RESEARCH ARTICLE

Active and Passive Smoking, and Alcohol Drinking and Breast Cancer Risk in Chinese Women

Chang-Ming Gao[1]*, Jian-Hua Ding[1], Su-Ping Li[1], Yan-Ting Liu[1], Yun Qian[2], Jun Chang[3], Jin-Hai Tang[1]*, Kazuo Tajima[4]

Abstract

To evaluate the relation between smoking, alcohol drinking and risk of breast cancer in Chinese women, we conducted a case-control study with 669 cases and 682 population-based controls in Jiangsu Province of China. A structured questionnaire was used to elicit detailed information. Unconditional logistic regression analysis was performed to calculate odds ratios (ORs) and 95% confidence intervals (CIs). The results revealed that smoking, whether active or passive through the husband, was related to increased risk of breast cancer. The ORs (adjusted for age, menopausal status, educational levels, occupation, body mass index and income) were 3.55 (95%CI: 1.27-9.91) for active smoking and 1.47 (95%CI: 1.18-1.84) for passive smoking from husbands, respectively. A significant positive relationship was observed between breast cancer risk and the degree of husbands' smoking. There were significant increase trend in ORs with the daily smoked number of cigarettes of husbands, the passive smoking years from husbands and the pack-years of husbands' smoking (trend test: p=0.00003, 0.00013 and 0.0001, respectively). Alcohol consumption was also found to be a risk factor. The findings of this study in particular suggest that husbands' smoking increases risk of breast cancer in Chinese women.

Keywords: Breast cancer - husband smoking - case control study - Chinese women

Asian Pacific J Cancer Prev, **14 (2)**, 993-996

Introduction

Tobacco smoking is the recognized and most important risk factor for development of cancer. It has been causally implicated for many sites of cancer. Breast cancer constitutes the most common cancer in women and is an important public health concern worldwide. Although the incidence rate of breast cancer in China is much lower than those in Western countries, there has been a marked increase in recent years (Parkin et al., 2005; Yang et al., 2005). Our previous study suggested that physiological and reproductive factors, particularly early age at menarche, late age at menopause, early age at first pregnancy, parity and breastfeeding may increased or reduced breast cancer risk in women (Liu et al., 2011). Human health evidence has been accumulating to suggest that active smoking is a likely cause of breast cancer, but the role of secondhand smoking is less clear, although there has been some suggestion for an increased risk for premenopausal breast cancer (Reynolds, 2012). In China, especially in the south of China, few women are smokers, while more than 60% of men aged more than 15 years are smokers (Liu et al., 2000). Now, no smoking in public places and workplaces qua a policy of public health has been practicing, but passive smoking at home still is a serious problem in China. To evaluate the relationship between husbands' smoking and breast cancer risk, we conducted this case-control study in Jiangsu Province, China.

Materials and Methods

Study Subjects

We recruited breast cancer cases using data of the Cancer Registries in Taixing, Wuxi, Jintan and Huian cities of the Jiangsu Province of China, and also recruited cases who visited the Jiangsu Province Cancer Hospital from these cities from June 2004 to December 2007. All cases were histopathologically diagnosed as having a primary breast cancer. Physicians at the hospital asked eligible cases to participate in our study, and doctors or nurses interviewed the participants after obtaining informed consent. Population-based controls were selected from healthy residents in 11 villages or towns of Taixing, Wuxi, Jintan and Huian cities. Doctors of the public health centers randomly selected one or two controls for each case, after matching for ethnicity and age within 2 years using the records of residents at the local governmental office, and then asked eligible residents for their participation. Interviews were conducted as for the cancer cases. A total

*[1]Division of Epidemiology, Jiangsu Province Institute of Cancer Research, Nanjing, [2]Wuxi City Center for Disease Control and Prevention, Wuxi, [3]Taixing City Center for Disease Control and Prevention, Taixing, China, [4]Division of Epidemiology and Prevention, Aichi Cancer Center Research Institute, Nagoya, Japan *For correspondence: gaocm888@126.com*

Table 1. Comparison of Cases and Controls by Selected Descriptive Characteristics

