



## Underage alcohol drinking and medical services use in Hong Kong: a cross-sectional study

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**Underage alcohol drinking and medical services use in Hong Kong: a cross-sectional study**

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## Abstract

**Objectives:** To investigate the association of underage alcohol drinking with medical consultation and hospitalisation in Hong Kong.

**Design:** Cross-sectional study.

**Setting:** Secondary schools in Hong Kong.

**Participants:** A total of 33300 secondary 1 (US grade 7) to 5 students (47.6% boys, mean age 14.6 ( $\pm 1.6$ ) years) in 85 randomly selected schools.

**Outcome measures:** Anonymous questionnaire was used to obtain information on medical consultation in the past 14 days, hospitalisation in the past 12 months, alcohol drinking, smoking, illicit drug use, physical activity, secondhand smoke exposure, feeling depressed, feeling anxious and socio-demographic characteristics. Alcohol drinking was categorised as non-drinking (reference),  $<1$  day/week, 1-2 days/week and 3-7 days/week. Logistic regression yielded adjusted odds ratios (AORs) for medical consultation and hospitalisation due to drinking in models adjusting for different potential confounders. Subgroup analysis was conducted among adolescents who did not report feeling anxious or depressed.

**Results:** More than one-fourth (27.6%) of adolescents drank alcohol, 15.9% had medical consultation and 5.1% had been hospitalised. In the fully adjusted model, the AORs (95% CI) for medical consultation were 1.14 (1.06-1.23) for  $<1$  day/week, 1.30 (1.13-1.50) for 1-2 days/week and 1.70 (1.41-2.06) for 3-7 days/week of drinking compared with non-drinking (P for trend  $<0.001$ ). The corresponding AORs (95% CI) for hospitalisation were 1.14 (1.02-1.28), 1.68 (1.32-2.14) and 2.38 (1.90-2.98) (P for trend  $<0.001$ ). Similar associations were observed among students without feeling anxious or depressed.

**Conclusions:** Alcohol consumption was associated with medical services use in Chinese adolescents. More rigorous alcohol control policies and health promotion programmes are needed to curb the growing alcohol epidemic in adolescents.

**Article summary**

**Article focus**

- To investigate the associations of alcohol drinking and medical consultation and hospitalisation among adolescents in Hong Kong.

**Key messages**

- Alcohol drinking is prevalent among adolescents (one-fourth) in Hong Kong.
- Underage alcohol drinking was significant associated with medical consultation and hospitalisation.
- Alcohol control policy is urgently needed in Hong Kong to curb the growing alcohol epidemic among adolescents in Hong Kong.

**Strengths and limitations of this study**

This is the first study investigated the association between alcohol consumption and medical services use among a large sample of Chinese adolescents. The findings are representatives to Hong Kong adolescents as random sampling was used and a high response rate was achieved. The cross-sectional design, self-reported alcohol consumption and medical services use are the major limitations of this study. Cohort studies with objective measures are warranted to confirm the findings.

## Introduction

The prevalence of underage drinking is increasing in most countries.<sup>1</sup> Underage alcohol drinking impairs brain development, causes violence and injury, increases risky sexual behaviours and unplanned pregnancy, and leads to psychological problems.<sup>2</sup> Psychosocial and educational primary prevention programmes were not effective in reducing alcohol drinking among youth.<sup>3</sup> Only small beneficial effects were observed for universal family and school-based programmes for preventing binge drinking and drunkenness.<sup>4,5</sup>

Although the effects of underage drinking on health are well documented, less is known about the effects on medical services use. In adults, some studies found moderate drinking associated with lower hospitalisation than abstinence or heavy drinking (U-shape association),<sup>6-9</sup> but other studies found that hospitalisation increased with alcohol consumption.<sup>10,11</sup> As regards outpatient services use, an inverse association with alcohol consumption was found in several studies.<sup>9,12,13</sup>

In adolescents, consequences of alcohol drinking such as unintended injuries, risky sexual behaviours and intoxication, often require acute medical care and hospitalisation.<sup>14-16</sup> These findings were mainly based on Western countries where alcohol consumption is high. For example, in US adolescents, 49% drank monthly and 23% had ever binged,<sup>2</sup> and 5.8% of hospitalisation among adolescents was attributable to alcohol use disorders.<sup>17</sup> Little is known about the effects of alcohol drinking on medical services use in Chinese adolescents, who consume less alcohol than their Western counterparts.<sup>1</sup>

In Hong Kong, a highly westernized Chinese society, 22%-26% of adolescents drank monthly.<sup>18</sup> Health services are easily accessible with primary care medical consultations provided mainly by general practitioners, and in-patient services by public hospitals at low costs<sup>19</sup>. We

investigated the association between alcohol drinking and medical services use among Chinese adolescents in Hong Kong. The results may have implications for alcohol control also in mainland China and other Asian countries experiencing a growing epidemic of underage alcohol use.<sup>20</sup>

**Methods**

*Sampling*

A school-based youth health survey was conducted among secondary 1 (US grade 7) to 5 students in Hong Kong in 2003-4. Details of the survey have been reported elsewhere.<sup>21,22</sup> Briefly, 85 secondary schools were randomly selected from all secondary schools (about 500) with a probability to the school enrolment size.<sup>23</sup> All form 1 classes and 2 randomly selected classes in each upper forms completed an anonymous questionnaire in the schools. To encourage candid reporting, separate answer sheets were provided. Teachers were present to maintain classroom order, but avoided patrolling or seeing the answers. Completed answer sheets were immediately put in an opaque envelope and collected by research assistants. Ethics approval was granted by a local institutional review board.

*Measurement*

Alcohol consumption was measured using the question “Do you drink alcohol including beer in usual days?” with drinking frequency categorised as non-drinking (reference), “less than 1 day/week”, “1-2 days/week” and “3-7 days/week”. Medical consultation was defined as any Chinese or Western medical consultations in the past 14 days. Hospitalisation was defined as any hospital admission in the past 12 months. Data collected also include housing type and parental highest education attainment (proxies of socioeconomic status), sex, age, family structure (intact or non-intact), parental smoking (both, either or none), peer smoking (any or

none), secondhand smoke exposure at home (any or none) and outside home (any or none), physical activity (never, occasionally or frequently), illicit drug use (ever or never), smoking (ever or never), feeling anxious (yes or no) and feeling depressed (yes or no).

### *Statistical analysis*

After excluding questionnaires due to response sets (dubious response patterns), excessive missing data (>50% missing items) (N=718, 2%), and age  $\geq 18$  (N=2094, 6%), 33300 (92.2%) remained for analysis using Stata 10.1. Logistic regression was used to calculate the adjusted odds ratios (AOR) of medical consultation and hospitalisation for alcohol drinking in models that progressively adjusted for more covariates: basic demographic factors, socioeconomic status and family structure (model 1); unhealthy behaviours (model 2); and parental smoking and peer smoking (model 3). Psychological distress of feeling anxious and depressed are common risk factors of alcohol drinking and medical services use.<sup>2,24</sup> To control for such potential confounding, subgroup analyses were conducted restricted to students who did not report feeling anxious or depressed (Model 4).

### **Results**

Of all 33300 students, 47.6% were boys, mean age was 14.6 ( $\pm 1.6$ ) years, 36.7% reported highest parental education of primary or below, and half (43.6%) were living in public housing estates (Table 1). One in four (27.6%) students drank alcohol and most commonly in <1 day/week (21.1%). As expected, medical consultation in the past 14 days (15.9%) was more frequently reported than hospitalisation in the past 12 months (5.1%). Girls were more likely to have medical consultation but less likely to be hospitalised than boys. Younger students were more likely to be hospitalised but medical consultation was similar by age. Lower

socioeconomic status, feeling depressed, feeling anxious, smoking, illicit drug use, physical inactivity and alcohol drinking were associated with medical consultation and hospitalisation.

Associations between alcohol drinking and medical services uses were consistently observed in crude and adjusted logistic regression models (models 1-4). In the fully adjusted model (model 3), the AORs (95% CI) for medical consultation were 1.14 (1.06-1.23) for <1 day/week, 1.30 (1.13-1.50) for 1-2 days/week and 1.70 (1.41-2.06) for 3-7 days/week of alcohol drinking (P for trend <0.001), compared with non-drinking. The corresponding AORs (95% CI) for hospitalisation were 1.14 (1.02-1.28), 1.68 (1.32-2.14) and 2.38 (1.90-2.98) (p <0.001 for trend). Similar associations were observed for medical consultation and hospitalisation among adolescents who did not feel anxious or depressed.

**Discussion**

To the best of our knowledge, this is the first study that investigates the association between medical services use and alcohol drinking among non-Western underage adolescents. Previous studies have documented the association between alcohol drinking and risk factors (e.g. digestive problems, respiratory symptoms, injury, etc.) of medical services use among Chinese adolescents.<sup>25</sup> Our results were consistent with Western studies that linked alcohol consumption to hospitalisation due to alcohol intoxication among adolescents and ambulance use among college students.<sup>14-16</sup> The present study did not require medical consultations and hospitalisations to be alcohol-related, and stronger associations were expected otherwise.

Contrary to the U-shaped<sup>6-9</sup> or inverse<sup>12,13</sup> associations between alcohol drinking and medical services use among adults in other studies, we found a positive linear association among adolescents. The U-shaped or inverse associations in adults could reflect that light and moderate



1  
2  
3 drinkers were more health conscious and less likely to seek medical care than heavy drinkers;  
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5 some abstainers might also have quit drinking due to illness. Such healthier profile in moderate  
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7 drinkers was not apparent in adolescents and potential differences in background characteristics  
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9 and health behaviours were adjusted for in different regression models. The putative health  
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11 benefits of moderate alcohol drinking, such as that on heart disease, among adults are also  
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13 controversial due to the favourable characteristics of such drinkers.<sup>26</sup>  
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18 In Hong Kong, beer and wine tax was unprecedentedly abolished in 2008 to boost alcohol  
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20 trading,<sup>27</sup> and this was followed by fierce promotion by the industry. Alcohol drinking is  
21  
22 increasingly publicised as stylish and fashionable without any legislation regulating such  
23  
24 promotion in Hong Kong. Our results provide support for establishing the Framework  
25  
26 Convention on Alcohol Control,<sup>28</sup> which will guide alcohol policy on taxation and promotion,  
27  
28 two of the most important strategies in reducing adolescent drinking.  
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34 Our study has several limitations. All the data were self-reported including alcohol drinking,  
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36 medical consultation and hospitalisation. Medical consultation and hospitalisation are obvious  
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38 events and similar questions have been used by other studies, which supported the validity of  
39  
40 such self-reported data by children and adolescents.<sup>29,30</sup> The significant associations of medical  
41  
42 services use with health complaints and poor self-rated health in the present study (all  $P < 0.05$ ,  
43  
44 data not shown in tables) also supported the validity of these data. Due to the cross-sectional  
45  
46 design, temporality between alcohol consumption and medical services use could not be  
47  
48 ascertained, although it seemed unlikely that medical services use had led to alcohol drinking.  
49  
50 On the contrary, students who had medical consultations or had been hospitalised would be  
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52 more likely to avoid drinking and resulted in an underestimation of the association. Although  
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54 robust and dose-response associations were observed in this study, prospective studies are  
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needed to ascertain temporality. Given the limited time provided by the schools, we used simple questions adapted from other studies to measure depression and anxiety.<sup>31</sup> Their validity was supported by our previous findings on a positive association with weight misperception using the same sample.<sup>32</sup> Finally, although the associations had been adjusted for many potential confounders including smoking, drug use and physical inactivity, residual confounding cannot be ruled out in observational studies.

