This is a repository copy of *The collectivity of British alcohol consumption trends across different temporal processes : a quantile age-period-cohort analysis*.

White Rose Research Online URL for this paper:
http://eprints.whiterose.ac.uk/148934/

Version: Accepted Version

Article:

Holmes, J. orcid.org/0000-0001-9283-2151, Ally, A.K., Meier, P.S. orcid.org/0000-0001-5354-1933 et al. (1 more author) (2019) The collectivity of British alcohol consumption trends across different temporal processes : a quantile age-period-cohort analysis. Addiction, 114 (11). pp. 1970-1980. ISSN 0965-2140

https://doi.org/10.1111/add.14754

This is the peer reviewed version of the following article: Holmes, J., Ally, A. K., Meier, P. S., and Pryce, R. (2019) The collectivity of British alcohol consumption trends across different temporal processes: A quantile age-period-cohort analysis. Addiction, which has been published online at https://doi.org/10.1111/add.14754. This article may be used for non-commercial purposes in accordance with Wiley Terms and Conditions for Use of Self-Archived Versions.

Reuse

Items deposited in White Rose Research Online are protected by copyright, with all rights reserved unless indicated otherwise. They may be downloaded and/or printed for private study, or other acts as permitted by national copyright laws. The publisher or other rights holders may allow further reproduction and re-use of the full text version. This is indicated by the licence information on the White Rose Research Online record for the item.

Takedown

If you consider content in White Rose Research Online to be in breach of UK law, please notify us by emailing eprints@whiterose.ac.uk including the URL of the record and the reason for the withdrawal request.

eprints@whiterose.ac.uk
https://eprints.whiterose.ac.uk/

Holmes John (Orcid ID: 0000-0001-9283-2151)

Meier Petra (Orcid ID: 0000-0001-5354-1933)

The collectivity of British alcohol consumption trends across different temporal processes: A quantile age-period-cohort analysis.

John Holmes[1], Abdallah K Ally[1], Petra S Meier[1], Robert Pryce[1].

[1]School of Health and Related Research, University of Sheffield, Sheffield, UK.

Running head: Collectivity of British alcohol consumption trends

Word count: 3,373

Conflicts of interest: JH has received funding for commissioned work unrelated to the present analyses from Systembolaget, the Swedish Government's alcohol retail monopoly. JH and PM have received funding for similar work from Alko, the Finnish Government's alcohol retail monopoly.

Accepted Article

This article has been accepted for publication and undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process which may lead to differences between this version and the Version of Record. Please cite this article as doi: 10.1111/add.14754

This article is protected by copyright. All rights reserved.

The collectivity of British alcohol consumption trends across different temporal processes: A quantile age-period-cohort analysis.

John Holmes[1], Abdallah K Ally[1], Petra S Meier[1], Robert Pryce[1].

[1]School of Health and Related Research, University of Sheffield, Sheffield, UK.

Background and aims: UK alcohol consumption per capita has fallen by 18% since 2004 while the alcohol-specific death rate has risen by 6%. Inconsistent consumption trends across the population may explain this. Drawing on the theory of the collectivity of drinking cultures and age-period-cohort analyses, we tested whether consumption trends are consistent across lighter and heavier drinkers for three temporal processes: (i) the life course, (ii) calendar time, (iii) successive birth cohorts.

Design: Sex-specific quantile age-period-cohort regressions using repeat cross-sectional survey data.

Setting: Great Britain, 1984-2011.

Participants: Adult (18+) drinkers responding to 17 waves of the General Lifestyle Survey (total N=175,986).

Measurements: Dependent variable: The 10th, 25th, 50th, 75th, 90th, 95th and 99th quantiles of the logged weekly alcohol consumption distribution (excluding abstainers). Independent variables: seven age groups (18-24, 25-34…65-74, 75+), five time periods (1984-1988…2002-2006, 2008-2011) and 16 five-year birth cohorts (1915-1919…1990-1994). Additional control variables: ethnicity and UK country.

Findings: Within age, period and cohort trends, changes in consumption were not consistently in the same direction at different quantiles of the consumption distribution. When they were, the scale of change sometimes differed between quantiles. For example, consumption among women decreased by 18% (CI95: -32% - -2%) but increased by 11% (CI95: 2% - 21%) at the median and by 28% (CI95: 19%-38%) at the 99th quantile, implying consumption fell among lighter drinkers and rose among heavier drinkers. This type of polarised trend also occurred between 1984-1988 and 1996-2000 for men and women. Age trends showed collectivity but cohort trends showed a mixture of collectivity and polarisation.

Conclusions: Countervailing alcohol consumption and alcohol-related harm trends in the UK may be explained by lighter and heavier drinkers having different period and cohort trends as well as by the presence of cohort trends that mean consumption may rise in some age groups while falling in others.

Conflicts of interest: JH has received funding for commissioned work unrelated to the present analyses from Systembolaget, the Swedish Government's alcohol retail monopoly. JH and PM have received funding for similar work from Alko, the Finnish Government's alcohol retail monopoly.

This article is protected by copyright. All rights reserved.

INTRODUCTION

The still-influential total consumption model of alcohol policy proposes that reducing average levels of alcohol consumption in a population will lead to reductions in heavy drinking and alcohol-related harm. However, in the UK, alcohol consumption per capita adult has fallen by 18% since its peak in 2004 while the alcohol-specific death rate has risen by 6% over the same period [1, 2]. This paper focuses on two potential explanations for these contrary trends. First, it considers whether the consumption decline is consistent across the population. In particular, it examines whether the trend is consistent across the consumption distribution, such that lighter and heavier drinkers are increasing and decreasing their consumption in concert. Second, it considers how trends identified in recent age-period-cohort (APC) analyses may affect the relationship between population-level consumption and harm.

Alcohol researchers have mainly considered the consistency of trends across the consumption distribution in the context of Skog's theory of the collectivity of drinking cultures [3]. The theory provides the main theoretical support for the total consumption model by arguing that social network processes cause different points in the consumption distribution to move up and down the consumption scale in unison and to proportionately similar degrees. For example, a five percent increase in consumption at the median of the consumption distribution should necessarily co-occur with a five per cent increase at the 95th percentile. This prevents a scenario where harm rates rise as consumption is falling due to a small number of heavy drinkers maintaining or increasing their consumption as the vast majority of drinkers cut down. Recent research analysing repeat cross-sectional surveys in several countries suggests collectivity is typically present in adult populations [4-6]. However, a series of analyses of different datasets from adolescents in Sweden yielded mixed results, with evidence of both collective and non-collective consumption changes [7-11].

APC studies have proliferated within alcohol research in recent years [12-19] and examine how population-level time trends in alcohol consumption and alcohol-related harm are comprised of changes across three temporal processes: the life course, calendar time and birth cohorts. Such studies typically identify strong age and cohort effects [12-15]. This implies that birth cohorts with differing levels of alcohol consumption moving through periods of the life course associated with lower and higher consumption may have a greater impact on population-level trends than changes affecting the whole population over time. For example, population-level alcohol consumption and harm may exhibit contrary trends if heavy drinking cohorts are in the age groups that dominate alcohol-related harm but lighter drinking cohorts are in the younger age groups, who typically dominate alcohol consumption.

No study to date has sought to examine collectivity theory and APC jointly but doing so can deepen our understanding of how contrary consumption and harm trends may arise. For example, if trends in consumption across the life course are not collective, such that the heavier drinkers consume more and the lighter drinkers consume less at older ages, this may exacerbate the potential for contrary trends between population-level consumption and harm, further challenging the propositions and policy implications of the total consumption model. This paper therefore uses a quantile APC analysis of a 27-year time series of British alcohol consumption data to test whether age, period and cohort trends display collective change (i.e. whether all points in the consumption distribution move in the same direction to the same degree across the life course, across calendar time and across birth cohorts).

