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Drinking and health in the 2007 National Drug Strategy Household Survey

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2007 NATIONAL DRUG STRATEGY

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1. Introduction

Like many other food components, ethanol is associated with health benefits and liabilities. For those who consume it to experience a powerful psychoactive effect, the health liabilities typically outweigh the benefits. The psychological and perhaps social benefits appear to balance the costs in these cases, as many heavy drinkers will persist in spite of considerable negative consequences to health as well as social and personal relationships. In contrast, many people consume alcohol in the hope that it will enhance their health as well as provide more modest psychological benefits. Such consumption is more restrained and perhaps more regular.

The most commonly cited benefit of moderate alcohol consumption is an apparent reduction in the risk of ischemic heart disease, and perhaps ischemic stroke (Corrao et al. 2004). The effect is not large, but given the morbidity and mortality due to these conditions in developed countries, substantial benefits may be gained by maximizing this effect. Reductions in risk have also been reported for obesity (Arif & Rohrer, 2005), Type II diabetes (Koppes et al., 2005) and the related metabolic syndrome (Freiburg et al., 2004). For other conditions such as hypertension, liver cirrhosis and various cancers (Corrao et al., 2004), there does not appear to be any protection, but rather an accelerating increase in risk with increasing consumption. These effects may be due to the interaction of a number of physiological processes. The present report looks at the relationship of drinking to self-reported health and disease prevalence in a large Australian survey (AIHW, 2008) to assess the extent of agreement between these measures of health and currently debated models of alcohol and health.

The use of a cross sectional survey departs from the studies of cohorts that are typically used to examine the relationship of drinking to health. However, the large sample and comprehensive assessment of drinking affords a different view of this relationship, and the extent to which the outcomes are consistent may provide useful information.

2. Materials and methods

The National Drug Strategy Household Survey samples respondents in all states and capital cities of Australia. Both hard copy ("drop and collect") and telephone ("CATI") surveys are used. In the survey conducted in 2007, which provides the basis for this analysis, data from 23356 respondents was available. Weights are calculated for the strata and population sampling units so that results can be analyzed both for the actual respondents and for a simulated Australian population.

The dataset was provided as a file of 1442 variables for each of the 23356 respondents. As the two types of survey differed in some details, there are systematic differences in the distribution of responses that were not collected. To the author's knowledge, these differences did not significantly affect the responses analyzed here. Derived variables will be described below. All analyses were conducted using the R statistical language (R Development Core Team, 2008), with the survey package (Lumley, 2003) providing the specialized functions for survey analysis and the plotrix package (Lemon, 2006) many of the illustrations. The disaggregations and statistical models are all weighted to approximate the Australian population rather than the sample. Generalized linear modelling was employed to summarize the combined effect of age, sex, usual drinks per session, average drinks per day and the derived variable for moderate, regular drinking on each outcome of interest while controlling for smoking. In building the final models, stepwise selection of variables using the Akaike Information Criterion (Akaike, 1974) was used on the unweighted data to reduce the probability that manual variable selection used in the weighted analyses would discard important variables.

3. Results

3.1 The drinking pattern of Australians over the lifespan

Figure 1a shows the usual number of drinks per session plotted against age. This rises rapidly, reaching a maximum of just under seven for males and just over five for females at age 20. A steep decline follows to about four for males and under three for females by about 40 years. A more gradual decline seems to continue at least until 80 years of age. Because this measure is answered by selecting categories, the lowest quantity any respondent who drinks can score is 1.5 (the midpoint of "1 to 2 drinks") and it is likely that the averages for ages above 80 are not reliable.

Figure 1b shows the frequency of drinking as the proportion of days drinking. The rise to between one and two days per week at 20 years is followed by a more gradual increase to about three days per week by 80 years, when the small numbers of respondents again render the estimates unreliable. Males drink somewhat more frequently as well as drinking more across this age range.

Figure 1c shows the average number of standard drinks per day. Females show a remarkably stable average consumption of just under one standard drink per day between ages 20 and 80. There appears to be a reduction in average consumption to about 1.5 drinks per day for males by about 40 years, then a rise to about 2 drinks per day at 50-60 years and finally a slow decline to 80 years. These fluctuations are visible but of smaller magnitude among females. To check that these patterns of drinking are stable over time, the same calculations were performed on the data from the 1998 NDSHS survey (AIHW, 1999). While the smaller number of respondents led to larger fluctuations across the age range, the patterns of quantity, frequency and average consumption were the same.

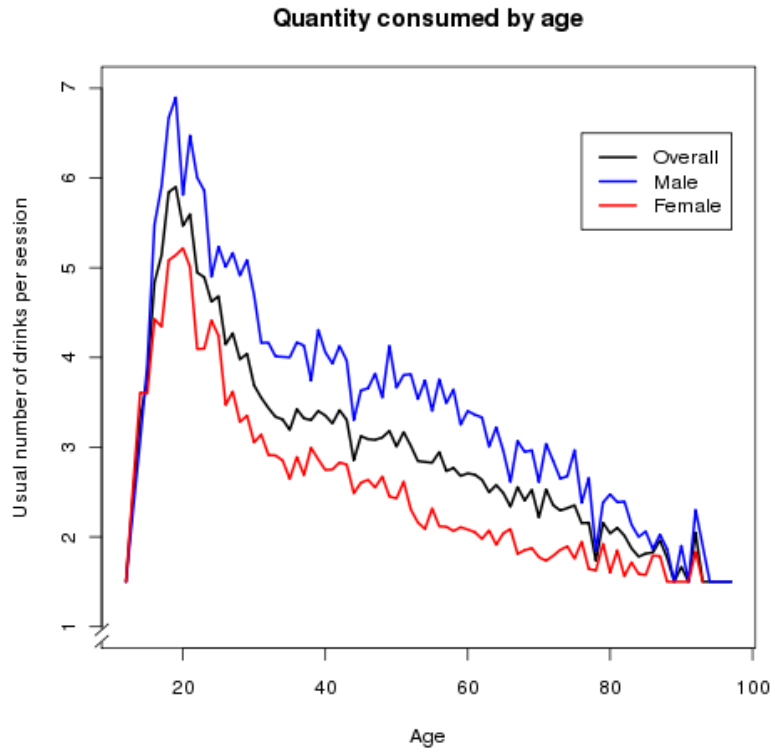
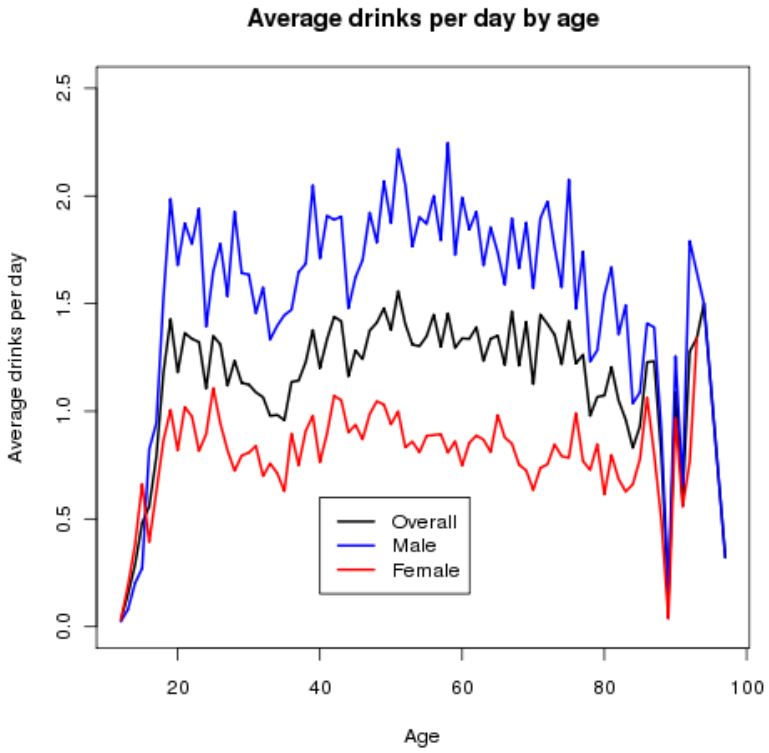


