EPIDEMIOLOGY

Age, Period and Cohort Analysis of Light and Binge Drinking in Finland, 1968–2008

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Abstract — Aims: To analyse the effects of age, period and cohort (APC) on light and binge drinking in the general population of Finland over the past 40 years. Methods: All analyses were based on six Drinking Habits Surveys between 1968 and 2008 of representative samples of the Finnish population aged between 15 and 69 (n = 16,400). The number of drinking occasions per year involving 1–2 drinks (light) and 4+ or 6+ drinks (binges) was used as a dependent variable in APC modelling. Descriptive cohort profiles and negative binomial models were used to assess the effects of APC. Results: Descriptive cohort profiles differed for light and binge drinking. No substantial differences were found across cohort profiles for light drinking, while APC modelling predicted declining cohort and increasing period effects. Differences between cohorts were found for binge drinking, with predictions of slightly declining or increasing period and increasing cohort effects. Conclusions: Light drinking has increased over time for each cohort, with no substantial differences between cohort profiles. Binge drinking has increased with more recent cohorts and there are distinct differences between cohort profiles, especially among women.

INTRODUCTION

Per capita alcohol consumption in Finland has increased at an almost constant rate over the last four decades. Although there have been broad studies of secular trends in per capita consumption (e.g., Lintonen et al., 2000; Mäkelä et al., 2010), only a few studies have used cohort design, for example, with regard to alcohol-related mortality (Valkonen and Kauppinen, 2005). Sulkunen (1979, 1987) provided some insightful conclusions regarding cohort change based on descriptive results, but no studies have simultaneously modelled the three time-related factors of age, period and cohort (APC). These effects must be taken into account to gain an adequate understanding of the temporal dynamics behind increased alcohol consumption. The increasing trend in alcohol consumption started between the 1960s and the early 1970s, when total consumption tripled following major alcohol law reform. The period from the mid-1970s to the end of the 1980s started with slight growth, followed by a more rapid increase towards the end. The increase in consumption slowed temporarily during the economic recession at the beginning of the 1990s but increased after 1995. The increase accelerated again after significant cuts in alcohol taxes in 2004, as a result of which annual consumption reached 10.5 l of absolute alcohol per capita by the end of 2008 (Mäkelä and Österberg, 2009).

The most explicit influence on the level of consumption can be traced to major historical events, also referred to as period effects (Kerr et al., 2004). Changes in alcohol policy (such as the New Alcohol Act of 1969 and tax cuts in 2004) increased consumption levels in the general population. Furthermore, economic conditions, such as the economic boom of the late 1980s, the recession of the early 1990s and changes in living conditions, are examples of period effects on consumption. Cohort effects account for the fact that changes in the surrounding society affect people of different ages in different ways (Ryder, 1965/1985). For youths, the characteristics of the surrounding society are particularly influential (Mannheim, 1928/1952). A well-known Finnish study that applied to the period of rapidly increasing consumption in the 1970s concluded that a ‘wet generation’ was formed as people who came of age in the 1960s gave up abstinence en masse (Sulkunen, 1979). The current study must make the distinction between period effects and cohort effects, given that cohorts drinking more have replaced those drinking less over the last four decades. Other studies have also identified the importance of distinguishing between ‘period change’ and ‘cohort change’ (Smith, 2008). Findings on cohorts may also be used to predict future alcohol consumption (Kerr et al., 2004). Finally, the population age structure in Finland is getting older, as it is in other developed countries, which also influences alcohol consumption.

Internationally, several indicators of alcohol consumption have been explored from the perspectives of APC. These include alcohol-related mortality (Rosén and Haglund, 2006), different beverage types (Kerr et al., 2004), volume of consumption (Kerr et al., 2009), drinking frequency (Levenson et al., 1998), heavy drinking frequency (Björk et al., 2008) and number of drinking days (Kerr et al., 2009). The present study benefits from the exceptionally high-quality data at its disposal: the six Finnish Drinking Habits Surveys, conducted at 8-year intervals from 1968 to 2008, include a wealth of measurements on alcohol consumption and offer ideal data for APC analyses.

