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GENDER DIFFERENCES IN THE RELATIONSHIP BETWEEN ALCOHOL CONSUMPTION AND DRINK PROBLEMS ARE LARGELY ACCOUNTED FOR BY BODY WATER

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Abstract — It is widely reported that women drink less and have a lower prevalence of drink problems than men, but the gender differences in the relationship between level of drinking and drink problems have rarely been investigated quantitatively. This paper reports results from the Medical Research Council National Survey of Health and Development (the 1946 British Cohort) when the subjects were 43 years old. Using 7-day recall for alcohol consumption and CAGE scores of 2, 3 or 4 for drink problems, it was found that the prevalence of drink problems increased with level of alcohol consumption. Women were more likely than men to report drink problems at the same level of alcohol consumption. However, this gender difference was largely accounted for by individual differences in weight of body water. Beer accounted for the excess of men's drinking over women's and the proportion of alcohol consumed as beer was inversely related to drink problems. Eighty per cent of women and 52% of men who had drink problems in the past year reported drinking less than an average of 3 U (women) or 4 U (men) a day in the past week. As drinking levels in women begin to approach those in men, rates of drink problems in women are likely to overtake those in men because of women's greater physiological sensitivity to the effects of alcohol.

INTRODUCTION

Alcohol consumption has become much more commonplace among women in western industrialized countries in recent years and there has been a rise in the rates of alcohol-related problems in women (Royal College of Psychiatrists, 1986; Plant, 1997). The General Household Survey provides evidence that women's drinking was increasing up to 1996, while men's stayed on a plateau (Office of National Statistics, 1998). Therefore understanding the risk factors for drink problems in women is a growing concern.

The CAGE questionnaire (Ewing, 1984) was developed as a screening device for alcoholism in clinical settings in which it has been tested almost entirely on men. More recently, it has been increasingly used in community surveys, in which it is used to indicate drink problems. For practical reasons, the CAGE has rarely been validated against clinical diagnosis in the general population, because the low prevalence of alcohol dependence means that large samples are required to provide accurate estimates. Such external validation has been undertaken by Chan *et al.* (1994) in a selective sample, but the results were only reported for men and women combined. A practical approach is to examine the relationship of the CAGE with level of alcohol consumption. The CAGE has been shown to have high sensitivity and specificity as a screen for at-risk drinking (in excess of 8 drinks daily) in a general practice sample (King, 1986), but again, perhaps because of the small numbers, the results were not reported by gender. Community surveys using the CAGE all report lower rates of drink problems in women than in men, a result which is not surprising, since women are also reported to drink less than men. For this reason, the gender difference in the relationship between level of consumption and drink problems has not often been investigated, but dismissed with the comment that

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the lower drink problems in women compared to men are a consequence of their lower consumption (Smart *et al.*, 1991; Chan *et al.*, 1994). In other words, it is assumed that the probability of having a drink problem at a given level of consumption is the same for men and for women.

On the other hand, biological evidence suggests that women are more sensitive to the physiological effects of alcohol than men. It has long been recognized that a given dose of alcohol results in a higher blood-alcohol level (BAL) in women than in men and it is thought that this is one reason why women suffer more physical harm from drinking the same amount of alcohol as men. The risk of liver cirrhosis, a disease which is predominantly attributable to alcohol (Pequignot *et al.*, 1978), has been shown to be greater for women than men in relation to alcohol consumption (Tuyns *et al.*, 1983). Possible mechanisms to explain the gender difference in BAL include gender differences in the metabolism of alcohol, the interaction of alcohol dehydrogenase (ADH) with female sex hormones, decreased 'first-pass' metabolism in women because of lower levels of gastric ADH, and more rapid metabolism of alcohol in the liver by women (Thomasson, 1995). However, the only biological difference consistently related to peak BAL, and readily measurable, is body water (Graham *et al.*, 1998). Women have, on average, a lower volume of body water than men, because of their lower weight and also because a lower proportion of their weight is lean. The lower volume of body water in women gives them a smaller volume for distribution of alcohol than men, which may account for their higher BAL at comparable quantities of alcohol consumed. Whilst this factor has been used to explain gender differences in general, individual body water has not hitherto been adjusted for in a general population study.