Figure 1a - Usual number of drinks per session by age

Figure 1b - Proportion of days drinking by age



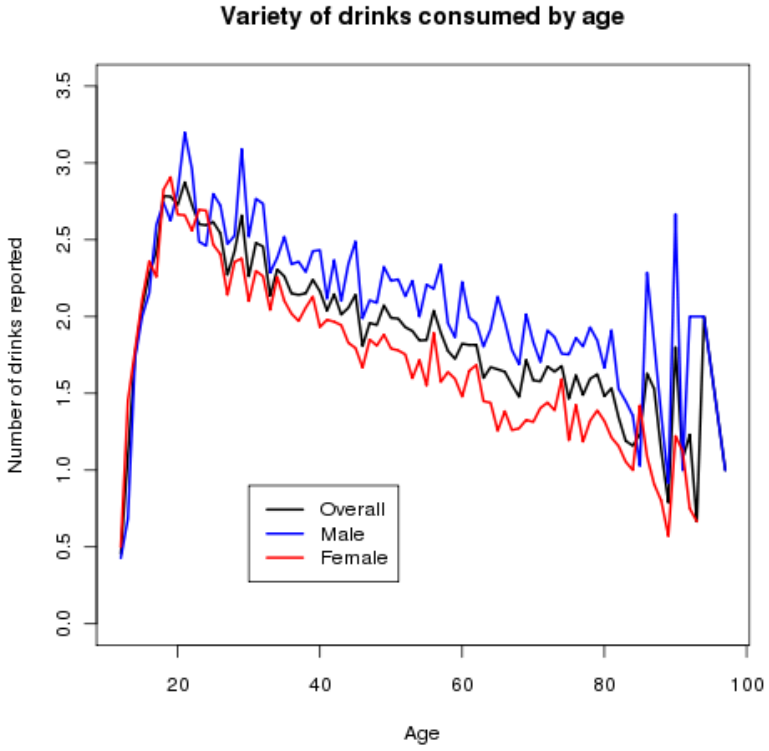


Figure 1c - Average drinks per day by age

Figure 1d - Different types of drinks consumed by age

These basic descriptions provide some fundamental information for the discussion of drinking and health. Males drink more than females per session, drink more frequently and thus consume about twice as much alcohol over a given interval. Drinkers of both sexes rapidly adopt a high consumption, infrequent pattern of drinking at about 20 years of age that almost certainly corresponds to heavy weekend drinking, then shift to lower consumption, more frequent drinking by about 40 years of age without greatly changing the average amount of alcohol consumed per day. There is considerable evidence that the pattern of drinking is of equal importance to the average amount of alcohol consumed (Tolstrup et al., 2006), and the combination of these changes marks a progression from more to less harmful drinking with age.

These figures are of course averaged over many respondents, and the variations will prove to be just as interesting as the averages. The relationship of these averages to societal conventions is not obscure. There is a clear weekly cycle in Australian society in which those who work usually have one or two free days per week, and those days are usually Sunday and perhaps Saturday. Most people cannot perform as well on the day after drinking heavily, and thus if heavy drinking is to be undertaken, it is wise to do so with a day in hand to recover. The average Australian drinker makes a rapid transition to a weekend heavy drinker at 20 and then almost as rapidly changes to a moderate drinker of increasing frequency by 30, appearing to reach a stable pattern by about 40. Is this due to the opportunities of youth, the increasing restrictions of adulthood, the effects of heavy drinking or some combination of these?

Before addressing this, a final descriptive average may be of interest. Figure 1d shows the average variety of drinks consumed by age. Both males and females drink an average of just under three drink types (such as beer, bottled wine, spirits) at the age of maximum drinking, then decline to about 1.5 drink types by 80 years of age. Does this change relate to the pattern of drinking?

3.2 Quantifying drinking and smoking

It is obvious that drinking is related to self-reported health, but is this relationship mediated by the usual quantity drunk, the average amount drunk per day, the frequency of drinking or some combination? The usual quantity per session and frequency are directly measured, and a graduated quantity frequency matrix was completed as well. Average drinks per day (AVDPD) was calculated by multiplying the midpoint of the usual amount per session by the proportion of days drinking.

There is considerable evidence that moderate, regular drinking is associated with the apparent health benefits of alcohol and a measure of this (MODREG) was calculated by dividing the frequency (proportion of days drinking) by the absolute value of the difference between the average number of standard drinks per session and two. Two drinks appears to be the quantity associated with the maximal health benefits of alcohol. With the available range of responses, this measure would achieve a maximum value of 1.5 if a respondent reported drinking every day and usually drinking within the minimum range of 1-2 drinks.

The graduated quantity frequency (GQF) measure data suffered from the usual problem found with this method. It is quite difficult to fill in such a matrix so that the number of days sums to the interval requested. Summing the numbers of days for the 78% of respondents who had at least one valid response category resulted in sums ranging from six days to over 2000 (mean= 289.5, median = 329.2). In order to generate quantitative estimates that were comparable between respondents, each score was scaled by the number of days recorded to an estimate for one year. It was not possible to assume that shortfalls were due to non-drinking days, as an explicit category of "None" was available. Thus some estimates, particularly those that sum to a small number of days, may be inaccurate.

Two measures of drinking pattern were calculated from the GQF. The first was based on the commonly reported maximal health benefit associated with 20g (two standard drinks) of alcohol per day. The reported frequency for each quantity range was divided by the absolute difference of the midpoint of the range from two drinks. These values were averaged to yield the first "healthy drinking score" QFM1. The maximum value of 2 was achieved if the respondent chose any frequency for "1-2 standard drinks a day" and "never" for all other ranges. The minimum value of 0.056 occurred when a respondent chose any frequency for "20 or more standard drinks a day" and "Never" for all other ranges. The second "healthy drinking score" (QFM2) was calculated as the average of the frequency divided by the number of drinks per day plus one (to avoid division by zero) ranging from a minimum of zero to a maximum of 1 if the respondent reported any frequency for "None" and "Never" for all other categories.

The number of years of daily smoking (SMKYRS) was calculated to control for the effect of smoking on health. The ability of the three "moderate drinking" measures to predict reported health separately while controlling for age, sex and SMKYRS was tested. It is important to remember that "abstainers" of either definition would not be included in these models if the instructions to skip the drinking measures had been followed, and thus the models to be discussed include few abstainers. The MODREG measure showed the strongest association with reported health ($t = 10.74$, $p < 0.0001$), followed by QFM1 ($t = 8.14$, $p < 0.0001$) and QFM2 ($t = 3.31$, $p = 0.0009$) and was used in subsequent models. It is worth noting that QFM1, with a maximal benefit at two drinks per day, was a much better predictor of reported health than QFM2, that assumed no benefit of moderate drinking.

3.3 Classifying drinkers

Two methods were used to classify drinkers. The first used the responses to the questions about actual drinking. Two questions asked, "Have you ever tried alcohol?" and "Have you ever had a full serve of alcohol?". As either of these might define an abstainer, separate analyses were run using each as the definition of an "Abstainer". An important thing to remember is that the two categories of "abstainer" are, in principle, exclusive. If a respondent reported never having tried alcohol, the questionnaire directed that respondent to skip a number of questions, including the succeeding question about having a full serve of alcohol. However, both the more and less strictly defined abstainers would be able to self-classify as "Non-drinker", of which 96% and 90% did, respectively. This explains, for instance, why the prevalance of Type II diabetes among respondents under 40 years of age is almost twice as high when the first, stricter definition of abstinence is used. Another question asked, "Have you had an alcoholic drink of any kind in the last 12 months?". A category of "Nil12month" was defined for those who answered "No", as the questionnaire requested that these respondents not answer most of the remaining questions about their drinking. The final two categories were based on a question that asked, "On a day that you have an alcoholic drink, how many standard drinks do you usually have?". If males answered a maximum of "3-4 drinks" and females a maximum of "1-2 drinks", they were classified as "Moderate" drinkers. All those answering with greater quantities were classified as "Immoderate" drinkers, consistent with the Australian alcohol guidelines current at the time of the survey (NH&MRC, 2001). The term "immoderate" is used to distinguish this category from the self-description of "heavy" drinker, and to indicate that the consumption of many "immoderate" drinkers would not be considered heavy drinking.

The second method used a single question that asked, "At the present time do you consider yourself...?", and offered seven options, "non-", "ex-", "occasional", "light", "social", "heavy" and "binge" drinker. This provided the sort of self-classification that has often been used in surveys and

allowed the correspondence between the respondents' reported drinking and their impression of themselves as drinkers to be assessed.

Crosstabulation of the two classifications by the self-reported classification revealed that the first definition ("Have you ever tried alcohol?") appeared to be a more accurate classification of abstainers, as only 4% of respondents (52) self-classified as other than "non-drinker". The alternative definition ("Have you ever had a full serve of alcohol?") resulted in just under 10% (108) of those respondents self-classifying as other than "non-drinker". The second most common classification in both cases was "occasional drinker", accounting for 2.3% using the more strict definition of abstainer and 5% using the alternative.

Of those respondents claiming not to have had a drink in the past 12 months, 83% self-classified as "non-drinker", with an additional 10% self-classifying as "ex-drinker". As not drinking for a year has sometimes been used to define abstainers, this will help in evaluating the "sick quitter" model, as a crucial assumption of that model is that the inclusion of ex-drinkers with "true" abstainers accounts for the apparent health benefits of alcohol. Using the more strict definition of abstainer, only one respondent classified as an abstainer self-classified as an "ex-drinker".

