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## Tobacco smoking and sexual difficulties among Australian adults: a cross-sectional study

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**Background:** Few studies have examined smoking and female sexual difficulties. The aim of this study was to investigate the association between current tobacco smoking and sexual difficulties in Australian men and women.

**Methods:** Data for this study came from the Second Australian Study of Health and Relationships (2012–13), which includes a representative sample of 18427 sexually active Australian adults (aged 16–69 years). The main study and outcome measures were tobacco smoking and sexual difficulties. A multiple logistic regression analysis was conducted to adjust for potential confounders. **Results:** Male heavy smokers (>20 cigarettes per day) were significantly more likely than non-smokers to have trouble keeping an erection [adjusted odds ratio (AOR) 4.14, 95% confidence interval (CI) 1.87 – 9.20;  $P < 0.0001$ ], lack interest in having sex (AOR 2.18, 95% CI 1.20 – 3.97;  $P = 0.011$ ), have anxiety about performance (AOR 2.46, 95% CI 1.24 – 4.86;  $P = 0.010$ ) and be unable to come to orgasm (AOR = 2.81, 95% CI 1.23–6.42;  $P = 0.015$ ). Female smokers were also significantly more likely than non-smokers to not find sex pleasurable (AOR 1.48, 95% CI 1.05 – 2.07;  $P = 0.025$ ); and light female smokers were significantly more likely than non-smokers to be unable to come to orgasm (AOR = 1.44, 95% CI 1.05–1.98;  $P = 0.025$ ). **Conclusions:** Current tobacco smoking was associated with sexual difficulties in both men and women. For women, even light smoking was associated with not finding sex pleasurable and being unable to come to orgasm.

**Additional keywords:** Australia, national survey, quantitative survey, representative-sample survey, sexual difficulties, tobacco smoking.

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### TOC summary

Few studies have examined smoking and female sexual difficulties. Data for this study came from the Second Australian Study of Health and Relationships (2012–13), which includes a representative sample of 18427 sexually active Australian men and women (aged 16–69 years). Current tobacco smoking was associated with sexual

difficulties in both men and women. This was more evident among male heavy smokers. For women, even light smoking was associated with not finding sex pleasurable and being unable to come to orgasm.

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Tobacco smoking and sexual difficulties

L. M. Wen *et al.*

## **Introduction**

Tobacco smoking is known to cause a wide range of health problems, and in developed countries, is considered the leading cause of preventable morbidity and mortality.<sup>1,2</sup> Despite global and national tobacco control efforts, tobacco smoking persists among a substantial proportion of adults.<sup>3-5</sup>

Over the past few decades, it has also been established that tobacco smoking can contribute to erectile difficulties among men, with erectile quality improving with smoking cessation.<sup>6,7</sup> Representative surveys of the general male population have found a significant association between smoking and erectile dysfunction.<sup>8,9</sup> A large Australian study found that this association was strengthened as the number of cigarettes smoked increased.<sup>10</sup>

Erectile dysfunction has been most frequently examined on sex-related consequences of smoking,<sup>11,12</sup> but it is also possible that tobacco smoking is directly associated with other sexual difficulties among men, such as reduced sexual arousal<sup>13</sup> or lack of interest in sex.<sup>14</sup> However, the few studies that have explored other sexual difficulties have mostly found associations only between tobacco smoking and erectile dysfunction.<sup>14,15</sup> Erectile difficulties, through reduced physical functioning, may indirectly affect desire or sexual satisfaction if sexual performance is reduced.<sup>16</sup>

Very few studies have examined possible associations between tobacco smoking and female sexual difficulties. Moreira found no association between tobacco smoking and inability to reach orgasm, lack of interest in sex and lubrication difficulties.<sup>14</sup> Christensen *et al.* also found no association between tobacco smoking and these sexual difficulties, but did find that unhealthy lifestyle risk factors were associated with sexual inactivity in the last year.<sup>15</sup>

Some studies have found smoking to have a negative effect upon women's sexual function. Choi *et al.* found that among current female Korean smokers, the frequency of female sexual difficulties was significantly higher and this difference remained significant after adjustment for confounding variables.<sup>17</sup> In one of the few longitudinal studies, tobacco smoking predicted the incidence, but not persistence/recurrence, of lacking interest in sex among Australian women.<sup>18</sup> Acute nicotine intake significantly attenuated physiological sexual arousal in healthy non-smoking women in a randomised controlled trial,<sup>13</sup> supporting the hypothesis that smoking reduces interest in sex.