This paper examines gender differences in the prevalence of reported drink problems, as measured by the CAGE questionnaire, at given levels of consumption for a sample of the British population aged 43 years in 1989. It addresses two main questions: (1) is the probability of reporting drink problems at a given level of consumption the same for men and women? and (2) if there is a gender difference in the relationship between alcohol consumption and reported drink problems, how is this affected by adjusting for individual estimates of body water?

METHODS

Subjects

The Medical Research Council National Survey of Health and Development (NSHD) is a follow-up of legitimate, single births to all wives of non-manual and agricultural workers and to one in four wives of manual workers in England, Wales or Scotland during the week 3–9 March 1946, a sample of 5362 births (Wadsworth, 1991). The cohort has been studied throughout childhood and adult life at 19 contacts, the last being an interview by trained nurses in 1989 when the study members were aged 43 years. At this time, 3262 (85%) of the 3854 with whom contact was attempted were interviewed, four (0.1%) had died, 11 (0.3%) were living abroad, 106 (2.7%) were permanent refusals, 195 (5.1%) temporarily refused because of personal or family problems, and 276 (7.2%) could not be traced. Of the 1508 of the birth sample whom there was no attempt to contact, 361 (24%) had died, 607 (40%) were living abroad, and 540 (36%) had permanently refused to take part at a previous contact (Wadsworth *et al.*, 1992). Excluding study members who were living abroad, whom the survey did not intend to represent, and those who had died, 74.5% (3262/4379) of those in the birth cohort who were still alive and resident in England, Wales or Scotland were interviewed at the age of 43 years.

Measures

At the interview in 1989, a self-completion questionnaire was completed by the study members containing questions about alcohol consumption and the CAGE questionnaire (Ewing, 1984).

The four CAGE questions, each with yes/no response options are as follows: (1) Have you ever felt you ought to *Cut down on* your drinking? (do not include dieting); (2) have people ever *Annoyed* you by criticizing your drinking?; (3) have you ever felt bad or *Guilty* about your drinking?; (4) have you ever had a drink first thing in the morning to steady your nerves or to get rid of a hangover? (*Eye-opener*).

The questions were asked of lifetime experience of such problems and where the answer to a question was 'yes', study members were asked whether they had experienced this 'in the last year'. Answers relating to the previous year were used in this analysis. The CAGE score is defined as the number of affirmative answers to these questions, ranging

from 0 to 4. Subjects with CAGE scores of 2, 3 or 4 are referred to as those having drink problems.

Consumption of alcohol was based on responses to the question 'in the last 7 days how many of the following drinks have you had?' Three categories of drink were differentiated: spirits (measures of spirits or liqueurs), wine (glasses of wine, sherry, Martini or port), and beer (half pints of beer, larger, cider or stout). Thus the quantities reported were approximately equivalent to units of alcohol. The total number of drinks was used as the measure of consumption of alcohol (U) in the past week, and this total was multiplied by 8 to give alcohol consumption in grams (Royal College of Physicians, 1996). Of the 3262 study members interviewed, over 97% (3169) answered the CAGE questions and the questions on consumption in the past week. Since the interviews took place from May 1989 to August 1990 the 7-day recall of the total sample included weeks throughout the year. However, the interviews were not equally distributed throughout the year, most (91.3%) having been conducted from June to November, and very few (0.6%) of the recalled weeks included the Christmas to New Year period when consumption may have been higher than usual.