	Cases(n=669)	Controls(n=682)	χ^2	*P*
Age(year)			0.98	0.807
<40	76 (11.36)	87 (12.76)		
40-49	226 (33.78)	229 (33.58)		
50-59	227 (33.93)	234 (34.31)		
≥60	140 (20.93)	132 (19.35)		
Menopausal status			1.56	0.212
Postmenopausal	360 (53.81)	390 (57.18)		
Premenopausal	309 (46.19)	292 (42.72)		
Childbirth			4.14	0.042
Never	25 (3.7)	13 (1.9)		
Have	644 (96.3)	669 (98.1)		
Oral contraceptive use			0.23	0.628
Never	602 (90.0)	619 (90.8)		
Have	67 (10.0)	63 (9.2)		
Educational levels			8.07	0.089
illiterate	118 (17.64)	133 (19.50)		
primary education	201 (30.04)	232 (34.02)		
junior high school	198 (29.60)	198 (29.03)		
senior high school	111 (16.59)	80 (11.73)		
college and over	41 (6.13)	39 (5.72)		
Occupation			64.09	0.001
workers*	175 (26.16)	110 (16.13)		
peasants	299 (44.69)	377 (55.28)		
professional**	48 (7.17)	65 (9.53)		
administration managers	48 (7.17)	21 (3.08)		
finance,business	45 (6.73)	22 (3.23)		
housework	26 (3.89)	67 (9.82)		
other	28 (4.19)	20 (2.93)		
BMI			4.88	0.087
<22	225 (33.63)	244 (35.78)		
22-24.9	256 (38.27)	282 (41.35)		
≥25	188 (28.10)	156 (22.87)		
Income/month			30.79	0.001
Low	171 (25.56)	259 (37.98)		
Middle	230 (34.38)	232 (34.02)		
High	268 (40.06)	191 (28.01)		

*Production, transport equipment operators and related workers; **Science, technology, education and medicine

of 669 cases and 682 controls completed the interview. A few patients and residents refused to participate in our study, but the response rates were 98% for cases and 99% for controls. The ethics committee of the Jiangsu Province Institute of Cancer Research approved this study.

Data collection and Statistical Analysis

A structured questionnaire was used to elicit detailed information on demographic background, socioeconomic status, occupational history, height and weight, physiological and reproductive history, lifestyle and the status of husbands' smoking. All subjects completed an in-person interview. The body mass index (BMI) was calculated based on weights and heights. Smokers were defined as the persons who had ever smoked at least one cigarette per day for ≥6 months. Alcohol drinkers were defined as the persons who had ever drunk alcoholic beverages at least once a week for ≥6 months. The passive smoke years from husbands and the pack-years of husbands' smoking were calculated based on the husbands' smoking status in married period. Odds ratios (ORs) and 95% confidence intervals (CIs) were estimated by unconditional logistic regression analysis. We calculated adjusted- ORs for age, menopausal status, educational levels, occupation, BMI and the mean income every person per month in family. All the analyses were performed in SAS (SAS Institute Inc., Cary, NC). All tests were two-sided, with the significance level of 0.05.

Table 2. Tobacco Smoking and Alcohol Drinking and Risk of Breast Cancer

	Cases(n=669)	Controls(n=682)	OR (95%CI)
Smoking status			
Never	653 (97.61)	677 (99.27)	1.00
Current	6 (0.90)	4 (0.59)	
Ever	10 (1.49)	1 (0.15)	
Current + ever	16 (2.39)	5 (0.74)	3.55 (1.27-9.91)
Alcohol drinking status			
Never	637 (95.22)	662 (97.07)	1.00
Current	18 (2.69)	17 (2.49)	
Ever	14 (2.09)	3 (0.44)	
Current + ever	32 (4.78)	20 (2.93)	1.86 (1.02-3.39)

*ORs were adjusted for age, menopausal status, Educational status, Occupation, BMI and Income/month

Results

Characteristics of Cases and Controls

A total of 669 cases and 682 controls were included in the study. The comparison of cases and controls by selected descriptive characteristics are summarized in Table 1. There were no significant differences between cases and controls in distribution of age, menopausal status, educational levels, oral contraceptive use and BMI, whereas significant differences were observed for childbirth, occupation and the mean income every person per month in family. Group of case had a higher income comparison with controls.