Given the mixed and limited findings in the area, there is a need to investigate the association between current tobacco smoking and sexual difficulties using a large and representative sample of both men and women.

## **Methods**

### *Study design and survey participants*

We analysed Australian national cross-sectional survey data from the Second Australian Study of Health Relationships (ASHR2). The methodology used in ASHR2 is described in detail elsewhere.<sup>19</sup> Briefly, between October 2012 and November 2013, computer-assisted telephone interviews were completed by a representative sample of 20 094 Australian residents aged 16–69 years from all states and territories. Ethics committee approval was obtained from the researchers' host universities. Respondents were selected using dual-frame modified random-digit dialling (RDD), combining directory-assisted, landline-based RDD with RDD of mobile telephones. The overall response rate (participation rate among eligible people) was 66.2%. For this analysis, only those respondents ( $n = 18\,427$ ) who reported being sexually active in the last year were included, accounting for 91.7% of the whole sample. Sexually active was defined using a broad definition, which covered oral, vaginal or anal intercourse, sexual contact involved stimulating the penis or vaginal area with male or female partners, any forms of group sex or had masturbation alone.

To maximise the number of interviews with people who had engaged in less-common and/or more-risky behaviours, all respondents who reported being sexually active in the previous year, who had had more than one partner in the previous year and/or who reported homosexual experience completed a long form of the survey instrument, which collected detailed data on their sexual attitudes, relationships and behaviours. Of respondents who reported having had one partner in the previous year and no homosexual experience, 20% were randomly selected to complete the long-form interview and the other 80% completed a short-form interview. As a consequence, 8577 completed the long-form interview and 11 517 completed the short-form interview. More information on the long and short forms of the question can be found in the main method paper for this study.<sup>17</sup>

### *Main variables of interest*

Questions asked about sexual difficulties reported in this study are shown in Box 1, and these variables are the study outcomes, each of which was categorised as a dichotomous outcome. They were asked of all who were sexually active in the last year. Skip patterns in the computer-assisted telephone interview prevented people being asked inappropriate questions; for example, they were not asked about pain

during intercourse unless they had reported experience of vaginal (or anal) intercourse. The primary study variable was current tobacco smoking. This was assessed by questions ‘Do you currently smoke cigarettes, cigars, pipes or any other tobacco products?’ and ‘On average, how many cigarettes do you smoke a day?’ Current tobacco smoking status was dichotomous and current smokers were further dichotomised as ‘≤20 cigarettes per day’ and ‘>20 cigarettes per day’ based on our previous study.<sup>10</sup>

### *Covariates*

Possible confounding variables included age, alcohol consumption, psychological distress, whether taking medication for cardiovascular disease (yes/no) and presence of diabetes or high blood sugar (yes/no). Respondents’ ages were recoded into six groups: 16–19, 20–29, 30–39, 40–49, 50–59 and 60–69 years. Reports of alcohol consumption frequency and volume were used to determine whether respondents exceeded the 2001 National Health and Medical Research Committee guidelines (28 standard drinks a week for men and 14 for women).<sup>20</sup>

Psychological distress was measured by the Kessler 6 Mental Health Scale (K6), which consists of six questions about depressive and anxiety symptoms that a person has experienced in the most recent 4-week period; one is the minimum score for each item (none of the time) and five is the maximum score (all of the time) in Australian surveys, and the sum of scores was ranged from 6 to 30. K6 dichotomous score groupings were then applied in the data analysis, with the sum scores between 6–18 and 19–30 being classified as ‘no probable serious mental illness’ and ‘probable serious mental illness’ respectively.<sup>21–23</sup>

Respondents’ reported highest completed level of education was recoded to distinguish between those who had not (yet) completed secondary school, those who had completed secondary school and those who had completed post-secondary education. To approximate the gross annual household income quintiles reported by the Australian Bureau of Statistics for 2009–10,<sup>24</sup> respondents’ reported annual income was grouped into five categories: very low (less than \$28 000), low (\$28 001–\$52 000), middle (\$52 001–\$83 000), high (\$83 001–\$125 000) and very high (more than \$125 000).