Finnish alcohol culture has traditionally considered drinking to intoxication as the core of drinking habits (Tigerstedt and Torrønen, 2007). Moreover, a number of studies have identified connections between binge drinking and various acute health and social problems (Rehm et al., 2006; Sundell, 2010). In addition, the frequency of binge drinking occasions has been shown to have a better predictive power than volume with regard to alcohol-related social problems (Kraus et al., 2009). From a cross-sectional viewpoint, however, it has been shown that binge drinking in Finland is more frequent among young drinkers and decreases with age, whereas light drinking increases with age, peaks during middle age and remains relatively stable among elderly drinkers (Mäkelä and Härkönen, 2010). These facts suggest that an analysis of both light and binge drinking is warranted.
The present study seeks to decompose trends in light and binge drinking in Finland in terms of APC effects by using six cross-sectional surveys conducted between 1968 and 2008. Furthermore, a descriptive trend analysis is provided as a background for the APC modelling. The APC analysis uses two different measurements, namely the number of light and binge drinking occasions per year. Light drinking is defined for both men and women as a drinking occasion that involves the consumption of one or two drinks. Binge drinking is measured as a drinking occasion involving six or more drinks for men and four or more drinks for women. The purpose of different cut-off points for binge drinking is to account for the fact that the same amount of alcohol results in a higher blood alcohol concentration for women (Dawson and Archer, 1992; see also Holmila and Raitasalo, 2005).

METHODS

Data

All analyses are based on data from six Finnish Drinking Habits Surveys conducted at 8-year intervals between 1968 and 2008. The study populations of these surveys consisted of representative samples of the Finnish population aged between 15 and 69 from 1976 to 2008 and between 14 and 68 in 1968 (when age was defined as the respondents’ age on the 31st December of the previous year). All the surveys were conducted as face-to-face interviews and have had high response rates from survey to survey, despite a downward trend: 97 percent (n = 1823), 96 percent (n = 2835), 94 percent (n = 3624), 87 percent (n = 3446), 78 percent (n = 1932) and 74 percent (n = 2725). The first four surveys used a two-stage cluster sampling design (Mustonen et al., 1999). In 2000 and 2008, the sample was drawn from population census records using simple random sampling (Metso et al., 2002). One means of assessing the success of the survey and sampling design is to calculate the coverage rate—that is, the survey mean consumption as a proportion of per capita consumption. The coverage rates from 1968 onwards were 56 percent, 47 percent, 38 percent, 56 percent, 46 percent and 46 percent. A potential bias could appear as a period effect in the analysis due to the low coverage rate in 1984. The total data set consists of 16,385 individuals (7893 females and 8492 males).

Measurements

The response variables in the APC analyses were the frequency of light and binge drinking occasions in the year preceding the survey. They were derived using a unique method of assessing respondents’ drinking habits that was developed by Mäkelä (1971) and was used in the Finnish Drinking Habits Surveys. Firstly, each respondent was asked about his/her typical drinking frequency with 11 answer categories (ranging from ‘daily’, ‘4–5 times a week’, ‘2–3 times a week’, etc. down to ‘never’). Next, a period was determined with which to create a detailed charting of drinking occasions. This so-called survey period varied between 1 week and 12 months, so that, with the reported drinking frequency, the period was to cover four drinking occasions. Thus, frequent drinkers had shorter survey periods, while infrequent drinkers had longer survey periods. Each drinking occasion that belonged to this period, even if it was just half a glass of wine, was then assessed with a series of questions concerning the amount and type of drinks consumed and the social context of the occasion. The amounts were then transformed to centilitres of pure alcohol. For the purposes of the present study, a drink was defined as 1.5 cl (11.85 g) of absolute alcohol. Finally, the number of occasions involving 1–2 or 6+/4+ drinks during the survey period was scaled to 12 months by multiplying using a constant based on the length of the survey period (for example, the survey period of 1 week was multiplied by 52). The different binge drinking cut-off points were assessed by calculating the average blood alcohol content levels in each survey with an updated Widmark’s formula (National Highway Traffic Safety Administration, 1994).