Active Smoking, Alcohol Drinking and Breast Cancer Risk

ORs and their 95%CIs for breast cancer are shown in Table 2. It indicated that increasing risk of beast cancer were associated with active smoking and alcohol drinking. The OR of smokers (including current and former smokers) was 3.55 (95%CI: 1.27-9.91) compared with never smokers and the OR of alcohol drinkers (including current and former drinkers) was 1.86 (95%CI 1.02-3.39) compared with nondrinkers.

Husbands' Smoking and Risk of female Breast Cancer

Table 3 shows the relationship between husbands' smoking and risk of female breast cancer. Husbands' smoking appeared to have a statistically significant association with their wives risk of breast cancer. Women of the husbands' smoking (including current and former) were at increased OR (1.47, 95%CI: 1.18-1.84) for breast cancer. A significant dose-response relationship between the severe degree of husbands' smoking and their wives risk of breast cancer was observed. There were significant increase trend in ORs with the daily smoking number of husbands, the passive smoke years from husbands and the pack-years of husbands' smoking (trend test: p=0.00003, 0.00013 and 0.0001, respectively).

Table 3. Husbands' Smoking and Wives' Risk of Breast Cancer

	Cases(n=669)	Controls(n=682)	OR (95%CI)
Smoking status of husbands			
Never	327 (48.88)	398 (58.36)	1.00
Current	303 (45.29)	259 (37.98)	1.45 (1.15-1.83)
Ever	39 (5.83)	25 (3.67)	1.63 (0.95-2.81)
Current + ever	342 (51.12)	284 (41.64)	1.47 (1.18-1.84)
Daily smoke number of husbands			
`0	327 (48.88)	398 (58.36)	1.00
`1-19	177 (26.46)	174 (25.51)	1.18 (0.91-1.54)
`20-29	144 (21.52)	98 (14.37)	1.93 (1.41-2.64)
`30-	21 (3.14)	12 (1.76)	2.65 (1.20-5.83)
Test for trend		χ^2=17.61	*P*=0.00003
Husbands' smoking years			
`0	327 (48.88)	398 (58.36)	1.00
`1-9	28 (4.19)	26 (3.81)	1.43 (0.77-2.63)
`10-19	80 (11.96)	78 (11.44)	1.30 (0.90-1.89)
`20-29	130 (19.43)	110 (16.13)	1.41 (1.04-1.92)
`30-	104 (15.55)	70 (10.26)	1.74 (1.21-2.52)
Test for trend		χ^2=14.69	*P*=0.00013
Pack-years of husbands' smoking			
`0	327 (48.88)	398 (58.36)	1.00
`1-9	93 (13.90)	96 (14.08)	1.13 (0.80-1.59)
`10-19	93 (13.90)	88 (12.90)	1.27 (0.90-1.79)
`20-29	82 (12.26)	55 (8.06)	1.84 (1.24-2.72)
`30-	74 (11.06)	45 (6.60)	2.10 (1.36-3.23)
Test for trend		χ^2=17.61	*P*=0.00001

*ORs were adjusted for age, menopausal status, Educational status, Occupation, BMI and Income/month

Discussion

In present study, we found active smoking and alcohol drinking to significantly increase the risk of breast cancer. We also found that husbands' smoking is associated significantly to elevated risk of female breast cancer.