Standing height and body weight were measured by the trained nurse interviewers (Braddon *et al.*, 1986; Kuh *et al.*, 1993). Body water weight of an individual was estimated using body weight (w in kg) and body mass index [BMI calculated as weight (kg) divided by the square of height (m)] using a standard method recommended by the Royal College of Physicians (Williams *et al.*, 1983). This assumes that body water weight is 73% of fat-free weight and the proportion of body weight which is fat is estimated from BMI using gender specific equations. Thus:

$$\text{for men: body water} = 0.73w\,(1 - (\text{BMI} \times 1.28 - 10.13)/100)$$

$$\text{for women: body water} = 0.73w\,(1 - (\text{BMI} \times 1.48 - 7.0)/100)$$

Statistical methods

The gender difference in the probability of having drink problems controlling for alcohol consumption (g), alcohol consumption in relation to body water (g alcohol/kg body water) and the proportion of alcohol consumed as beer was modelled using logistic regression analysis using SPSS V 6.4. Since the distribution of alcohol consumption was highly positively skewed, the logarithmic transformation was applied and people who reported consuming no alcohol in the previous week were excluded from this analysis. Descriptive statistics and analyses were repeated using weighting to compensate for the differential sampling across social class groups used in the survey. The results were consistent with the unweighted results reported here.

RESULTS

Distribution of alcohol consumption and CAGE scores by gender

The distribution of alcohol consumption was highly positively skewed for men and women, with most subjects reporting no or very low levels of drinking and a few very high quantities. Table 1 shows that the average consumption for men was three times that of women (13.9 and 4.5 U, respectively). The difference in mean consumption reflects the fact that some men drank much more than women (maximum consumption 132 U for men and 60 U for women), but also that a smaller proportion of men than women drank at low levels. About half as many men as women reported drinking no alcohol (14.2 vs 29.5%) and among those who reported drinking any alcohol, men drank more on average than women (16.2 vs 6.4 U). The difference between the genders increased with the level of consumption. For example, about five times the proportion of men compared to women

Table 1. Reported units of alcohol consumed in the last 7 days by gender

Alcohol consumed in the last 7 days (U)	Male n = 1597[a]	Female n = 1572[a]
Range	0–132	0–60
Mean (SD)	13.9 (16.0)	4.5 (6.1)
Mean (SD) >0 U	16.2 (16.1)	6.4 (6.4)
% 0 U	14.0	29.5
% 1–6 U	26.6	45.7
% 7–13 U	22.7	17.0
% 14–20 U	15.3	5.2
% 21–27 U	7.0	1.4
% 28+ U	14.4	1.3

[a]This table excludes four men and two women who had no CAGE score, each of whom reported consuming 0 U.

Table 2. Proportion of men and women by CAGE score

CAGE 'last year' score	Male $n = 1597$[a]	Female $n = 1572$[b]
0	73.7	88.3
1	15.2	6.2
2	7.6	4.3
3	3.1	1.0
4	0.3	0.2
>1	11.1	5.5

[a]This table excludes seven men and 18 women who did not report their alcohol consumption. Of these one man (14.3%) and one woman (5.6%) had a CAGE score of 2, the rest had a CAGE score of 0.

drank more than 14 U (33.2 vs 6.1%), whilst eight times the proportion of men compared to women drank more than 21 U in the week (20.4 vs 2.6%). More than three times as many men as women drank more than the recommended gender-specific limits of 21 and 14 U respectively (20.4 vs 6.1%). Fewer women than men responded positively to the CAGE questions asking about drink problems in the last year (Table 2). The prevalence of CAGE scores greater than 1 was 11.1% for men and 5.5% for women.

Alcohol consumption and CAGE scores

Figure 1 illustrates the level of alcohol consumption in the past 7 days within each CAGE score for men and women. For both men and women, average consumption of alcohol increased as the CAGE score increased from 0 to 3, but decreased at CAGE 4, although the numbers of cases in this category were too low to draw any firm conclusion. Women who reported having drink problems had lower average consumption than men and the excess of male drinking over that of women at each CAGE score was accounted for by their consumption of beer.