**Conclusions**

Alcohol consumption was associated with medical services use in Chinese adolescents. More rigorous alcohol control policies and health promotion programmes are needed to curb the growing alcohol epidemic in adolescents.

**Contributors:** SYH and THL conceived and designed the study. MPW and SYH analyzed the data. MPW, SYH and THL wrote the paper and approved the final version.

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**Declaration:** All authors have no relevant financial interest and any conflict of interest in this article.

**Data Sharing**  
No additional data are available

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For peer review only

Table 1. Prevalence of medical consultation and hospitalisation by basic characteristics among students aged 11-17.

	N (%)	Medical consultation		Hospitalisation	
		%	$\chi^2$ P	%	$\chi^2$ P
Sex			<0.001		<0.001
Boys	15845 (47.6)	15.1		5.9	
Girls	17455 (52.4)	16.6		4.4	
Age			0.30		0.02
11-14	13812 (41.5)	16.1		5.5	
15-17	19488 (58.5)	15.7		4.9	
Highest parental education			<0.001		<0.001
Unknown	5749 (18.0)	14.1		4.4	
Uneducated or kindergarten	514 (1.6)	19.8		7.8	
Primary school	3885 (12.2)	15.4		4.6	
Form 1-3	7361 (23.1)	15.2		4.5	
Form 4-5	8082 (25.4)	16.0		5.3	
Form ≥6	6269 (19.7)	18.1		6.2	
Housing type			<0.001		<0.001
Public housing estate	13470 (42.6)	14.2		4.4	
Subsidised private housing	3121 (9.9)	15.2		5.1	
Private (owner)	10290 (32.5)	17.2		5.0	
Private (tenant)	2676 (8.5)	16.6		6.0	
Temporary	326 (1.0)	27.9		18.1	
Others	1771 (5.6)	18.0		7.2	
Feeling depressed			<0.001		0.05
No	28350 (85.1)	15.4		5.1	
Yes	2950 (14.9)	18.4		5.6	
Feeling anxious			<0.001		<0.001
No	30485 (91.6)	15.4		4.9	
Yes	2815 (8.5)	20.8		7.7	
Smoking			<0.001		<0.001
Never-smokers	25201 (76.1)	14.8		4.0	
Ever-smokers	7914 (23.9)	19.3		8.6	
Illicit drugs			<0.001		<0.001
Never-use	31111 (93.6)	15.1		4.6	
Ever-use	2130 (6.4)	26.4		13.2	
Physical activity			<0.001		0.05
Frequently	7448 (22.4)	15.9		5.6	
Sometimes	14668 (44.1)	15.2		4.9	
Never/rarely	11155 (33.5)	17.2		5.2	
Alcohol drinking			<0.001		<0.001
Non-drinker	24097 (72.4)	14.6		4.2	
<1 day/week	7014 (21.1)	17.5		5.8	
1-2 days/week	1285 (3.9)	22.1		11.8	
3-7 days/week	904 (2.7)	28.4		16.8	

Table 2. Associations of underage alcohol drinking with medical consultation and hospitalisation.

Alcohol drinking	Crude OR	Adjusted OR (95% CI)			
	(95% CI)	Model 1	Model 2	Model 3	Model 4
<b>Medical consultation</b>					
Non-drinker	1	1	1	1	1
<1 day/week	1.23 (1.14-1.33)***	1.24 (1.16-1.32)***	1.17 (1.08-1.26)***	1.14 (1.06-1.23)**	1.09 (1.00-1.19)*
1-2 days/week	1.66 (1.44-1.90)***	1.64 (1.44-1.86)***	1.40 (1.22-1.61)***	1.30 (1.13-1.50)***	1.26 (1.07-1.49)**
3-7 days/week	2.32 (2.00-2.69)***	2.24 (1.89-2.65)***	1.77 (1.46-2.15)***	1.70 (1.41-2.06)***	1.63 (1.36-1.95)***
P for trend	<0.001	<0.001	<0.001	<0.001	<0.001
<b>Hospitalisation</b>					
Non-drinker	1	1	1	1	1
<1 day /week	1.41 (1.26-1.59)***	1.42 (1.27-1.59)***	1.20 (1.08-1.35)**	1.14 (1.02-1.28)*	1.12 (0.99-1.28)
1-2 days/week	3.10 (2.58-3.71)***	2.87 (2.30-3.59)***	1.95 (1.55-2.44)***	1.68 (1.32-2.14)***	1.64 (1.27-2.11)***
3-7 days/week	4.66 (3.87-5.61)***	4.09 (3.37-4.97)***	2.63 (2.12-3.28)***	2.38 (1.90-2.98)***	2.42 (1.93-3.05)***
P for trend	<0.001	<0.001	<0.001	<0.001	<0.001

Model 1: Adjusted for sex, age, parental education, housing type, family structure and school clustering effects.

Model 2: Additionally adjusted for smoking, illicit drug use and physical activity.

Model 3: Additionally adjusted for peer smoking, parental smoking and secondhand smoke exposure.

Model 4: Among students who did not report feeling anxious or depressed, and adjusting for Model 3 variables.

\*P<0.05, \*\*P<0.01, \*\*\*P<0.001.



STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Done
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	✓
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	✓
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	✓
Objectives	3	State specific objectives, including any prespecified hypotheses	✓
Methods			
Study design	4	Present key elements of study design early in the paper	✓
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	✓
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	✓
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	✓
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	✓
Bias	9	Describe any efforts to address potential sources of bias	✓
Study size	10	Explain how the study size was arrived at	✓
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	✓
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	✓
		(b) Describe any methods used to examine subgroups and interactions	✓
		(c) Explain how missing data were addressed	✓
		(d) If applicable, describe analytical methods taking account of sampling strategy	✓
		(e) Describe any sensitivity analyses	N/A
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	N/A
		(b) Give reasons for non-participation at each stage	N/A
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	✓
		(b) Indicate number of participants with missing data for each variable of interest	N/A
Outcome data	15*	Report numbers of outcome events or summary measures	✓
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	✓
		(b) Report category boundaries when continuous variables were categorized	✓
		(c) If relevant, consider translating estimates of relative risk into absolute risk for	N/A



		a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	✓
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	✓
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	✓
Generalisability	21	Discuss the generalisability (external validity) of the study results	✓
<b>Other information</b>			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	✓

\*Give information separately for exposed and unexposed groups.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).



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## Abstract

**Objectives:** To investigate the association of underage alcohol drinking with medical consultation and hospitalisation in Hong Kong.

**Design:** Cross-sectional study.

**Setting:** Secondary schools in Hong Kong.

**Participants:** A total of 33300 secondary 1 (US grade 7) to secondary 5 students (47.6% boys; mean age 14.6 years, SD: 1.6) in 85 randomly selected schools.

**Outcome measures:** An anonymous questionnaire was used to obtain information about medical consultation in the past 14 days, hospitalisation in the past 12 months, alcohol drinking, smoking, illicit drug use, physical activity, secondhand smoke exposure, feeling depressed, feeling anxious, and socio-demographic characteristics. Alcohol drinking was categorised as non-drinking (reference), <1 day/week, 1-2 days/week and 3-7 days/week. Logistic regression yielded adjusted odds ratios (AORs) for medical consultation and hospitalisation due to drinking in models adjusting for different potential confounders. Subgroup analysis was conducted among adolescents who did not report feeling anxious or depressed.

**Results:** More than one-fourth (27.6%) of adolescents drank alcohol, 15.9% had medical consultation and 5.1% had been hospitalised. In the fully adjusted model, the AORs (95% CI) for medical consultation were 1.14 (1.06-1.23) for <1 day/week, 1.30 (1.13-1.50) for 1-2 days/week and 1.70 (1.41-2.06) for 3-7 days/week of drinking compared with non-drinking (P for trend <0.001). The corresponding AORs (95% CI) for hospitalisation were 1.14 (1.02-1.28), 1.68 (1.32-2.14) and 2.38 (1.90-2.98) (P for trend <0.001). Similar associations were observed among students without feeling anxious or depressed.

**Conclusions:** Alcohol consumption was associated with medical services use in Chinese adolescents. More rigorous alcohol control policies and health promotion programmes are needed to reduce alcohol drinking and related harms in adolescents.

**Article summary**

**Article focus**

- To investigate the associations of alcohol drinking with medical consultation and hospitalisation among adolescents in Hong Kong.

**Key messages**

- Alcohol drinking is prevalent among adolescents (one-fourth) in Hong Kong.
- Underage alcohol drinking was significantly associated with medical consultation and hospitalisation.
- More rigorous alcohol control policies and health promotion programmes are needed to reduce alcohol drinking and related harms in adolescents.

**Strengths and limitations of this study**

This is the first study to investigate the association between alcohol drinking and medical services use among a large sample of Chinese adolescents. The findings are representative of Hong Kong adolescents as random sampling was used and a high response rate was achieved. The cross-sectional design, self-reported alcohol use and medical services use were the major limitations of this study. Prospective studies with objective measures are warranted to confirm the findings.