Accepted Article

This article is protected by copyright. All rights reserved.

METHODS

Data

The General Lifestyle Survey (GLF; formerly the General Household Survey) was an annual cross-sectional household survey of approximately 20,000 individuals living in around 13,000 private households in Great Britain (i.e. the UK excluding Northern Ireland) conducted by the Office for National Statistics (ONS). A probability-stratified two-stage sample design was used to draw a nationally representative sample of private households from the postal address file. Interviewers asked all household members aged 18+ to complete the drinking section during face-to-face interviews. The ONS collected alcohol consumption data in the GLF from 1978 to 2011 but this analysis uses only surveys from 1984 onwards due to unexplained inconsistencies in time trends across earlier years. The required alcohol consumption data are available biennially between 1984 and 2000 and annually from 2000 to 2011, except for 2003/4, 2004/5 and 2007. See Table S1 in the appendix for full details of survey years and sample sizes and note that ONS sometimes collected data within calendar years and sometimes within financial years. In total, the GLF surveys provide 17 waves of data over 27 years, with a combined sample size of drinkers totalling 175,986.

Measures

GLF respondents who drank at all in the 12 months prior to the survey are asked beverage-specific quantity-frequency (QF) questions, which have been summarised for 1978-1998 by Kemm [20]. We use the QF data to calculate our dependent variable: drinkers' average weekly consumption in UK units (1 unit=7.9g/10ml ethanol). A number of changes to these measures occurred during the study period: The ONS introduced small and large beer cans as quantity measures in 1990, strong beers and alcopops as beverage categories in 1997 and specification of wine glass sizes (125ml, 175ml and 250ml) between 2006 and 2008, alongside new assumptions about beverage alcohol content [21]. The 2006 changes led to an immediate increase in consumption estimates, which captured real shifts in drinking that had occurred over the preceding years.

The independent variables of interest are age groups (18-24, 25-34, 35-44, 45-54, 55-64, 65-74, 75+ years), time periods (1984-1988, 1990-1994, 1996-2000, 2002-2006, 2008-2011) and birth cohorts (16 five-year cohorts from 1915-1919 to 1990-1994). Categorising APC variables is preferred to using continuous measures as it disrupts perfect linear dependence (i.e. age+cohort=period) and helps to address the identifiability problem faced by APC models. Additional independent control variables are ethnicity (three groups: White, Asian, other) and country (England, Scotland, Wales).

Analysis

We analyse the data using quantile APC regression models. A standard APC regression would estimate the mean of the dependent variable (i.e. weekly consumption) in a given age group independent of the time period, birth cohort and other controls. It would also estimates similar independent effects for the period and birth cohort. Quantile APC regression allows estimation of the dependent variable at different points in its distribution simultaneously (e.g. at the median, 25th and 75th quantile), rather than just at its mean. This allows estimation of separate age, period, cohort and control variable coefficients for each quantile rather than assuming the relationship between the dependent variable and these covariates is the same across the distribution. Quantile regression has the additional advantage of not imposing restrictive assumptions of normality of errors and homoscedasticity (constant variance) and it is therefore more robust and capable of capturing salient features, such as skewness, which are commonly observed in alcohol consumption distributions.

This article is protected by copyright. All rights reserved.

We estimate effects for the following quantiles: 10th, 25th, 50th, 75th, 90th, 95th and 99th. These permit examination of consumption changes across the consumption distribution and particularly at its upper quantiles, which account for a disproportionate share of total consumption and within which evidence of non-collectivity has previously been identified [4, 5, 9, 11]. Skog does not specify whether abstainers form part of the consumption distribution and we exclude them as we have previously estimated APC trends for abstention in these data [12].

Analyses are carried out using the *sqreg* command in Stata 14 and use survey weights provided in the original annual datasets by ONS. The *sqreg* command estimates equations simultaneously and also produces bootstrapped errors; we use 20 bootstraps in the estimation process and use robust standard errors. In line with Skog's theory, we log mean weekly units consumed to permit examination of relative rather than absolute consumption changes and we convert the resulting Incident Rate Ratios to percentages for ease of comprehension. We also estimate separate models for males and females following previous identification of different APC trends by sex in these data [12]. Reference categories for the main independent variables are the 45-54 age group, the 1996-2000 period and the 1950-54 birth cohort. Although individuals are nested within households, we are unable to control for this, as ONS have not made household linkage data available.

We assess collectivity across 12 (2x3x2) trends, specifically, the male and female age, period and cohort trends between the first and reference category (e.g. between 1984-1988 and 1996-2000) and between the reference and last category (e.g. between 1996-2000 and 2008-2011). By testing across two extended trends rather than between consecutive data points, we reflect Skog's view that collectivity is a long-term, rather than immediate, process [22]. We assess significance of differences between quantiles by comparing across confidence intervals.

RESULTS

Descriptive analysis

Researchers often assess collectivity by inspecting graphs of logged consumption trends for quantiles of the distribution. There graphs are shown in Figures 1a-f and suggest gender-specific APC trends are generally collective, with quantiles tending to increase and decrease consumption levels in concert. However, there is some evidence that the scale of change varies across the distribution (e.g. male age trends) and that the distribution may polarise at some points, with some quantiles increasing consumption while others decrease (e.g. female period trends). The online appendix shows unlogged trends in alcohol consumption for information (Figures S1a-f).

[Figures 1a-1f about here]

Quantile age-period-cohort analysis

Interpreting the results

Figures 2 and 3 show the estimated changes in consumption at each quantile over each temporal trend of interest for men and women. For example, at the 10th quantile, women decrease their weekly consumption by 79% between ages 18-24 and 45-54 year-old after controlling for period effects, cohort effects, region and ethnicity. The confidence intervals are wide for some estimates, but the overall pattern of results is largely consistent with analyses using alternative model specifications (e.g. unweighted and without robust standard errors – results available on request). Numerical results are in Tables S2 and S3 in the appendix.

This article is protected by copyright. All rights reserved.

[Table 1 and Figures 2a-2f about here]

Given inconsistency in the literature as to the definition of collective change, we use the following terms to describe our results: (i) hard collectivity – no significant differences between quantiles; (ii) soft collectivity – significant differences but all quantiles moving in the same direction and (iii) polarisation – significant differences with some quantiles increasing consumption and others decreasing consumption. Table 3 uses these terms to summarise the results described below.

[Table 3 about here]

Age effects

There were hard collective consumption changes for women and men across early and late adulthood. Overall, consumption declines across the first half of the life course but then increases into older age for women while remaining stable for men. These changes were broadly similar in size across the consumption distribution.

Period effects

There were polarised consumption changes for men and women in the earlier period between 1984-1988 and 1996-2000, with consumption decreases for lighter drinkers and consumption increases or stability for heavier drinkers. Between 1996-2000 and 2008-2011, there was polarisation for women with consumption decreasing over time for lighter drinkers but increasing for heavier drinkers. For men, there was hard collectivity with consumption decreasing consistently across the consumption distribution.

Cohort effects

Cohort effects showed mixed trends. Cohorts born between 1915-1919 and 1950-1954 showed soft collective changes in drinking across the consumption distribution for women but hard collectivity for men. In both cases, consumption increases across successive birth cohorts but these increases were smaller for women among the lightest and heaviest drinkers compared to those in the middle of the consumption distribution. Cohorts born between 1950-1954 and 1990-1994 showed hard collectivity for women with consumption increases across successive birth cohorts that were of similar size across the consumption distribution. For men, these birth cohorts showed polarised changes in drinking with consumption increases in later cohorts among the lightest and heaviest drinkers but consumption decreases or stability in the middle of the consumption distribution.