CAGE scores by level of consumption

Table 3 shows the proportion of men and women who had CAGE scores greater than 1, referred to below as having drink problems. As expected, the proportion of subjects with drink problems increased with the level of alcohol consumption. However, even light drinkers (those consuming less than 7 U of alcohol/week) reported having drink problems. Although this was no more true of women than men, there were more light drinkers amongst women with drink problems (as seen in Fig. 1), because many more women than men were light drinkers. At levels above light drinking, the prevalence of drink problems was greater for women than for men, but since many more men drank at higher levels than women, there were more excessive drinkers among men with drink problems. The results given in Table 3 also indicate that the prevalence of reported drink problems at a given level of consumption was not the same for men and women.

Modelling gender differences in the probability of drink problems at given levels of consumption

The difference between the genders, taking into account individual differences in body water, was quantified by a logistic regression analysis and is

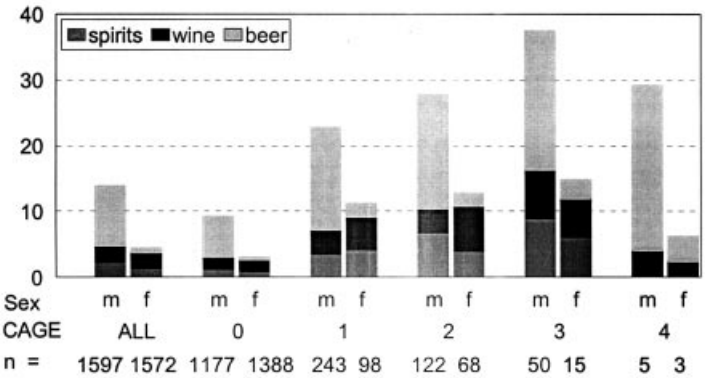

Fig. 1. Mean units of different types of alcoholic drink by gender and CAGE score.

Table 3. Proportion of men and women with drink problems by level of alcohol consumption

Alcohol consumed in last 7 days (U)	Male			Female		
	Total	CAGE>1 (*n*)	CAGE>1 (%)	Total	CAGE>1 (*n*)	CAGE>1 (%)
0	223	7	3.1	463	6	1.3
1–6	425	10	2.4	718	13	1.8
7–13	363	23	6.3	267	32	12.0
14–20	244	30	12.3	82	18	22.0
21–27	112	22	19.6	22	7	31.8
28+	230	85	37.0	20	10	50.0
All	1597	177	11.1	1572	86	5.5

Table 4. Odds ratios (OR) of drink problems (CAGE>1) in women compared to men

Factors adjusted for	OR female vs male	95% confidence interval	(*P*) Significance
	0.55	(0.42, 0.73)	<0.0001
Alcohol consumption (g alcohol)	1.88	(1.34, 2.64)	0.0002
Alcohol consumption in relation to body water (g alcohol/kg body water)	1.24	(0.91, 1.70)	0.1788
Alcohol consumption in relation to body water and percentage of alcohol consumption as beer	0.99	(0.69, 1.43)	0.9563

summarized in Table 4. Women were less likely than men to report drink problems [odds ratio, OR 0.55 (0.42,0.73)], but at the same level of alcohol consumption women were significantly more likely to report problems than men [OR 1.88 (1.34,2.64)].

Since a gender difference was observed, the second question posed by our study was investigated. The difference between the genders, taking into account individual differences in body water, was quantified by a logistic regression analysis, and this is also summarized in Table 4. The estimated mean weights of body water for men and women were 43.9 and 33.0 kg respectively. Thus the estimated ratio of average BAL in the survey women compared to men resulting from the same dose of alcohol was 4 : 3 (1.33 = 43.9/33.0). After adjustment for alcohol consumption relative to body water (g alcohol/kg body water), the greater likelihood of women compared to men reporting drink problems was attenuated [OR 1.24 (0.91, 1.70)]. Although the difference between men and women was no longer statistically significant at the 5% level, on average women were still more likely than men to report drink problems at the same level of consumption relative to their body water. Since the excessive consumption of alcohol by men compared to women was largely accounted for by beer drinking, it was possible that the amount of beer men drank contributed relatively less to their drink problems than the amount of wine or spirits. This was confirmed by also controlling for the percentage of alcohol drunk as beer. The probability of drink problems decreased as the proportion of beer drunk increased. After adjustment for this factor, as well as total consumption relative to body water, women were as likely as men to report drink problems [OR 0.99 (0.69,1.43)].