## Introduction

The prevalence of underage drinking is increasing in most countries.<sup>1</sup> Underage alcohol drinking impairs brain development, causes violence and injury, increases risky sexual behaviours and unplanned pregnancy, and leads to psychological problems.<sup>2</sup> Psychosocial and educational primary prevention programmes were not effective in reducing alcohol drinking among youth.<sup>3</sup> Only small preventive effects on binge drinking and drunkenness were observed in family- and school-based programmes.<sup>4, 5</sup>

Although the effects of underage drinking on health are well documented, less is known about the effects on medical services use. In adults, some studies found moderate drinking associated with lower hospitalisation than abstinence or heavy drinking (U-shape association),<sup>6-9</sup> but other studies found that hospitalisation increased with alcohol consumption.<sup>10, 11</sup> As regards outpatient services use, an inverse association with alcohol consumption was found in several studies.<sup>9, 12, 13</sup> These inconsistent associations are complex and may not be directly comparable given the differences in outcome measures, settings and methods.

In adolescents, consequences of alcohol drinking such as unintended injuries, risky sexual behaviours and intoxication, often require acute medical care and hospitalisation. For example, 16% of ambulance calls concerning college students were attributable to alcohol drinking in the US; alcohol intoxication occupied 1.5% of adolescent hospital admissions in the Slovak Republic; and the prevalence of hospitalisation due to alcohol intoxication was increasing in the Netherlands.<sup>14-16</sup> Existing data were mainly based on Western countries, where alcohol consumption is high. For example, in US adolescents, 49% drank monthly and 23% had ever binged,<sup>2</sup> and 5.8% of hospitalisation among adolescents were attributable to alcohol use

disorders.<sup>17</sup> Little is known about the effects of alcohol drinking on medical services use in Chinese adolescents, who consume less alcohol than their Western counterparts.<sup>1</sup>

In Hong Kong, a highly westernised Chinese society, 22%-26% of adolescents drank monthly.<sup>18</sup> Health services are easily accessible with primary care medical consultations provided mainly by general practitioners, and in-patient services by public hospitals at low costs.<sup>19</sup> We investigated the association between alcohol drinking and medical services use among Chinese adolescents in Hong Kong. The results may have implications for alcohol control also in mainland China and other Asian countries experiencing a growing epidemic of underage alcohol use.<sup>20</sup>

**Methods**

*Sampling*

A school-based youth health survey was conducted among secondary 1 (US grade 7) to secondary 5 students in Hong Kong in 2003-4. Details of the survey have been reported elsewhere.<sup>21, 22</sup> Briefly, 85 secondary schools were randomly selected from all secondary schools (about 500) with a probability to the school enrolment size.<sup>23</sup> All form 1 classes and 2 randomly selected classes in each upper forms completed an anonymous questionnaire in the schools. To encourage candid reporting, separate answer sheets were provided. Teachers were present to maintain classroom order, but avoided patrolling or seeing the answers. Completed answer sheets were immediately put in an opaque envelope and collected by research assistants. Ethics approval was granted by a local institutional review board.

*Measurement*

Alcohol consumption was measured using the question “Do you drink alcohol including beer in usual days?” with drinking frequencies categorised as non-drinking (reference), “less than 1 day/week”, “1-2 days/week” and “3-7 days/week”. Medical consultation was defined as any Chinese or Western medical consultations in the past 14 days. Hospitalisation was defined as any hospital admission in the past 12 months. Data collected also included housing type and parental highest education attainment (proxies of socioeconomic status), sex, age, family structure (intact or non-intact), parental smoking (both, either or none), peer smoking (any or none), secondhand smoke exposure at home (any or none) and outside home (any or none), physical activity (never, occasionally or frequently), illicit drug use (ever or never), smoking (ever or never), feeling anxious (yes or no) and feeling depressed (yes or no).

### *Statistical analysis*

Stata 10.1 was used for data analysis. After excluding questionnaires with dubious response patterns or excessive missing data (>50% missing items) (N=718, 2.0%), and students with age  $\geq 18$  (N=2094, 5.8%), 33300 (92.2%) students remained for data analysis. The sample was representative of the corresponding population in Hong Kong.<sup>21</sup> Logistic regression was used to calculate the adjusted odds ratios (AOR) of medical consultation and hospitalisation for alcohol drinking in models that progressively adjusted for more covariates: basic demographic factors, socioeconomic status and family structure (model 1); unhealthy behaviours (model 2); and parental smoking and peer smoking (model 3). The linear associations between alcohol drinking and medical services use were tested by treating alcohol drinking as a continuous variable (p for trend). Psychological distress of feeling anxious and depressed are common risk factors of alcohol drinking and medical services use.<sup>2, 24</sup> To control for such potential confounding, subgroup analyses were conducted restricted to students who did not report feeling anxious or depressed (Model 4). All models have satisfactory goodness-of-fit (all  $\chi^2 > 0.20$ ).



**Results**

Of all 33300 students, 47.6% were boys, mean age was 14.6 years (SD 1.6), 36.7% reported highest parental education of primary or below, and half (43.6%) were living in public housing estates (Table 1). One in four (27.6%) students drank alcohol and most commonly in <1 day/week (21.1%). Medical consultation in the past 14 days (15.9%) was more frequently reported than hospitalisation in the past 12 months (5.1%). Girls were more likely to have medical consultation but less likely to be hospitalised than boys. Younger students were more likely to be hospitalised but medical consultation was similar by age. Lower socioeconomic status, feeling depressed, feeling anxious, smoking, illicit drug use, physical inactivity and alcohol drinking were associated with medical consultation and hospitalisation.

Associations between alcohol drinking and medical services use were consistently observed in crude and adjusted logistic regression models (models 1-4). In the fully adjusted model (model 3), the AORs (95% CI) for medical consultation were 1.14 (1.06-1.23) for <1 day/week, 1.30 (1.13-1.50) for 1-2 days/week and 1.70 (1.41-2.06) for 3-7 days/week of alcohol drinking (P for trend <0.001), compared with non-drinking. The corresponding AORs (95% CI) for hospitalisation were 1.14 (1.02-1.28), 1.68 (1.32-2.14) and 2.38 (1.90-2.98) (p <0.001 for trend). Similar associations were observed for medical consultation and hospitalisation among adolescents who did not feel anxious or depressed. The associations were also similar in boys and girls (p for interaction >0.05).

**Discussion**

To the best of our knowledge, this is the first non-Western study that investigates the association between medical services use and alcohol drinking among underage adolescents. Previous

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3 studies have documented the association between alcohol drinking and risk factors (e.g.  
4 digestive problems, respiratory symptoms, injury, etc.) of medical services use among Chinese  
5 adolescents.<sup>25</sup> Our results were consistent with Western studies that linked alcohol consumption  
6 to hospitalisation due to alcohol intoxication among adolescents and ambulance use among  
7 college students.<sup>14-16</sup> The present study did not require medical consultation and hospitalisation  
8 to be alcohol-related, and stronger associations were expected otherwise.  
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18 Contrary to the U-shaped<sup>6-9</sup> or inverse<sup>12, 13</sup> associations between alcohol drinking and medical  
19 services use among adults in other studies, we found a positive linear association among  
20 adolescents. The U-shaped or inverse associations in adults could reflect that light and moderate  
21 drinkers were more health conscious and less likely to seek medical care than heavy drinkers;  
22 some abstainers might also have quit drinking due to illness. Such healthier profile in moderate  
23 drinkers was not apparent in adolescents, and potential differences in background characteristics  
24 and health behaviours were adjusted for in different regression models. The putative health  
25 benefits of moderate alcohol drinking, such as that for heart disease, among adults are also  
26 controversial due to the favourable characteristics of such drinkers.<sup>26</sup>  
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41 In Hong Kong, beer and wine tax was unprecedentedly abolished in 2008 to boost alcohol  
42 trading,<sup>27</sup> and this was followed by fierce promotion by the industry. Alcohol drinking is  
43 increasingly publicised as stylish and fashionable without any legislation regulating such  
44 promotion in Hong Kong. Our findings suggest that any increase in adolescent drinking may be  
45 accompanied by a rise in medical services use. Following the success of the World Health  
46 Organisation Framework Convention on Tobacco Control, a similar international treaty for  
47 alcohol control is needed to guide policies on alcohol taxation and promotion,<sup>28</sup> two of the most  
48 important strategies in reducing adolescent drinking.  
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Our study has several limitations. All the data were self-reported including alcohol drinking, medical consultation and hospitalisation. We only have data on the frequency of alcohol drinking. Future studies should also consider the amount of alcohol consumed. Medical consultation and hospitalisation are obvious events and similar questions have been used by other studies, which supported the validity of such self-reported data by children and adolescents.<sup>29,30</sup> Using the same data, we also found significant associations of medical consultation and hospitalisation with health complaints (medical consultation OR 2.27; hospitalisation OR 1.29) and poor self-rated health (medical consultation OR 3.46; hospitalisation OR 2.09) supporting the validity of these data (data not shown in tables). Due to the cross-sectional design, causality between alcohol consumption and medical services use could not be ascertained, although it seemed unlikely that medical services use had led to alcohol drinking. On the other hand, health services use might prompt the students to avoid drinking or influence their reporting of alcohol consumption, which could bias the associations in either direction. Although robust and dose-response associations were observed in this study, prospective studies are needed to ascertain temporality. Given the limited time provided by the schools, we used simple questions adapted from other studies to measure depression and anxiety.<sup>31</sup> Their validity was supported by our previous findings on a positive association with weight misperception using the same sample.<sup>32</sup> Finally, although the associations had been adjusted for many potential confounders including smoking, drug use and physical inactivity, residual confounding cannot be ruled out in observational studies.

**Conclusions**

Alcohol consumption was associated with medical services use in Chinese adolescents. More rigorous alcohol control policies and health promotion programmes are needed to reduce alcohol drinking and related harms in adolescents.

**Contributors:** SYH and THL conceived and designed the study. MPW and SYH analyzed the data. MPW, SYH and THL wrote the paper and approved the final version.

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**Declaration:** All authors have no relevant financial interest and any conflict of interest in this article.

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For peer review only



Table 1. Prevalence of medical consultation and hospitalisation by basic characteristics among students aged 11-17.