Those classified as "moderate" or "immoderate" drinkers from their reported drinking self-classified in a reasonably consistent way, with the bulk of both "moderate" and "immoderate" drinkers classifying themselves as "occasional", "light" or "social". However, much greater proportions of "immoderate" drinkers classified themselves as "heavy" or "binge" drinkers. As the self classification mixed quantity, frequency and rationale for drinking, the overlap is not unexpected.

3.4 Assessing health

There are also two ways of assessing health in the survey. The easiest method is provided by a question asking, "In general, would you say your health is ...?", with options of "excellent", "very good", "good", "fair" and "poor". A second question asks, "In the last 12 months have you been diagnosed or treated for ...?" with options for various illnesses. The most useful of these for the present analysis are those for which an association with alcohol is suspected, viz. Type II diabetes, heart disease, hypertension and cancer.

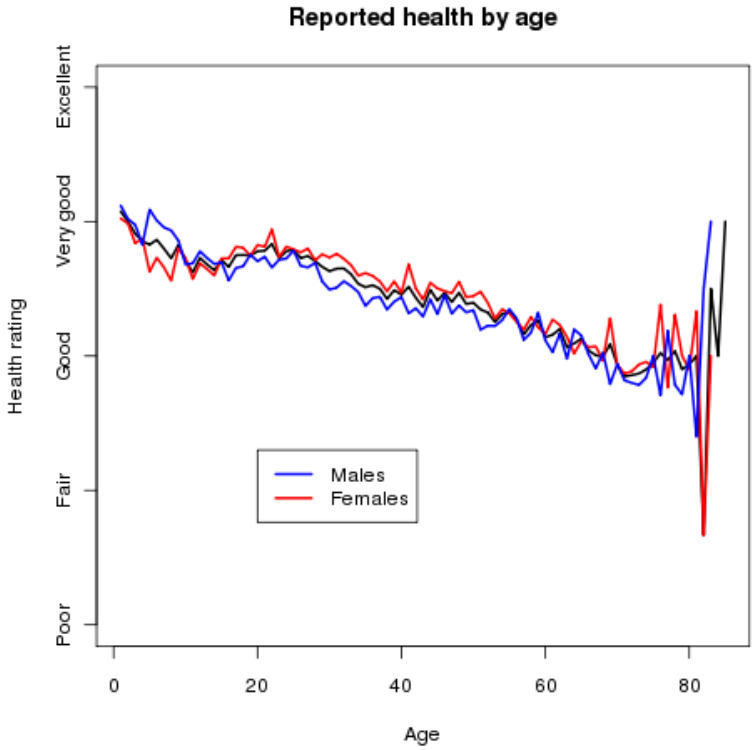


Figure 2a - Mean reported health by age of respondent

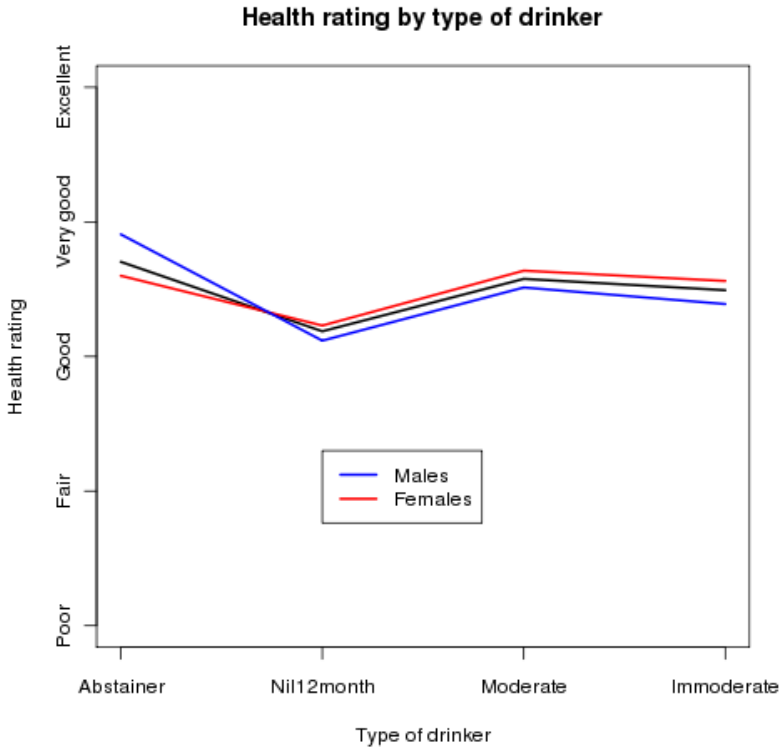


Figure 2b - Mean reported health by calculated drinker classification

3.5 Self-reported health

The most consistent effect on reported general health was the number of years of daily smoking (SMKYRS), with the effect of age almost as strong. The highest average, corresponding to "Very good" is seen in the youngest respondents, and with only a slight decline and rebound in teenagers, the average reported health decreases steadily to just below "Good" at 80 years (Figure 2a).

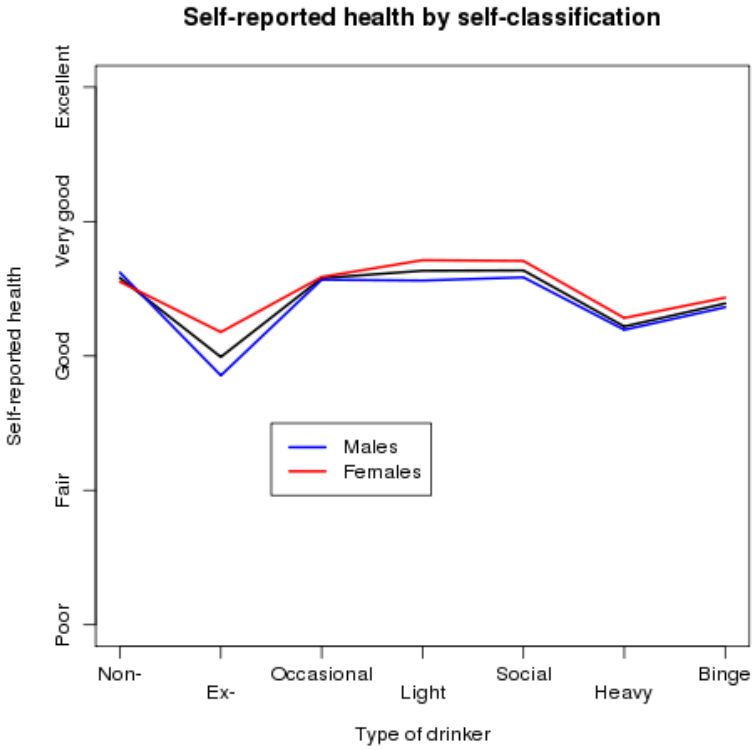


Figure 2c - Mean reported health by self classification

Breaking down self-reported health by calculated drinking classification shows that the worst average health is reported by those respondents claiming not to have drunk alcohol in the past year, followed by immoderate drinkers. Overall, there is a slight advantage for abstainers over moderate drinkers, but when separated by sex, it is clear that this is only apparent for males, as female moderate drinkers report slightly better health than female abstainers (Figure 2b).

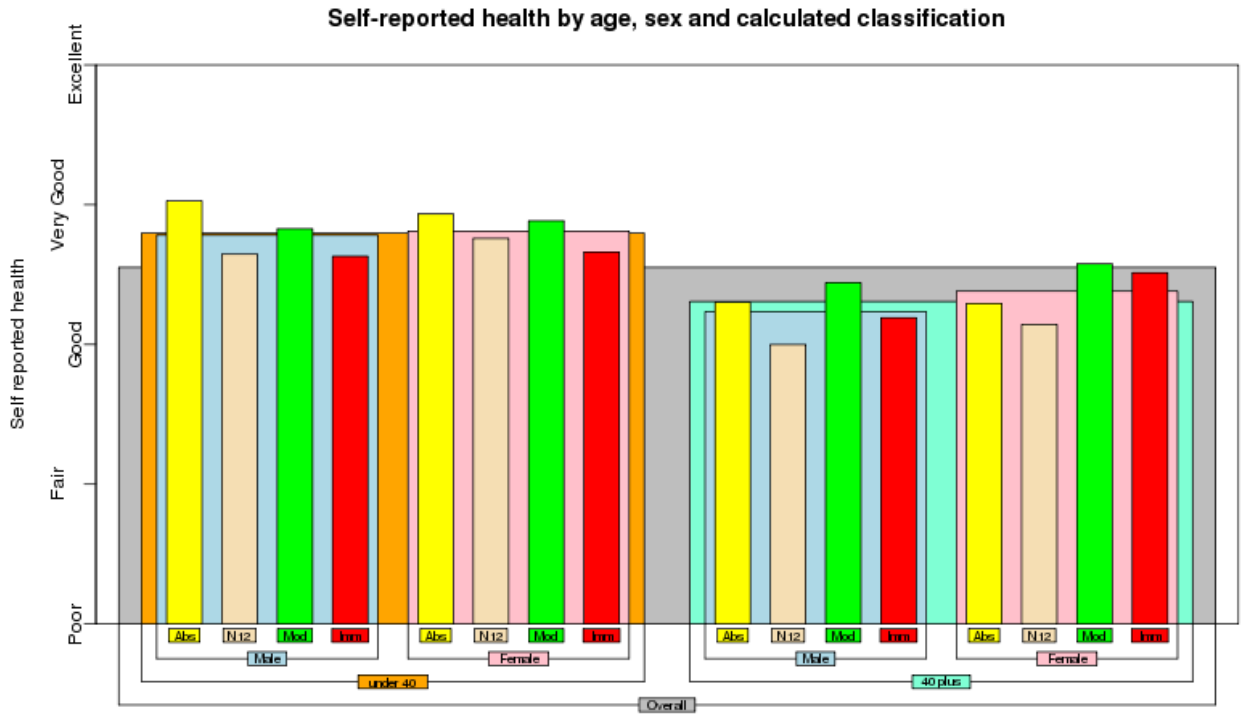
A breakdown of self-reported health by self-classification shows even more striking differences. The worst average health is reported by those respondents classifying themselves as "ex-drinkers", while the best averages are reported by "light" and "social" drinkers. These differences are again more marked for female respondents (Figure 2c).

