



Effect of household passive smoking exposure on the risk of ischaemic heart disease in never-smoke female patients in Hong Kong

D Ding, J Wing-Hong Fung, Q Zhang, G Wai-Kwok Yip, C-K Chan and C-M Yu

Tob. Control 2009;18:354-357; originally published online 7 May 2009;
doi:10.1136/tc.2008.026112

Updated information and services can be found at:
<http://tobaccocontrol.bmj.com/cgi/content/full/18/5/354>

These include:

References

This article cites 21 articles, 11 of which can be accessed free at:
<http://tobaccocontrol.bmj.com/cgi/content/full/18/5/354#BIBL>

Rapid responses

You can respond to this article at:
<http://tobaccocontrol.bmj.com/cgi/eletter-submit/18/5/354>

Email alerting service

Receive free email alerts when new articles cite this article - sign up in the box at the top right corner of the article

Notes

To order reprints of this article go to:
<http://journals.bmj.com/cgi/reprintform>

To subscribe to *Tobacco Control* go to:
<http://journals.bmj.com/subscriptions/>

Effect of household passive smoking exposure on the risk of ischaemic heart disease in never-smoke female patients in Hong Kong

D Ding,^{1,2} J Wing-Hong Fung,¹ Q Zhang,¹ G Wai-Kwok Yip,¹ C-K Chan,³ C-M Yu¹

¹ Division of Cardiology, Department of Medicine and Therapeutics, Prince of Wales Hospital, The Chinese University of Hong Kong, Hong Kong;

² Huashan Hospital, Fudan University, Shanghai, China;

³ Department of Medicine, Alice Ho Miu Ling Nethersole Hospital, Hong Kong

Correspondence to:

Professor C-M Yu, Institute of Vascular Medicine, Division of Cardiology, Department of Medicine and Therapeutics, Prince of Wales Hospital, The Chinese University of Hong Kong, Shatin, New Territories, Hong Kong; cmYu@cuhk.edu.hk

Received 14 May 2008

Accepted 7 April 2009

Published Online First 7 May 2009

ABSTRACT

Objective: To investigate the relation between household passive smoking exposure and risk of ischaemic heart disease (IHD) among never-smoke female patients by a retrospective case-control analysis.

Methods: This study recruited 314 patients with IHD who had never smoked and 319 controls who were admitted for other reasons in the same hospital during the same period. Subjects were interviewed about their exposure to household passive smoking. The dose metrics of passive smoking exposure were evaluated by using "pack years" and "hour years", which indicated the cumulative amount and duration of exposure. The ORs and 95% CIs were computed by unconditional logistic regression, adjusted for other risk factors.

Results: Subjects with passive smoking exposure were associated with higher risk of IHD (OR 1.51, 95% CI 1.01 to 2.27, $p = 0.043$) when compared to non-exposed subjects. Subjects exposed to an average of ≥ 1 pack of cigarette per day had an OR of 1.69 (95% CI 1.07 to 2.68, $p = 0.025$). The OR was 1.52 for those exposed for ≥ 5 years (95% CI 1.01 to 2.29, $p = 0.043$) and was 1.82 for those exposed ≥ 4 h per day (95% CI 1.05 to 3.15, $p = 0.032$). Similarly, the risk of IHD increased with cumulative exposure duration, with an OR of 1.53 (95% CI 1.01 to 2.32, $p = 0.043$) at the exposure level ≥ 5 pack years, and an OR of 1.61 (95% CI 1.03 to 2.52, $p = 0.037$) at the exposure level ≥ 20 hour years. There was a significant dose-response association between the exposure measures and risk of IHD ($p < 0.01$ for trend).

Conclusion: Our data suggested an increased risk of IHD from passive household smoking in female never-smoke subjects, and demonstrated a dose-response association.

