Low-to-moderate alcohol intake and breast cancer risk in Chinese women

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BACKGROUND: Despite extensive investigation of the association between alcohol consumption and breast cancer risk, effect of low-to-moderate alcohol intake on breast cancer incidence has been inconsistent.

METHODS: A case–control study was conducted in China, 2004–2005 to examine the association by menopausal status, oestrogen (ER) and progesterone receptor (PR) status of the tumour. There were 1009 incident cases with histologically confirmed breast cancer and 1009 age-matched controls recruited. We assessed alcohol consumption by face-to-face interview using a validated questionnaire and obtained tumour ER and PR status from pathology reports.

RESULTS: Low-to-moderate alcohol consumption was inversely associated with breast cancer risk. Compared with nondrinkers, the adjusted odds ratios (ORs) for alcohol <5 g per day were 0.41 (95% confidence interval 0.27–0.62) and 0.62 (0.48–0.79) in postmenopausal and premenopausal women, respectively. The inverse association was consistent for alcohol <15 g per day across hormone receptor status groups with ORs of 0.36–0.56 in postmenopausal women and 0.57–0.64 in premenopausal women. An exception was that alcohol ≥15 g per day appeared to increase the risk of breast cancers with discordant receptor status in postmenopausal women, that is, ER+/PR– or ER–/PR+ (4.27, 1.57–11.65).

CONCLUSION: We found that low-to-moderate alcohol intake was not associated with increased risk of breast cancer in pre- or postmenopausal Chinese women. Future studies are required to understand differences in effect of alcohol on breast cancers by tumour hormone receptor status.

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Despite extensive research on the association between alcohol consumption and breast cancer risk, a consensus is not apparent, especially on the effect of low-to-moderate alcohol intake (Brown et al, 2010). Since a meta-analysis provided evidence for a dose-response relation, admittedly with a weak ascending slope, alcohol has been treated as a risk factor for breast cancer even at low-to-moderate daily intake levels (Longnecker, 1994). Alcohol consumption has been reported to be associated with higher risk of breast cancer incidence (Smith-Warner et al, 1998; Bagnardi et al, 2001; Terry et al, 2006). However, subsequent studies based on more detailed data on consumption habits have not consistently supported the finding, particularly in premenopausal women (Garland et al, 1999; Kinney et al, 2000; Kropp et al, 2001; Baumgartner et al, 2002; Nagata et al, 2007; Bessaoud and Daurès, 2008; Brown et al, 2010; Kabat et al, 2010). Thus, the effect of low-to-moderate alcohol intake on breast cancer risk remains contentious.

Little is known about the relationship between alcohol intake and breast cancer risk in Chinese women, a population that consumes alcohol at very low levels (WHO, 2004). WHO reported that the lifetime prevalence of abstainers was 61.2% and that only 2.1% of Chinese women consumed three or more standard drinks on a typical drinking day (WHO, 2004). There have been a few studies on alcohol consumption and breast cancer risk in Chinese women. One study in premenopausal Vietnamese and Chinese women reported that those who consumed alcohol had an increased risk of breast cancer compared with women who did not (Nichols et al, 2005). However, a recent study suggested that low alcohol intake was not related to increased breast cancer risk in Asian Americans including Chinese women (Brown et al, 2010).

Considering that alcohol consumption is one of the few modifiable factors associated with breast cancer risk, investigations to further clarify this issue are warranted. We conducted a case–control study in southeast China specifically to examine associations between alcohol intake, primarily low-to-moderate levels and breast cancer risk in the population using a validated questionnaire. The analyses were stratified according to pre- and postmenopausal status and the study also explored whether differences exist in the effect of alcohol according to oestrogen (ER) and progesterone receptor (PR) status of the tumour.