DISCUSSION

The results above provide the first evidence of whether collective changes in alcohol consumption exists across age, period and cohort trends. In doing so, they provide new insights into why population-level alcohol consumption and harm trends may not move in the same direction or exhibit a consistent relationship over time. We highlight four main findings.

First, as seen in previous studies, population-level consumption trends are produced by a combination of age, period and cohort trends [12, 13, 15, 17-19, 24, 25]. We described in the introduction to this paper how the movement of lighter and heavier drinking birth cohorts through points in the life course that are associated with lesser and greater risk of harm can lead to a contrary temporal relationship between population-level consumption and harm. For example, this can happen when the heavier drinking birth cohorts in the population are at younger ages and are thus less likely to experience alcohol-related harm.

This article is protected by copyright. All rights reserved.

Second, our results show population-level consumption trends may comprise of a mixture of hard collective, soft collective and polarised trends. The exact mixture of these trends will affect the consistency of the temporal relationship between population-level consumption and harm over time depending on factors such as how baseline harm is distributed between lighter and heavier drinkers.

Third, clear instances of polarisation exist within the observed trends. This was particularly the case for period effects among women between 1984 and 2011, with lighter drinkers generally consuming less and heavier drinkers consuming more. A similar polarisation occurred for men between 1984 and 2000 and across birth cohorts reaching adulthood from the mid-1970s onwards, a period of heightened concern regarding binge drinking among young people [26]. As above, this polarisation will disrupt the temporal relationship between population-level consumption and harm, with the exact effect determined by baseline conditions.

Fourth, collectivity does not hold consistently across the sexes, as demonstrated by different period trends for men and women between 1996 and 2011. Although not part of our initial framing of the problem of contrary consumption and harm trends, a lack of collectivity across the sexes raises further questions about systematically different trends across subgroups of the population and how these may affect the temporal relationship between population-level consumption and harm.

Before considering the implications of these findings further, we note that Skog did anticipate some circumstances in which collectivity, and therefore a consistent relationship between population-level consumption and harm, might not apply. These include the society having a highly restricted alcohol market, the presence of strict informal controls on drinking, drinking patterns that are highly heterogeneous across population subgroups, individuals who have limited mutual influence over one another's drinking or a general lack of societal connectedness [27]. None of these explanations applies convincingly to our results. The polarisation of women's consumption trends between 1984 and 2011 might reflect a breakdown of informal social controls as women adopted new gender roles, in general and in relation to alcohol [28, 29], but these controls were already permissive by international standards. Similarly, the polarisation seen across later male birth cohorts may suggest the 'Binge Britain' period [26] created a disconnect in drinking patterns *between* generations given the much-discussed emergence of 'a new culture of intoxication' and 'determined drunkenness' among young adults [30]. However, there is little evidence available to explain a divergence in drinking patterns *within* generations. Moreover, it is unclear why we observe polarisation for men but hard collectivity for women in these birth cohorts despite the drinking patterns of young women generating similar, if not greater, concerns during the Binge Britain period [31]. As such, collectivity theory and its caveats appear unable to explain our results.

This conclusion and the findings above therefore present major challenges to collectivity theory and the total consumption model. They suggest that a complex mixture of strong age and cohort effects, hard and soft collectivity, and some polarised trends underpin the findings of general collectivity observed when examining simple time trends in previous studies. These more complex findings do not imply a consistent relationship between population-level consumption and harm over time. Instead, they suggest the relationship will often be inconsistent, sometimes contrary and generally difficult to predict. This has important implications for epidemiology and policy analyses.

Focusing first on epidemiology, if consumption trends are driven by strong age, period and cohort effects that do not exhibit consistent collectivity, the relationship between a population's alcohol consumption per capita and rates of alcohol-related harm will vary over time as a function of which population subgroups are changing their consumption, by how much and what their baseline rates of harm were. For example, cohort-driven consumption changes will appear in harm trends later

This article is protected by copyright. All rights reserved.

than period-driven changes and polarised cohort-driven changes will have affect harm trends to a different degree to collective ones. This may help to explain the countervailing trends in UK alcohol consumption and harm data. It may also help to explain other unexpected findings, such as the weakening over time of the relationship between per capita consumption and liver disease rates in Australia [32]. Individual- and subgroup-level epidemiological simulations may be able to predict such variations under favourable conditions [33, 34], but population-level time series analyses will have more limited predictive power. Indeed, under some divergences from collectivity, the latter may deliver misleading results (e.g. they may suggest a negative or greatly attenuated relationship between population-level consumption and harm where stable or falling consumption arises from polarised trends). Therefore, conclusions drawn from such analyses should be cautious and limited in the absence of a robust demonstration that the underlying trends are collective across the study period.

Regarding policy analysis, a large body of evaluation evidence concludes that policies affecting mean consumption also tend to affect levels of alcohol-related harm [35], despite some contradictory findings [36]. The general effectiveness of policies targeting mean consumption may be attributed broadly to two alternative explanations: (i) the total consumption model and associated theories of collective change through social network effects or (ii) the accumulation of discrete individual-level changes arising from differential exposure and responsiveness of those individuals to policy effects. These explanations are not mutually exclusive as diverse individual-level changes may ripple across social networks and interact to produce collective changes. Conversely, estimates of the long-term individual-level effects of a policy may embed a degree of collective change within them, dampening or amplifying initial effects. However, our study and others showing similarly mixed distributional trends weaken the case for collectivity and suggest discrete, individual-level changes may be the more dominant explanation. Although the total consumption model remains a valid and useful means of explaining a general tendency to policy stakeholders, alcohol policy advocates should use careful language when invoking it, as the timing and extent of harm reductions following a policy-induced reduction in consumption may be less certain than implied by collectivity theory.

The major strengths of our analysis are the innovative quantile APC design and the 27-year time series comprising 17 survey waves. This permits detailed tracking of the consumption distribution during periods of rising and falling consumption and offers more statistical power than is available in many APC or collectivity studies. The analysis also has several limitations, most of which apply to APC and collectivity studies in general. First, our data underestimate alcohol consumption when compared with sales and excise data, although to a lesser degree than similar surveys in other countries [37] and the data also account for important shifts in serving sizes and strengths of alcoholic drinks over time. The impact on our results will be reduced if underestimation is relatively stable over time and across model covariates [38]. Second, under-representation of heavy consumers and poor test-retest reliability of quantity-frequency measures for heavy consumption also mean findings related to the highest consumption quantiles (e.g. Q99) should be interpreted cautiously [39]. Third, the data only observe the most recent cohorts at young ages and the oldest cohorts at older ages. This means these birth cohorts contribute only partially to age effects and have less robust cohort effects. Fourth, as ONS do not provide household linkage data, we cannot account for clustering of individuals within households. Finally, we cannot control for changes in the GLF survey questions over time, which have been explored elsewhere [41].

CONCLUSIONS

Countervailing alcohol consumption and alcohol-related harm trends in the UK may be explained by lighter and heavier drinkers having different age, period and cohort trends. Collective changes in

Accepted Article

This article is protected by copyright. All rights reserved.

consumption, as described by Skog, are observed only inconsistently and alongside both a softer form of collectivity and polarised trends.