	N (%)	Medical consultation		Hospitalisation	
		%	$\chi^2$ P	%	$\chi^2$ P
Sex			<0.001		<0.001
Boys	15845 (47.6)	15.1		5.9	
Girls	17455 (52.4)	16.6		4.4	
Age			0.30		0.02
11-14	13812 (41.5)	16.1		5.5	
15-17	19488 (58.5)	15.7		4.9	
Highest parental education			<0.001		<0.001
Unknown	5749 (18.0)	14.1		4.4	
Uneducated or kindergarten	514 (1.6)	19.8		7.8	
Primary school	3885 (12.2)	15.4		4.6	
Form 1-3	7361 (23.1)	15.2		4.5	
Form 4-5	8082 (25.4)	16.0		5.3	
Form $\geq 6$	6269 (19.7)	18.1		6.2	
Housing type			<0.001		<0.001
Public housing estate	13470 (42.6)	14.2		4.4	
Subsidised private housing	3121 (9.9)	15.2		5.1	
Private (owner)	10290 (32.5)	17.2		5.0	
Private (tenant)	2676 (8.5)	16.6		6.0	
Temporary	326 (1.0)	27.9		18.1	
Others	1771 (5.6)	18.0		7.2	
Feeling depressed			<0.001		0.05
No	28350 (85.1)	15.4		5.1	
Yes	2950 (14.9)	18.4		5.6	
Feeling anxious			<0.001		<0.001
No	30485 (91.6)	15.4		4.9	
Yes	2815 (8.5)	20.8		7.7	
Smoking			<0.001		<0.001
Never-smokers	25201 (76.1)	14.8		4.0	
Ever-smokers	7914 (23.9)	19.3		8.6	
Illicit drugs			<0.001		<0.001
Never-use	31111 (93.6)	15.1		4.6	
Ever-use	2130 (6.4)	26.4		13.2	
Physical activity			<0.001		0.05
Frequently	7448 (22.4)	15.9		5.6	
Sometimes	14668 (44.1)	15.2		4.9	
Never/rarely	11155 (33.5)	17.2		5.2	
Alcohol drinking			<0.001		<0.001
Non-drinker	24097 (72.4)	14.6		4.2	
<1 day/week	7014 (21.1)	17.5		5.8	
1-2 days/week	1285 (3.9)	22.1		11.8	
3-7 days/week	904 (2.7)	28.4		16.8	



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Table 2. Associations of underage alcohol drinking with medical consultation and hospitalisation.

Alcohol drinking	Crude OR	Adjusted OR (95% CI)			
	(95% CI)	Model 1	Mode2	Model 3	Model 4
<b>Medical consultation</b>					
Non-drinker	1	1	1	1	1
<1 day/week	1.23 (1.14-1.33)***	1.24 (1.16-1.32)***	1.17 (1.08-1.26)***	1.14 (1.06-1.23)**	1.09 (1.00-1.19)*
1-2 days/week	1.66 (1.44-1.90)***	1.64 (1.44-1.86)***	1.40 (1.22-1.61)***	1.30 (1.13-1.50)***	1.26 (1.07-1.49)**
3-7 days/week	2.32 (2.00-2.69)***	2.24 (1.89-2.65)***	1.77 (1.46-2.15)***	1.70 (1.41-2.06)***	1.63 (1.36-1.95)***
P for trend	<0.001	<0.001	<0.001	<0.001	<0.001
<b>Hospitalisation</b>					
Non-drinker	1	1	1	1	1
<1 day /week	1.41 (1.26-1.59)***	1.42 (1.27-1.59)***	1.20 (1.08-1.35)**	1.14 (1.02-1.28)*	1.12 (0.99-1.28)
1-2 days/week	3.10 (2.58-3.71)***	2.87 (2.30-3.59)***	1.95 (1.55-2.44)***	1.68 (1.32-2.14)***	1.64 (1.27-2.11)***
3-7 days/week	4.66 (3.87-5.61)***	4.09 (3.37-4.97)***	2.63 (2.12-3.28)***	2.38 (1.90-2.98)***	2.42 (1.93-3.05)***
P for trend	<0.001	<0.001	<0.001	<0.001	<0.001

Model 1: Adjusted for sex, age, parental education, housing type, family structure and school clustering effects.

Model 2: Additionally adjusted for smoking, illicit drug use and physical activity.

Model 3: Additionally adjusted for peer smoking, parental smoking and secondhand smoke exposure.

Model 4: Among students who did not report feeling anxious or depressed, and adjusting for Model 3 variables.

\*P<0.05, \*\*P<0.01, \*\*\*P<0.001.

# Underage alcohol drinking and medical services use in Hong Kong: a cross-sectional study

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**Abstract**

**Objectives:** To investigate the association of underage alcohol drinking with medical consultation and hospitalisation in Hong Kong.

**Design:** Cross-sectional study.

**Setting:** Secondary schools in Hong Kong.

**Participants:** A total of 33300 secondary 1 (US grade 7) to secondary 5 students (47.6% boys; mean age 14.6 years, SD: 1.6) in 85 randomly selected schools.

**Outcome measures:** An anonymous questionnaire was used to obtain information about medical consultation in the past 14 days, hospitalisation in the past 12 months, alcohol drinking, smoking, illicit drug use, physical activity, secondhand smoke exposure, feeling depressed, feeling anxious, and socio-demographic characteristics. Alcohol drinking was categorised as non-drinking (reference), <1 day/week, 1-2 days/week and 3-7 days/week. Logistic regression yielded adjusted odds ratios (AORs) for medical consultation and hospitalisation due to drinking in models adjusting for different potential confounders. Subgroup analysis was conducted among adolescents who did not report feeling anxious or depressed.

**Results:** More than one-fourth (27.6%) of adolescents drank alcohol, 15.9% had medical consultation and 5.1% had been hospitalised. In the fully adjusted model, the AORs (95% CI) for medical consultation were 1.14 (1.06-1.23) for <1 day/week, 1.30 (1.13-1.50) for 1-2 days/week and 1.70 (1.41-2.06) for 3-7 days/week of drinking compared with non-drinking (P for trend <0.001). The corresponding AORs (95% CI) for hospitalisation were 1.14 (1.02-1.28), 1.68 (1.32-2.14) and 2.38 (1.90-2.98) (P for trend <0.001). Similar associations were observed among students without feeling anxious or depressed.

**Conclusions:** Alcohol consumption was associated with medical services use in Chinese adolescents. More rigorous alcohol control policies and health promotion programmes are needed to reduce alcohol drinking and related harms in adolescents.

## Article summary

### Article focus

- To investigate the associations of alcohol drinking with medical consultation and hospitalisation among adolescents in Hong Kong.

### Key messages

- Alcohol drinking is prevalent among adolescents (one-fourth) in Hong Kong.
- Underage alcohol drinking was significantly associated with medical consultation and hospitalisation.
- More rigorous alcohol control policies and health promotion programmes are needed to reduce alcohol drinking and related harms in adolescents.

### Strengths and limitations of this study

This is the first study to investigate the association between alcohol drinking and medical services use among a large sample of Chinese adolescents. The findings are representative of Hong Kong adolescents as random sampling was used and a high response rate was achieved. The cross-sectional design, self-reported alcohol use and medical services use were the major limitations of this study. Prospective studies with objective measures are warranted to confirm the findings.

**Introduction**

The prevalence of underage drinking is increasing in most countries.<sup>1</sup> Underage alcohol drinking impairs brain development, causes violence and injury, increases risky sexual behaviours and unplanned pregnancy, and leads to psychological problems.<sup>2</sup> Psychosocial and educational primary prevention programmes were not effective in reducing alcohol drinking among youth.<sup>3</sup> Only small preventive effects on binge drinking and drunkenness were observed in family- and school-based programmes.<sup>4, 5</sup>

Although the effects of underage drinking on health are well documented, less is known about the effects on medical services use. In adults, some studies found moderate drinking associated with lower hospitalisation than abstinence or heavy drinking (U-shape association),<sup>6-9</sup> but other studies found that hospitalisation increased with alcohol consumption.<sup>10, 11</sup> As regards outpatient services use, an inverse association with alcohol consumption was found in several studies.<sup>9, 12, 13</sup> These inconsistent associations are complex and may not be directly comparable given the differences in outcome measures, settings and methods.

In adolescents, consequences of alcohol drinking such as unintended injuries, risky sexual behaviours and intoxication, often require acute medical care and hospitalisation. For example, 16% of ambulance calls concerning college students were attributable to alcohol drinking in the US; alcohol intoxication occupied 1.5% of adolescent hospital admissions in the Slovak Republic; and the prevalence of hospitalisation due to alcohol intoxication was increasing in the Netherlands.<sup>14-16</sup> Existing data were mainly based on Western countries, where alcohol consumption is high. For example, in US adolescents, 49% drank monthly and 23% had ever binged,<sup>2</sup> and 5.8% of hospitalisation among adolescents were attributable to alcohol use

disorders.<sup>17</sup> Little is known about the effects of alcohol drinking on medical services use in Chinese adolescents, who consume less alcohol than their Western counterparts.<sup>1</sup>

In Hong Kong, a highly westernised Chinese society, 22%-26% of adolescents drank monthly.<sup>18</sup> Health services are easily accessible with primary care medical consultations provided mainly by general practitioners, and in-patient services by public hospitals at low costs.<sup>19</sup> We investigated the association between alcohol drinking and medical services use among Chinese adolescents in Hong Kong. The results may have implications for alcohol control also in mainland China and other Asian countries experiencing a growing epidemic of underage alcohol use.<sup>20</sup>

## Methods

### *Sampling*

A school-based youth health survey was conducted among secondary 1 (US grade 7) to [secondary](#) 5 students in Hong Kong in 2003-4. Details of the survey have been reported elsewhere.<sup>21, 22</sup> Briefly, 85 secondary schools were randomly selected from all secondary schools (about 500) with a probability to the school enrolment size.<sup>23</sup> All form 1 classes and 2 randomly selected classes in each upper forms completed an anonymous questionnaire in the schools. To encourage candid reporting, separate answer sheets were provided. Teachers were present to maintain classroom order, but avoided patrolling or seeing the answers. Completed answer sheets were immediately put in an opaque envelope and collected by research assistants. Ethics approval was granted by a local institutional review board.

### *Measurement*

Alcohol consumption was measured using the question “Do you drink alcohol including beer in usual days?” with drinking frequencies categorised as non-drinking (reference), “less than 1 day/week”, “1-2 days/week” and “3-7 days/week”. Medical consultation was defined as any Chinese or Western medical consultations in the past 14 days. Hospitalisation was defined as any hospital admission in the past 12 months. Data collected also included housing type and parental highest education attainment (proxies of socioeconomic status), sex, age, family structure (intact or non-intact), parental smoking (both, either or none), peer smoking (any or none), secondhand smoke exposure at home (any or none) and outside home (any or none), physical activity (never, occasionally or frequently), illicit drug use (ever or never), smoking (ever or never), feeling anxious (yes or no) and feeling depressed (yes or no).