PARTICIPANTS AND METHODS

Study design and participants

A hospital-based case–control study of breast cancer risk was conducted in Hangzhou, the capital city of Zhejiang Province, during July 2004 and September 2005. All participants were
Chinese women resident in Zhejiang Province and aged between 20 and 87 years. Cases were identified from medical records in four teaching hospitals of the School of Medicine, Zhejiang University. All the participating hospitals were public hospitals with 500–2000 beds and received patients from all over the province. A total of 1009 female patients, who newly diagnosed with invasive ductal carcinomas or in situ carcinoma of the breast, were recruited to the study. All diagnoses were histopathologically confirmed after surgery. The diagnoses occurred no more than 1 year before the interview and there was no previous diagnosis of cancer at any site. The patients were excluded if breast cancer was neither the primary nor final diagnosis. All relevant hospital and laboratory pathology reports were reviewed daily to ensure the completion of recruitment. The proportion of lost or non-responding patients among the cases was 1.2%. Among 1009 cases recruited, we obtained information on ER status in 756 cases (74.9%) and PR status in 755 cases (74.8%) from pathology reports filed in the patients’ medical records of immunohistochemistry assays undertaken at the time of diagnosis. Oestrogen receptor levels obtained from the pathology reports referred to the α-subtype of the receptor.

During the same period of data collection, 1009 outpatients who remained healthy were selected consecutively in the participating hospitals as controls to match each case’s age within 5-year age groups, using a daily update of the list of cases after they had consulted their doctors. Each control was recruited as the first in the matched age group to attend the breast clinic for routine consultation. Each control was recruited as the first in their matched age group to attend the breast clinic for routine consultation and was asked to participate. The proportion of lost or non-responding patients among the controls was 98.7%. Potential control women were excluded if they had a diagnosis of any benign or neoplastic breast disease, or another malignant disease at the time of recruitment. The project received ethics clearance from both the Human Research Ethics Committee of The University of Western Australia and the Chinese hospital authorities.

Questionnaire and interview

Subjects were briefed regarding the general aims of the study to investigate lifestyle factors. An appointment for an interview was made after obtaining their consent at initial contact. A face-to-face interview was then conducted by trained staff using a structured questionnaire that usually took 40–50 min. The cases were interviewed in breast surgery wards and most of them (91.6%) within 3 months after diagnosis, while the controls were interviewed in the outpatient clinic of the same hospital. A validated and reliable questionnaire was used to collect the information on: (a) demographic and lifestyle characteristics, for example, residential area, education, weight and height, smoking, alcohol consumption, tea drinking, and physical activity; (b) habitual dietary intake assessed by a 100-item food frequency questionnaire (FFQ); and (c) factors relevant to hormonal status, including menstrual history and menopausal status, reproductive and lactation history, hormone replacement treatment, history of use of oral contraceptives, other factors relevant to hormonal status, benign proliferative breast disease and family history of breast cancer. After interview, anthropometric measurements were requested of all participants.

Alcohol consumption was assessed using the FFQ to measure three different types of alcoholic beverages, that is, beer, wine and liquor. The frequency of consumption was assigned to one of nine categories of never or hardly ever, once a month, 2–3 times a month, once a week, 2–3 times a week, 4–6 times a week, once a day, twice a day and ≥3 times a day. Information was also sought on quantities consumed of alcohol in ml. Standard drinking vessels used by Zhejiang residents were displayed during the interview to increase the accuracy of measurement. Alcohol consumption was based on a usual drinking pattern and a ‘reference’ recall period was set as 1 year before diagnosis in cases or interview in controls. If there was any recent change in habits or quitting drinking, information was sought on the respondent’s habits before the change and the year of quitting.

The questionnaire was adapted from that used in our previous studies on cancers (Zhang et al, 2002). The questionnaire was first pre-tested on 51 adult Chinese women who recently migrated to Perth, Australia, to assess the feasibility, face and content validity. The participants in the preliminary study reported their alcohol consumption when they were in China. The feedback from the participants indicated that they could estimate frequency and quantity of beer, wine and liquor consumed without difficulty. A test–retest study was then undertaken to assess the reliability of the questionnaire. Another sample of 41 Chinese women residing in Hangzhou was interviewed twice within 11.3 (s.d. 6.2) weeks (Zhang et al, 2005). No significant difference was found in alcohol consumption variables between the two interviews. Intraclass correlations ranged from 0.51 for wine intake to 0.87 for beer intake. The results, shown in Table 1, thus suggested that the questionnaire was a suitable and reproducible instrument to measure alcohol exposure for Chinese women.