References

1. British Beer and Pub Association. Statistical Handbook 2017 London: Brewing Publications Ltd; 2017.
2. Office for National Statistics. Alcohol-specific deaths in the UK: registered in 2017; 2018.
3. Skog O. J. The Collectivity of Drinking Cultures: A Theory of the Distribution of Alcohol Consumption, Br J Addict 1985: 80: 83-99.
4. Gomes de Matos E., Kraus L., Pabst A., Piontek D. Does a Change Over All Equal a Change in All? Testing for Polarized Alcohol Use Within and Across Socio-Economic Groups in Germany, Alcohol Alcohol 2015: 50: 700-707.
5. Raninen J., Leifman H., Ramstedt M. Who is not drinking less in Sweden? An analysis of the decline in consumption for the period 2004-2011, Alcohol Alcohol 2013: 48: 592-597.
6. Rossow I., Mäkelä P., Kerr W. The collectivity of changes in alcohol consumption revisited, Addiction 2014: 109: 1447-1455.
7. Norström T., Svensson J. The declining trend in Swedish youth drinking: collectivity or polarization?, Addiction 2014: 109: 1437-1446.
8. Raninen J., Livingston M., Leifman H. Declining trends in alcohol consumption among Swedish youth: Does the theory of collectivity of drinking cultures apply?, Alcohol Alcohol 2014: 49: 681-686.
9. Hallgren M., Leifman H., Andreasson S. Drinking less but greater harm: Could polarised drinking habits explain the divergence between alcohol consumption and harms among youth?, Alcohol Alcohol 2012: 47: 581-590.
10. Brunborg G. S., Bye E. K., Rossow I. Collectivity of drinking behavior among adolescents: An analysis of the Norwegian ESPAD data 1995-2011, Nordic Studies on Alcohol and Drugs 2014: 31: 389-400.
11. Zeebari Z., Lundin A., Dickman P. W., Hallgren M. Are Changes in Alcohol Consumption Among Swedish Youth Really Occurring 'in Concert'? A New Perspective Using Quantile Regression, Alcohol Alcohol 2017: 52: 487-495.
12. Meng Y., Hill-Mcmanus D., Holmes J., Brennan A., Meier P. Trend analysis and modelling of gender specific age, period and birth cohort effects on alcohol abstention and consumption level for drinkers in Great Britain using the General Lifestyle Survey 1984-2009, Addiction 2013: 109: 206-215.
13. Harkonen J. T., Mäkelä P. Age, Period and Cohort Analysis of Light and Binge Drinking in Finland, 1968-2008, Alcohol Alcohol 2011: 46: 349-356.
14. Kraus L., Østhus S., Amundsen E., Piontek D., Härkönen J., Legleye S. et al. Changes in mortality due to major alcohol-related diseases in four Nordic Countries, France and Germany between 1980-2009: A comparative age-period-cohort analysis, Addiction 2015.
15. Kerr W. C., Greenfield T. K., Bond J., Ye Y., Rehm J. Age-period-cohort modelling of alcohol volume and heavy drinking days in the US National Alcohol Surveys: divergence in younger and older adult trends, Addiction 2009: 104: 27-37.
16. Trias-Llimós S., Bijlsma M. J., Janssen F. The role of birth cohorts in long-term trends in liver cirrhosis mortality across eight European countries, Addiction 2017: 112: 250-258.

Accepted Article

This article is protected by copyright. All rights reserved.

17. Kraus L., Tinghög M. E., Lindell A., Pabst A., Piontek D., Room R. Age, Period and Cohort Effects on Time Trends in Alcohol Consumption in the Swedish Adult Population 1979–2011, Alcohol Alcohol 2015: 50: 319-327.
18. Kerr W. C., Greenfield T. K., Ye Y., Bond J., Rehm J. Are the 1976–1985 birth cohorts heavier drinkers? Age-period-cohort analyses of the National Alcohol Surveys 1979–2010, Addiction 2013: 108: 1038-1048.
19. Pabst A., Kraus L., Piontek D., Mueller S. Age, Period, and Cohort Effects on Time Trends in Alcohol Consumption in the German Adult Population, SUCHT 2010: 56: 349-359.
20. Kemm J. An analysis by birth cohort of alcohol consumption by adults in Great Britain 1978-1998, Alcohol Alcohol 2003: 38: 142-147.
21. Goddard E. Estimating alcohol consumption from survey data: updated method of converting volumes to units, London; 2007.
22. Skog O. J. The long waves of alcohol consumption: a social network perspective on cultural change, Social Networks 1986: 8: 1-32.
23. Yang Y., Land K. C. Age–Period–Cohort Analysis of Repeated Cross-Section Surveys: Fixed or Random Effects?, Sociological Methods & Research 2008: 36: 297-326.
24. Zhang Y., Guo X., Saitz R., Levy D., Sartini E., Niu J. et al. Secular Trends in Alcohol Consumption over 50 Years: The Framingham Study, The American Journal of Medicine: 121: 695-701.
25. Keyes K. M., Miech R. Age, period, and cohort effects in heavy episodic drinking in the US from 1985 to 2009, Drug Alcohol Depend: 132: 140-148.
26. Plant M., Plant M. Binge Britain: Alcohol and the National Response Oxford: Oxford University Press; 2006.
27. Room R., Livingston M. The Distribution of Customary Behavior in a Population:The Total Consumption Model and Alcohol Policy, Sociological Perspectives 2017: 60: 10-22.
28. Wilsnack S. C. The GENACIS project: a review of findings and some implications for global needs in women-focused substance abuse prevention and intervention, Subst Abuse Rehabil 2012: 3: 5-15.
29. Wilsnack R. W., Vogeltanz N. D., Wilsnack S. C., Harris T. R. Gender differences in alcohol consumption and adverse drinking consequences: cross-cultural patterns, Addiction 2000: 95: 251-265.
30. Measham F., Brain K. 'Binge' drinking, British alcohol policy and the new culture of intoxication, Crime Media Culture 2005: 1: 262-283.
31. Nicholls J. UK news reporting of alcohol: An analysis of television and newspaper coverage, Drug: Educ Prev Polic 2011: 18: 200-206.
32. Jiang H., Livingston M., Room R., Dietze P., Norström T., Kerr W. C. Alcohol Consumption and Liver Disease in Australia: A Time Series Analysis of the Period 1935–2006, Alcohol Alcohol 2014: 49: 363-368.
33. Holmes J., Angus C., Buykx P., Ally A., Stone T., Meier P. Mortality and morbidity risks from alcohol consumption in the UK: Analyses using the Sheffield Alcohol Policy Model (v.2.7) to inform the UK Chief Medical Officers' review of the UK lower risk drinking guidelines, Sheffield: ScHARR, University of Sheffield; 2016.
34. Angus C., J H., Pryce R., P M., A B. Alcohol and cancer trends: Intervention scenarios, Sheffield and London: ScHARR, University of Sheffield and Cancer Research UK; 2016.
35. Babor T. F., Caetano R., Casswell S., Edwards G., Giesbrecht N., Graham K. et al. Alcohol: No ordinary commodity: research and public policy Oxford: Oxford University Press; 2010.
36. Room R., Österberg E., Ramstedt M., Rehm J. Explaining change and stasis in alcohol consumption, Addiction Research & Theory 2009: 17: 562-576.
37. Stockwell T., Zhao J., Sherk A., Rehm J., Shield K., Naimi T. Underestimation of alcohol consumption in cohort studies and implications for alcohol's contribution to the global burden of disease, Addiction: 0.