### *Statistical analysis*

Data were weighted to adjust for the probability of each respondent being selected for a landline or mobile phone interview, a long-form interview and (for landline participants) the number of in-scope adults in the household. Data were then weighted to match the Australian population on the basis of age, gender, area of residence [i.e. state by (Accessibility/Remoteness Index of Australia category)] and telephone ownership (i.e. mobile telephone only vs other), resulting in an adjusted sample of 10 056 men

and 10038 women (total 20094). The data were thus weighted to account for the specifics of our sample design and the fact that particular types of people were slightly over- or under-represented. Therefore, the data presented describe the Australian population aged 16–69 years.<sup>19</sup>

Weighted data were analysed using the survey estimation commands in Stata Version 13.1.<sup>25</sup> Descriptive statistics of the study variables were calculated by stratifying by gender. In assessing the association between current tobacco smoking and sexual difficulties in men and women, two steps were taken. The first used univariate logistic regression for dichotomous outcomes, and in the second, variables found to be associated with sexual difficulties on univariate analyses ( $P < 0.25$ ) were further entered into a multiple logistic regression model in order to adjust for potential confounding factors. In the multiple logistic regression analysis, all variables were entered in one step and removed from the model if they were not significant or non-confounders. Adjusted odds ratios (ORs) with their 95% confidence intervals were then calculated as a measure of strength of the association.

## Results

A weighted total of 9611 men and 8816 women reported being sexually active in the previous 12 months. Table 1 shows the main characteristics of the study participants stratified by gender. The mean age of male and female respondents was 41.2 and 40.4 years respectively. Of male respondents, ~7% were aged between 16 and 19 years and 15% were aged between 60 and 69 years. Approximately half (49%) had post-secondary education. Over half (52.5%) were married, 9.6% were separated or divorced and 37.4% had never married. Most respondents were in full-time employment (67.5%), 13.4% worked part-time and 3.7% were unemployed, with the rest studying, retired or engaged in other activities such as volunteering. The majority (91.8%) spoke English at home. Most respondents (87%) did not consume alcohol exceeding the National Health and Medical Research Council guidelines. Fifteen per cent reported taking medication for cardiovascular diseases ('high blood pressure or a heart condition') and 7% had been told by a doctor or nurse that they had diabetes or high blood sugar. Similar proportions of men and women had diabetes or high blood sugar. Fewer women (10.3%) than men (15.0%) took medication for cardiovascular disease and the majority (94% women and 88.6% men) had not consumed alcohol exceeding the NHMRC guidelines. Less than 5% (4.7%) of women and 2.5% of men reported probable serious mental illness.

Table 2 shows sexual difficulties and tobacco smoking reported by men and women. Among men, 28% reported that they lacked interest in having sex, 12% had 'trouble keeping an erection', 14% were 'anxious about performance' and 7% were 'unable to come to orgasm'. Almost one-fifth (19%) of male

respondents were current smokers, with 16.3% smoking  $\leq 20$  cigarettes per day and 2.6% smoking  $> 20$  cigarettes per day.

Among women, over half (53%) reported that they lacked interest in having sex, nearly one-quarter (24%) were unable to come to orgasm and 19% did not find sex pleasurable. Similarly to men, 14% of women also reported being anxious about their sexual performance. Regarding current tobacco smoking, 15% were current smokers, with 13.7% smoking  $\leq 20$  cigarettes per day and 1.4% smoking  $> 20$  cigarettes per day.

On univariate analysis, male smoking was found to be significantly associated with lacking interest in having sex, having trouble keeping an erection, having anxiety about performance or being unable to come to orgasm. Female smoking was significantly associated with not finding sex pleasurable, having anxiety about performance or being unable to come to orgasm. These sexual difficulties were also found to be associated with age, alcohol consumption, Kessler 6 Mental Health Scale (K6) dichotomous score groupings, taking medication for CVD and having diabetes or high blood sugar. But no associations with smoking were found for the other types of sexual difficulties listed in Table 2 for men or women.