Generalized linear models of the association of age, sex, average drinks per day, average quantity per drinking day, MODREG and SMKYRS to self-reported health revealed that SMKYRS had the strongest association ($t = -20.3$, $p < 0.0001$), followed by age ($t = -17.8$, $p < 0.0001$) and usual drinks

per session (t = -9.28, p < 0.0001). MODREG was also significantly associated with reported health (t = 4.45, p < 0.0001). Sex interacted with MODREG (t = 3.46, p = 0.0006) with females achieving a greater benefit from regular, moderate drinking than males.

As previously mentioned, the average pattern of drinking appears to change considerably up to 40 years of age, becoming more steady thereafter. The diseases that have been most strongly associated with chronic alcohol consumption, such as cardiovascular diseases, liver disease and cancers also become much more prevalent after the age of 40. Separate analyses of reported health were conducted for those respondents under the age of 40 and those 40 and above.

Among respondents under the age of 40 who reported drinking, the strongest predictor of reported health was again SMKYRS (t = -12.28, p < 0.0001) followed by usual drinks per session (t = -7.72, p < 0.0001). In the model including respondents 40 years of age or over, SMKYRS was the best predictor of health (t = -17.7, p < 0.0001), followed closely by age (t = 16.5, p < 0.0001). MODREG was next (t = 6.19, p < 0.0001), then usual drinks per session (t = -5.72, p < 0.0001). Females reported somewhat



better health than males (t = 4.03, p < 0.0001).

Figure 3a - Breakdown of self-reported health using calculated drinker classification

This relationship can be seen in Figure 3a, in which abstainers are included, where the age range was divided into "under 40" and "40 plus". Respondents under 40 years of age reported better health than

those 40 and above, with almost no difference between males and females. Abstainers reported the best health among those under 40, with moderate drinkers next. Both those reporting immoderate drinking or no drinking in the past year reported worse health. Looking at the respondents 40 years of age and over, females reported better health than males. Moderate drinkers of both sexes reported the best health, with those reporting no drinking in the past year also reporting the worst average health. Male abstainers report somewhat better health than male immoderate drinkers, while female abstainers report worse health than female immoderate drinkers.

Figure 3a also suggests that while reported health declines with age, that of abstainers and those not drinking in the past year declines to a greater extent than drinkers. A separate analysis of the interaction of the "under 40" and "current drinker" contrasts showed that this effect was significant ($t = 8.97$, $p < 0.0001$) after controlling for SMKYRS. This effect did not appear within the above model as the "current drinker" contrast is highly correlated with calculated drinker classification.

Figure 3b - Breakdown of self-reported health using self-classification of drinkers

Turning to Figure 3b, in which reported health is broken down by age, sex and self-classification of drinker type, much the same pattern is apparent. Among males under 40 years of age, abstainers report the best health, while ex-drinkers report the worst. There appears to be a decline in reported health with increasing quantity and irregularity of drinking. Females in this age group are similar except that those classifying themselves as "heavy" drinkers report the worst average health. The same reversal of reported health between abstainers and drinkers is apparent in those 40 years of age and over, with "occasional", "light" and "social" drinkers all reporting better average health than abstainers. "Ex-drinkers" still report the worst average health.

The above results were obtained using the stricter definition of abstainer ("No" to "Have you ever tried alcohol?"). The same analyses performed with the less strict definition ("No" to "Have you ever had a full serve of alcohol?") gave similar results, but with abstainers reporting somewhat better health relative to drinkers, and male abstainers 40 years and over reporting better health than drinkers.

A separate breakdown of only those respondents claiming not to have had a drink in the past year showed that for both sexes and age groups, respondents self identifying as "ex-drinkers" reported worse health than those identifying as "non-drinkers". Thus one premise of the "sick quitter" model, that ex-drinkers have generally worse health than non-drinkers among those who have not drunk in the past year, is supported by the present data.

3.6 Specific disease conditions

Self-reported health is not an ideal measure, as the respondents' expectations might bias such reports. That is, an older respondent with chronic disease might justify their report of good health with the rejoinder that he or she was in good health for a person of that age with common health problems. Self-reported health might represent a relative judgement that does not reveal the accumulation of health problems that is an important aspect of the study of the effect of alcohol on health. Respondents were also requested to indicate whether they had been diagnosed or treated for a number of specified conditions during the past year. Cases were defined as respondents who reported either or both of these events. For two of these conditions, heart disease and Type II diabetes, there is some evidence that regular, moderate consumption of alcohol is associated with reduced risk. In two other conditions, hypertension and cancer, alcohol is thought to increase risk proportionate to consumption. Hepatic cirrhosis would also fall into this category, but this condition was not specified. Cancer was restricted to bladder, bowel, breast, liver, lung, colon, prostate, ovarian, leukaemia, cervical, kidney, pancreas, throat, thyroid and uterus/uterine. These cancers were analysed as a group as the numbers of cases of individual cancer types were too small to provide reliable estimates. Cancers such as skin cancers were omitted as being less likely to be caused by alcohol. As the diseases considered become much more common with age and as their association with alcohol is assumed to be the result of cumulative effects, the models of specific diseases include only respondents over 40 years of age.