Accepted Article

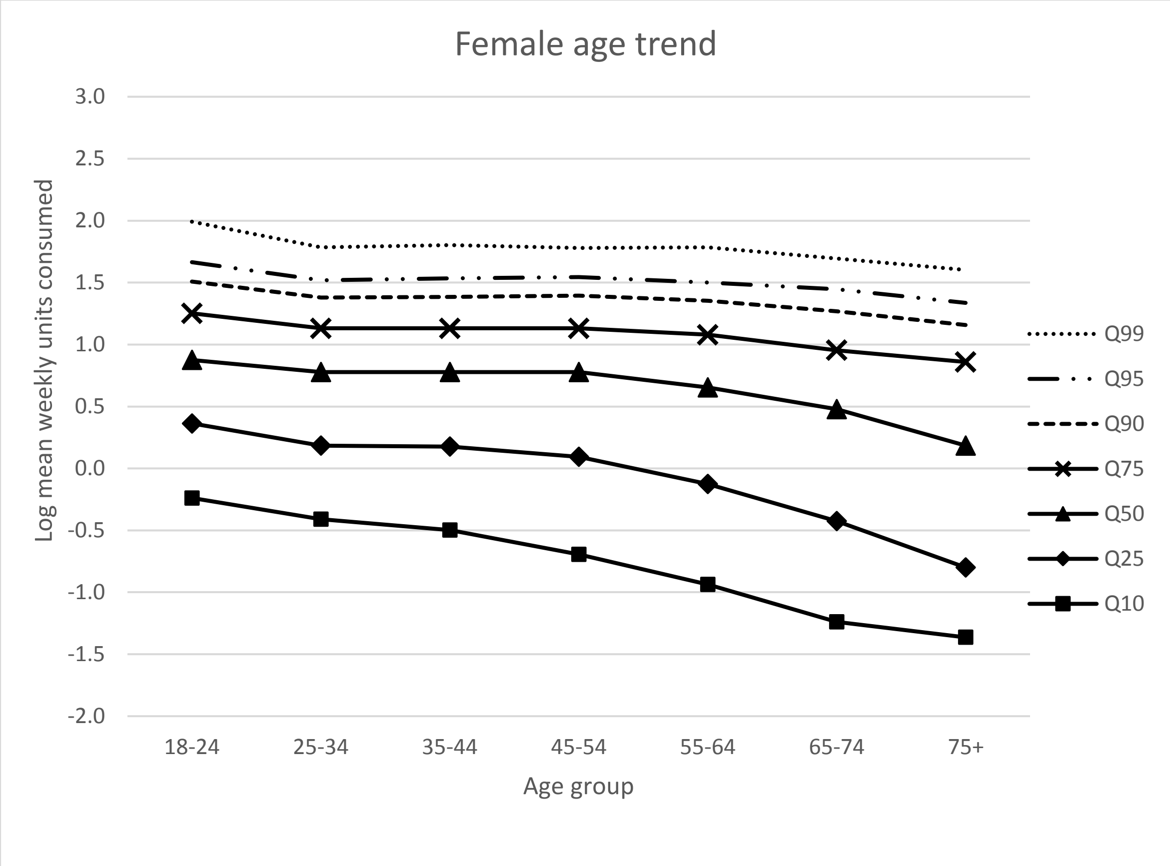
This article is protected by copyright. All rights reserved.

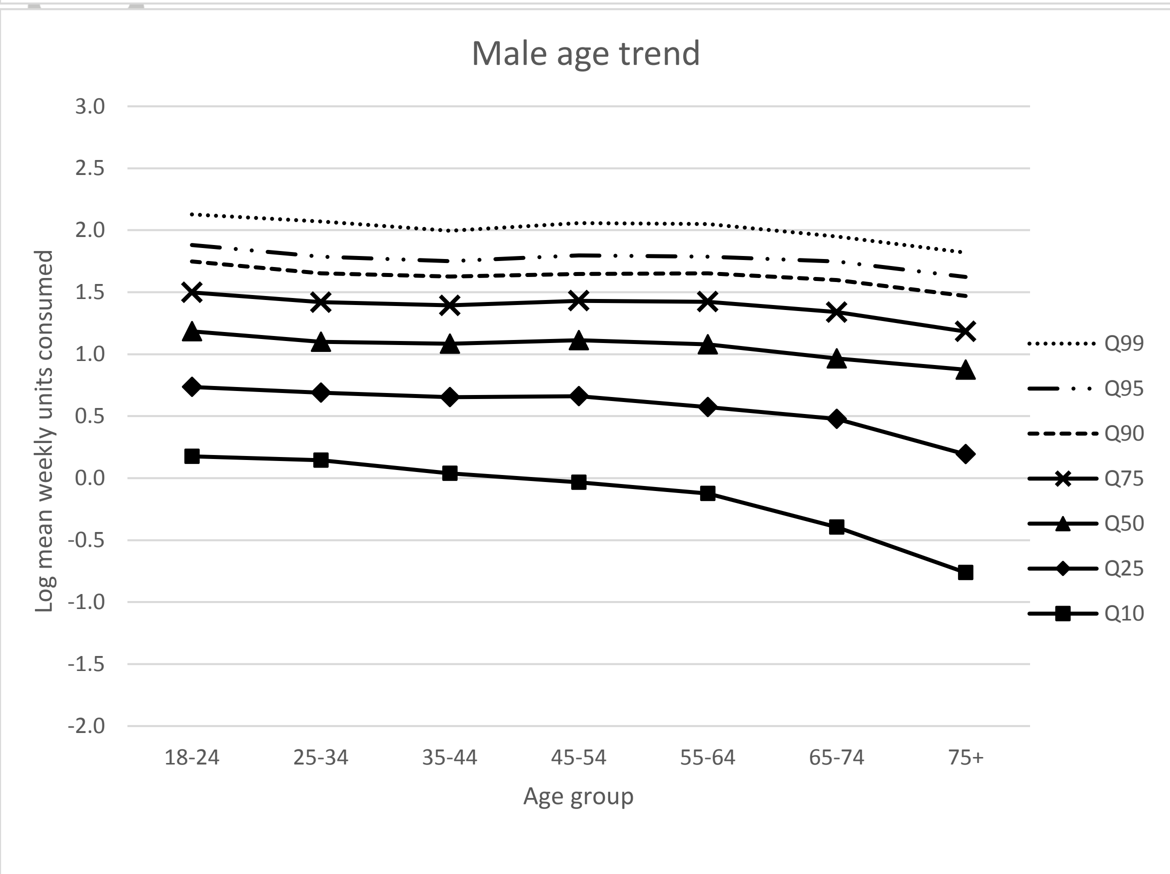
38. Meier P. S., Meng Y., Holmes J. Adjusting for unrecorded consumption in survey and per capita sales data: quantification of impact on gender- and age-specific alcohol-attributable fractions for oral and Pharyngeal Cancers in Great Britain, Alcohol Alcohol 2013: 48: 241-249.
39. Webb G. R., Redman S., Gibberd R. W., Sanson-Fisher R. W. The realiability and stability of a quantity-frequency method and a diary method of measuring alcohol consumption, Drug Alcohol Depend 1991: 27: 223-231.
40. Solon G., Haider S., Wooldridge J. What are we weighting for?, The Journal of Human Resources 2015: 50: 301-316.
41. Stead M., Bauld L., Angus K., MacDonald L. Scoping and feasibility study to develop and apply a methodology for retrospective adjustment of alcohol consumption data. http://phrclshtmacuk/papers/FINAL_REPORT_PHRC_Scoping_and_feasibility_study_-_alcohol_consumption_data_(October_2013)pdf; 2013 accessed 5/20/2014.

