10.23)
Boys	679	58.31 (48.18, 68.45)	12.40 (9.92, 14.87)
Total	1434	50.05 (44.17, 55.93)	10.34 (8.77, 11.91)
2011			
Girls	499	30.15 (23.39, 36.91)	4.26 (2.50, 6.03)
Boys	463	61.76 (45.64, 77.87)	9.34 (6.70, 11.98)
Total	984	45.03 (36.68, 53.37)	6.84 (5.27, 8.41)

Note: [1]Centiliters of 100% alcohol; [2]consumed more than 100 cl of 100% alcohol in the last 30 days; CI = confidence intervals.

medium drinkers, moderate drinkers, near-heavy-drinkers, and heavy drinkers, respectively. In this way, the percentile values indicate the consumption levels of all groups of drinkers. Skog assumed that the consumption levels of these drinkers (i.e. the corresponding percentile values) would strongly depend on the mean consumption level in the population. For instance, the consumption level of a person who drinks more than 95% of the population (i.e. the 95th percentile value) should vary from one population to the next according to the mean consumption level in the populations.

We used the aggregate level dataset to assess whether all drinking groups changed collectively with a change in mean consumption. In line with Skog's (1985) own analyses, we regressed logged percentile values (P25, P50, P75, P90 and P95) on logged consumption means.

Results

Mean alcohol consumption increased from 1995 to 2003 and decreased from 2003 to 2011 (see Table 1). This was evident for both girls and boys. The proportion of heavy drinkers also increased from 1995 to 2003 and decreased from 2003 to 2011.

First we investigated whether change in mean alcohol consumption was positively associated with a change in the proportion of heavy drinkers. The association was strong, positive and statistically significant; the pooled estimate was 1.70, the

standard error of the estimate was 0.18 and the *p*-value was < .001. Since both variables were logged, the regression coefficient is an elasticity. Thus, a 1% increase in mean alcohol consumption was associated with a 1.7% increase in prevalence of heavy drinkers.

Next, we investigated whether a change in mean alcohol consumption was positively associated with a change at all consumption levels; that is among light drinkers (the 25 percentile value, P25), medium drinkers (P50), moderate drinkers (P75), near-heavy drinkers (P90) and heavy drinkers (P95). Table 2 shows that an increase in mean consumption was strongly associated with an increase at all consumption levels. More specifically, a 1% increase in mean consumption was associated with 1.33%, 0.8%, 1%, 1% and 1.17% increase in the 25, 50, 75, 90 and 95 percentile values, respectively. Figure 1 shows the percentile values by mean consumption in the 10 gender specific samples and further illustrates this systematic pattern in the distribution of consumption.

Sensitivity analyses
Several approaches were used to test the robustness of our findings. First, we tested whether the association between mean consumption and the proportion of heavy drinking was dependent on the chosen cut-off point for heavy drinking (1.0 liter pure alcohol in the past 30 days), and we repeated the analysis using cut-off points set at both 0.5 liters and at 1.5 liters. Using either of these cut-off points, there was still a significant relationship between mean alcohol consumption and the proportion of heavy drinkers.

Next, we assessed whether the change

Table 2. Percentile values (logged) regressed on mean consumption (logged).

	b	*SE*	*P*
P25	1.33	0.14	.000
P50	0.80	0.11	.002
P75	1.00	0.24	.016
P90	1.00	0.22	.011
P95	1.17	0.21	.005

in response categories from 1995/1999 to 2003 and onwards had an impact on the results. The analyses were re-run applying only the gender specific samples in the 2003, 2007, and 2011 surveys (*n* = 6) and the pooled estimates were nearly the same (although not all were statistically significant) as those for the entire data set. This may be inferred also from Figure 1 as there are no samples that represent clear deviance from the systematic pattern.

Finally, we assessed whether the exclusion of infrequent past year drinkers in the alcohol consumption measure had an impact on the results by repeating the analyses using a measure of past year consumption. For those who had consumed alcohol in the preceding 30 days, the estimated consumption for this period was multiplied with 12. For those who had consumed alcohol in the past year but not in the past 30 days (n= 4039; 35% of all past year drinkers) past year consumption was calculated based on past 12 months frequency and volume at the most recent drinking occasion. The results from these analyses corresponded well with those already described, and consequently there was no indication that exclusion of infrequent past year drinkers had any impact on the results.