Results of multivariate analysis are presented in Tables 3 and 4. After adjusting for age, alcohol consumption, Kessler 6 Mental Health Scale (K6) dichotomous score groupings, taking medication for CVD and having diabetes or high blood sugar, male smokers ( $> 20$  cigarettes per day) were significantly more likely than non-smokers to report having trouble keeping an erection (AOR 4.14, 95% CI 1.87–9.20;  $P < 0.0001$ ), lack interest in having sex (AOR 2.18, 95% CI 1.20–3.97;  $P = 0.011$ ), have anxiety about performance (AOR 2.46, 95% CI 1.24–4.86;  $P = 0.010$ ) and report being unable to come to orgasm (AOR = 2.81, 95% CI 1.23–6.42;  $P = 0.015$ ) (Table 3). Female smokers ( $\leq 20$  cigarettes per day) were also significantly more likely than non-smokers to report not finding sex pleasurable (AOR 1.48, 95% CI 1.05–2.07;  $P = 0.025$ ) and being unable to come to orgasm (AOR = 1.44, 95% CI 1.05–1.98;  $P = 0.025$ ) (Table 4). For women, smoking  $> 20$  cigarettes per day was not found to be significantly associated with sexual difficulties, which was due to a smaller sample size resulting in wider confidence intervals.

## **Discussion**

This study using a large national representative sample of Australian men and women found that current smoking was significantly associated with sexual difficulties. This was more evident in male heavy smokers ( $> 20$  cigarettes per day). For women, current smoking was significantly associated with not finding sex pleasurable, and light to moderate smoking was also significantly associated with not finding sex pleasurable and being unable to come to orgasm.

Our study confirms the findings of a previous Australian population-based study conducted in 2003, the first Australian Study of Health and Relationships, which linked smoking with erectile dysfunction.<sup>10</sup> This was further supported by heavy male smokers being more likely to report lacking interest in sex and having anxiety about sexual performance, which is likely to be related to having erectile difficulties.

The findings for women are important, and may be a function of a similar physiological response to tobacco smoking. If reduced peripheral blood circulation affects female lubrication, this could contribute to sex not being pleasurable, although the responses to the question on vaginal dryness was not significantly associated with smoking. However, vaginal dryness is known to be associated with foreplay and various sexual practises designed to arouse, and these practises or their absence are likely to have more influence on vaginal dryness than smoking.<sup>26</sup> Recent research using in-depth interviews with women found some women who experienced low desire or pain during intercourse still engaged in intercourse primarily to connect with and please male partners.<sup>27,28</sup>

The number of women smoking more than 20 cigarettes per day was quite small ( $n = 126$ ). This is likely to have contributed to wide confidence intervals and lack of statistical association with sexual difficulties. However, the size of the adjusted odds ratio and the direction of the association between smoking and sexual difficulties was consistent with that of light to moderate smokers.

While we have presented some evidence for an association between some sexual difficulties and the quantity of tobacco smoked daily, another smoking-related factor that may be important is how long a person smoked for. Although we did not assess duration of smoking, it is highly plausible that a longer period of smoking would cause more physiological damage in combination with regular smoking, particularly heavy smoking, and this could affect sexual function. To some extent, age is a proxy for duration of smoking, because the uptake of tobacco smoking is very low once adults are in their twenties. A 60-year-old smoker is most likely to have smoked for ~40 years.

### *Strengths and weaknesses*

This study provides a strong evidence of association between tobacco smoking and sexual difficulties using a large national representative sample. The current tobacco smoking was assessed by a widely used population health survey questionnaire for assessing smoking status with good validity and reliability. The questions for assessing sexual difficulties for men and women had been used previously in the first Australian Study of Health and Relationships,<sup>29</sup> and by several recent studies.<sup>18,30</sup> The significance of the findings is strengthened by the fact that our sample included both men and women from a wide age range and that we were able to control for many of the potential confounding factors including age, alcohol consumption, psychological distress, taking medication for CVD and whether the participants had



diabetes or high blood sugar. However, we acknowledge the need to exercise caution in making inferences about causality based on cross-sectional surveys of this kind. The association found in this study between smoking and sexual difficulties warrants further investigation to establish whether this relationship is causal. In particular, the biological mechanism of this association in women requires further investigation. Having had no blood or hormonal data collected limits the exploration of possible causal pathways.