Accepted Article

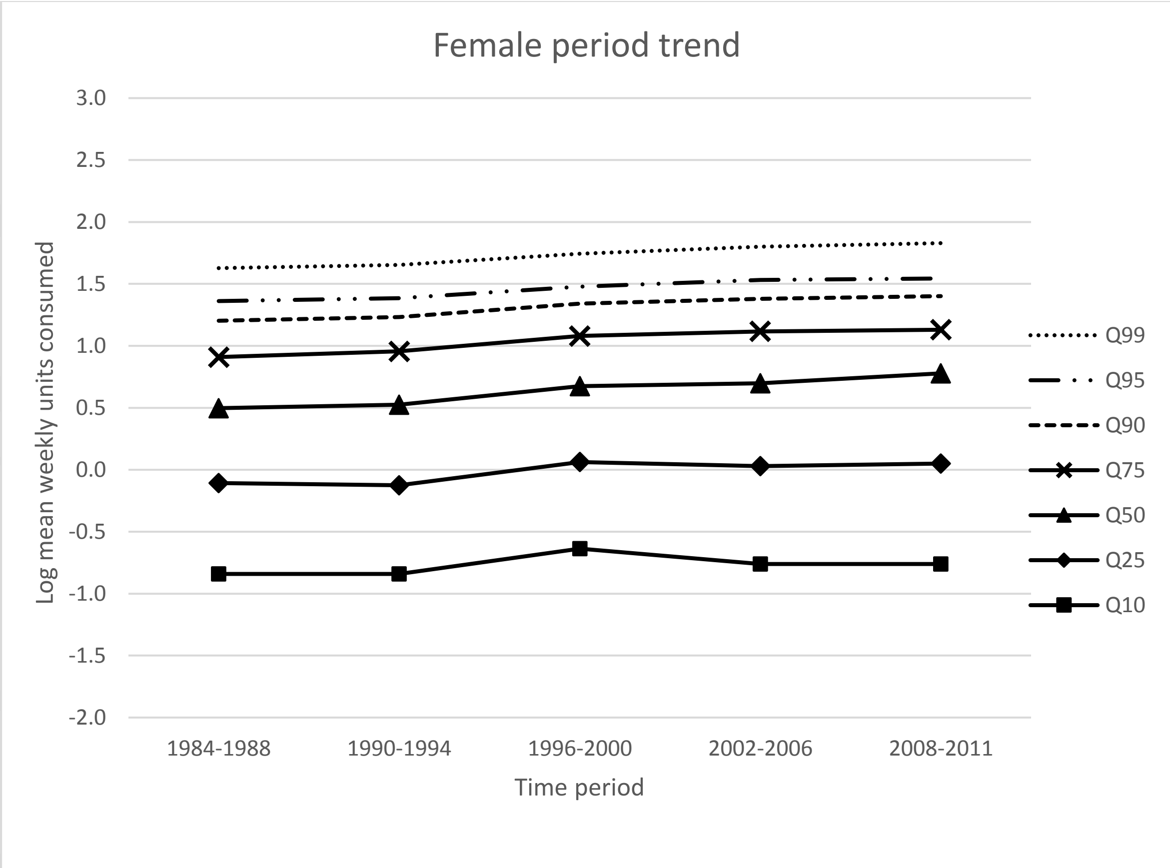
This article is protected by copyright. All rights reserved.

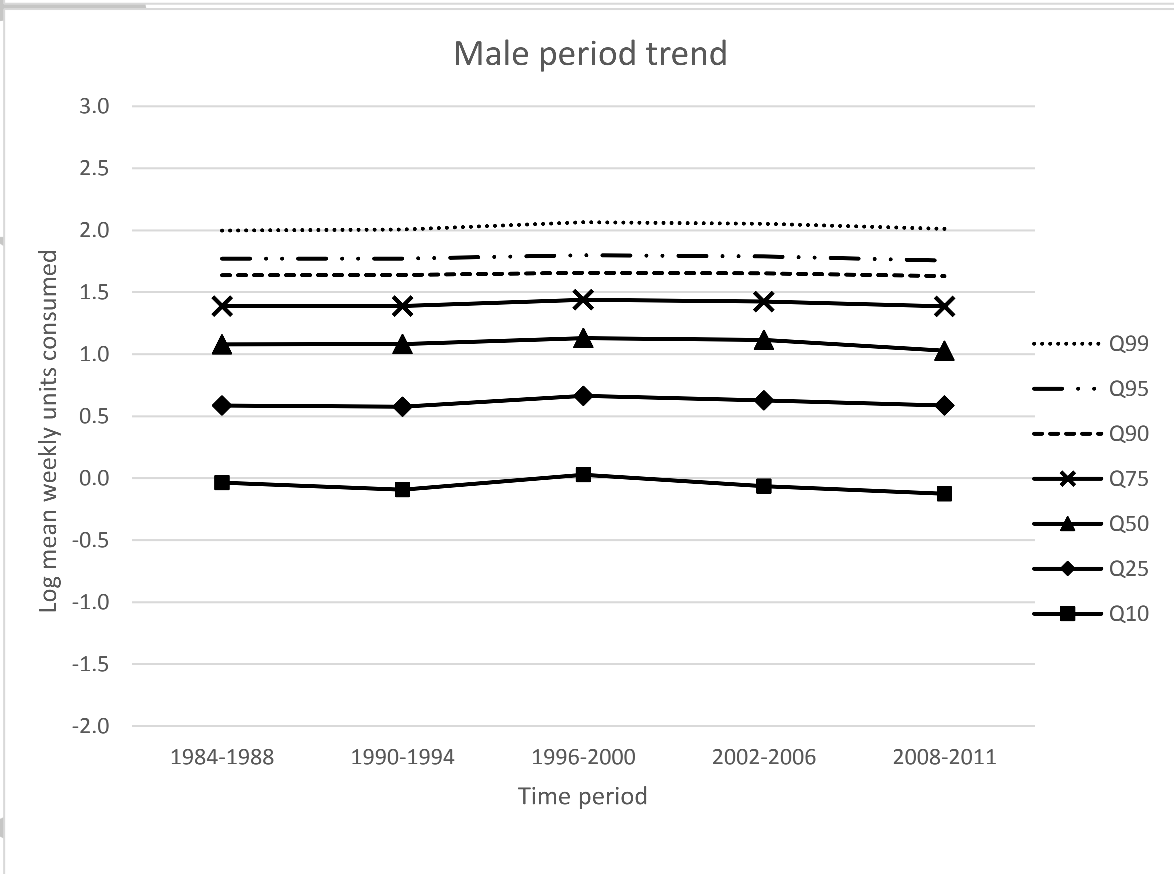
Figure 1a-1f: Logged age, period and cohort trends at each quantile for females and males.