Independent variables were also categorized. Age was defined in seven 8-year groups, starting with a group of 15- to 21-year olds and continuing to age 69. Periods were coded as consecutive numbers of the survey from 1 to 6. Cohorts were based on a quasi-cohort design in which birth cohorts were defined in 8-year groups, starting with people born between 1898 and 1905. Gender-specific cohorts were used in the analyses.

Statistical analysis

A classic identification problem had to be considered when modelling APC effects: variables that quantify APC effects are linearly correlated (Mason and Fienberg, 1985), and it is not possible to separate the individual effect of one parameter without additional assumptions (Björk et al., 2008; Kerr et al., 2004, 2009). A large amount of different assumptions regarding APC parameters were tested to identify the most consistent and robust model for both men and women. Several different restrictions resulted in similar estimated coefficients but with varying estimated confidence intervals. Eventually, different restricting assumptions were used for light and binge drinking. For light drinking, the age groups of 30–37 and 38–45 were assumed to be equal. For binge drinking, the age groups of 46–53 and 54–61 were assumed to be equal. The restrictions were made on the basis that consumption levels by age in Finland follow an inverted U-shape and are somewhat stable at these ages (Mäkelä and Härkönen, 2010) and also based on the finding that the estimated confidence intervals were the most stable when these restrictions were used.

The analysis was made with the SAS 9.1 statistical package using negative binomial regression. The negative binomial distribution was used to model the distribution of cell counts, which were indicated by the number of light and binge drinking occasions per year. The significance of each partial effect in the model was assessed. Sample weights were used to adjust estimates, while sample design was taken into account when fitting the models with the GENMOD procedure.

RESULTS

Descriptive results: secular trends

Figure 1 presents the secular trends for the mean number of light and binge drinking occasions among respondents.
Concurrent with the overall increase in alcohol consumption during the early 1970s, the average annual number of both light and binge drinking occasions increased between 1968 and 1976 among both men and women. The trend for increased light and binge drinking occasions halted temporarily in 1984, apparently due, at least in part, to the low coverage rate of the survey. After 1992, the estimates of binge drinking have not increased while those of light drinking have, even if this may partly be due to changes in coverage rate.

Despite some variation in the average number of annual binge drinking occasions, the proportion of women engaging in some form of binge drinking has increased continuously from 18 percent in 1968 to 30 percent in 2008 (not presented as a figure). Concurrent with the general increasing trend in alcohol consumption, the spreading of binge drinking among women has been partly due to the decreasing proportion of non-drinkers (defined as those who drank no alcohol during the preceding 12 months), which dropped from 39 percent to 10 percent between 1968 and 2000 (Mäkelä et al., 2010). Among men, the prevalence of binge drinking has been quite stable. Even the extensive increase in alcohol consumption during the early 1970s did not change the proportion of male binge drinkers, which has remained at 50 percent over the past 40 years.

**Descriptive results: drinking profiles of different cohorts by age**

When cohort trajectories are drawn by age, the drinking profiles of different cohorts at the same ages can be compared. Before continuing to more detailed results of Figs 2 and 3, it is important to note two factors when reading the cohort trajectories. (a) Each trajectory consists of results from different time periods, i.e. from consecutive surveys with 8-year intervals. This means that the trajectories for the 1938–1945 and older cohorts start from the 1968 results, continue with results from the 1976 survey and so on. In contrast, the last result for the 1946–1953 and younger cohorts are from the 2008 survey, the second last result is from 2000 and so on. (b) The historically substantial increase in alcohol consumption in Finland between the 1968 and 1976 surveys can cause the trajectories to bounce or behave unexpectedly (for example, the substantial increase in light and binge drinking for the 1906–1913 male cohort). The other notable time period is 1984, for which the low coverage rate caused the trajectories to drop. These random variations between survey years have caused the waves that can be seen in some trajectories, especially in the results on binge drinking. However, it is also possible to distinguish some regularities from the figures.

Figure 2 shows the average number of light drinking occasions by age for each birth cohort. The overall finding from the cohort profiles is that light drinking increased between the ages of 15 and 29 for nearly every cohort. After that, however, profiles for men and women differed: among men, the increase continued at least to age 38–45, while light drinking declined somewhere after the age of 22 for women, depending on the cohort.