Figure 1. Percentile values by mean consumption for 10 gender specific samples.
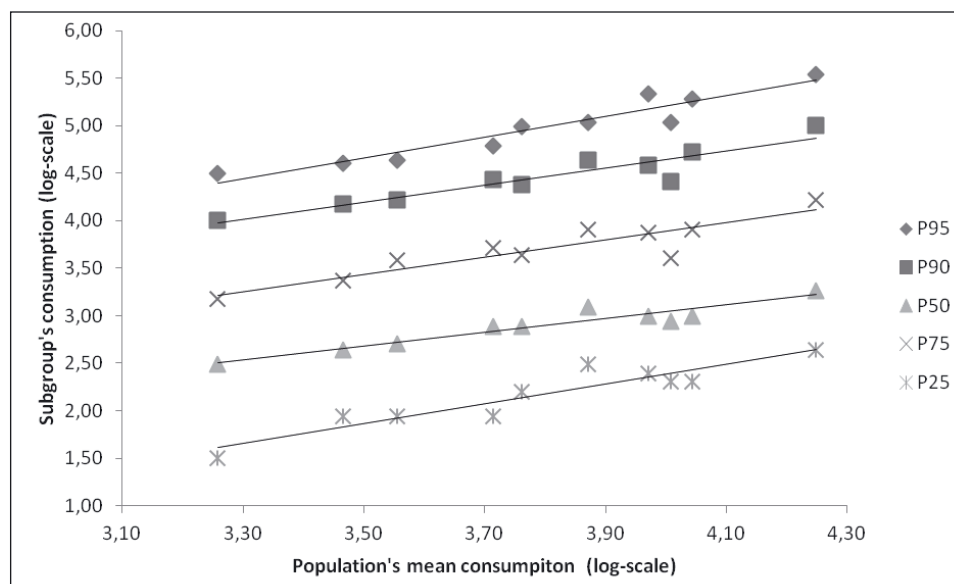
Note: Percentile values for the 25; 50; 75, 90 and 95 percentiles (P25; P50; P75; P90; P95)

Discussion

This study is one of few that have addressed the validity of Skog's theory with respect to collective temporal changes in alcohol consumption, applying temporal data from youth populations. The results of the current study are in line with the two predictions from Skog's (1985) theory of collectivity of drinking behavior that we have tested. We found a strong relationship between mean alcohol consumption and the proportion of heavy drinkers. We also found that increase in mean consumption was associated with increase in all consumption groups, from light to heavy drinkers.

The observed relationship between changes in mean consumption and changes in the prevalence of heavy drinkers is in line with previous studies from the general population, which have shown a relationship between changes in mean consumption and levels of harm typically seen in heavy drinkers (Kerr, Karriker-Jaffe, & Ye, 2013; Mäkelä & Österberg, 2009; Norström & Rossow, 2013; Ramstedt, 2001). A few previous studies have addressed collective changes in alcohol consumption over longer periods of time, but these have reported mixed results (Hallgren et al., 2012; Knibbe, Drop, Reek, & Saenger, 1985; Lemmens, Tan, & Knibbe, 1990). The Dutch studies of general population samples found empirical support for a collective displacement over a period with increasing consumption (Knibbe et al., 1985; Lemmens et al., 1990), whereas this was not the case in the Swedish study of youth alcohol consumption addressing a period with an overall decreasing trend in consumption (Hallgren et al., 2012). The present study found support for a collective

shift in youth drinking over a period when consumption first increased and thereafter decreased, which may suggest symmetry in the collective displacement; i.e. high and low consumer groups move collectively in the same direction, both with upwards and downward shifts in total consumption. It is important to note that the observed collective changes refer to groups of drinkers. At the individual level, we may well find that some individuals deviate from a collective movement, for instance some reduce their consumption while the overall consumption increases (Skog, 2001; Skog & Rossow, 2006). The present study used repeated cross-sectional data from which individual changes could not be assessed and there are, in general, few data sets that provide insight to both individual and collective changes in consumption when total consumption changes (Skog & Rossow, 2006). Panel data from Finland in 1968 and 1969 showed, however, that also at the individual level alcohol consumption increased in all consumer groups when the mean consumption increased markedly (Mäkelä, 2002).