DISCUSSION

In a sample of the native British population born in the early post-war years, both reported alcohol consumption and drink problems were lower for women than men at the age of 43 years. However, the rate of drink problems in women was higher than would be expected on the basis of their overall consumption. Men reported drinking three times as many units of alcohol as women, yet only twice as many men as women had drink problems. The higher than expected rate of drinking problems in

women is not accounted for by the distribution of alcohol consumption, since the higher the drinking level the more men outnumber women. The probability of having drink problems increased with the level of consumption and was significantly greater for women than men who drank the same amount. Much of this gender difference could be accounted for (statistically) by a simple physical factor — the variation in the amount of body water. We also found that the probability of having drink problems decreased with the increase in the proportion of alcohol that was consumed as beer, and when this factor was adjusted for, in addition to alcohol consumption relative to the amount of body water, there were no gender differences in the probability of reporting drink problems.

The results for consumption and CAGE score were compared to those found in the Health and Lifestyle Survey of 1991/2 (HALS2) (Whichelow, 1993), since, of all the British surveys, its methods of data collection were closest to those used in the NSHD. Whichelow (1993) reported that in the age range 39–45 years, the mean consumption of alcohol in the past 7 days was 18.3 for men and 4.0 for women, whilst the corresponding proportions of CAGE scores 2–4 were 18 and 8% for lifetime experience (compared with 15.4 and 7.7% in our study). Our results at age 43 years are consistent with those for HALS2, especially if we take into account the decline in consumption and CAGE scores in mid-life, which is found particularly in men. The ratio of average BAL in women compared to men resulting from the same dose of alcohol (4 : 3) in our study is very close to that reported by Eriksson (1998) of an average of 30% higher BAL in women compared to men based on a Swedish population.

The models excluded those who reported drinking no alcohol in the previous week. The indications are that the prevalence of drink problems for those in this category, as well as those who reported light drinking, was no greater for women than men, a result in agreement with research in the Netherlands (Bongers *et al.*, 1998). Although the numbers of study members who answered all four CAGE questions affirmatively are too small to draw any firm conclusions, the fact that a high proportion reported drinking no alcohol in the previous week and those who did tended to drink more beer and less spirits indicates that some of these people may have been in the process of cutting down on their alcohol. This is consistent with results reported by Dent *et al.* (1995) that the CAGE questionnaire identifies people who not only have drink problems but are ready to make changes to combat them; that is, they are more likely to be in the contemplation and action phases identified in models of change (Prochaska and DiClemente, 1988).

Our findings suggest that the gender differences in reported drink problems relative to drinking levels can be accounted for mainly by physiological factors. This is not to deny that the development of drink problems is a complex process depending on psychological and social factors as well as the physiological effects of alcohol itself. The analysis presented here does not purport to explain why men or women develop drink problems. The first three CAGE questions relate to psychological problems with drinking, and only the last ('eye-opener') relates to physical dependency. Individuals' experiences of psychological problems with drinking will depend not only on their drinking behaviour but also on the social context and psychological function of their drinking. Our findings show that there is a wide variation in the level of consumption associated with drink problems and that drink problems are present even among light drinkers. Some of this variation is attributable to the fact that consumption refers to the past 7 days only, whereas the CAGE questions refer to the past year; the variability in consumption during the past 7 days will be greater than in average consumption over the past year.