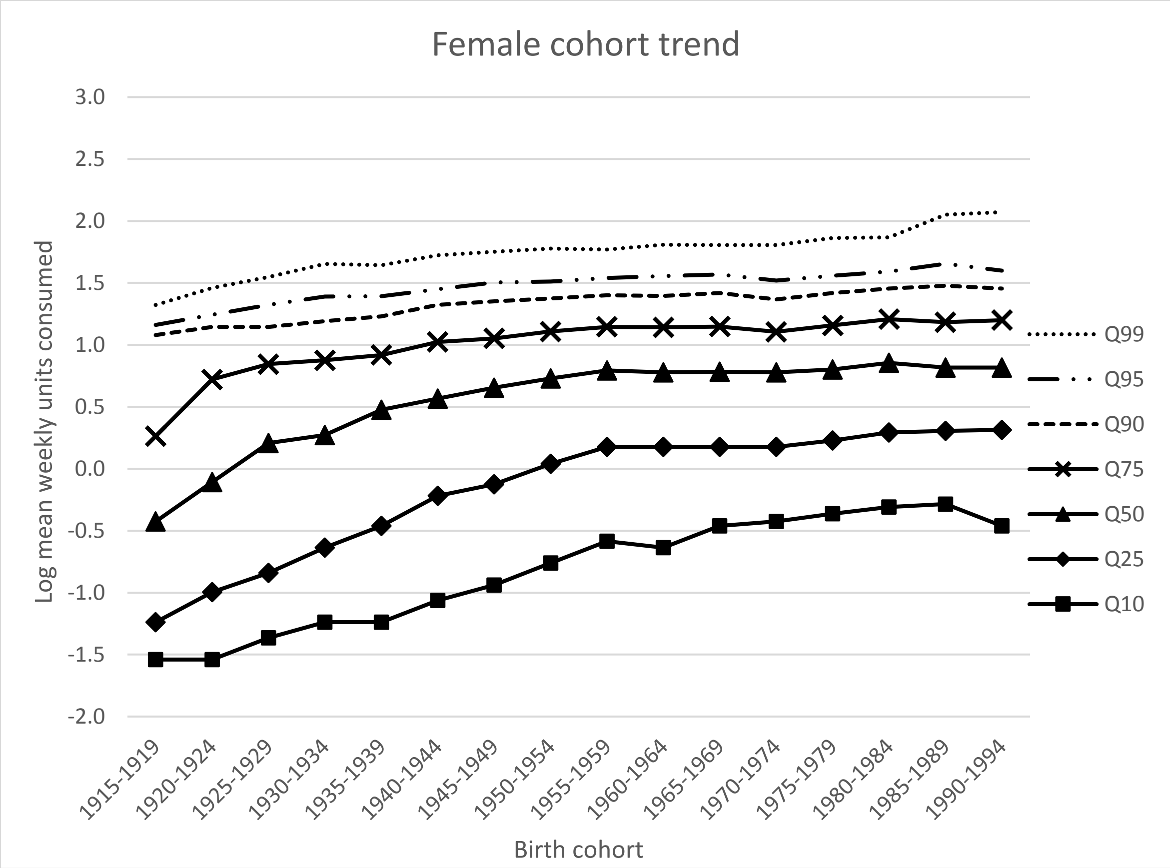


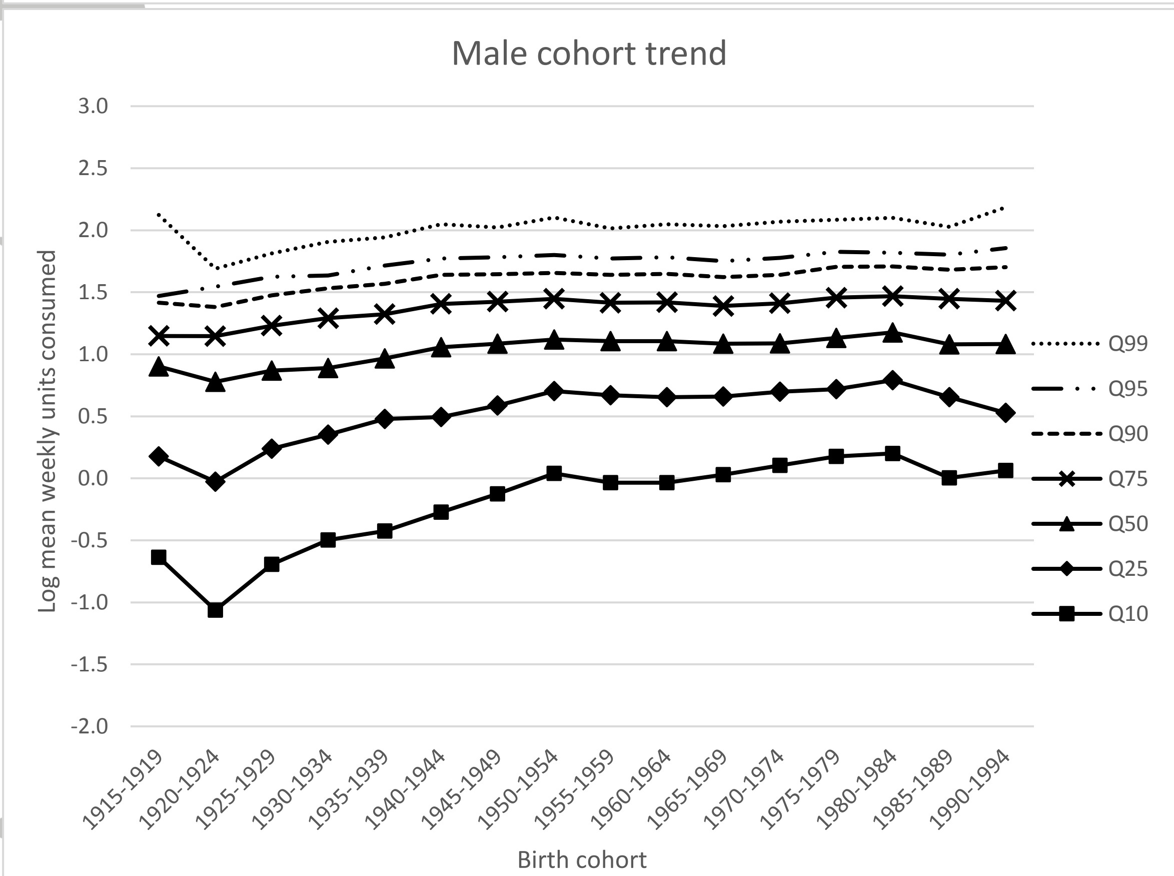
This article is protected by copyright. All rights reserved.