*Statistical analysis*

Stata 10.1 was used for data analysis. After excluding questionnaires with dubious response patterns or excessive missing data (>50% missing items) (N=718, 2.0%), and students with age  $\geq 18$  (N=2094, 5.8%), 33300 (92.2%) students remained for data analysis. The sample was representative of the corresponding population in Hong Kong.<sup>21</sup> Logistic regression was used to calculate the adjusted odds ratios (AOR) of medical consultation and hospitalisation for alcohol drinking in models that progressively adjusted for more covariates: basic demographic factors, socioeconomic status and family structure (model 1); unhealthy behaviours (model 2); and parental smoking and peer smoking (model 3). The linear associations between alcohol drinking and medical services use were tested by treating alcohol drinking as a continuous variable (p for trend). Psychological distress of feeling anxious and depressed are common risk factors of alcohol drinking and medical services use.<sup>2, 24</sup> To control for such potential confounding, subgroup analyses were conducted restricted to students who did not report feeling anxious or depressed (Model 4). All models have satisfactory goodness-of-fit (all  $\chi^2 > 0.20$ ).

## Results

Of all 33300 students, 47.6% were boys, mean age was 14.6 years (SD 1.6), 36.7% reported highest parental education of primary or below, and half (43.6%) were living in public housing estates (Table 1). One in four (27.6%) students drank alcohol and most commonly in <1 day/week (21.1%). Medical consultation in the past 14 days (15.9%) was more frequently reported than hospitalisation in the past 12 months (5.1%). Girls were more likely to have medical consultation but less likely to be hospitalised than boys. Younger students were more likely to be hospitalised but medical consultation was similar by age. Lower socioeconomic status, feeling depressed, feeling anxious, smoking, illicit drug use, physical inactivity and alcohol drinking were associated with medical consultation and hospitalisation.

Associations between alcohol drinking and medical services use were consistently observed in crude and adjusted logistic regression models (models 1-4). In the fully adjusted model (model 3), the AORs (95% CI) for medical consultation were 1.14 (1.06-1.23) for <1 day/week, 1.30 (1.13-1.50) for 1-2 days/week and 1.70 (1.41-2.06) for 3-7 days/week of alcohol drinking (P for trend <0.001), compared with non-drinking. The corresponding AORs (95% CI) for hospitalisation were 1.14 (1.02-1.28), 1.68 (1.32-2.14) and 2.38 (1.90-2.98) (p <0.001 for trend). Similar associations were observed for medical consultation and hospitalisation among adolescents who did not feel anxious or depressed. The associations were also similar in boys and girls (p for interaction >0.05).

## Discussion

To the best of our knowledge, this is the first non-Western study that investigates the association between medical services use and alcohol drinking among underage adolescents. Previous



studies have documented the association between alcohol drinking and risk factors (e.g. digestive problems, respiratory symptoms, injury, etc.) of medical services use among Chinese adolescents.<sup>25</sup> Our results were consistent with Western studies that linked alcohol consumption to hospitalisation due to alcohol intoxication among adolescents and ambulance use among college students.<sup>14-16</sup> The present study did not require medical consultation and hospitalisation to be alcohol-related, and stronger associations were expected otherwise.

Contrary to the U-shaped<sup>6-9</sup> or inverse<sup>12, 13</sup> associations between alcohol drinking and medical services use among adults in other studies, we found a positive linear association among adolescents. The U-shaped or inverse associations in adults could reflect that light and moderate drinkers were more health conscious and less likely to seek medical care than heavy drinkers; some abstainers might also have quit drinking due to illness. Such healthier profile in moderate drinkers was not apparent in adolescents, and potential differences in background characteristics and health behaviours were adjusted for in different regression models. The putative health benefits of moderate alcohol drinking, such as that for heart disease, among adults are also controversial due to the favourable characteristics of such drinkers.<sup>26</sup>

In Hong Kong, beer and wine tax was unprecedentedly abolished in 2008 to boost alcohol trading,<sup>27</sup> and this was followed by fierce promotion by the industry. Alcohol drinking is increasingly publicised as stylish and fashionable without any legislation regulating such promotion in Hong Kong. Our findings suggest that any increase in adolescent drinking may be accompanied by a rise in medical services use. Following the success of the World Health Organisation Framework Convention on Tobacco Control, a similar international treaty for alcohol control is needed to guide policies on alcohol taxation and promotion,<sup>28</sup> two of the most important strategies in reducing adolescent drinking.

Our study has several limitations. All the data were self-reported including alcohol drinking, medical consultation and hospitalisation. We only have data on the frequency of alcohol drinking. Future studies should also consider the amount of alcohol consumed. Medical consultation and hospitalisation are obvious events and similar questions have been used by other studies, which supported the validity of such self-reported data by children and adolescents.<sup>29,30</sup> Using the same data, we also found significant associations of medical consultation and hospitalisation with health complaints (medical consultation OR 2.27; hospitalisation OR 1.29) and poor self-rated health (medical consultation OR 3.46; hospitalisation OR 2.09) supporting the validity of these data (data not shown in tables). Due to the cross-sectional design, causality between alcohol consumption and medical services use could not be ascertained, although it seemed unlikely that medical services use had led to alcohol drinking. On the other hand, health services use might prompt the students to avoid drinking or influence their reporting of alcohol consumption, which could bias the associations in either direction. Although robust and dose-response associations were observed in this study, prospective studies are needed to ascertain temporality. Given the limited time provided by the schools, we used simple questions adapted from other studies to measure depression and anxiety.<sup>31</sup> Their validity was supported by our previous findings on a positive association with weight misperception using the same sample.<sup>32</sup> Finally, although the associations had been adjusted for many potential confounders including smoking, drug use and physical inactivity, residual confounding cannot be ruled out in observational studies.

## Conclusions

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Alcohol consumption was associated with medical services use in Chinese adolescents. More rigorous alcohol control policies and health promotion programmes are needed to reduce alcohol drinking and related harms in adolescents.

**Contributors:** SYH and THL conceived and designed the study. MPW and SYH analyzed the data. MPW, SYH and THL wrote the paper and approved the final version.

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**Declaration:** All authors have no relevant financial interest and any conflict of interest in this article.

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Table 1. Prevalence of medical consultation and hospitalisation by basic characteristics among students aged 11-17.

	N (%)	Medical consultation		Hospitalisation	
		%	$\chi^2$ P	%	$\chi^2$ P
Sex			<0.001		<0.001
Boys	15845 (47.6)	15.1		5.9	
Girls	17455 (52.4)	16.6		4.4	
Age			0.30		0.02
11-14	13812 (41.5)	16.1		5.5	
15-17	19488 (58.5)	15.7		4.9	
Highest parental education			<0.001		<0.001
Unknown	5749 (18.0)	14.1		4.4	
Uneducated or kindergarten	514 (1.6)	19.8		7.8	
Primary school	3885 (12.2)	15.4		4.6	
Form 1-3	7361 (23.1)	15.2		4.5	
Form 4-5	8082 (25.4)	16.0		5.3	
Form ≥6	6269 (19.7)	18.1		6.2	
Housing type			<0.001		<0.001
Public housing estate	13470 (42.6)	14.2		4.4	
Subsidised private housing	3121 (9.9)	15.2		5.1	
Private (owner)	10290 (32.5)	17.2		5.0	
Private (tenant)	2676 (8.5)	16.6		6.0	
Temporary	326 (1.0)	27.9		18.1	
Others	1771 (5.6)	18.0		7.2	
Feeling depressed			<0.001		0.05
No	28350 (85.1)	15.4		5.1	
Yes	2950 (14.9)	18.4		5.6	
Feeling anxious			<0.001		<0.001
No	30485 (91.6)	15.4		4.9	
Yes	2815 (8.5)	20.8		7.7	
Smoking			<0.001		<0.001
Never-smokers	25201 (76.1)	14.8		4.0	
Ever-smokers	7914 (23.9)	19.3		8.6	
Illicit drugs			<0.001		<0.001
Never-use	31111 (93.6)	15.1		4.6	
Ever-use	2130 (6.4)	26.4		13.2	
Physical activity			<0.001		0.05
Frequently	7448 (22.4)	15.9		5.6	
Sometimes	14668 (44.1)	15.2		4.9	
Never/rarely	11155 (33.5)	17.2		5.2	
Alcohol drinking			<0.001		<0.001
Non-drinker	24097 (72.4)	14.6		4.2	
<1 day/week	7014 (21.1)	17.5		5.8	
1-2 days/week	1285 (3.9)	22.1		11.8	
3-7 days/week	904 (2.7)	28.4		16.8	

Table 2. Associations of underage alcohol drinking with medical consultation and hospitalisation.

Alcohol drinking	Crude OR	Adjusted OR (95% CI)			
	(95% CI)	Model 1	Model 2	Model 3	Model 4
<b>Medical consultation</b>					
Non-drinker	1	1	1	1	1
<1 day/week	1.23 (1.14-1.33)***	1.24 (1.16-1.32)***	1.17 (1.08-1.26)***	1.14 (1.06-1.23)**	1.09 (1.00-1.19)*
1-2 days/week	1.66 (1.44-1.90)***	1.64 (1.44-1.86)***	1.40 (1.22-1.61)***	1.30 (1.13-1.50)***	1.26 (1.07-1.49)**
3-7 days/week	2.32 (2.00-2.69)***	2.24 (1.89-2.65)***	1.77 (1.46-2.15)***	1.70 (1.41-2.06)***	1.63 (1.36-1.95)***
P for trend	<0.001	<0.001	<0.001	<0.001	<0.001
<b>Hospitalisation</b>					
Non-drinker	1	1	1	1	1
<1 day /week	1.41 (1.26-1.59)***	1.42 (1.27-1.59)***	1.20 (1.08-1.35)**	1.14 (1.02-1.28)*	1.12 (0.99-1.28)
1-2 days/week	3.10 (2.58-3.71)***	2.87 (2.30-3.59)***	1.95 (1.55-2.44)***	1.68 (1.32-2.14)***	1.64 (1.27-2.11)***
3-7 days/week	4.66 (3.87-5.61)***	4.09 (3.37-4.97)***	2.63 (2.12-3.28)***	2.38 (1.90-2.98)***	2.42 (1.93-3.05)***
P for trend	<0.001	<0.001	<0.001	<0.001	<0.001

Model 1: Adjusted for sex, age, parental education, housing type, family structure and school clustering effects.

Model 2: Additionally adjusted for smoking, illicit drug use and physical activity.

Model 3: Additionally adjusted for peer smoking, parental smoking and secondhand smoke exposure.

Model 4: Among students who did not report feeling anxious or depressed, and adjusting for Model 3 variables.

\*P<0.05, \*\*P<0.01, \*\*\*P<0.001.



STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Done
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	✓
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	✓
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	✓
Objectives	3	State specific objectives, including any prespecified hypotheses	✓
Methods			
Study design	4	Present key elements of study design early in the paper	✓
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	✓
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	✓
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	✓
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	✓
Bias	9	Describe any efforts to address potential sources of bias	✓
Study size	10	Explain how the study size was arrived at	✓
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	✓
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	✓
		(b) Describe any methods used to examine subgroups and interactions	✓
		(c) Explain how missing data were addressed	✓
		(d) If applicable, describe analytical methods taking account of sampling strategy	✓
		(e) Describe any sensitivity analyses	N/A
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	N/A
		(b) Give reasons for non-participation at each stage	N/A
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	✓
		(b) Indicate number of participants with missing data for each variable of interest	N/A
Outcome data	15*	Report numbers of outcome events or summary measures	✓
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	✓
		(b) Report category boundaries when continuous variables were categorized	✓
		(c) If relevant, consider translating estimates of relative risk into absolute risk for	N/A

		a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	✓
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	✓
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	✓
Generalisability	21	Discuss the generalisability (external validity) of the study results	✓
<b>Other information</b>			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	✓

\*Give information separately for exposed and unexposed groups.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).



## Underage alcohol drinking and medical services use in Hong Kong: a cross-sectional study

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**Underage alcohol drinking and medical services use in Hong Kong: a cross-sectional study**

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## Abstract

**Objectives:** To investigate the association of underage alcohol drinking with medical consultation and hospitalisation in Hong Kong.

**Design:** Cross-sectional study.

**Setting:** Secondary schools in Hong Kong.

**Participants:** A total of 33300 secondary 1 (US grade 7) to secondary 5 students (47.6% boys; mean age 14.6 years, SD: 1.6) in 85 randomly selected schools.

**Outcome measures:** An anonymous questionnaire was used to obtain information about medical consultation in the past 14 days, hospitalisation in the past 12 months, alcohol drinking, smoking, illicit drug use, physical activity, secondhand smoke exposure, feeling depressed, feeling anxious, and socio-demographic characteristics. Alcohol drinking was categorised as non-drinking (reference), <1 day/week, 1-2 days/week and 3-7 days/week. Logistic regression yielded adjusted odds ratios (AORs) of medical consultation and hospitalisation for drinking, adjusting for different potential confounders. Subgroup analysis was conducted among adolescents who did not report feeling anxious or depressed.

**Results:** More than one-fourth (27.6%) of adolescents drank alcohol, 15.9% had medical consultation and 5.1% had been hospitalised. In the fully adjusted model, the AORs (95% CI) for medical consultation were 1.14 (1.06-1.23) for <1 day/week, 1.30 (1.13-1.50) for 1-2 days/week and 1.70 (1.41-2.06) for 3-7 days/week of drinking compared with non-drinking (P for trend <0.001). The corresponding AORs (95% CI) for hospitalisation were 1.14 (1.02-1.28), 1.68 (1.32-2.14) and 2.38 (1.90-2.98) (P for trend <0.001). Similar associations were observed among students without feeling anxious or depressed.

**Conclusions:** Alcohol consumption was associated with medical services use in Chinese adolescents. More rigorous alcohol control policies and health promotion programmes are needed to reduce alcohol drinking and related harms in adolescents.

**Article summary**

**Article focus**

- To investigate the associations of alcohol drinking with medical consultation and hospitalisation among adolescents in Hong Kong, the most westernised city in China but with a much lower adult drinking prevalence than the West.

**Key messages**

- Alcohol drinking is prevalent among adolescents (one-fourth) in Hong Kong.
- Underage alcohol drinking was significantly associated with medical consultation and hospitalisation.
- More rigorous alcohol control policies and health promotion programmes are needed to reduce alcohol drinking and related harms in adolescents.

**Strengths and limitations of this study**

This is the first study to show dose-response relation between alcohol drinking and medical services use among a large sample of Chinese adolescents in an Asian city with low adult drinking prevalence. The findings are representative of Hong Kong adolescents from random sampling and with a high response rate. The cross-sectional design, self-reported alcohol use and medical services use were major limitations. Prospective studies with objective measures are warranted.

## Introduction

The prevalence of underage drinking is increasing in most countries.<sup>1</sup> Underage alcohol drinking impairs brain development, causes violence and injury, increases risky sexual behaviours and unplanned pregnancy, and leads to psychological problems.<sup>2</sup> Psychosocial and educational primary prevention programmes were not effective in reducing alcohol drinking among youth.<sup>3</sup> Only small preventive effects on binge drinking and drunkenness were observed in family- and school-based programmes.<sup>4, 5</sup>

Although the effects of underage drinking on health are well documented, less is known about the effects on medical services use. In adults, some studies found moderate drinking associated with lower hospitalisation than abstinence or heavy drinking (U-shaped association),<sup>6-9</sup> but other studies found that hospitalisation increased with alcohol consumption.<sup>10, 11</sup> As regards outpatient services use, an inverse association with alcohol consumption was found in several studies.<sup>9, 12, 13</sup> These inconsistent associations are complex and may not be directly comparable given the differences in outcome measures, settings and methods.

In adolescents, many consequences of alcohol drinking such as unintended injuries, risky sexual behaviours and intoxication, often require acute medical care and hospitalisation. For example, 16% of ambulance calls concerning college students were attributable to alcohol drinking in the US; alcohol intoxication occupied 1.5% of adolescent hospital admissions in the Slovak Republic; and the prevalence of hospitalisation due to alcohol intoxication was increasing in the Netherlands.<sup>14-16</sup> Existing data were mainly based on Western countries, where prevalence of alcohol drinking is high. For example, in US adolescents, 49% drank monthly and 23% had ever binged,<sup>2</sup> and 5.8% of hospitalisation among adolescents were attributable to alcohol use

disorders.<sup>17</sup> Little is known about the effects of alcohol drinking on medical services use in Chinese adolescents, who consume less alcohol than their Western counterparts.<sup>1</sup>

In Hong Kong, the most westernised city in China, 22%-26% of adolescents drank monthly.<sup>18</sup> Health services are easily accessible with primary care medical consultations provided mainly by general practitioners, and in-patient services by public hospitals at very low costs.<sup>19</sup> We investigated the association between alcohol drinking and medical services use among Chinese adolescents in Hong Kong. The results may have implications for alcohol control also in mainland China and other Asian countries experiencing a growing epidemic of underage and adult alcohol use.<sup>20</sup>

**Methods**

*Sampling*

A school-based youth health survey was conducted among secondary 1 (US grade 7) to secondary 5 students in Hong Kong in 2003-4. Details of the survey have been reported elsewhere.<sup>21, 22</sup> Briefly, 85 secondary schools were randomly selected from all secondary schools (about 500) with a probability proportional to the school enrolment size.<sup>23</sup> All form 1 classes and 2 randomly selected classes in each upper forms completed an anonymous questionnaire in the schools. To encourage candid reporting, separate answer sheets were provided. Teachers were present to maintain classroom order, but avoided patrolling or seeing the answers. Completed answer sheets were immediately put in an opaque envelope and collected by research assistants. Ethics approval was granted by a local institutional review board.

*Measurement*



Alcohol consumption was measured using the question “Do you drink alcohol including beer in usual days?” with drinking frequencies categorised as non-drinking (reference), “less than 1 day/week”, “1-2 days/week” and “3-7 days/week”. Medical consultation was defined as any Chinese or Western medical consultations in the past 14 days. Hospitalisation was defined as any hospital admission in the past 12 months. A shorter period was used for medical consultation as this is more common than hospitalisation and a longer period was used for hospitalisation to identify more cases. The 2-week period of medical consultation is also used in government surveys.<sup>24</sup> Data collected also included housing type and parental highest education attainment (proxies of socioeconomic status), sex, age, family structure (intact or non-intact), parental smoking (both, either or none), peer smoking (any or none), secondhand smoke exposure at home (any or none) and outside home (any or none), physical activity (never/rarely, sometimes or frequently), illicit drug use (ever or never), smoking (ever or never), feeling anxious (yes or no) and feeling depressed (yes or no).

### *Statistical analysis*

Stata 10.1 was used for data analysis. After excluding questionnaires with dubious response patterns or excessive missing data (>50% missing items) (N=718, 2.0%), and students with age  $\geq 18$  (N=2094, 5.8%), 33300 (92.2%) students remained for complete case analysis. The sample was representative of the corresponding population in Hong Kong.<sup>21</sup> Logistic regression was used to calculate the crude and adjusted odds ratios (AOR) of medical consultation and hospitalisation for alcohol drinking in models that progressively adjusted for more covariates: basic demographic factors, socioeconomic status and family structure (model 1); unhealthy behaviours (model 2); and parental smoking and peer smoking (model 3). The linear associations between alcohol drinking and medical services use were tested by treating categorised alcohol drinking frequency as a continuous variable of 0, 1, 2 and 3 to derive P for

trend. Psychological distress of feeling anxious and depressed are common risk factors of alcohol drinking and medical services use.<sup>2, 25</sup> To control for such potential confounding, subgroup analyses were conducted among students who did not report feeling anxious or depressed (Model 4).

Results

Of all 33300 students, 47.6% were boys, mean age was 14.6 years (SD 1.6), 36.7% reported highest parental education of primary or below, and half (43.6%) were living in public housing estates (Table 1). One in four (27.6%) students drank alcohol and most commonly at <1 day/week (21.1%). Medical consultation in the past 14 days (15.9%) was more frequently reported than hospitalisation in the past 12 months (5.1%). Girls were more likely to have medical consultation but less likely to be hospitalised than boys. Younger students were more likely to be hospitalised but medical consultation was similar by age. Lower socioeconomic status, feeling depressed, feeling anxious, smoking, illicit drug use, physical inactivity and alcohol drinking were associated with medical consultation and hospitalisation.

Associations between alcohol drinking and medical services use were consistently observed in crude and adjusted logistic regression models (models 1-4). In the fully adjusted model (model 3), the AORs (95% CI) for medical consultation were 1.14 (1.06-1.23) for <1 day/week, 1.30 (1.13-1.50) for 1-2 days/week and 1.70 (1.41-2.06) for 3-7 days/week of alcohol drinking (P for trend <0.001), compared with non-drinking. The corresponding AORs (95% CI) for hospitalisation were 1.14 (1.02-1.28), 1.68 (1.32-2.14) and 2.38 (1.90-2.98) (P <0.001 for trend). Similar associations were observed for medical consultation and hospitalisation among adolescents who did not feel anxious or depressed. The associations were also similar in boys and girls (P for interaction >0.05).