Table I  Reliability assessment for alcohol intake in the test–retest study

| Alcohol intake (ml per day) | First interview Mean (s.d.) | Second interview Mean (s.d.) | Pearson correlation | Intraclass correlation |
|-----------------------------|-----------------------------|-----------------------------|-------------------|-----------------------|
| Beer                        | 0.15 (0.49)                 | 0.23 (0.81)                 | 0.98              | 0.87                  |
| Wine                        | 0.06 (0.21)                 | 0.11 (0.56)                 | 0.76              | 0.51                  |
| Liquor                      | 0.03 (0.11)                 | 0.02 (0.08)                 | 0.71              | 0.67                  |

Statistical analysis

All data were checked for completeness at the end of each interview. The data were coded and analysed using the SPSS version 17.0 (SPSS Inc., New York, NY, USA). Data collected by different interviewers were compared and we confirmed that no consistent difference in recording key variables, such as alcohol consumption, tea drinking and physical activity, occurred within cases or controls. The frequency and quantity variables derived from the FFQ were converted into daily intake (in ml) of beer, wine and liquor. Amounts of ethanol intake were calculated by assuming 10 g of ethanol per 285 ml of beer, per 100 ml of wine and per 30 ml of liquor based on a method used in a previous study (Kropp et al, 2001). Food consumption was adjusted for the edible portions of foods, cooking methods, seasonal factors and market availability (Whitemore et al, 1990). Total energy intake was estimated using Chinese Food Composition Tables (Institute of Nutrition and Food Hygiene, 1999). Intakes of folate in μg were calculated based on daily food consumption, using an updated version of the USDA nutrient database (USDA, 2007). The mean daily intakes of folate were tabulated separately for case and control groups. The quantitative variables of folate intake were divided into tertiles based on the corresponding empirical distribution in controls, with the low tertile being the reference category. Some category variables were defined as: a total of 20
 resultados

Selected demographic characteristics and lifestyle factors in cases with breast cancer and controls are compared in Table 2. Fewer breast cancer cases (33.1%) were current drinkers compared with controls (46.6%). Among current drinkers, the majority of participants (77% cases, 87% controls) consumed < 10 g daily, in contrast to 39 cases (12%) and 16 controls (3%) who consumed ≥ 30 g daily. Cases had less education and tea drinking, and more use of oral contraceptives. More of cases had a higher BMI at age 5-years ago, breast cancer in a first-degree relative and energy intake were estimated using unconditional logistic regression including the matching factors as covariates. Univariate analysis was undertaken to screen potential explanatory variables for subsequent multivariate analysis. In each analysis, effects of alcohol of different patterns and intake levels were assessed within current drinkers, excluding ex-drinkers (1.2% of participants), with abstainers who never drank alcohol as a reference group. We examined potential confounders of the alcohol effect through use of stratified analysis by menopausal status (premenopausal vs postmenopausal). Separate sub-analyses were conducted for each subtype of breast cancer (in situ and invasive). Each fitted regression equation was adjusted for age, education, BMI, oral contraceptive use, hormone replacement therapy, breast cancer in first-degree relatives, total energy intake, folate intake, tea drinking and menopausal status (only included the models for all women). These potential confounders were included in the models, because either they emerged as risk factors for breast cancer in previous studies (Kropp et al., 2001) or because we observed some evidence of potential confounding in our data set by comparisons of univariate and multivariate analyses (Zhang et al., 2007, 2009). The proportion of in situ carcinoma was only 2.2% of all breast cancer patients in the study, making it impracticable to study them separately. Therefore, the patients with in situ carcinomas and invasive breast cancer were combined to form a single case group in analyses.