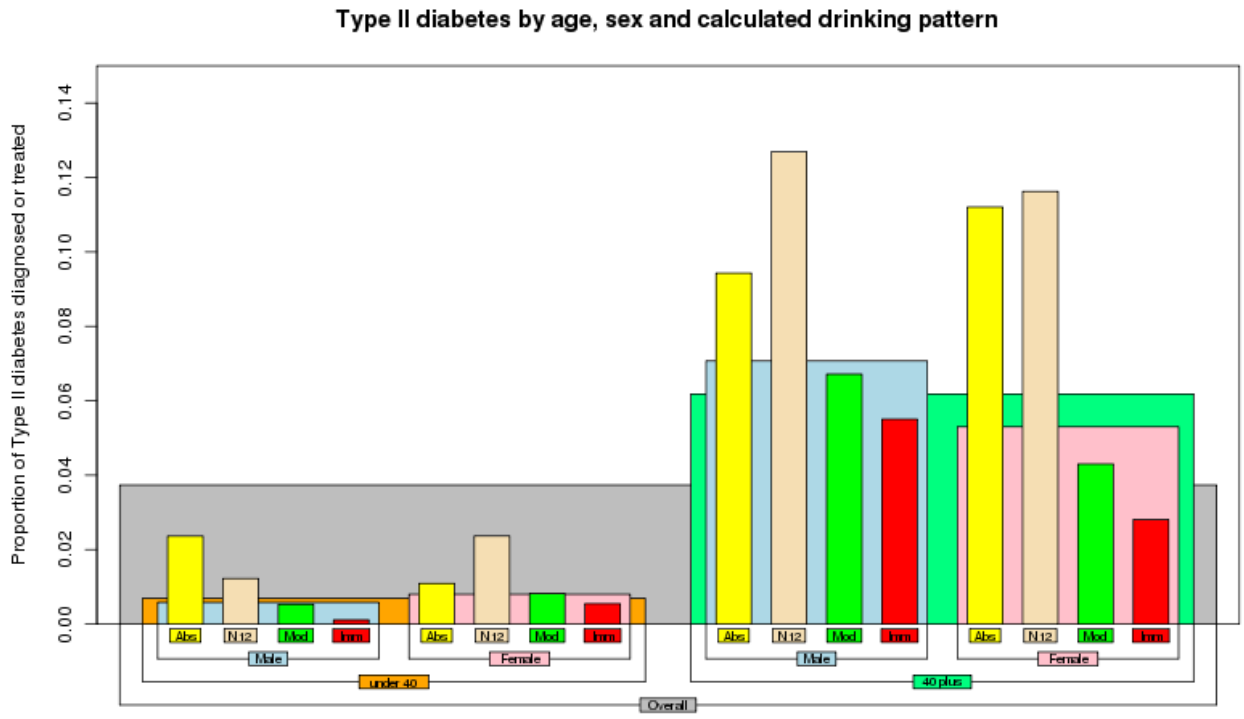
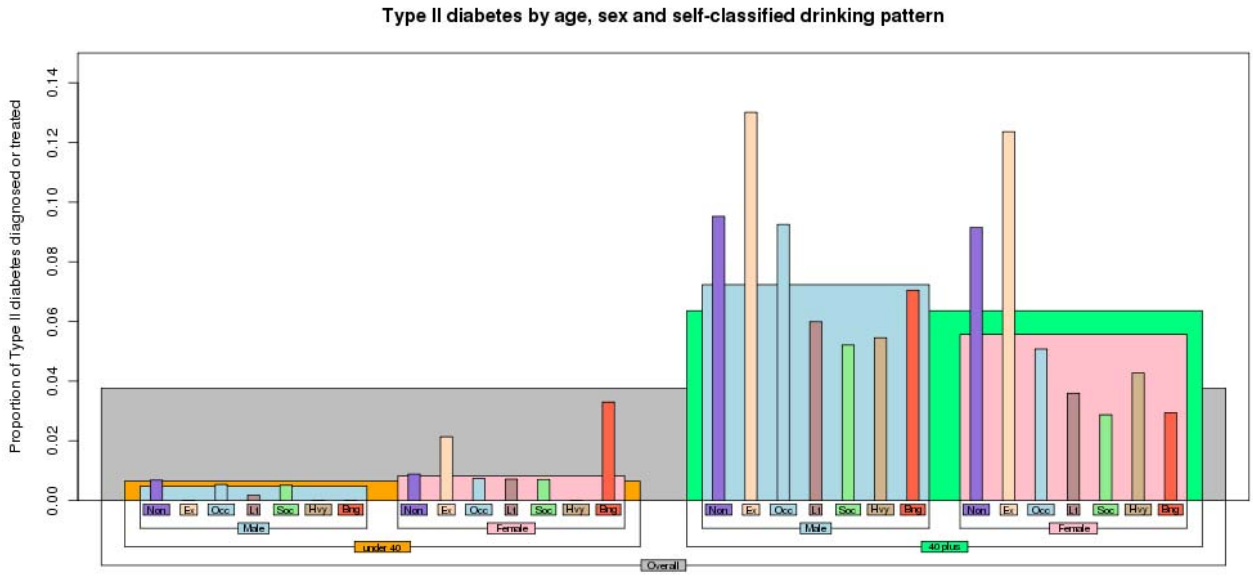


Figure 4a - Breakdown of Type II diabetes prevalence using calculated classification

3.6.1 Type II diabetes

In Figure 4a, the proportion of Type II diabetes cases is broken down by age group, sex and calculated drinking pattern. The low prevalence of this disease in younger people is evident, as is the predominance of female cases among those under 40 years of age. Prevalence rises with age, and male cases become more common. The association with calculated drinking pattern is similar to that found with reported health. Those reporting no drinking in the past year also have the highest proportion of cases, followed by abstainers. More surprisingly, increased usual quantity per session, as categorized into "moderate" and "immoderate", does not seem to increase the risk of this disease in those over 40. Figure 4b, showing the same breakdown except that the drinking patterns are self-classified, repeats this pattern with "ex-drinkers" having the highest proportion of cases, followed by "non-drinkers".

In a logistic regression model of Type II diabetes prevalence for respondents under the age of 40, age was the best predictor ($t = 3.92$, $p < 0.0001$), with a significant trend for lower risk as the calculated drinking category went from "abstainer" to "immoderate drinker" ($t = -3.65$, $p = 0.0003$). For respondents aged 40 or over, age was again the best predictor ($t = 15.5$, $p < 0.0001$), with MODREG next ($t = -5.52$, $p < 0.0001$), SMKYRS ($t = 4.99$, $p < 0.0001$) and sex ($t = 4.17$, $p < 0.0001$).