## Discussion

To the best of our knowledge, this is the first non-Western study that investigates the association between medical services use and alcohol drinking among underage adolescents. Previous studies have documented the association between alcohol drinking and risk factors of medical services use (e.g. digestive problems, respiratory symptoms, injury, etc.) among Chinese adolescents.<sup>26</sup> Our results were consistent with Western studies that linked alcohol consumption to hospitalisation due to alcohol intoxication among adolescents and ambulance use among college students.<sup>14-16</sup> The present study did not require medical consultation and hospitalisation to be alcohol-related, and stronger associations between alcohol drinking and medical services use were expected otherwise.

Contrary to the U-shaped<sup>6-9</sup> or inverse<sup>12, 13</sup> associations between alcohol drinking and medical services use among adults in other studies, we found a positive linear association among adolescents. The U-shaped or inverse associations in adults could reflect that light and moderate drinkers were more health conscious and less likely to seek medical care than heavy drinkers; some abstainers might also have quit drinking due to illness. Such healthier profile in moderate drinkers was not apparent in adolescents, and potential differences in background characteristics and health behaviours were adjusted for in different regression models. The putative health benefits of moderate alcohol drinking, such as that for heart disease, among adults are also controversial due to the favourable characteristics of moderate drinkers.<sup>27</sup>

In Hong Kong, beer and wine tax was unprecedentedly abolished in 2008 to boost alcohol trading,<sup>28</sup> and this was followed by aggressive promotion by the industry. Alcohol drinking is increasingly publicised as stylish and fashionable without any legislation regulating such

promotion in Hong Kong. Our findings suggest that any increase in adolescent drinking may be accompanied by a rise in medical service use. Following the success of the World Health Organisation Framework Convention on Tobacco Control, a similar international treaty for alcohol control is needed to guide policies on alcohol taxation and promotion,<sup>20, 29</sup> two of the most important strategies in reducing adolescent drinking.

Our study has several limitations. All the data were self-reported including alcohol drinking, medical consultation and hospitalisation. We only have data on the frequency of alcohol drinking; future studies should also consider the amount of alcohol consumed. Medical consultation and hospitalisation are obvious events and similar questions have been used by other studies, which supported the validity of such self-reported data by children and adolescents.<sup>30, 31</sup> Using the same data, we also found significant associations of medical consultation and hospitalisation with health complaints (medical consultation OR=2.27, 95% CI: 2.07-2.50; hospitalisation OR=1.29, 95% CI: 1.13-1.47) and poor self-rated health (medical consultation OR=3.46, 95% CI: 3.27-3.67; hospitalisation OR=2.09, 95% CI: 1.91-2.29) supporting the validity of these data (data not shown in tables). Due to the cross-sectional design, causality between alcohol consumption and medical services use could not be ascertained, although it seemed unlikely that medical services use had led to alcohol drinking. On the other hand, health services use might prompt the students to avoid drinking or influence their reporting of alcohol consumption, which could bias the associations in either direction. Although robust and dose-response associations were observed in this study, prospective studies are needed to ascertain temporality. Given the limited time provided by the schools, we used simple questions adapted from other studies to measure depression and anxiety.<sup>32</sup> Their validity was supported by our previous findings on a positive association with weight misperception using the same sample.<sup>33</sup> Finally, although the associations had been adjusted for many

potential confounders including smoking, drug use and physical inactivity, residual confounding cannot be ruled out in observational studies.

## Conclusions

Alcohol consumption was associated with medical services use in Chinese adolescents. More rigorous alcohol control policies and health promotion programmes are needed to reduce alcohol drinking and related harms in adolescents.

**Contributors:** SYH and THL conceived and designed the study. MPW and SYH analyzed the data. MPW, SYH and THL wrote the paper and approved the final version.

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**Declaration:** All authors have no relevant financial interest and any conflict of interest in this article.

**Data sharing:** No additional data are available.

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Table 1. Prevalence of medical consultation and hospitalisation by basic characteristics among students aged 11-17.

	N (%)	Medical consultation		Hospitalisation	
		%	$\chi^2$ P	%	$\chi^2$ P
Sex			<0.001		<0.001
Boys	15845 (47.6)	15.1		5.9	
Girls	17455 (52.4)	16.6		4.4	
Age			0.30		0.02
11-14	13812 (41.5)	16.1		5.5	
15-17	19488 (58.5)	15.7		4.9	
Highest parental education			<0.001		<0.001
Unknown	5749 (18.0)	14.1		4.4	
Uneducated or kindergarten	514 (1.6)	19.8		7.8	
Primary school	3885 (12.2)	15.4		4.6	
Form 1-3	7361 (23.1)	15.2		4.5	
Form 4-5	8082 (25.4)	16.0		5.3	
Form $\geq 6$	6269 (19.7)	18.1		6.2	
Housing type			<0.001		<0.001
Public housing estate	13470 (42.6)	14.2		4.4	
Subsidised private housing	3121 (9.9)	15.2		5.1	
Private (owner)	10290 (32.5)	17.2		5.0	
Private (tenant)	2676 (8.5)	16.6		6.0	
Temporary	326 (1.0)	27.9		18.1	
Others	1771 (5.6)	18.0		7.2	
Feeling depressed			<0.001		0.05
No	28350 (85.1)	15.4		5.1	
Yes	2950 (14.9)	18.4		5.6	
Feeling anxious			<0.001		<0.001
No	30485 (91.6)	15.4		4.9	
Yes	2815 (8.5)	20.8		7.7	
Smoking			<0.001		<0.001
Never-smokers	25201 (76.1)	14.8		4.0	
Ever-smokers	7914 (23.9)	19.3		8.6	
Illicit drugs			<0.001		<0.001
Never-use	31111 (93.6)	15.1		4.6	
Ever-use	2130 (6.4)	26.4		13.2	
Physical activity			<0.001		0.05
Frequently	7448 (22.4)	15.9		5.6	
Sometimes	14668 (44.1)	15.2		4.9	
Never/rarely	11155 (33.5)	17.2		5.2	
Alcohol drinking			<0.001		<0.001
Non-drinker	24097 (72.4)	14.6		4.2	
<1 day/week	7014 (21.1)	17.5		5.8	
1-2 days/week	1285 (3.9)	22.1		11.8	
3-7 days/week	904 (2.7)	28.4		16.8	

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Table 2. Associations of underage alcohol drinking with medical consultation and hospitalisation.

Alcohol drinking	Crude OR	Adjusted OR (95% CI)			
	(95% CI)	Model 1	Model 2	Model 3	Model 4
<b>Medical consultation</b>					
Non-drinker	1	1	1	1	1
<1 day/week	1.23 (1.14-1.33)***	1.24 (1.16-1.32)***	1.17 (1.08-1.26)***	1.14 (1.06-1.23)**	1.09 (1.00-1.19)*
1-2 days/week	1.66 (1.44-1.90)***	1.64 (1.44-1.86)***	1.40 (1.22-1.61)***	1.30 (1.13-1.50)***	1.26 (1.07-1.49)**
3-7 days/week	2.32 (2.00-2.69)***	2.24 (1.89-2.65)***	1.77 (1.46-2.15)***	1.70 (1.41-2.06)***	1.63 (1.36-1.95)***
P for trend <sup>†</sup>	<0.001	<0.001	<0.001	<0.001	<0.001
<b>Hospitalisation</b>					
Non-drinker	1	1	1	1	1
<1 day /week	1.41 (1.26-1.59)***	1.42 (1.27-1.59)***	1.20 (1.08-1.35)**	1.14 (1.02-1.28)*	1.12 (0.99-1.28)
1-2 days/week	3.10 (2.58-3.71)***	2.87 (2.30-3.59)***	1.95 (1.55-2.44)***	1.68 (1.32-2.14)***	1.64 (1.27-2.11)***
3-7 days/week	4.66 (3.87-5.61)***	4.09 (3.37-4.97)***	2.63 (2.12-3.28)***	2.38 (1.90-2.98)***	2.42 (1.93-3.05)***
P for trend <sup>†</sup>	<0.001	<0.001	<0.001	<0.001	<0.001

Model 1: Adjusted for sex, age, parental education, housing type, family structure and school clustering effects.

Model 2: Additionally adjusted for smoking, illicit drug use and physical activity.

Model 3: Additionally adjusted for peer smoking, parental smoking and secondhand smoke exposure.

Model 4: Among students who did not report feeling anxious or depressed, and adjusting for Model 3 variables.

\*P<0.05, \*\*P<0.01, \*\*\*P<0.001.

<sup>†</sup>P for trend by treating alcohol drinking as 0, 1, 2 and 3.

# Underage alcohol drinking and medical services use in Hong Kong: a cross-sectional study

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**Abstract**

**Objectives:** To investigate the association of underage alcohol drinking with medical consultation and hospitalisation in Hong Kong.

**Design:** Cross-sectional study.

**Setting:** Secondary schools in Hong Kong.

**Participants:** A total of 33300 secondary 1 (US grade 7) to secondary 5 students (47.6% boys; mean age 14.6 years, SD: 1.6) in 85 randomly selected schools.

**Outcome measures:** An anonymous questionnaire was used to obtain information about medical consultation in the past 14 days, hospitalisation in the past 12 months, alcohol drinking, smoking, illicit drug use, physical activity, secondhand smoke exposure, feeling depressed, feeling anxious, and socio-demographic characteristics. Alcohol drinking was categorised as non-drinking (reference), <1 day/week, 1-2 days/week and 3-7 days/week. Logistic regression yielded adjusted odds ratios (AORs) of medical consultation and hospitalisation for drinking, adjusting for different potential confounders. Subgroup analysis was conducted among adolescents who did not report feeling anxious or depressed.

**Results:** More than one-fourth (27.6%) of adolescents drank alcohol, 15.9% had medical consultation and 5.1% had been hospitalised. In the fully adjusted model, the AORs (95% CI) for medical consultation were 1.14 (1.06-1.23) for <1 day/week, 1.30 (1.13-1.50) for 1-2 days/week and 1.70 (1.41-2.06) for 3-7 days/week of drinking compared with non-drinking (P for trend <0.001). The corresponding AORs (95% CI) for hospitalisation were 1.14 (1.02-1.28), 1.68 (1.32-2.14) and 2.38 (1.90-2.98) (P for trend <0.001). Similar associations were observed among students without feeling anxious or depressed.

**Conclusions:** Alcohol consumption was associated with medical services use in Chinese adolescents. More rigorous alcohol control policies and health promotion programmes are needed to reduce alcohol drinking and related harms in adolescents.