Table 2 Selected characteristics of cases with and without breast cancer

| Age at interview (years) | Cases subjects (n = 1009) | Controls subjects (n = 1009) | P-value* |
|-------------------------|--------------------------|-----------------------------|---------|
| <25                     | 794 (78.7)               | 841 (83.3)                  | 0.06    |
| ≥25                     | 215 (21.3)               | 168 (16.7)                  |         |

**Abbreviation:** MET = metabolic equivalent task. *Two-sided, t-test for continuous variables and χ²-test for categorical variables. Values expressed as mean ± s.d. or number (percent).
Table 3  Association between alcohol consumption and breast cancer risk

| Alcohol consumption | No. cases/controls | OR (95% CI)* | P-value |
|---------------------|------------------|-------------|--------|
| All women           |                  |             |        |
| Abstainers          | 660/529          | 1.00b       |        |
| Ex-drinkers         | 15/10            | 1.34 (0.56–3.22) | 0.51 |
| Current drinkers    | 334/470          | 0.63 (0.52–0.76) | <0.001 |
| Premenopausal women |                  |             |        |
| Abstainers          | 416/332          | 1.00b       |        |
| Ex-drinkers         | 10/4             | 2.44 (0.71–8.39) | 0.16 |
| Current drinkers    | 246/335          | 0.66 (0.53–0.84) | 0.001 |
| Postmenopausal women|                |             |        |
| Abstainers          | 244/197          | 1.00b       |        |
| Ex-drinkers         | 5/6              | 0.68 (0.17–2.67) | 0.58 |
| Current drinkers    | 88/135           | 0.55 (0.38–0.78) | 0.001 |

Table 4  Combined effect of dietary folate intake and alcohol consumption on breast cancer risk

| Ethanol intake (g per day) | Folate intake (µg per day) | No. Cases/controls | OR (95% CI)* | P-value |
|---------------------------|---------------------------|-------------------|-------------|--------|
| Abstainers                |                            |                   |             |        |
| Low                       | 245/177                   | 1.00              |             |        |
| Middle                    | 229/166                   | 0.70 (0.51–0.95)  |             |        |
| High                      | 186/186                   | 0.30 (0.20–0.44)  |             |        |
| >0–<15                    | 70/136                    | 0.43 (0.30–0.61)  | <0.001      |        |
| Middle                    | 99/154                    | 0.35 (0.25–0.50)  |             |        |
| High                      | 87/122                    | 0.23 (0.15–0.36)  |             |        |
| ≥15                       | 21/12                     | 0.93 (0.47–1.84)  |             |        |
| Middle                    | 21/12                     | 0.99 (0.46–2.16)  |             |        |
| High                      | 36/28                     | 0.38 (0.20–0.72)  |             |        |

DISCUSSION

Despite extensive investigation of the association between alcohol consumption and breast cancer risk, the conclusion remains controversial especially for low-to-moderate alcohol intake (Brown et al., 2010). Some studies reported that alcohol consumption was associated with a higher risk of incident breast cancer (Smith-Warner et al., 1998; Bagnardi et al., 2001; Terry et al., 2006), while others based on more detailed consumption measures have found no relationship with breast cancer, particularly in premenopausal women (Garland et al., 1999; Kinney et al., 2000; Kropp et al., 2001; Baumgartner et al., 2002; Nagata et al., 2007; Bessaoud and Daure`s, 2008; Brown et al., 2010; Kabat et al., 2010). This study was specifically designed to examine associations between low-to-moderate intake of alcohol and the risk of breast cancer by menopausal status in the women and ER and PR status in the breast tumours. We observed that women who consumed alcohol at a low frequency and quantity had a reduced risk of breast cancer regardless of menopausal status. Compared with non-drinkers, those who consumed alcohol at <5 g per day had a reduced breast cancer risk in pre- and postmenopausal women. For all tumour receptor subtypes combined, a small nonsignificant increased risk of higher alcohol intake (>15 g daily) was generally associated with breast cancer in this study. There was no clear association between types of alcohol consumed and breast cancer risk, although significantly reduced risks from wine and beer drinking were observed in pre- and postmenopausal women, respectively.