Our first model showed that, at the same level of consumption, women were more likely than men to have drink problems. This is consistent with the belief that women are more susceptible to both the physiological effects and the psycho-social effects of drinking: that women who drink the same amount tend to experience more psychological problems with their drinking than men because of greater social stigma (Bongers *et al.*, 1998). We tried to ascertain the relative importance of the physical effects of alcohol itself and the psycho-social effects of drinking on drink problems measured by the CAGE. The second model showed that the difference between men and women in response to CAGE was attenuated (to a non-significant level) by adjusting for body water. In this study, we have not been able to take into account gender differences in the metabolism of alcohol. Reports of gender

differences in liver metabolism rates of alcohol have shown inconsistent results (Graham *et al.*, 1998). While sex hormone interaction with ADH has been found to make female animals more susceptible to liver disease, this is difficult to test in humans (Thomasson, 1995). Gastric ADH activity is lower in women but decreases with age in men, so that gender differences are found only in younger people (Seitz and Poschl, 1997). Therefore gender differences in gastric ADH activity are unlikely to be relevant to our subjects who are in mid-life. The fact that several studies have shown that adjusting alcohol dosage for total body water eliminates gender differences in peak BAL (Graham *et al.*, 1998) supports our use of body water alone to adjust for physiological gender differences. If this is accepted, then psychological or social factors either make a relatively minor contribution to the gender difference or are important but tend to cancel each other out. For example, women may feel more guilty about their drinking than men, be more health conscious or more religious, but may also be more reluctant to admit to drink problems because of social stigma. Such psychological and social differences between men and women may be age-dependent and only reduced in mid-life when women are less likely to have responsibility for young children and men tend to be more staid than in their younger years.

The crudeness of the measures of alcohol consumption and drink problems can be balanced against the high response rate among those who were interviewed (97%). In this longitudinal survey, attrition makes a greater contribution to missing values than non-response to the questions about drinking. The high contact rate in relation to the birth cohort who were still alive and resident in England, Wales or Scotland (74.5%) may be attributed to the annual contact by way of birthday cards and the fact that the interview was conducted in the person's home. Although this contact rate is high in comparison with surveys of drinking in the general population (for example 44.2% in the study by Bongers *et al.*, 1998), it is important to consider the effect of attrition on the results reported here. The homeless could not be traced and interviewed and heavy drinking is associated with homelessness (Bines, 1994). Also refusal to be interviewed may be associated with heavy drinking and alcohol consumption is generally under-reported. Hence our estimates of drinking level and CAGE positive scores are likely to under-estimate the level in the native population. However, this would result in bias in our study of gender differences only if women were more or less likely than men to have drink problems at a given level of consumption among those who were not contacted or refused to be interviewed compared with those who were interviewed.

The CAGE questionnaire is widely used in general population surveys in Britain, including the Health and Lifestyle Survey, National Child Development Study, and the Health Surveys for England. In this paper, we have used the term 'drink problems' as a synonym for CAGE scores of 2 or more, in consensus with the literature reporting results from these surveys (Hedges, 1997; Richards *et al.*, 1997; Hope *et al.*, 1998). The usefulness of CAGE as an indicator of drink problems has been generally inferred from its validity as a screening tool for alcoholism in clinical populations. The indications are that it has lower sensitivity for alcohol dependency or abuse (DSM-III-R) in general populations compared to clinical ones (Chan *et al.*, 1994) and in women, compared to men in clinical populations (Bradley *et al.*, 1998), but not lower specificity. Our finding of a positive relationship between drinking level and CAGE scores, which is similar in men and women once body water is taken into account, goes some way towards validating the use of the CAGE in general population surveys in Britain.

Our findings imply that studies of alcohol problems should allow for a gender-specific level of consumption. They provide an empirical basis for the equivalent levels based on the ratio of 3 : 4 average body water in women, compared to men. These results are consistent with the gender ratio of sensible limits currently advised by the UK Government. However, our data are not supportive of the level of 'safe drinking', which for women is 3 U daily (Health Education Authority, 1996) if this is interpreted as 21 U a week, as it has been by the media and some medical experts (Wright and Cameron, 1997). We found that four out of five women (69/86) who had drink problems in the past year reported drinking less than this quantity in the previous week, whilst over half of men (92/177) with drink problems reported drinking less than 28 U. It may be that some of these people had drink problems previously in the year, but were in the process of cutting down their consumption in the past week.