Passive smoking can cause respiratory problems such as chronic obstructive pulmonary disease, asthma, chronic bronchitis and lung cancer.¹⁻³ Moreover, passive smoking has been suggested to increase the risk of chronic heart disease through several potential mechanisms, such as carboxyhaemoglobinaemia, increased platelet aggregation, damage to the arterial endothelium and reduced high-density lipoprotein cholesterol concentration.⁴⁻⁶ The effects of even brief passive smoking (minutes to hours) are often nearly as great as chronic active smoking, averaging 80% to 90%.⁴

Epidemiological data on the relationship between passive smoking and heart disease have been accumulating since the mid-1980s. Previous studies have shown a pooled relative risk of 1.31 (95% confidence interval (CI) 1.21 to 1.41), indicating a higher risk of ischaemic heart disease (IHD) in never-smokers exposed to second-hand or

passive smoking than those not exposed.⁴ However, the risk might change with differences in socioeconomic status, environmental factor and possibly ethnic susceptibility. Therefore, studies in diverse geographic population are needed to provide more evidence of the effect of passive smoking on cardiovascular diseases.

Two studies were conducted in mainland China to investigate the relationship between passive smoking and ischaemic cardiovascular and neurovascular diseases in non-smoking women,^{7,8} while the only previous study in Hong Kong provided preliminary evidence suggesting that passive smoking was associated with death due to various diseases, including IHD (odds ratio (OR) 1.35, 95% CI 1.03 to 1.76).⁹ However, further study and quantification are still required to determine whether passive household smoking would increase the risk of IHD. Passive smoking has incurred costs of US \$156 million due to direct medical costs, long-term care fees and productivity loss in 1998 in Hong Kong.¹⁰ Given that the population of a single city is about 6.7 million and that the prevalence of IHD is increasing worldwide, it is imperative to further understand the potentially hazardous role of passive smoking as a risk factor for IHD. This is particularly relevant in female subjects who are exposed to passive household smoking when their spouses or other family members are smokers. Therefore, the objective of current study was to investigate the association between household passive smoking exposure and presence of IHD among female never-smoke patients in Hong Kong enrolled in a hospital-based retrospective case-control study.

METHODS

Study subjects

The study was conducted in the period 2004-2007 in three regional hospitals in Hong Kong (the Prince of Wales Hospital, Alice Ho Miu Ling Nethersole Hospital and Northern District Hospital). These are the major regional hospitals managed by Hospital Authority New Territories East Cluster, serving Shatin, Tai Po, Northern New Territories, Sai Kung and the outlying islands of Hong Kong.

All the subjects of this study were female never-smokers. IHD cases were recruited from the cardiac wards or coronary care unit during the study period. These included patients with angina pectoris who were confirmed to have coronary stenosis of 70% or more in at least one coronary artery; patients with acute coronary syndrome

who had chest pain, typical electrocardiogram changes and elevation of cardiac enzyme in the form of creatine kinase-MB or troponin T; and patients who had a clinical diagnosis of IHD and received either percutaneous coronary intervention or coronary artery bypass grafting surgery. Diagnosis of IHD was based on International Classification of Diseases 10th revision (ICD-10) codes I20 to I25. Controls were defined as patients attending the same hospitals during the same period of IHD cases without any clinical symptom, sign or suspicion of cardiovascular disease in their medical history. In the case and the control groups, individuals who fulfilled the criteria of "non-consent" (3%) and "conditions related to cigarette use" (5%) were excluded, such as chronic obstructive pulmonary disease, asthma, bronchitis and lung cancer.

Passive smoking exposure

The subjects were interviewed in person, using a standardised questionnaire, regarding their demographics (gender, age, education level), lifestyle (smoking habit, alcohol intake, physical activity), family IHD history and duration and intensity of exposure to household passive smoking. The interviewers were blinded to the case/control status of the subjects. The habit of smoking and alcohol intake were determined by asking "Do you have the habit of smoking/alcohol intake?". Physical activity was assessed with the question "Do you exercise routinely (aerobic exercise at least 3 times per week, for at least 30 min every time)?" while family IHD history was determined with the question "Do you have any family members who got IHD before 55 years old?" Passive smoking exposure at home was determined by asking "Do (have) any of your family members smoke (smoked) in your household? If yes, answer how many years has (did) each person smoked; how many packs of cigarettes per day does (did) each person smoke; and how many hours per day are (were) you exposed to smoking?" Other medically related risk factors for IHD, such as hypertension, diabetes, hypercholesterolaemia, obesity, gout, stroke, menopause and hormonal exposure, were confirmed by reviewing medical records from the hospital computer system.