The findings from this study that low-to-moderate alcohol intake was, if anything, inversely associated with risk of breast cancer are supported by results from other observational studies. One study recently reported that breast cancer risk was not significantly associated with alcohol drinking (0.9, 0.7–1.1) in Asian Americans including Chinese women, a population consuming alcohol at a low level with a median intake of 0.48 g per day in cases and 0.40 g per day in controls (Brown et al., 2010). Another
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Table 5 Association between alcohol intake (g per day) and breast cancer risk by hormone receptor status

|                | ER+ | ER− | PR+ | PR− |
|----------------|-----|-----|-----|-----|
|                | OR  | OR  | OR  | OR  |
|                | (95% CI)* | (95% CI)* | (95% CI)* | (95% CI)* |
| All women      |     |     |     |     |
| None           | 1.00b | 1.00b | 1.00b | 1.00b |
| >0–<15         | 0.97 | 1.00 | 0.99 | 1.00 |
| ≥15            | 0.99 | 1.00 | 0.98 | 1.00 |
| Premenopausal women |     |     |     |     |
| None           | 1.00b | 1.00b | 1.00b | 1.00b |
| >0–<15         | 0.96 | 1.00 | 0.98 | 1.00 |
| ≥15            | 0.98 | 1.00 | 0.98 | 1.00 |
| Postmenopausal women |     |     |     |     |
| None           | 1.00b | 1.00b | 1.00b | 1.00b |
| >0–<15         | 0.96 | 1.00 | 0.98 | 1.00 |
| ≥15            | 0.98 | 1.00 | 0.98 | 1.00 |

Abbreviations: CI = confidence interval; OR = odds ratio. *Estimates from unconditional logistic regression models included terms for age at interview (continuous), education (none, primary, secondary, tertiary), BMI (5-years ago), oral contraceptive use (never, ever), hormone replacement therapy (never, ever), breast cancer in first-degree relatives (no, yes), total energy intake (continuous), folate intake (continuous), tea drinking (no, yes) and menopausal status (no, yes; only for all women). Reference category.

Table 6 Association between alcohol intake (g per day) and breast cancer risk by joint hormone receptor status

|                | ER+/PR+ | ER−/PR− | ER+/PR− or ER−/PR+ |
|----------------|---------|---------|---------------------|
|                | OR  | OR  | OR  |
|                | (95% CI)* | (95% CI)* | (95% CI)* |
| All women      |     |     |     |
| None           | 1.00b | 1.00b | 1.00b |
| >0–<15         | 0.97 | 1.00 | 0.99 |
| ≥15            | 0.99 | 1.00 | 0.98 |
| Premenopausal women |     |     |     |
| None           | 1.00b | 1.00b | 1.00b |
| >0–<15         | 0.96 | 1.00 | 0.98 |
| ≥15            | 0.98 | 1.00 | 0.98 |
| Postmenopausal women |     |     |     |
| None           | 1.00b | 1.00b | 1.00b |
| >0–<15         | 0.96 | 1.00 | 0.98 |
| ≥15            | 0.98 | 1.00 | 0.98 |

Abbreviations: CI = confidence interval; OR = odds ratio. *Estimates from unconditional logistic regression models included terms for age at interview (continuous), residential area (urban, rural), education (none, primary, secondary, tertiary), BMI (5-years ago), age at menarche (continuous), oral contraceptive use (never, ever), hormone replacement therapy (never, ever), breast cancer in first-degree relatives (no, yes), total energy intake (continuous), folate intake (continuous), smoking (no, yes), tea drinking (no, yes), physical activity (weekly MET-hour, continuous) and menopausal status (no, yes; only for all women). Reference category.

study conducted in France found that women who had an average consumption of <1.5 drinks per day had a lower risk (0.58, 0.34–0.97) when compared with nondrinkers (Bessaoud and Daurès, 2008). Another study reported that alcohol intake of <148 g per week was associated with a reduced risk in non-Hispanic Whites (0.49, 0.35–0.69), and that the protective effect was present in both pre- and postmenopausal women (Baumgartner et al. 2002). Furthermore, a reduced risk of breast cancer was found in premenopausal German women, whose average ethanol intake was ≤11 g per day defined for a lower-level consumption of alcohol (Kropp et al, 2001). A systematic review of three cohort studies and eight case–control studies concluded that there were inconsistent results regarding alcohol drinking and breast cancer risk in the Japanese population (Nagata et al, 2007).