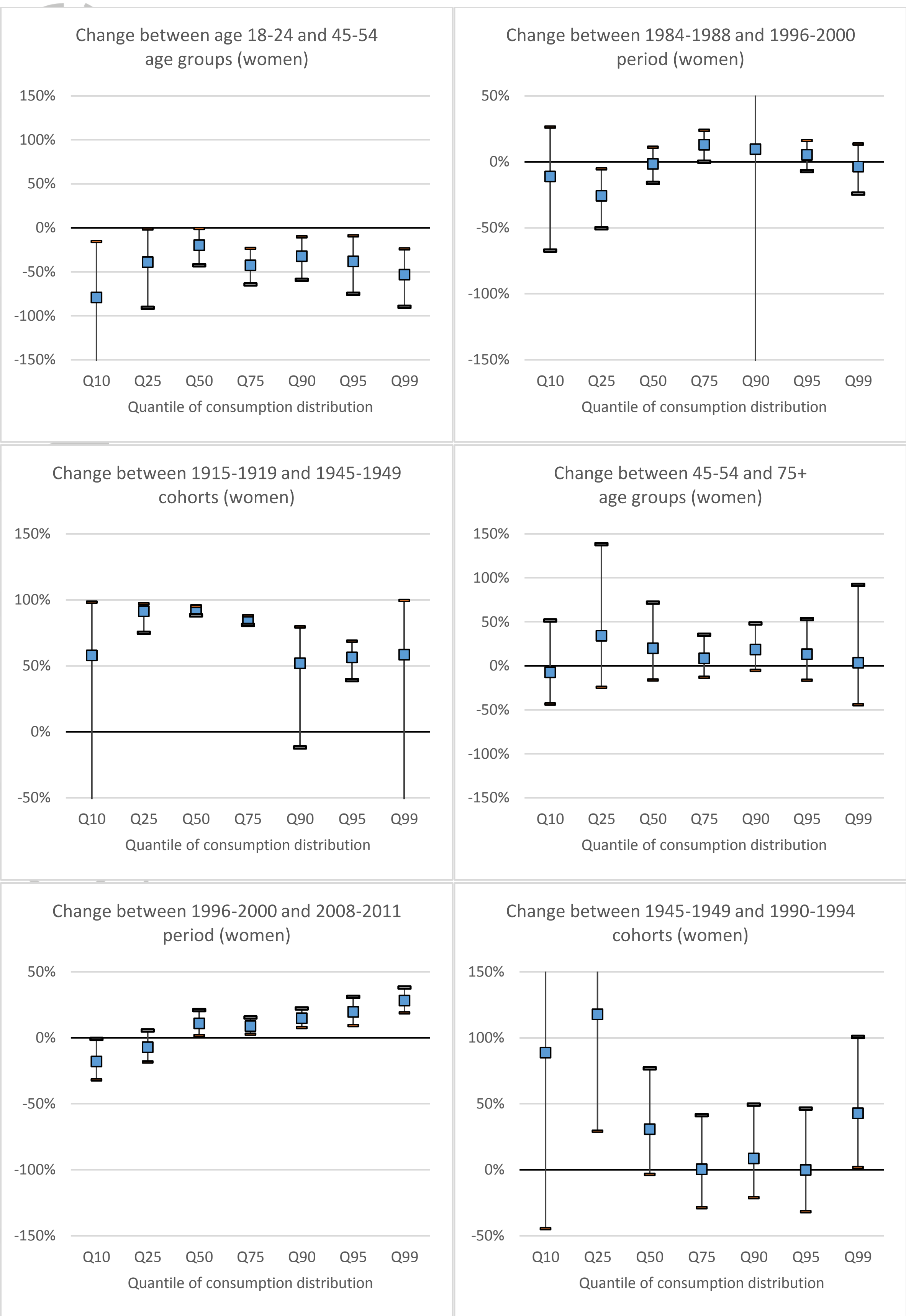
This article is protected by copyright. All rights reserved.





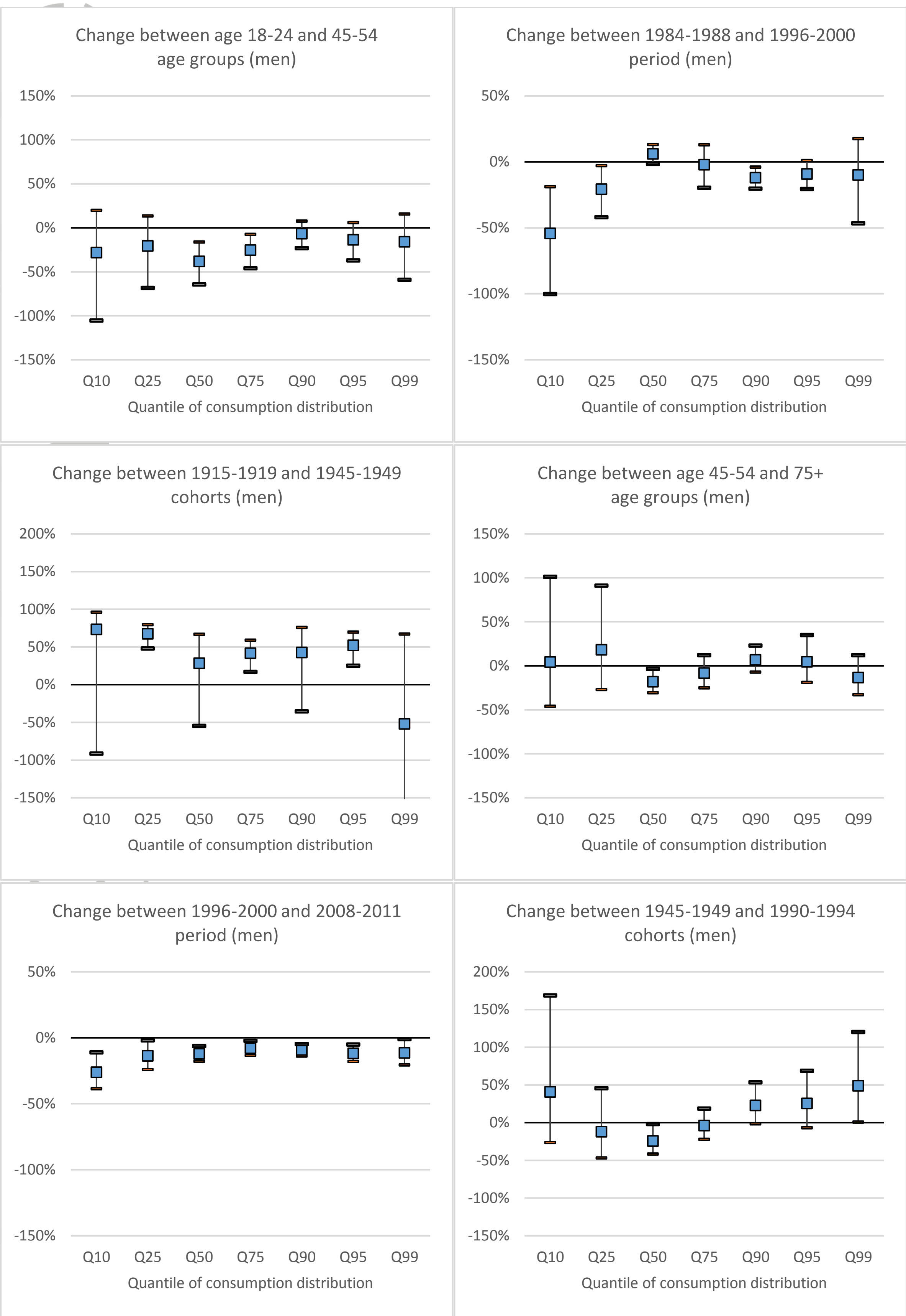
This article is protected by copyright. All rights reserved.

Figure 2: Change in units consumed by women across age, period and cohort trends by quantile of the consumption distribution.



This article is protected by copyright. All rights reserved.

Figure 3: Change in units consumed by men across age, period and cohort trends by quantile of consumption distribution



This article is protected by copyright. All rights reserved.

Table 1: Summary of quantile age-period-cohort analysis results

Effects			Finding	Comments
Age	Early: 18-24 to 45-54	Female Male	Hard collectivity	Consumption declines to middle-age for women and men but then increases into older-age for women while remaining stable for men. Consumption changes are similar in size across the distribution.
	Later: 45-54 to 75+	Female Male		
Period	Early: 1984-1988 to 1996-2000	Female Male	Polarisation	Consumption decreased over time for lighter drinkers but increased or remained stable for heavier drinkers.
	Later: 1996-2000 to 2008-2011	Female	Polarisation	Consumption decreased over time for lighter drinkers but increased for heavier drinkers.
		Male	Hard collectivity	Consumption decreased over time to a similar degree across the consumption distribution.
Cohort	Early: 1915-1919 to 1950-1954	Female	Soft collectivity	Consumption increased across successive birth cohorts but less so for the lightest and heaviest drinkers.
		Male	Hard collectivity	Consumption increased across successive birth cohorts to a similar degree across the consumption distribution
	Later: 1950-1954 to 1990-1994	Female	Hard collectivity	Consumption increased across successive birth cohorts to a similar degree across the consumption distribution
		Male	Polarisation	Consumption increased across successive birth cohorts for the lightest and heaviest drinkers but remained stable or decreased for other drinkers.

Accepted Article

This article is protected by copyright. All rights reserved.