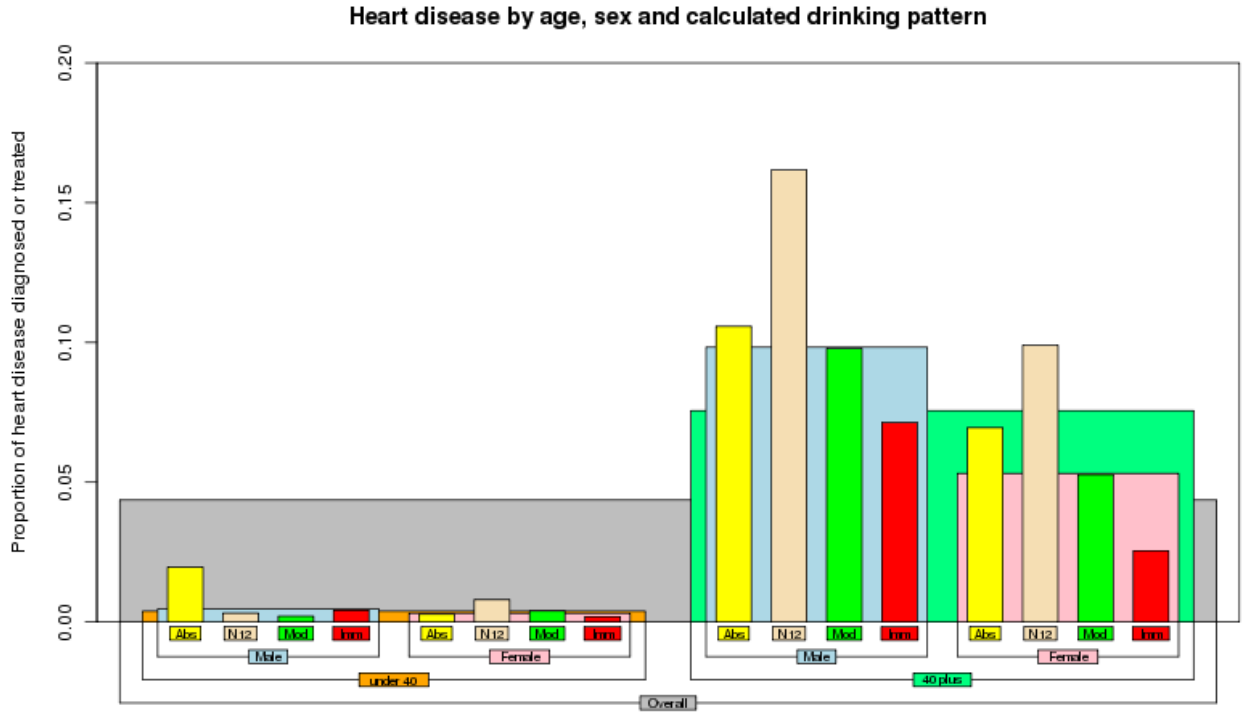


Figure 4b - Breakdown of Type II diabetes prevalence by self-classification

Figure 5a - Breakdown of heart disease prevalence by calculated classification

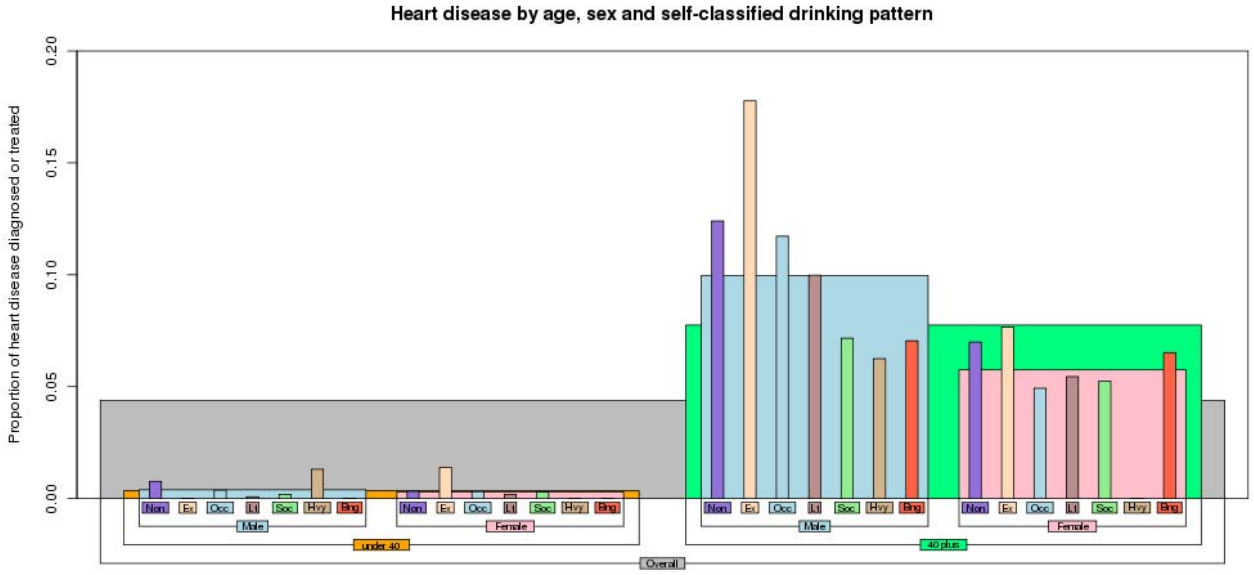
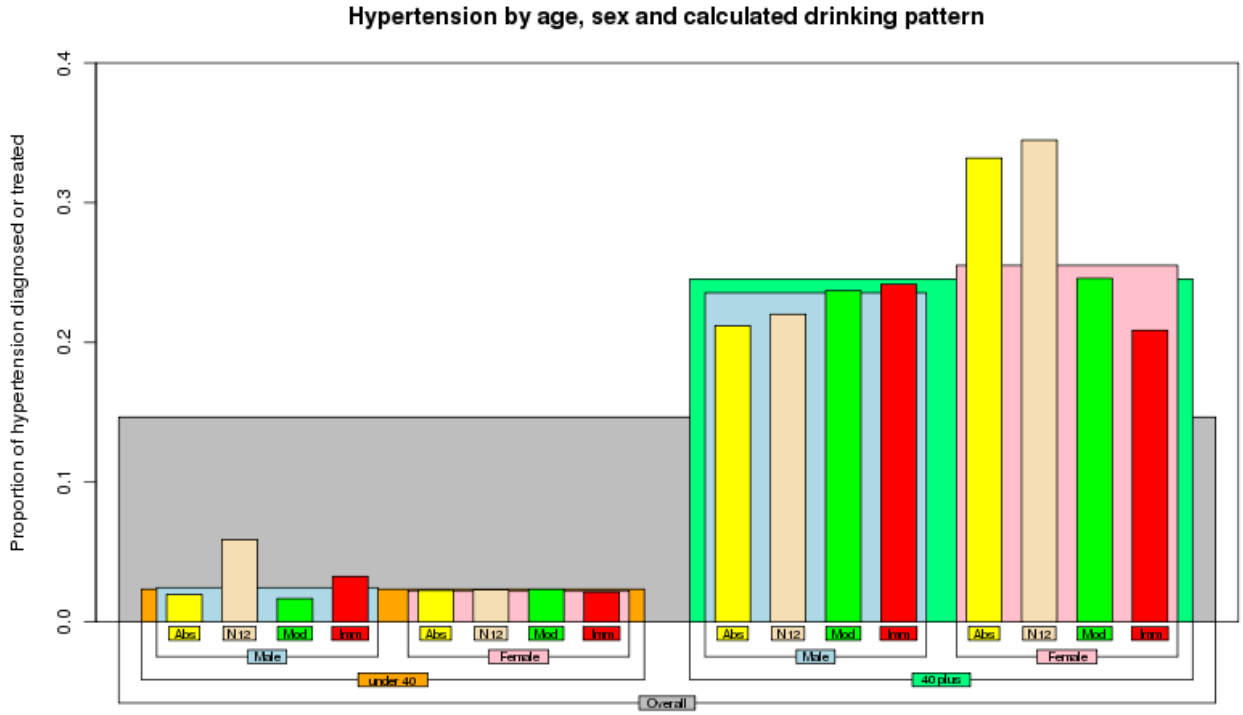


Figure 5b - Breakdown of heart disease prevalence by self-classification

3.6.2 Heart disease

Figures 5a and 5b display the same breakdowns of heart disease cases, with much the same results. Heart disease is much more common in the 40 and over age group, and the highest proportions of cases are found among those not drinking in the past year and "ex-drinkers", followed by "abstainers" and "non-drinkers" respectively. Again, apart from those self-classifying as "binge drinkers", increasing quantity of alcohol does not appear to lead to an increasing number of cases.

For heart disease prevalence for respondents under 40, the interaction of the calculated drinker classification with the usual quantity per session showed that usual quantity per session ($t = -40.7$, $p < 0.0001$), the interaction term ($t = 38.9$, $p < 0.0001$) and calculated drinker classification ($t = -12.8$, $p < 0.0001$) were all associated with heart disease. Among respondents 40 and over, age ($t = 23.6$, $p < 0.0001$) and sex ($t = -8.19$, $p < 0.0001$) were the most closely associated with heart disease, with females less likely to be diagnosed or treated. SMKYRS ($t = 7.37$, $p < 0.0001$) and the self classification of drinker type ($t = -2.59$, $p = 0.009$) were also significantly associated.