Figure 3 shows the cohort profiles for the average number of binge drinking occasions by age. As with light drinking, binge drinking increased for nearly every cohort between the ages of 15 and 45 among men and between 15 and 29 among women. Compared with light drinking profiles, however, the differences between cohorts were much more pronounced so that binge drinking was systematically more common in more recent cohorts. Male cohorts born after the 1930s have surpassed older cohorts. There is an especially striking divide between cohorts born before and after 1938. Every female cohort has had a higher frequency of binge drinking than the previous cohort at least until the cohort born in 1962–1969. It also seems that binge drinking for the cohorts born after 1940s has not declined with age, as it has with the older cohorts. The drinking profile for the two youngest cohorts differs in that the onset frequency for binge drinking is highest among female cohorts, but there is a substantial drop after the age of 15–21. This is in clear contrast to young men’s situation.

**APC model for light drinking**

Figure 4 presents the results for the negative binomial model that estimates the effects of APC on light drinking. For age effects, the estimated beta coefficients were found to roughly follow an inverted U- or J-shape for both men and women.

Period effects on light drinking were consistent between men and women and corresponded closely with the trends shown in Fig. 1. The period effects for men and women in 1968 were only half of that of 1992. The period effects have increased for each survey year since the 1960s, with the exception of 1984, in 2008, they were 50 percent greater in relation to the reference period.

Cohort effects declined for both men and women over the studied period. For men, the decline was systematic for every birth cohort and the effects dropped from 130 percent higher to 70 percent lower effect in relation to the 1938–1945 cohort. The decline was not as linear for women; the cohort effects were stable for cohorts born between 1906 and 1937, increased temporarily for the 1938 to 1945 cohort and then declined.

**APC model for binge drinking**

Figure 5 presents the results for the negative binomial model that estimates the effects of APC on binge drinking. Similar
to effects on light drinking, age effects on binge drinking were found to roughly follow an inverted U- or J-shape for both men and women.

Period effects on binge drinking showed a slightly increasing trend for women, although there was variation between certain survey years. For men, the period effects declined throughout the studied time frame.

Cohort effects on binge drinking were found to increase with more recent cohorts, with the effects peaking for the youngest male and female cohorts. For male cohorts, the increase was found to accelerate with cohorts born after the 1920s. For female cohorts, the relative cohort effects increased continuously for cohorts born between 1914 and 1961. The cohort effects for the 1954–1961 cohort were 250 percent higher than the 1914–1921 cohort. The increase stabilized for cohorts born between 1962 and 1985 but peaked for the most recent 1986–1993 cohort.

**DISCUSSION**

The aim of this study was to decompose trends in light and binge drinking in Finland in terms of the effects of APC. A particular area of interest was distinguishing period and cohort effects, as cohorts drinking more have replaced those drinking less over the last four decades. This study contrasted with more traditional cross-sectional designs by applying APC modelling, which offered the advantage of separating the three time-related factors.

In general, the descriptive results showed that there were no substantial differences between cohorts for light drinking. Cohorts born prior to the 1940s had lower light drinking frequencies but greater similarities in terms of light drinking profiles appeared as more recent cohorts were analysed. However, men and women differed in terms of how aging affects light drinking. For male cohorts, light drinking
increased with age, whereas it started to decline for female cohorts between the ages of 22 and 50, depending on the cohort.

Binge drinking was found to increase systematically with more recent cohorts. Male cohorts born after the 1930s clearly surpassed older cohorts in terms of binge drinking but the speed of change was found to slow down for younger cohorts, and the binge drinking profiles for cohorts born between 1946 and 1977 were found to be quite similar. No such convergence between more recent cohorts was found for women, as every cohort surpassed earlier cohorts until the two youngest cohorts. This might reflect the marked changes in women’s drinking in Finland over the past four decades (Mäkelä et al., 2010) and the changes in the surrounding alcohol culture in each cohort’s early adulthood.