While this study has shown that collective displacement in consumption occurred within the youth population, in line with Skog's theory, it remains to discuss how divergent trends in youth and adult drinking may be consistent with the theory. According to Skog, collectivity could be expected within larger segments of society where individuals interact in social networks. However, young people, below the legal drinking age and adults are not likely to share many drinking occasions and interact socially while drinking, nor are they necessarily influenced by the same external factors that may influ-

ence the demand for alcohol as are adults. Consequently, Skog's theory does not predict that all demographic or other types of sub-groups in a population necessarily change in the same direction and to the same extent. Previous studies (Caetano, Suzman, Rosen, & Voorhees-Rosen, 1983; Gustafsson, 2010; Mustonen, Mäkelä, & Huhtanen, 2007) have indeed found that sub-population groups by age, gender or region may change their consumption differently.

Strengths and limitations
The data comprised five representative cross sections of youths over sixteen years, which allowed investigation of trends in alcohol consumption over time, as well as investigation of differences in trends in sub-groups of drinkers. Overall, the response rates were quite high compared to other surveys due to anonymity and the survey administration taking place in school classrooms.The findings were robust, as repeated analyses applying different consumption estimates and different cut-off points for heavy drinkers, did not alter the findings much.

There are, however, several limitations that should be noted. Firstly, alcohol consumption was self-reported, which can lead to under-reporting (Midanik, 1982; Ramstedt, 2010). There were also some differences in the response rates at the different time points. For instance, the response rate in 2011 was markedly lower than for the previous four time points. The reason for this may be that students not present at the time of the data collection were not asked to complete the survey at a later time, and that absence was more common in 2011 compared to previous

years. This in turn can be explained by the gradual adaptation from 2002 of a reform in Norwegian schools were there has been a shift away from teaching school classes and toward more flexible modes of dissemination, such as lectures and group-work. The effect of different response rates on our findings is unknown, but if the heavy consumers were over-represented among non-responders, as has been shown previously (Romelsjö & Branting, 2000), selective non-response would deflate the mean, the variance and reduce skewness. If this is the case, low response rates will result in underestimation of the strength of the relationship between the mean and the proportion of heavy drinkers, and the strength of the relationship between the mean and the percentile values (especially higher percentiles).

The use of the "last occasion method" to measure volume of alcohol consumption may not be ideal, but no thorough investigation of its performance is currently available. The quantity consumed at the last drinking occasion can be different from the individual's typical quantity. Whether this results in biased estimates of volume of consumption, and the direction of such bias, is unknown. It is also unknown whether the size of the bias will be related to level of consumption. Adolescents with a high volume of consumption will have a higher drinking frequency and probably also greater variance in the quantity they consume when drinking. It is therefore more likely that a high consumer (compared to a moderate or low consumer) will report from an occasion where an unusual quantity was consumed. Whether this leads to inflated or deflated estimates is not known, but it is not impossible that over- and underestimation of quantity will cancel each other out. Moreover, as most of the variation in volume of consumption will be due to differences in drinking frequency, we believe that the difference between the "last drinking occasion method" and other methods will be small.

Implications
According to recent ESPAD data around 80 percent of students in Europe had used alcohol in the past 12 months in 2011 (Hibell et al., 2012). As young people are particularly susceptible to alcohol related harm, the importance of prevention is substantial (Toumbourou et al., 2007). The findings of this study suggest that by reducing the total consumption of alcohol among young people, consumption and risk of harm may be reduced in all consumer groups. Effective measures of relevance in this respect include high alcohol taxes (Chaloupka, Grossman, & Saffer, 2002; Wagenaar, Salois, & Komro, 2009) and restrictions on availability of alcohol, e.g. minimum legal age for purchase (Babor et al., 2010; Wagenaar & Toomey, 2002).

The scarcity of studies applying temporal data to test Skog's theory of collectivity represents a challenge to be met in future studies. Ideally, these should also include panel data to assess both collective and individual changes, and they should also include data from drinking cultures in other parts of the world where alcohol is less integrated in society.

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