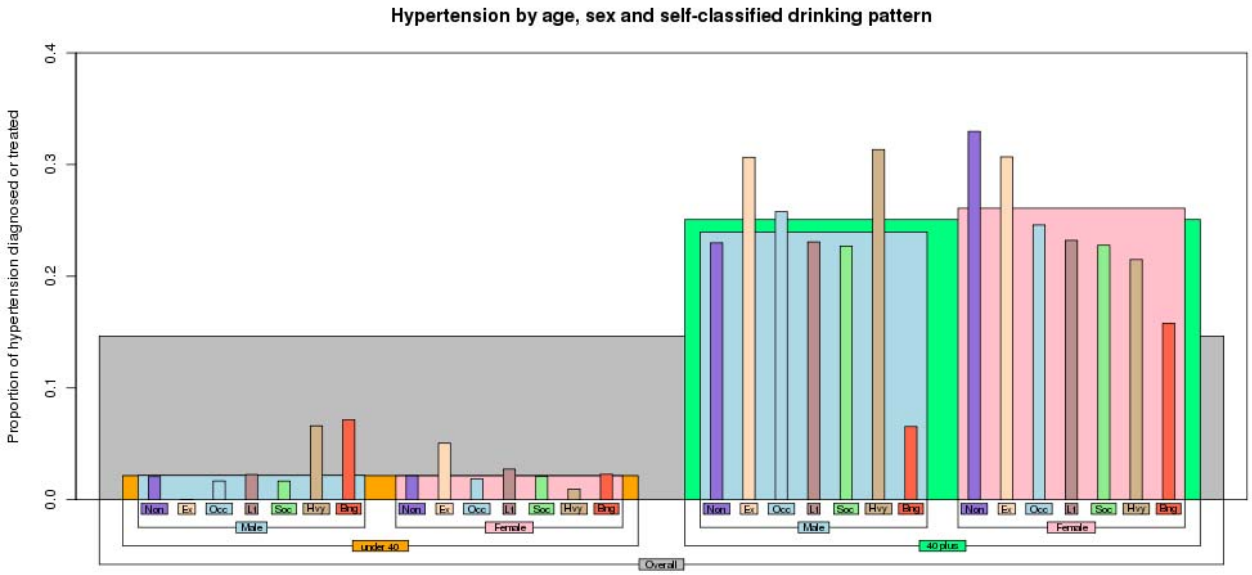


Figure 6a - Breakdown of hypertension prevalence by calculated classification

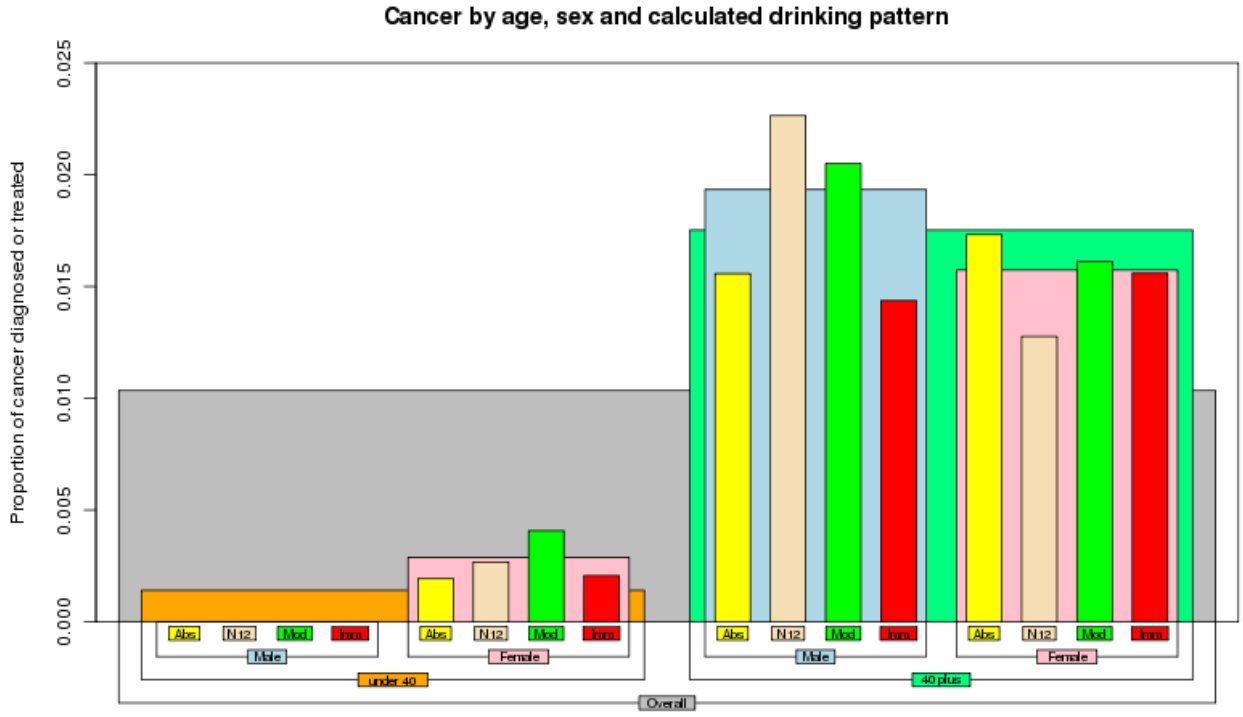
Figure 6b - Breakdown of hypertension prevalence by self-classification

3.6.3 Hypertension

Figures 6a and 6b show the breakdown of hypertension cases. There was an increased prevalence among younger females in the less strict abstainer category (not shown) which was probably related to pregnancy (Barbieri &Repke, 2008). Among respondents over 40, males show a gradual increase in the

proportion of cases as the level of drinking rises, while females show the opposite trend, with those not drinking in the past year and abstainers more likely to report hypertension than drinkers.

In the model of hypertension for those under 40, age was again the best predictor ($t = 5.9$, $p < 0.0001$) followed by the usual quantity per session ($t = 3.69$, $p = 0.0002$). For those 40 and over, age was also most strongly associated with hypertension ($t = 28.3$, $p < 0.0001$) along with MODREG ($t = -4.22$, $p <$



0.0001) and calculated drinker type ($t = 3.1$, $p = 0.002$).

Figure 7a - Breakdown of cancer prevalence by calculated classification

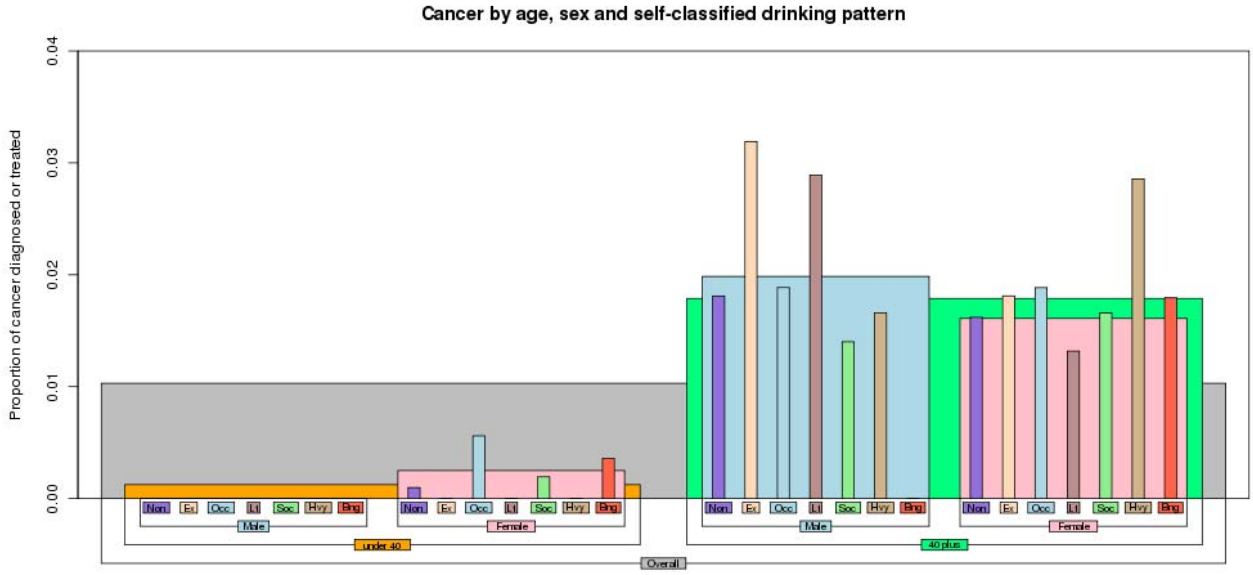


Figure 7b - Breakdown of cancer prevalence by self-classification

3.6.4 Cancer

Finally, Figures 7a and 7b illustrate the breakdown of cancer cases by drinking patterns. There is little similarity to the previous results, apart from the high prevalence in those not reporting drinking in the past year and "ex-drinkers" among males and "heavy drinkers" among females. Abstainers are no more likely to report cancer than the average of drinkers.

Only sex ($t = 55.1$, $p < 0.0001$) was associated with cancer cases in those under 40 as only females reported cancer. For those 40 and over, age ($t = 11.53$, $p < 0.0001$) was the only significant predictor of cancer cases.

Variety of beverages and amount of drinking

The variety of beverages consumed was not related to self-reported health after controlling for age, sex and SMKYRS. However, variety was related to amount drunk, with those respondents reporting greater variety tending to drink more per session ($t = 9.26$, $p < 0.0001$).

4. DISCUSSION

4.1 Patterns of drinking with age

The overall changes in drinking patterns with age are consistent with previous studies (e.g. Schulenberg et al., 1996) in finding the maximum consumption per session at or near 20 years of age. Differences between males and females were minor apart from the larger average quantities consumed by males.

4.2 Age and perception of the effect of drinking

Perhaps the most obvious conclusion to be drawn from the preceding analyses is that increasing age is associated with a decline in perceived health, and that many health effects of drinking, whether beneficial or not, emerge with age and long term use of alcohol. The effect of age was prominent in the model for all respondents and that for respondents 40 years of age or more. Respondents under the age of 40 tended to report good health and those classified as abstainers or self-classifying as non-drinkers had the highest average ratings. Those reporting not drinking in the past year and classified as immoderate drinkers had somewhat lower ratings. Similarly, usual drinks per session was most strongly associated with reported health for those under 40 after controlling for smoking. The differences were not as great as those found among respondents over 40. If the general impression of drinking among those under 40 years of age is consistent with the health ratings, it might seem as though drinking does not do any great harm, and that moderation does not confer any great benefit. While this is obviously not the case, it may provide some insight into the motivation to drink at that time of life. The short term effects of immoderate drinking appear to become more aversive with increasing age (Thumin & Wims, 1975) and probably influence the trend toward moderate drinking. The increasing responsibilities of adult life are also important factors (Bachman, O'Malley & Johnston., 1984).

4.3 Non-drinkers, ex-drinkers and abstainers

The results to be discussed are drawn from a cross-sectional survey and so are not directly comparable to similar results obtained from longitudinal studies. Nevertheless, these results afford a comparison between subjective and objective measures of health and drinking pattern. The differences in drinking pattern between self-classification and classification by reported average drinking per session are particularly interesting.

Overall, those respondents indicating that they had not had a drink in the past year were the least healthy of the groups defined by their reports of drinking. Among those respondents 40 or over, they consistently reported the worst health ratings, and except for cancer in females and hypertension in males were the most likely to be classified as cases. Are these all "sick quitters"? The self-classifications argue otherwise, as only ten percent identify as "ex-drinkers", with 83% claiming to be "non-drinkers".

Identifying as an "ex-drinker" was also associated with reporting worse overall health and being more likely to report Type II diabetes or heart disease among those over 40. While the greatest number (173) of those identifying as an ex-drinker also reported not drinking during the past year, about half that number (84) were divided among the respondents classified as "moderate" or "immoderate" drinkers.

The definition of an abstainer is particularly relevant to the "abstainer error hypothesis" (AEH - Fillmore et al., 2006), as that model asserts that the aggregated health of abstainers is reduced if occasional drinkers or ex-drinkers are included in the abstainer category. Comparing the analyses in which the two definitions of abstainer were used, the stricter definition that excluded almost all respondents who self-classified as other than "non-drinker" led to lower ratings of overall health. The analyses of specific diseases provide an even more striking comparison, as males classified as abstainers with the less strict definition fare better in each disease type, particularly heart disease. The AEH predicts that the stricter definition of abstention should lead to higher ratings of health and lower proportions of disease cases. An implicit assumption of the AEH is that occasional drinkers are less healthy than abstainers, yet those over 40 years of age identifying themselves as occasional drinkers report better health than abstainers and are less likely to report Type II diabetes or heart disease and no more likely to report hypertension.