Traditional cross-sectional analysis of age and drinking has shown that drinking figures have declined with age, especially for women, in Finland (Mäkelä and Härkönen, 2010). However, the findings from cohort profiles in the present study suggest that what seems to be an aging effect in a cross-sectional study might actually be a cohort effect. Male cohorts born between 1946 and 1977 varied so little in their light and binge drinking profiles that the pattern found in cross-sectional study in 2008 for 30–61-year olds represents the cohorts’ profiles quite accurately. For female cohorts, however, the cross-sectional picture hides the fact that binge drinking is no longer declining with age for cohorts born between 1946 and 1977, as was the case for older female cohorts.

The APC modelling confirmed some of the descriptive results and also provided new findings with regard to light and binge drinking trends. Earlier studies with APC modelling have shown major cohort effects in various indicators of alcohol consumption (e.g. Björk et al., 2008; Kerr et al., 2008).

Fig. 3. Average number of binge drinking occasions by age for each birth cohort.
while period effects have also been found to be significant (Kerr et al., 2004). In the present study, when the frequency of light drinking occasions was modelled in terms of APC, the cohort effects were stable or declining with more recent cohorts, while the period effects increased from one survey year to the next. As the descriptive results showed, there were no substantial differences between more recent cohorts’ profiles for either men or women, although, in terms of secular trends, light drinking has been increasing. This result suggests that period effects on light drinking—that is, the cultural, economic and legal conditions during the survey years—have surpassed cohort effects. Historical events have affected each cohort’s light drinking to a greater degree than the specific background of the cohort, per se. As a result, light drinking has increased in the general population over time. Light drinking as a phenomenon seems to permeate cohort boundaries.

The APC modelling for binge drinking showed that cohort effects increased with more recent cohorts, while period effects decreased slightly for men and increased for women over the various survey years. Accordingly, the differences between cohort profiles for binge drinking can
be traced back to the different characteristics of each cohort rather than to the time of the surveys. The increasing cohort effects on binge drinking may also imply that if no major period-related events occur in the near future and the aging effects remain constant, the prevalence of problematic alcohol use in the older age groups is likely to increase. Such an increase would be most visible in older female age groups because of the extensive changes between female cohorts.

In Finland, the cohort change in alcohol consumption was first reported when Sulkunen (1979) introduced the concept of the so-called wet generation. This concept argues that a generation was born in Finland between 1946 and 1955 that drank significantly more than the generations before and after it. The results of the present study, however, do not fully support this concept. When the cohort profiles were investigated for binge drinking, the 1946–1953 cohort (closest to the ‘wet generation’) could be regarded as the first

Fig. 5. APC estimates of binge drinking occasions for men and women. Reference groups are the 38–45 age group, the period of 1992 and the 1938–1945 birth cohort. 95% confidence interval: dotted lines.
cohort to reach higher binge drinking frequencies. However, this cohort was followed by cohorts that drank similarly or even more. Moreover, when the three time-related factors were controlled for, the 1946–1953 cohort was followed by more recent cohorts with greater cohort effects. In terms of light drinking, the cohort profiles showed no particular characteristics for the 1946–1953 cohort, and the APC modelling predicted declining cohort effects for the following younger cohorts. In other words, the cohort effects on light and binge drinking for the ‘wet generation’ followed an existing trend rather than creating a completely new one.

There are a number of limitations to be considered in the present study. Two age groups were assumed to be equal for light and binge drinking in the full APC model, which might have affected findings regarding the age effects. In addition, aging effects in the APC model are assumed to be equal among cohorts, although this assumption was not fully supported by the descriptive results, especially for women. Furthermore, period effects for binge drinking differed from the actual changes, which might have been due to the variation in the survey coverage rates and which could also be interpreted as a signal of significant cohort effects on the modelled indicator (Kerr et al., 2004).

CONCLUSIONS

This study sought to achieve a more dynamic view of changes in alcohol consumption in Finland, which has increased for the past four decades. The results, which imply that APC have conjoint effects on drinking trends over time, can be utilized to make future predictions about alcohol consumption. However, the dynamics behind light and binge drinking trends seem to be essentially different phenomena. For light drinking, period effects were found to be salient, while for binge drinking, the differences between cohorts stand out.

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