Tobacco smoke, either mainstream or sidestream, is now known to contain over 7,000 chemicals, 69 of which are established carcinogens, including over 20 of which are established mammary carcinogens (Reynolds, 2012). There is good evidence for uptake of many of these carcinogens reaching mammary tissue (Hecht, 2002). Although results from studies evaluating the relationship between tobacco smoking and breast cancer are inconsistent, most recent studies revealed that active smoking is associated to an increased risk of breast cancer (Band et al., 2002; Al-Delaimy et al., 2004; Reynolds, et al., 2004; Gram, et al., 2005; Li et al., 2005; Olson et al., 2005; Cui et al., 2006; Luo et al., 2011). In the California Teachers Study (CTS), Reynolds et al. (2004) observed an elevated risk of breast cancer associated with active smoking that increased with smoking intensity and, to a lesser extent, duration. The association with intensity was present in both pre-/peri- and postmenopausal women, but the association with duration appeared to be limited to postmenopausal women. In another large population-based cohort of women, Gram IT et al. (2005) followed 102,098 women of Norwegian-Swedish and found that the increased RR associated with smoking was observed among nondrinkers of alcohol, women with and without a family history of breast cancer, premenopausal and postmenopausal women, and in both countries. The results of Cui et al. (2006) in the Canadian National Breast Screening Study strongly suggest that cigarette smoking might play an important role in the etiology of breast cancer, particularly when initiated relatively early in life and when engaged in for long durations. These associations between smoking and breast cancer risk have been further confirmed in postmenopausal women in large prospective study of Luo and Margolis et al. (2011). Our result in present case-control study also support that active smoking increases the risk of breast cancer.

The results of epidemiologic study on breast cancer in relation to passive smoking also are inconsistent (Reynolds, 2012). In a prospective cohort study of 111,140 participants of the Nurses' Health Study from 1976 to 2006 for active smoking and 79,010 women from 1982 to 2006 for passive smoking, Xue FWW et al. (2011) found that passive smoking in childhood or adulthood was not associated with breast cancer risk. Other two large cohort studies suggest that a modest risk elevation in breast cancer was associated with secondhand smoking exposure. In the California Teachers Study, Reynolds et al. (2009) found that cumulative exposures to high levels of sidestream smoke may increase breast cancer risk among postmenopausal women who themselves have never smoked tobacco products. Among 41,022 lifetime nonsmokers in the Women's Health Initiative study, Luo and Margolis et al. (2011) found those with the most extensive exposure to passive smoking (≥10 years' exposure in childhood, ≥20 years' exposure as an adult at home, and ≥10 years' exposure as an adult at work) had a 32% excess risk of breast cancer compared with those who had never been exposed to passive smoking (hazard ratio=1.32, 95%CI: 1.04 -1.67). Lee SH et al. (1999) in Korean women found that there was a relation between husbands' smoking habits and morbidity from breast cancer in their wives, the risk of developing breast cancer by duration of husbands' smoking (>30 years) was significant. In present study, we found husbands' smoking significantly increased their wives' risk of developing breast cancer. The ORs for breast cancer were increased with husbands' smoking intensity and duration. Our results support that passive smoking are associated with risk of breast cancer.

Previous epidemiologic studies have consistently suggested that alcohol drinking was associated with an elevated the risk of breast cancer (Chen et al., 2011; Coronado et al., 2011; Ronco et al., 2011; Seitz et al., 2012; Wu et al., 2012; Giacosa et al., 2013). In present study, we also found that alcohol drinkers had a significant increased OR for breast cancer. Our result is consistent with that of other authors. It is suggested that the following mechanisms explain the effect of alcohol on the development of breast cancer. Alcohol drinking is shown to increase levels of endogenous estrogens, known risk factors for breast cancer. Products of alcohol metabolism are known to be toxic and may lead to breast cancer. A lot of evidence suggests that antioxidant intake (e.g.folate) may reduce alcohol-associated breast cancer risk, because it neutralizes reactive oxygen species, a second-stage product of alcohol metabolism. Diets lacking sufficient

antioxidant intake, as a result, may further elevate the risk of breast cancer among alcohol consumers (Coronado et al., 2011).

References

Al-Delaimy WK, Cho E, Chen WY, et al (2004). A prospective study of smoking and risk of breast cancer in young adult women. *Cancer Epidemiol Biomarkers Prev*, **13**, 398-404.

Band PR, Le ND, Fang R, et al (2002). Carcinogenic and endocrine disrupting effects of cigarette smoke and risk of breast cancer. *Lancet*, **360**, 1044-9.

Chen WY, Rosner B, Hankinson SE, et al (2011). Moderate alcohol consumption during adult life, drinking patterns, and breast cancer risk. *JAMA*, **306**, 1884-90.

Coronado GD, Beasley J, Livaudais J (2011). Alcohol consumption and the risk of breast cancer. *Salud Publica Mex*, **53**, 440-7.