## **Conclusion**

Studies on smoking and sexual difficulties are often limited because they are based on small samples, often of older people or patients. This study used a large national representative and relatively young general population and found current tobacco smoking to be associated with sexual difficulties in both Australian men and women. This was more evident among male heavy smokers. The findings of this study provide more evidence of an adverse effect of smoking on sexual health. The association found in this study between smoking and sexual difficulties warrants further investigation to establish whether this relationship is causal.

## **Conflicts of interest**

None declared.

## **Acknowledgements**

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**Table 1. Main characteristics of study participants stratified by gender: weighted frequencies (and column percentages) (Australian Study of Health and Relationships 2013)**

NHMRC, National Health and Medical Research Council

Covariates	Men ( <i>n</i> = 9611 <sup>A</sup> ) <i>n</i> (%)	Women ( <i>n</i> = 8816 <sup>A</sup> ) <i>n</i> (%)
Age (years)		
16–19	680 (7.1)	479 (5.4)
20–29	1993 (20.7)	1893 (21.5)
30–39	1874 (19.5)	2006 (22.8)
40–49	1883 (19.6)	1933 (21.9)
50–59	1790 (18.6)	1580 (17.9)
60–69	1391 (14.5)	927 (10.5)
Household income level		
Very low	1121 (12.4)	1154 (14.2)
Low	1288 (14.3)	1247 (15.4)
Middle	1901 (21.1)	1796 (22.1)
High	1983 (21.9)	1866 (23.0)
Very high	2731 (30.3)	2054 (25.3)
Education level		
Less than secondary	1380 (14.4)	1325 (15.0)
Secondary	3520 (36.7)	2118 (24.0)
Post-secondary	4703 (48.9)	5368 (60.9)
Marital status		
Married	5042 (52.5)	4978 (56.5)
Divorced	644 (6.7)	638 (7.2)
Separated	282 (2.9)	249 (2.8)
Widowed	48 (0.5)	103 (1.2)
Never married	3593 (37.4)	2843 (32.3)
Language spoken at home		
English	8822 (91.8)	8287 (94.1)
Other	788 (8.2)	524 (5.9)
Employment status		
Full time	6479 (67.5)	3153 (35.8)
Part time	1288 (13.4)	2987 (33.9)
Unemployed	357 (3.7)	227 (2.6)
Not in labour force	1483 (15.4)	2443 (27.7)
Alcohol consumption exceeds NHMRC guidelines		
Yes	1280 (13.4)	530 (6.0)
No	8282 (86.6)	8257 (94.0)
Alcohol consumption		
Non-drinker	1089 (11.4)	1452 (16.5)
1–4 drinks per day	6230 (65.1)	6498 (74.0)
4+ drinks per day	2247 (23.5)	838 (9.5)
Taking meds for cardiovascular disease		
Yes	1441 (15.0)	907 (10.3)
No	8171 (85.0)	7914 (89.7)

Diabetes or high blood sugar		
Yes	655 (6.8)	641 (7.3)
No	8956 (93.2)	8178 (92.7)
Kessler6 dichotomous score groupings		
No probable serious mental illness (6–18)	9322 (97.5)	8352 (95.3)
Probable serious mental illness (19–30)	235 (2.5)	414 (4.7)

<sup>A</sup>Number may not add up due to missing values.

**Table 2. Sexual difficulties and tobacco smoking reported by men and women (weighted frequencies) (Australian Study of Health and Relationships 2013)**

Note: All variables were weighted

Outcomes	Male ( <i>n</i> = 9611 <sup>A</sup> ) <i>n</i> (%)	Female ( <i>n</i> = 8816 <sup>A</sup> ) <i>n</i> (%)
Sexual difficulties		
Lacked interest in sex	2367 (27.5)	4259 (52.8)
Unable to come to orgasm	573 (6.7)	1932 (24.4)
Orgasm too quickly	1837 (21.4)	434 (5.5)
Physical pain during intercourse	130 (1.5)	1346 (16.9)
Did not find sex pleasurable	379 (4.4)	1510 (18.8)
Anxious about performance	1225 (14.3)	1092 (13.6)
Trouble keeping erection	987 (11.5)	–
Vaginal dryness	–	1783 (22.2)
Current tobacco smoking		
Non-smokers	7724 (81.1)	7423 (84.8)
Smokers	1803 (18.9)	1326 (15.1)
≤20 cigarettes per day	1554 (16.3)	1200 (13.7)
>20 cigarettes per day	249 (2.6)	126 (1.4)

<sup>A</sup>Number may not add up due to missing values.