The scope of passive smoking was household exposure. The source of exposure included those from parents, spouse, children, siblings, relatives and others at home. We evaluated the dose metrics of passive smoking exposure in terms of "pack years" (1 pack year = 365 packs, or the equivalent of 1 pack/day for 1 year) and "hour years" (1 hour year = 365 h, or the equivalent of 1 h/day for 1 year), which indicated the cumulative amount and duration of exposure.¹¹ We also inquired about passive smoking exposure at work, however nearly all subjects were housewives who did not work outside home and a few were long-retired persons who may have had significantly poor recall. Therefore, occupational exposure to passive smoking was negligible in the current study.

Statistical analysis

All data were analysed using statistical software (SPSS 13.0; SPSS, Chicago, Illinois, USA). Differences between the two groups were identified by independent Student *t* test for parametric continuous variables and Mann-Whitney *U* test for non-parametric variables. The Pearson χ^2 test or Fisher exact probability test was used when appropriate for categorical variables. A *p* value <0.05 was considered as statistically significant.

ORs and 95% CIs were computed by unconditional logistic regression, adjusted for covariates such as age, education level, history of hypertension, diabetes mellitus, hypercholesterolaemia, stroke, gout, family history of IHD, physical activities, alcohol intake and oestrogen use. "Never exposed" was defined as the reference category with OR = 1.

RESULTS

Clinical characteristics

A total of 314 female patients who had been diagnosed with IHD and 319 controls were enrolled in this study. The clinical characteristics of patients with IHD and controls are shown in table 1. Patients with IHD were slightly older than control subjects (mean (SD) 72.3 (8.5) vs 68.7 (12.2) years, *p*<0.001), and had a higher prevalence of hypertension (74.2%), diabetes mellitus (43.0%) and hypercholesterolaemia (55.1%) than controls (*p*<0.001). In addition, 12.1% of cases had a family history of IHD (*p* = 0.037), and a smaller proportion of IHD cases were physically active (40.1% vs 48.6%, *p* = 0.032). Other factors did not differ between the IHD and control groups.

Exposure to passive smoking

Table 1 shows that more cases with IHD than controls (30.3% vs 20.4%, *p* = 0.004) were exposed to household passive smoking. After being adjusted for age, education, hypertension, diabetes mellitus, hypercholesterolaemia, gout, history of stroke, family history of IHD, physical inactivity, alcohol intake and oestrogen use, non-smokers ever exposed to household passive smoking were associated with a significantly higher risk of IHD (OR 1.52, 95% CI 1.01 to 2.27, *p* = 0.043) when compared to those who were never exposed (table 2).

Subjects exposed to an average of <1 pack of cigarettes per day from their family members had an OR for IHD of 1.14 (95% CI 0.58 to 2.23), whereas subjects exposed to an average of \geq 1 pack per day had an increased OR of 1.69 (95% CI 1.07 to 2.68, *p* = 0.025). The risk of IHD was already high for duration of exposure of <5 years, with an OR of 1.26 (95% CI 0.18 to 8.77). However, a much higher risk for IHD was present for a longer duration of exposure for \geq 5 years, with an OR of 1.52 (95% CI 1.01 to 2.29, *p* = 0.043). An OR of 1.28 (95% CI 0.76 to 2.15) was found for passive smoking exposure of <4 h per day, while a higher OR of 1.82 (95% CI 1.05 to 3.15, *p* = 0.032) was found for exposure of \geq 4 h per day. Pack years of exposure displayed an increasing OR of 1.44 (95% CI 0.38 to 5.48, *p* = 0.591) and 1.53 (95% CI 1.01 to 2.32, *p* = 0.043) with an increasing exposure level of <5 pack years and \geq 5 pack years, respectively. Similarly, the risk of IHD increased by the cumulative exposure duration, with ORs of 1.22 (95% CI 0.59 to 2.52, *p* = 0.587) and 1.61 (95% CI 1.03 to 2.52, *p* = 0.037) at the exposure level of <20 hour years and \geq 20 hour years, respectively. There was a significant dose-response association of all the exposure measures to risk of IHD (*p*<0.01 for trend) (table 2).