The recommendation of the Department of Health (1995) report that advice on sensible drinking levels should be cast in daily rather than weekly terms draws attention to a major limitation of our study. Using weekly recall as a measure of consumption precluded taking into account patterns of drinking, and these are important in determining the physiological effects of alcohol (Royal College of Psychiatrists, 1986). The physiological effect of consuming 21 U on one occasion would be very different from that of consuming 3 U daily throughout the week. Nor could we take into account whether the drink was taken with a meal, the pace of drinking or the use of non-standard measures or concentration of alcohol, all of which affect BAL and may be different in men and women (Graham *et al*., 1998). However, we were able to take into account gender differences in beverage preference. Men drank substantially greater quantities of beer than women, but the amount of beer drunk was relatively less important than the amount of wines or spirits as a predictor of reported drink problems. There may be some physical basis for this finding, since the alcohol in beer is less concentrated than in wines or spirits and it is absorbed more slowly, resulting in lower peak BAL (Royal College of Psychiatrists, 1986). On the other hand, social attitudes provide an equally feasible explanation. Since beer consumption is so common and socially acceptable among men, drinking large quantities of it is accepted by many as the norm.

The greater social acceptance of drinking in men compared to women may explain why fewer women than men drank excessively, even when physiologically equivalent alcohol levels are compared. For example, only 2.7% of women reported drinking 21 U or more, compared with 14.4% of men drinking at least 28 U. These findings relate to people in mid-life in 1989. Since the late 1980s, drinking amongst women, and particularly among the young, has increased at a greater pace than in men (Office of National Statistics, 1998). If drinking levels in women approach those of men, then we can expect that rates of drink problems amongst women will overtake those in men because of their physiological sensitivity to the effects of alcohol.

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REFERENCES

Bines, W. (1994) *The Health of Single Homeless People*. Centre for Housing Policy Discussion Paper, University of York.

Bongers, I. M. B., Van de Goor, L. A. M., Van Oers J. A. M. and Garretsen, H. F. L. (1998) Gender differences in alcohol-related problems: controlling for drinking behaviour. *Addiction* **93**, 411–421.

Braddon, F. E. M., Rodgers, B., Wadsworth, M. E. J. and Davies, J. M. C. (1986) Onset of obesity in a 36 year birth cohort study. *British Medical Journal* **293**, 299–303.

Bradley, K. A., Boyd-Wickizer J., Powell, S. H. and Burman, M. L. (1998) Alcohol screening questionnaires in women. *Journal of the American Medical Association* **280**, 166–171.

Chan, A. W., Pristach, E. A. and Welte, J. W. (1994) Detection by the CAGE of alcoholism or heavy drinking in primary care outpatients and the general population. *Journal of Substance Abuse* **6**, 123–135.

Dent, T. H., Shepherd, R. M., Alexander, G. J. and London, M. (1995) Do CAGE scores predict readiness to reduce alcohol consumption in medical in-patients? *Alcohol and Alcoholism* **30**, 577–580.

Department of Health (1995) *Sensible Drinking: The Report of an Interdepartmental Working Group*. Department of Health, London.

Eriksson, C. J. P. (1998) Alcohol and acetaldehyde metabolism in women and men. ESBRA 1997 Abstracts *Alcohol and Alcoholism* **33**, 322.

Ewing, J. A. (1984) Detecting alcoholism, the CAGE questionnaire. *Journal of the American Medical Association* **252**, 1905–1907.

Graham, K., Wilsnack, R., Dawson, D. and Vogeltanz, N. (1998) Should alcohol consumption measures be adjusted for gender differences? *Addiction* **93**, 1137–1147.

Health Education Authority (1996) *Think about Drink*. Health Education Authority, London.