**Table 3. Association between current tobacco smoking and sexual difficulties among men (Australian Study of Health and Relationships 2013)**

CI, confidence interval; CVD, cardiovascular disease; OR, odds ratio

Variables	Lacked interest in sex			Had trouble keeping erection			Anxiety about performance			Unable to come to orgasm		
	%	Adjusted OR (95% CI) <sup>A</sup>	P-value	%	Adjusted OR (95% CI) <sup>A</sup>	P-value	%	Adjusted OR (95% CI) <sup>A</sup>	P-value	%	Adjusted OR (95% CI) <sup>A</sup>	P-value
Current tobacco smoking												
Non-smokers	26.9	1		11.1	1		13.7	1		6.4	1	
≤20 cigarettes per day	29.2	1.17 (0.87 – 1.59)	0.302	11.4	1.43 (0.96 – 2.14)	0.080	15.9	1.38 (0.95 – 2.00)	0.096	7.2	1.26 (0.80 – 1.99)	0.318
>20 cigarettes per day	41.4	2.18 (1.20 – 3.97)	0.011	27.2	4.14 (1.87 – 9.20)	<0.0001	24.6	2.46 (1.24 – 4.86)	0.010	13.5	2.81 (1.23 – 6.42)	0.015
Current tobacco smoking												
Non-smokers	26.9	1		11.1	1		13.7	1		6.4	1	
Smokers	30.2	1.24 (0.94 – 1.63)	0.129	13.2	1.68 (1.16 – 2.42)	0.006	16.8	1.46 (1.04 – 2.05)	0.029	7.8	1.36 (0.89 – 2.06)	0.154

<sup>A</sup>Adjusting for age, alcohol consumption, Kessler6 dichotomous score groupings, taking medication for CVD and whether having diabetes or high blood sugar.

**Table 4. Association between current tobacco smoking and sexual difficulties among women (Australian Study of Health and Relationships 2013)**

CI, confidence interval; CVD, cardiovascular disease; OR, odds ratio

Variables	Not finding sex pleasurable			Anxiety about performance			Unable to come to orgasm		
	%	Adjusted OR (95% CI) <sup>A</sup>	P-value	%	Adjusted OR (95% CI) <sup>A</sup>	P-value	%	Adjusted OR (95% CI) <sup>A</sup>	P-value
Current tobacco smoking									
Non-smokers	17.9	1		12.8	1		23.6	1	
≤20 cigarettes per day	24.2	1.48 (1.05 – 2.07)	0.025	18.6	1.32 (0.91 – 1.93)	0.141	29.8	1.44 (1.05 – 1.98)	0.025
>20 cigarettes per day	29.9	1.59 (0.61 – 4.11)	0.342	17.2	0.99 (0.31 – 3.13)	0.980	24.2	1.04 (0.38 – 2.79)	0.944
Current tobacco smoking									
Non-smokers	17.9	1		12.8	1		23.6	1	
Smokers	24.0	1.43 (1.04 – 1.97)	0.026	17.7	1.21 (0.85 – 1.73)	0.282	28.5	1.34 (0.99 – 1.81)	0.055

### Box 1. Sexual difficulty questions asked

*Response options: Yes/No*

*Asked of all who were sexually active in the last year:*

During the last year has there been a period of one month or more when you lacked interest in having sex?

Has there been a period of one month or more when you were unable to come to orgasm?

Has there been a period of one month or more when you came to orgasm too quickly?

Has there been a period of one month or more when you experienced physical pain during intercourse?

Has there been a period of one month or more when you did not find sex pleasurable?

Has there been a period of one month or more when you felt anxious about your ability to perform sexually?

*Asked of men only:*

Has there been a period of one month or more when you had trouble keeping an erection when you wanted to?

*Asked of women only:*

Has there been a period of one month or more when you had trouble with vaginal dryness?