DISCUSSION

The current study reported the association between household passive smoking and presence of IHD among never-smoke female subjects. Since most study subjects were housewives who did not work and hence did not receive substantial exposure outside the home, there was little exposure misclassification due to unquantified workplace exposures. A significant association persisted even after being adjusted for other known risk factors and a dose-response pattern was also found for the

Table 1 Demographics and clinical characteristics of cases and controls

Variable	Cases (n = 314)	Controls (n = 319)	p Value
Age, years (mean (SD))	72.3 (8.5)	68.7 (12.2)	<0.001*
Education level, n (%):			
Primary or below	263 (83.8)	251 (78.7)	0.246†
Secondary	44 (14.0)	57 (17.9)	
College and above	7 (2.2)	11 (3.4)	
Medical history, n (%):			
Hypertension	233 (74.2)	185 (58.0)	<0.001†
Diabetes mellitus	135 (43.0)	93 (29.2)	<0.001†
Hypercholesterolaemia	173 (55.1)	84 (26.3)	<0.001†
Stroke	38 (12.1)	29 (9.1)	0.218†
Gout	44 (14.0)	39 (12.2)	0.505†
Family history of IHD, n (%)	38 (12.1)	23 (7.2)	0.037†
Physical activity, n (%)	126 (40.1)	155 (48.6)	0.032†
Alcohol drinking, n (%)	9 (2.9)	7 (2.2)	0.590‡
Oestrogen use, n (%)	118 (37.6)	103 (32.3)	0.163†
Smoking exposure at home, n (%)	95 (30.3)	65 (20.4)	0.004†

*Student t test; † χ^2 test; ‡Fisher exact test.
IHD, ischaemic heart disease.

cumulative amount and duration of exposure to passive smoking.

Over the past two decades, many epidemiological studies and reviews attempted to explore the effect of passive smoking on the risk of IHD. Hazardous effect of passive smoking exposure was more obvious in population studies that contained both genders.^{12–15} Only a few studies focused on household passive smoking exposure among female never-smokers. In 1988 to 1989, within the framework of the Gruppo Italiano per lo Studio della Sopravvivenza nell'Infarto Miocardico (GISSI)-2 study, a case-control study was conducted to investigate 113 patients with first-ever acute myocardial infarction (AMI) and 225 controls for the exposure to spousal smoking. The association between passive household smoking and IHD in

females, however, was not established.¹⁴ He *et al* conducted a case-control study that enrolled 59 female patients with IHD and 126 controls in China (Xi'an) from 1989 to 1992. The crude OR and adjusted OR for passive smoking from husbands' cigarette smoke were 2.12 (95% CI 1.06 to 4.25) and 1.24 (95% CI 0.56 to 2.72), respectively.⁷ Although the risk of passive smoking and IHD was statistically insignificant, a significant dose-response relationship between the ORs for IHD and spousal cigarette consumption, expressed as the cumulative quantity and duration of passive smoking, was observed from this study. Another case-control study conducted in Argentina between 1991 and 1994 indicated that the multivariate ORs of AMI for female passive smokers were 1.24 to 4.03, according to the different smoking status of their relatives.¹⁵ These studies

Table 2 Odds ratios for ischaemic heart disease (IHD) among never-smoke subjects at different levels of passive household smoking exposure

Variable	Cases	Controls	OR* (95% CI*)	p Value	p Value for trend
Exposure:					
Never exposed†	219	254	1.00		
Ever exposed	95	65	1.52 (1.01 to 2.27)	0.043	
Exposure amount:					
Never exposed†	219	254	1.00		
<1 pack/day	25	19	1.14 (0.58 to 2.23)	0.711	
≥1 pack/day	70	46	1.69 (1.07 to 2.68)	0.025	0.004
Duration of exposure:					
Never exposed†	219	254	1.00		
<5 years	4	2	1.26 (0.18 to 8.77)	0.815	
≥5 years	91	63	1.52 (1.01 to 2.29)	0.043	0.005
Time of exposure:					
Never exposed†	219	254	1.00		
<4 h/day	45	38	1.28 (0.76 to 2.15)	0.358	
≥4 h/day	50	27	1.82 (1.05 to 3.15)	0.032	0.002
Cumulative amount of exposure, ("pack years"):					
Never exposed†	219	254	1.00		
<5 pack years‡	8	4	1.44 (0.38 to 5.48)	0.591	
≥5 pack years‡	87	61	1.53 (1.01 to 2.32)	0.043	0.006
Duration of exposure, ("hour years"):					
Never exposed†	219	254	1.00		
<20 hour years§	23	18	1.22 (0.59 to 2.52)	0.587	
≥20 hour years§	72	47	1.61 (1.03 to 2.52)	0.037	0.004