Hedges, B. (1997) Alcohol consumption. In *Health Survey for England, 1995*, Colhoun, H. and Prescott-Clarke, P. eds, pp. 338–365. HMSO, London.

Hope, S., Power, C. and Rodgers, B. (1998) The relationship between parental separation in childhood and problem drinking in adulthood. *Addiction* **93**, 505–514.

King, M. (1986) At risk drinking among general practice attenders: validation of the CAGE questionnaire. *Psychological Medicine* **16**, 213–217.

Kuh, D. J. L., Coggan, D., Mann, S., Cooper, C. and Yusuf, E. (1993) Height, occupation and back pain in a national prospective study. *British Journal of Rheumatology* **32**, 911–916.

Office of National Statistics (1998) *Living in Britain 1996 General Household Survey*. HMSO, London.

Pequignot, G., Tuyns, A. J. and Berta, J. L. (1978) Ascitic cirrhosis in relation to alcohol consumption. *International Journal of Epidemiology* **7**, 113–120.

Plant, M. (1997) *Women and Alcohol: Contemporary and Historical Perspectives*. Free Association Books, London.

Prochaska, J. O. and DiClemente, C. C. (1988) Towards a comprehensive model of change. In *Treating Addictive Behaviours: Processes of Change*, Miller W. R. and Heather N. eds, pp. 3–27. Plenum Press, New York.

Richards, M., Hardy, R. and Wadsworth, M. E. J. (1997) The effects of divorce and separation on mental health in a national birth cohort. *Psychological Medicine* **27**, 1121–1128.

Royal College of Physicians (1996) *Preventing the Harm Related to Alcohol Use: Reducing Population Risk*. Guidelines for Health Promotion Number 46. Policy Office, Faculty of Public Health Medicine, London.

Royal College of Psychiatrists (1986) *Alcohol: Our Favourite Drug*. Tavistock Publications, London.

Seitz, H. K. and Poschl, G. (1997) The role of gastrointestinal factors in alcohol metabolism. *Alcohol and Alcoholism* **32**, 543–549.

Smart, R. G., Adalf, E. M. and Knoke, D. (1991) Use of the CAGE scale in a population survey of drinking. *Journal of Studies on Alcohol* **52**, 593–596.

Thomasson, H. R. (1995) Gender differences in alcohol metabolism: physiological responses to ethanol. In *Recent Developments in Alcoholism*, Vol. 12, Galanter, M. ed., pp. 163–179. Plenum Press, New York.

Tuyns, A. J., Pequignot, G. and Esteve, J. (1983) Greater risk of ascitic cirrhosis in females in relation to alcohol consumption. *International Journal of Epidemiology* **13**, 53–57.

Wadsworth, M. E. J. (1991) *The Imprint of Time: Childhood, History and Adult Life*. Clarendon Press, Oxford.

Wadsworth, M. E. J., Mann, S. L., Rodgers, B., Kuh, D. J. L., Hilder, W. S. and Yusuf, E. J. (1992) Loss and representiveness in a 43 year follow up of a national birth cohort. *Journal of Epidemiology and Community Health* **46**, 300–304.

Whichelow, M. J. (1993) Trends in alcohol consumption. In *The Health and Lifestyle Survey: Seven Years On*. Cox, B. D., Huppert, F. A. and Whichelow, M. J. eds, pp. 237–255. Dartmouth, Aldershot.

Williams, D., Skinner, R., Silverstone, J., Mann, J., Miller, D., Pyke, D., Garrow, J. S., Hockerday, T., Lewis, B., Pilkington, T., Black, D., James, W. P. T., Besser, G., Brook, C. and Graddock, D. (1983) Obesity: a report of the Royal College of Physicians. *Journal of the Royal College of Physicians* **17**, 5–65.

Wright, N. R. and Cameron D. (1997) A pilot study of prospectively recorded drinking patterns among British men who habitually drink 1–4 units of alcohol per day. *Alcohol and Alcoholism* **32**, 777–778.