Chinese women have presently a very low level of alcohol consumption. WHO reported that 61.2% of the population were lifetime abstainers and only 2.1% of them consumed three or more standard drinks on a typical drinking day although the WHO has noted that alcohol consumption in Asia is rising rapidly (WHO, 2004). In this study, 63.4% cases and 52.4% controls self-reported as lifetime abstainers, while the majority of current drinkers consumed <10 g of alcohol per day, thus providing an opportunity to evaluate the association of low-to-moderate alcohol intake and breast cancer risk with reasonable precision. However, for the opposite reason, our study may be unsuitable to assess the effect of higher alcohol intake on breast cancer as few participants consumed at levels ≥30 g daily. Few other studies have investigated the association of breast cancer with alcohol consumption in Chinese women. One such study was performed in premenopausal Vietnamese and Chinese women and reported that those who consumed alcohol had an increased risk of breast cancer (1.85, 1.32–2.61) compared with nondrinkers but no details on alcohol intake available (Nichols et al, 2005). However, another study suggested that low alcohol intake was unrelated to breast cancer risk (0.9, 0.7–1.1) in Asian Americans including Chinese women (Brown et al, 2010).

It is unclear whether the relationship between alcohol consumption and breast cancer risk differs across ER and PR tumours subtype (Suzuki et al, 2007). In the study, we classified hormone receptor status separately and jointly and found that low-to-moderate alcohol intake was consistently associated with a reduced risk of all tumour receptor subtypes except where tumours had discordant receptor
status, that is, ER+ /PR− or ER− /PR+. This risk reduction was evident in both pre- and postmenopausal women, but was more pronounced in postmenopausal women. There was no association between higher alcohol intake (daily ≥15 g) and breast cancer risk with the exception of where discordant receptor status existed in postmenopausal women. There is no known biological basis for this result and we are reluctant to place much emphasis of it as an isolated finding in just one study.

Our findings regarding hormone receptor status are inconsistent to some extent with the results of other research. One study found that moderate alcohol consumption was associated positively with breast cancer in postmenopausal women with hormone receptor-positive tumours (Lew et al, 2009). A meta-analysis uncovered that an increase in alcohol consumption of 10 g per day was associated with statistically significant increased risks for all ER+, all ER−, ER+ PR+ and ER+ PR− but not ER− PR− tumours (Suzuki et al, 2008).

The biological mechanisms of the effects of alcohol on breast cancer aetiology have been widely discussed but remain to be characterised by detailed evidence. Investigators have suggested that alcohol consumption increases the risk of breast cancer in women by influencing oestrogen metabolism (Ginsburg, 1999). Alcohol appears to raise circulating oestrogen levels in premenopausal women and has a much more pronounced effect in postmenopausal women taking oestrogen replacements than in those not on replacement therapy (Ginsburg, 1999). The promotion of the growth of breast cancer may also be explained by an increased production of the liver of an insulin-like growth factor associated with alcohol consumption, like other personal habits, can be reported by breast cancer before and at the time of the research. Although alcohol consumption, like other personal habits, can be reported by the subjects with reasonable accuracy, misclassification of exposure results towards the null and would have been unlikely to account for the strongly inverse associations reported here. Exposure of cases to risk factors may change because of disease status. However, over 90% cases were newly diagnosed and interviewed within 3 months. It appears unlikely, therefore, that disease status materially affected the interview responses in reporting alcohol habits using a ‘reference’ recall period.

In conclusion, this study found that low alcohol intake (<5 g daily) was inversely associated breast cancer in Chinese women. When considered according to hormone receptor status, the inverse association was consistently observed for all breast tumour receptor subtypes except those with a discordant receptor status, that is, ER+/PR− or ER−/PR+. The reduced risk was evident in both pre- and postmenopausal women, but was more pronounced in postmenopausal women. An increased risk from daily alcohol intake of ≥15 g was found for tumours with a discordant receptor status in postmenopausal women. Given the number of women affected by breast cancer worldwide and the widespread consumption of alcohol, future studies are justified to fully understand the different effects of alcohol at low, moderate and high levels of intake on different breast tumour receptor subtypes according to hormone receptor status, including possible biological mechanisms.

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