*Adjusted for: age, education, history of hypertension, history of diabetes mellitus, history of hypercholesterolaemia, history of stroke, history of Gout, family history, physical activity, alcohol and oestrogen use; †reference category; ‡1 pack year: 365 packs, or the equivalent of 1 pack/day for 1 year; §1 hour year: 365 h, or the equivalent of 1 h/day for 1 year.

What this paper adds

- ▶ Household passive smoking exposure was associated with a higher risk of ischaemic heart disease (IHD).
- ▶ The risk of IHD showed an increasing trend with increasing intensity and duration of passive smoking.

either had small sample sizes or demonstrated only an increased risk for high level of exposure, though they suggested a potential link between passive household smoking and IHD in female subjects. In contrast, the current study established that passive household smoking contributed a 1.5-fold increased risk of IHD in female never-smoke subjects compared to those without exposure in a relatively larger population. Furthermore, the risk was also higher for female subjects exposed to a “high-dose”, which was 1.7-fold, 1.8-fold and 1.5-fold for ≥ 1 pack of cigarettes per day, ≥ 4 h of exposure per day and ≥ 5 years of exposure, respectively.

There were potential limitations in this study. Selection and information bias are the main sources of systematic errors in case-control studies. Since the study subjects were selected from hospitals, they were not completely representative of community residents. Recruited subjects were limited to those who could respond to questionnaires. It is possible that patients and controls who did not respond to questionnaires were associated with passive smoking exposure in a different way. Although we strictly followed the inclusion criteria during subject selection, insignificant misclassification might still exist since a small percentage of asymptomatic patients with IHD may have been wrongly assigned as controls. Thus, the ORs of IHD reported from our study would be underestimated.¹⁶

We tried to avoid information bias through accurate and detailed data acquisition from the medical records via the hospital computer system, in particular the onset of cardiovascular risk factors investigated. We also avoided interviewer bias by blinding interviewers to the case-control status. However, recall bias may still be an important issue in terms of our reliance on self-report, because cases were more likely to recall their passive smoking exposure than controls. Studies based on self-report seem to underestimate the risks of exposure to passive smoking.¹⁶ Potential measures to avoid recall bias in assessment of passive smoking in future studies include test-retest design and biochemical markers test of salivary and urinary cotinine assay.^{17–19} Moreover, large prospective studies will be helpful to confirm a causal relation between household passive smoking and IHD in female subjects.

In conclusion, our findings add to the accumulating epidemiological evidence linking household passive smoking exposure with a higher risk of IHD. Current data have indicated that 50% of non-smokers in mainland China and 48% of

non-smokers in Hong Kong are exposed to passive smoking.^{20–21} Considering the high prevalence of passive smoking exposure, the consequences of passive smoking with regard to cardiovascular disease burden underscore the public health policy that all persons, and especially women, should be fully protected from tobacco smoke.

Acknowledgements: We would like to thank the following students for their help in data collection: Chun-Ngai Chan, Yau-Fung Cheung, Ka-Wai Fung, Wai-Man Lee, Ka-Ki Li, Ho-Yan Luk, Fung-Him Ng, Kit-Chung Ng, Sheung-Yan Siu, Yu-Hon Wan, Kuan-Ming Yam, Po-Chu Yam, Lo-Yee Yau, Man-Kwan Yeung, Tsz-Kin Yim, Yu-Young Yip and Sze-Man Yuen.

Competing interests: None.

Provenance and peer review: Not commissioned; externally peer reviewed.