4.4 Drinkers

As previously noted, respondents under the age of 40 reported decreasing health with increasing drinking, with usual number of drinks per session most closely associated with reported health. Among respondents over 40 years of age, moderate drinkers reported the highest general health ratings. Using the self-classifications, those identifying as occasional, light and social drinkers have the highest ratings. The proportions of Type II diabetes and heart disease cases are lower for all types of current drinkers. Hypertension increases slowly in males with increasing consumption, but appears to decrease in females, a sex-related difference that has previously been observed (Klatsky & Gunderson, 2008). All cancers showed little relationship to drinking, having a strong relationship to sex of respondent among those under the age of 40 years, and age among those over 40.

4.5 Consistent factors in reported health and disease occurrence

The measure of drinking most consistently associated with lower reported health and occurrence of Type II diabetes, heart disease and hypertension in respondents under the age or 40 was usual drinks per session. Figures 4a, 5a and 6a show that abstainers or those not drinking in the past year accounted for a substantial proportion of the small number of disease cases reported by the younger respondents. For those under 40, it seems that the amount consumed in the less frequent drinking sessions is the

most important determinant of perceived health and the onset of some diseases.

Sex differences in reported health and specific diseases emerged among the respondents 40 years of age and over. Females reported better health and lower proportions of disease cases except for cancers. The moderate, regular drinking score (MODREG) joined the usual number of drinks per session as a predictor of reported health, Type II diabetes and hypertension. Age appeared or became a more important component of the models.

4.6 Alternative explanations for the benefits of moderate drinking

The consistent association of moderate drinking and health has aroused a great deal of debate about the mechanisms underlying this. The objection that misclassification of drinkers as abstainers is responsible has arisen twice, first as the "sick quitter" model (Shaper, Wannamethee & Walker, 1988) in which ex-drinkers who carry the cumulative damage of their alcohol consumption are responsible for the apparently worse health of abstainers. While ex-drinkers are certainly less healthy than abstainers, a large number of studies have applied stringent definitions of abstention and still found protective effects. Using the present data and removing every abstainer who self-classified as other than a non-drinker resulted in a very slightly worse mean health rating for abstainers. More recently the AEH (Fillmore et al., 2006) proposed that occasional drinkers who were classified as abstainers accounted for the benefits. This implies that occasional drinkers have worse health outcomes than abstainers, yet in most studies that distinguish the two and in the present data, occasional drinkers report better health and fewer alcohol-related diseases excepting cancer than abstainers.

Large sample studies have provided the bulk of the evidence in support of the health benefits of alcohol. In such studies, the information gathered about each participant is usually less complete than with smaller samples. This has led to the criticism that the apparent health benefits are an artifact of measurement error. In particular, the "sick quitter" model (Shaper, Wannamethee & Walker, 1988) and the "abstainer error hypothesis" (AEH; Fillmore et al., 2006) argue that misclassification of ex-drinkers and occasional drinkers respectively as abstainers is responsible for the apparent health benefits. Subsequent tests have not confirmed these criticisms (McIntosh, 2008), and both find their greatest support in the British Regional Heart Study, a cohort of middle-aged British men recruited at doctors' surgeries (Wannamethee & Shaper, 1998). Perhaps the most obvious problem with the "sick quitter" model is that the typical changes in drinking due to perceived or actual ill health are reduction rather than abstinence (Kaner et al., 2007; Kerr, Fillmore & Bostrom, 2002). Thus the "sick reducers" would affect the overall health of the more moderate drinking categories. The proportion of "sick reducers" to "sick quitters" is thus of considerable interest. The AEH also relies upon the assumption that occasional drinkers are less healthy than abstainers which, as discussed above, is generally not the case.

It has often been observed that moderate drinkers tend to have better diets, exercise more and are less likely to have a range of risk factors for cardiovascular disease (Naimi et al., 2005). Does this mean that moderate drinking is just one part of a "healthy lifestyle" that accounts for the better health? A recent test of this conjecture found that the cardioprotective benefits of alcohol were most evident among those with less healthy habits (Britton, Marmot & Shipley, 2008), arguing that the protective effect of moderate drinking is not dependent upon concurrent healthy habits (Mukamal, Chiuve & Rimm, 2006).

4.7 The reasoned abstainer

One plausible explanation might be called the "reasoned abstainer" model, in which individuals who are diagnosed with, or suspect the existence of, disorders that would be adversely affected by alcohol avoid drinking. Individuals with low activity aldehyde dehydrogenase (ALDH2) are not only troubled by the aversive consequences of drinking, but may be at greater risk of disorders related to chronic exposure to aldehydes produced in the metabolism of alcohol (Hashibe et al., 2008). Similarly, those with essential hypertension are routinely advised to avoid alcohol (Kotchen, 2008). Those who follow such advice are genuine abstainers but are at greater risk of negative health outcomes from their existing conditions. The notion that lifetime abstention or extremely limited drinking could result from such a decision has been suggested for some time (Wiley & Camacho, 1980, Wannamethee & Shaper, 1997), but explicit tests of this are not evident. Cryer et al. (2001) looked at the relationship of medical service utilization to drinking, but did not verify that the clusters of individuals with high service utilization actually contained "sick quitters". Baumeister et al. (2006) also used service utilization as an outcome and concluded that "last year" abstainers had more risk factors for chronic diseases than drinkers. Again, it is uncertain to what extent the increased burden of disease among abstainers was due to previous drinking. Huth et al. (2007) identified 113 "teetotalers" (defined as drinking at most one alcoholic drink per month) in a larger sample of participants in a study of risk factors for chronic conditions and divided these into lifetime abstainers and non-lifetime abstainers who had ceased drinking more regularly. Lifetime abstainers tended to attribute their decision to dislike, lack of interest in or adverse consequences of alcohol, whereas non-lifetime abstainers were more likely to report health concerns, whether these were the result of alcohol consumption or not. However, half of the non-lifetime abstainers that were characterized as "sick quitters" had decided to abstain due to "concerns among those with existing health problems" (p7), with a further 30% citing "adverse consequences from drinking (such as headache or nausea)" (p7). In the absence of the ability to identify individuals whose decision to abstain was based upon knowledge or suspicion of a disease condition, reasoned abstainers might well contribute to the apparent benefits of moderate drinking.

4.8 Possible mechanisms for the benefits of moderate drinking

Alcohol has been shown to produce a number of physiological changes associated with reduced risk of disease. Beneficial changes in lipid metabolism (Rimm et al., 1999), thrombogenic factors (Renaud & Ruf, 1996), inflammatory response (Stewart, 2002) and aldehyde metabolism (Al Abed et al., 1999) have been linked to the cardioprotective effects of moderate drinking. Increasing quantity and decreasing regularity of consumption rapidly abolish these benefits (Klatsky, Friedman & Sieglaub, 1981). This suggests that there is an optimal level of consumption that probably varies between individuals, similar to other dietary components like vitamin A (Penniston & Tanumihardjo, 2006) and sodium chloride (Council, 1989).

Even if alcohol causes no beneficial changes directly, it is possible that physiologic changes due to alcohol lead to improved health. The "hygiene hypothesis" of the increasing frequency of atopy in developed countries proposes that conditions like asthma become more prevalent because of reduced exposure to allergens and infections (Chinen & Shearer, 2008). Animal models have shown that alcohol exposure can reduce the damage due to cardiac ischemia by increasing the activity of ALDH2 (Chen et al., 2008). This might promote better survival from myocardial infarction.

4.9 Conclusions

The analysis of the 2007 NDSHS data relating to alcohol and health has produced results very similar to those of cohort studies. As important measures like drinker classification and drinking pattern could be drawn from more than one set of data items, it was possible to assess reliability by comparing the results of different calculations. In every case, these converged to very similar outcomes.

For those respondents less than 40 years of age, the quantity drunk per session was the most consistent predictor of reported health if those respondents not drinking in the past year are excluded. Abstainers report the best health among these respondents. However, abstainers and those respondents not drinking in the past year report Type II diabetes, heart disease and hypertension more frequently than drinkers. This is consistent with the model of reasoned abstention due to early onset illness.

Moderate, regular drinking is associated with better reported health and lower prevalence of Type II diabetes and heart disease among those respondents 40 years of age or more. Females in that age group who currently drink also appear to have lower prevalence of hypertension, while males show a steady increase in the prevalence of hypertension with increasing current drinking. An interpretable relationship of drinking to all cancers examined was not evident, probably due to the small numbers of cancers reported by the respondents.

The question of whether respondents who drank more heavily when young are responsible for the

worse reported health of older non-drinkers who have ceased drinking cannot be conclusively answered with the use of cross-sectional data. However, the fact that the reported health of strictly defined abstainers showed the same pattern does not support this conjecture.

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