Cui Y, Miller AB, Rohan TE (2006). Cigarette smoking and breast cancer risk: update of a prospective cohort study. *Breast Cancer Res Treat*, **100**, 293-9.

Giacosa A, Barale R, Bavaresco L, et al (2013). Cancer prevention in Europe: the Mediterranean diet as a protective choice. *Eur J Cancer Prev*, **22**, 90-5.

Gram IT, Braaten T, Terry PD, et al (2005). Breast cancer risk among women who start smoking as teenagers. *Cancer Epidemiol Biomarkers Prev*, **14**, 61-6.

Hecht SS (2002). Tobacco smoke carcinogens and breast cancer. *Environ Mol Mutagen*, **39**, 119-26.

Lee SH, Ohrr H, Kim IS (1999). Effects of hansbands' smoking on the incidence of lung cancer in Korean women. *Int J Epidemiol,* **28**, 824-8.

Li CI, Malone KE, Daling JR (2005). The relationship between various measures of cigarette smoking and risk of breast cancer among older women 65-79 years of age (United States). *Cancer Causes Control*, **16**, 975-85

Liu L, Wu K, Lin X, et al (2000). Passive smoking and other factors at different periods of life and breast cancer risk in Chinese women who have never smoked - a case-control study in Chongqing, People's Republic of China. *Asian Pac J Cancer Prev*, **1**, 131-7.

Liu YT, Gao CM, Ding JH et al (2011). Physiological, reproductive factors and breast cancer risk in Jiangsu Province of China. *Asian Pac J Cancer Prev*, 12, 787-90

Luo J, Horn K, Ockene JK, et al (2011). Interaction between smoking and obesity and the risk of developing breast cancer among postmenopausal women, the women's health initiative observational study. *Am J Epidemiol*, **174**, 919-28.

Luo J, Margolis KL, Wactawski-Wende J, et al (2011). Association of active and passive smoking with risk of breast cancer among postmenopausal women: a prospective cohort study. BMJ, 342, d1016. (doi: 10.1136/bmj. d1016)

Olson JE, Vachon CM, Vierkant RA, et al (2005). Prepregnancy exposure to cigarette smoking and subsequent risk of postmenopausal breast cancer. *Mayo Clin Proc*, **80**, 1423-8.

Parkin DM, Bray F, Ferlay J, Pisani P (2005). Global cancer statistics, 2002. CA Cancer J Clin, 55, 74-108. Reynolds P (2012). Smoking and breast cancer. J Mammary Gland Biol Neoplasia, DOI 10.1007/s10911-012-9269-x.

Reynolds P, Hurley S, Goldberg DE, et al (2004). Active smoking, household passive smoking, and breast cancer: evidence from the California Teachers Study. *J Natl Cancer Inst*, **96**, 29-37.

Reynolds P, Goldberg D, Hurley S, et al (2009). Passive smoking and risk of breast cancer in the California teachers study. *Cancer Epidemiol Biomarkers Prev*, **18**, 3389-98.

Reynolds P (2012). Smoking and breast cancer. J Mammary Gland Biol Neoplasia, DOI 10.1007/s10911-012-9269-x.

Ronco AL, De Stefani E, Correa P, et al (2011). Dietary benzo[a] pyrene, alcohol drinking, and risk of breast cancer: a case-control study in Uruguay. *Asian Pac J Cancer Prev*, **12**, 1463-7.

Seitz HK, Pelucchi C, Bagnardi V, La Vecchia C (2012). Epidemiology and pathophysiology of alcohol and breast cancer: Update 2012. *Alcohol*, **47**, 204-12.

Xue FWW, Rosner BA, Hankinson SE, Michels KB (2011). Cigarette smoking and the incidence of breast cancer. *Arch Intern Med*, **171**, 125-33.

Yang L, Parkin DM, Ferlay J, et al (2005). Estimates of Cancer Incidence in China for 2000 and Projections for 2005. *Cancer Epidemiol Biomarkers Prev*, **14**, 243-50.

Wu AH, Vigen C, Razavi P, et al (2012). Alcohol and breast cancer risk among Asian-American women in Los Angeles County. *Breast Cancer Res*, **14**, R151.