REFERENCES

1. **Radon K**, Busching K, Heinrich J, *et al*. Passive smoking exposure: a risk factor for chronic bronchitis and asthma in adults. *Chest* 2002;**122**:1086–90.
2. **Fong P**. The hazard of cigarette smoke to nonsmokers. *J Biol Phys* 1982;**10**:65–73.
3. **Kabat GC**, Wynder EL. Lung cancer in nonsmokers. *Cancer* 1984;**53**:1214–21.
4. **Barnoya J**, Glantz SA. Cardiovascular effects of secondhand smoke nearly as large as smoking. *Circulation* 2005;**111**:2684–98.
5. **Ambrose JA**, Barua RS. The pathophysiology of cigarette smoking and cardiovascular disease: an update. *J Am Coll Cardiol* 2004;**43**:1731–7.
6. **Glantz SA**, Parmley WW. Passive smoking and heart disease: mechanisms and risk. *JAMA* 1995;**273**:1047–53.
7. **He Y**, Lam TH, Li LS, *et al*. Passive smoking at work as a risk factor for coronary heart disease in Chinese women who have never smoked. *BMJ* 1994;**308**:380–4.
8. **He Y**, Lam TH, Jiang B, *et al*. Passive smoking and risk of peripheral arterial disease and ischemic stroke in Chinese women who never smoked. *Circulation* 2008;**118**:1535–40.
9. **McGhee SM**, Ho LM, Lapsley HM, *et al*. Cost of tobacco-related diseases, including passive smoking, in Hong Kong. *Tob Control* 2006;**15**:125–30.
10. **McGhee SM**, Ho SY, Schooling M, *et al*. Mortality associated with passive smoking in Hong Kong. *BMJ* 2005;**330**:287–8.
11. **Rosenlund M**, Berglund N, Gustavsson A, *et al*. Environmental tobacco smoke and myocardial infarction among never-smokers in the Stockholm Heart Epidemiology Program (SHEEP). *Epidemiology* 2001;**12**:558–64.
12. **Panagiotakos DB**, Chrysohoou C, Pitsavos C, *et al*. The association between secondhand smoke and the risk of developing acute coronary syndromes, among non-smokers, under the presence of several cardiovascular risk factors: The CARDIO2000 case-control study. *BMC Public Health* 2002;**24**:2–9.
13. **Teo KK**, Ounpuu S, Hawken S, *et al*. Tobacco use and risk of myocardial infarction in 52 countries in the INTERHEART study: a case-control study. *Lancet* 2006;**368**:647–58.
14. **La Vecchia C**, D'Avanzo B, Franzosi MG, *et al*. Passive smoking and the risk of acute myocardial infarction GISSI-EFRIM investigations. *Lancet* 1993;**341**:505–6.
15. **Ciruzzi M**, Pramparo P, Esteban O, *et al*. Case-control study of passive smoking at home and risk of acute myocardial infarction. Argentine FRICAS Investigators. Factores de Riesgo Coronario en America del Sur. *J Am Coll Cardiol* 1998;**31**:797–803.
16. **Whincup PH**, Gilg JA, Emberson JR, *et al*. Passive smoking and risk of coronary heart disease and stroke: prospective study with cotinine measurement. *BMJ* 2004;**329**:200–5.
17. **Pron GE**, Burch JD, Howe GR, *et al*. The reliability of passive smoking histories reported in a case-control study of lung cancer. *Am J Epidemiol* 1988;**127**:267–73.
18. **Emmons KM**, Abrams DB, Marshall R, *et al*. An evaluation of the relationship between self-report and biochemical measures of environmental tobacco smoke exposure. *Prev Med* 1994;**23**:35–9.
19. **Cummings KM**, Markello SJ, Mahoney M, *et al*. Measurement of current exposure to environmental tobacco smoke. *Arch Environ Health* 1990;**45**:74–9.
20. **Yang GH**, Ma JM, Liu N, *et al*. Smoking and passive smoking in Chinese, 2002. *Chinese J Epidemiology* 2005;**26**:77–83.
21. **McGhee SM**, Hedley AJ, Ho LM. Passive smoking and its impact on employers and employees in Hong Kong. *Occup Environ Med* 2002;**59**:842–6.