## Article summary

### Article focus

- To investigate the associations of alcohol drinking with medical consultation and hospitalisation among adolescents in Hong Kong, [the most westernised city in China but with a much lower adult drinking prevalence than the West](#).

### Key messages

- Alcohol drinking is prevalent among adolescents (one-fourth) in Hong Kong.
- Underage alcohol drinking was significantly associated with medical consultation and hospitalisation.
- More rigorous alcohol control policies and health promotion programmes are needed to reduce alcohol drinking and related harms in adolescents.

### Strengths and limitations of this study

This is the first study to [show dose-response relation](#) between alcohol drinking and medical services use among a large sample of Chinese adolescents [in an Asian city with low adult drinking prevalence](#). The findings are representative of Hong Kong adolescents [from](#) random sampling and [with](#) a high response rate. The cross-sectional design, self-reported alcohol use and medical services use were major limitations. Prospective studies with objective measures are warranted.

**Introduction**

The prevalence of underage drinking is increasing in most countries.<sup>1</sup> Underage alcohol drinking impairs brain development, causes violence and injury, increases risky sexual behaviours and unplanned pregnancy, and leads to psychological problems.<sup>2</sup> Psychosocial and educational primary prevention programmes were not effective in reducing alcohol drinking among youth.<sup>3</sup> Only small preventive effects on binge drinking and drunkenness were observed in family- and school-based programmes.<sup>4, 5</sup>

Although the effects of underage drinking on health are well documented, less is known about the effects on medical services use. In adults, some studies found moderate drinking associated with lower hospitalisation than abstinence or heavy drinking (U-shaped association),<sup>6-9</sup> but other studies found that hospitalisation increased with alcohol consumption.<sup>10, 11</sup> As regards outpatient services use, an inverse association with alcohol consumption was found in several studies.<sup>9, 12, 13</sup> These inconsistent associations are complex and may not be directly comparable given the differences in outcome measures, settings and methods.

In adolescents, **many** consequences of alcohol drinking such as unintended injuries, risky sexual behaviours and intoxication, often require acute medical care and hospitalisation. For example, 16% of ambulance calls concerning college students were attributable to alcohol drinking in the US; alcohol intoxication occupied 1.5% of adolescent hospital admissions in the Slovak Republic; and the prevalence of hospitalisation due to alcohol intoxication was increasing in the Netherlands.<sup>14-16</sup> Existing data were mainly based on Western countries, where **prevalence of alcohol drinking** is high. For example, in US adolescents, 49% drank monthly and 23% had ever binged,<sup>2</sup> and 5.8% of hospitalisation among adolescents were attributable to alcohol use

disorders.<sup>17</sup> Little is known about the effects of alcohol drinking on medical services use in Chinese adolescents, who consume less alcohol than their Western counterparts.<sup>1</sup>

In Hong Kong, the most westernised city in China, 22%-26% of adolescents drank monthly.<sup>18</sup> Health services are easily accessible with primary care medical consultations provided mainly by general practitioners, and in-patient services by public hospitals at very low costs.<sup>19</sup> We investigated the association between alcohol drinking and medical services use among Chinese adolescents in Hong Kong. The results may have implications for alcohol control also in mainland China and other Asian countries experiencing a growing epidemic of underage and adult alcohol use.<sup>20</sup>

## Methods

### *Sampling*

A school-based youth health survey was conducted among secondary 1 (US grade 7) to secondary 5 students in Hong Kong in 2003-4. Details of the survey have been reported elsewhere.<sup>21, 22</sup> Briefly, 85 secondary schools were randomly selected from all secondary schools (about 500) with a probability proportional to the school enrolment size.<sup>23</sup> All form 1 classes and 2 randomly selected classes in each upper forms completed an anonymous questionnaire in the schools. To encourage candid reporting, separate answer sheets were provided. Teachers were present to maintain classroom order, but avoided patrolling or seeing the answers. Completed answer sheets were immediately put in an opaque envelope and collected by research assistants. Ethics approval was granted by a local institutional review board.

### *Measurement*

Alcohol consumption was measured using the question “Do you drink alcohol including beer in usual days?” with drinking frequencies categorised as non-drinking (reference), “less than 1 day/week”, “1-2 days/week” and “3-7 days/week”. Medical consultation was defined as any Chinese or Western medical consultations in the past 14 days. Hospitalisation was defined as any hospital admission in the past 12 months. A shorter period was used for medical consultation as this is more common than hospitalisation and a longer period was used for hospitalisation to identify more cases. The 2-week period of medical consultation is also used in government surveys.<sup>24</sup> Data collected also included housing type and parental highest education attainment (proxies of socioeconomic status), sex, age, family structure (intact or non-intact), parental smoking (both, either or none), peer smoking (any or none), secondhand smoke exposure at home (any or none) and outside home (any or none), physical activity (never/rarely, sometimes or frequently), illicit drug use (ever or never), smoking (ever or never), feeling anxious (yes or no) and feeling depressed (yes or no).

*Statistical analysis*

Stata 10.1 was used for data analysis. After excluding questionnaires with dubious response patterns or excessive missing data (>50% missing items) (N=718, 2.0%), and students with age ≥18 (N=2094, 5.8%), 33300 (92.2%) students remained for complete case analysis. The sample was representative of the corresponding population in Hong Kong.<sup>21</sup> Logistic regression was used to calculate the crude and adjusted odds ratios (AOR) of medical consultation and hospitalisation for alcohol drinking in models that progressively adjusted for more covariates: basic demographic factors, socioeconomic status and family structure (model 1); unhealthy behaviours (model 2); and parental smoking and peer smoking (model 3). The linear associations between alcohol drinking and medical services use were tested by treating categorised alcohol drinking frequency as a continuous variable of 0, 1, 2 and 3 to derive P for



[trend](#). Psychological distress of feeling anxious and depressed are common risk factors of alcohol drinking and medical services use.<sup>2, 25</sup> To control for such potential confounding, subgroup analyses were conducted among students who did not report feeling anxious or depressed (Model 4).

## Results

Of all 33300 students, 47.6% were boys, mean age was 14.6 years (SD 1.6), 36.7% reported highest parental education of primary or below, and half (43.6%) were living in public housing estates (Table 1). One in four (27.6%) students drank alcohol and most commonly [at](#) <1 day/week (21.1%). Medical consultation in the past 14 days (15.9%) was more frequently reported than hospitalisation in the past 12 months (5.1%). Girls were more likely to have medical consultation but less likely to be hospitalised than boys. Younger students were more likely to be hospitalised but medical consultation was similar by age. Lower socioeconomic status, feeling depressed, feeling anxious, smoking, illicit drug use, physical inactivity and alcohol drinking were associated with medical consultation and hospitalisation.

Associations between alcohol drinking and medical services use were consistently observed in crude and adjusted logistic regression models (models 1-4). In the fully adjusted model (model 3), the AORs (95% CI) for medical consultation were 1.14 (1.06-1.23) for <1 day/week, 1.30 (1.13-1.50) for 1-2 days/week and 1.70 (1.41-2.06) for 3-7 days/week of alcohol drinking (*P* for trend <0.001), compared with non-drinking. The corresponding AORs (95% CI) for hospitalisation were 1.14 (1.02-1.28), 1.68 (1.32-2.14) and 2.38 (1.90-2.98) (*P* <0.001 for trend). Similar associations were observed for medical consultation and hospitalisation among adolescents who did not feel anxious or depressed. The associations were also similar in boys and girls (*P* for interaction >0.05).

**Discussion**

To the best of our knowledge, this is the first non-Western study that investigates the association between medical services use and alcohol drinking among underage adolescents. Previous studies have documented the association between alcohol drinking and risk factors of medical services use (e.g. digestive problems, respiratory symptoms, injury, etc.) among Chinese adolescents.<sup>26</sup> Our results were consistent with Western studies that linked alcohol consumption to hospitalisation due to alcohol intoxication among adolescents and ambulance use among college students.<sup>14-16</sup> The present study did not require medical consultation and hospitalisation to be alcohol-related, and stronger associations between alcohol drinking and medical services use were expected otherwise.

Contrary to the U-shaped<sup>6-9</sup> or inverse<sup>12, 13</sup> associations between alcohol drinking and medical services use among adults in other studies, we found a positive linear association among adolescents. The U-shaped or inverse associations in adults could reflect that light and moderate drinkers were more health conscious and less likely to seek medical care than heavy drinkers; some abstainers might also have quit drinking due to illness. Such healthier profile in moderate drinkers was not apparent in adolescents, and potential differences in background characteristics and health behaviours were adjusted for in different regression models. The putative health benefits of moderate alcohol drinking, such as that for heart disease, among adults are also controversial due to the favourable characteristics of moderate drinkers.<sup>27</sup>

In Hong Kong, beer and wine tax was unprecedentedly abolished in 2008 to boost alcohol trading,<sup>28</sup> and this was followed by aggressive promotion by the industry. Alcohol drinking is increasingly publicised as stylish and fashionable without any legislation regulating such

promotion in Hong Kong. Our findings suggest that any increase in adolescent drinking may be accompanied by a rise in medical service use. Following the success of the World Health Organisation Framework Convention on Tobacco Control, a similar international treaty for alcohol control is needed to guide policies on alcohol taxation and promotion,<sup>20, 29</sup> two of the most important strategies in reducing adolescent drinking.

Our study has several limitations. All the data were self-reported including alcohol drinking, medical consultation and hospitalisation. We only have data on the frequency of alcohol drinking; future studies should also consider the amount of alcohol consumed. Medical consultation and hospitalisation are obvious events and similar questions have been used by other studies, which supported the validity of such self-reported data by children and adolescents.<sup>30, 31</sup> Using the same data, we also found significant associations of medical consultation and hospitalisation with health complaints (medical consultation OR=2.27, 95% CI: 2.07-2.50; hospitalisation OR=1.29, 95% CI: 1.13-1.47) and poor self-rated health (medical consultation OR=3.46, 95% CI: 3.27-3.67; hospitalisation OR=2.09, 95% CI: 1.91-2.29) supporting the validity of these data (data not shown in tables). Due to the cross-sectional design, causality between alcohol consumption and medical services use could not be ascertained, although it seemed unlikely that medical services use had led to alcohol drinking. On the other hand, health services use might prompt the students to avoid drinking or influence their reporting of alcohol consumption, which could bias the associations in either direction. Although robust and dose-response associations were observed in this study, prospective studies are needed to ascertain temporality. Given the limited time provided by the schools, we used simple questions adapted from other studies to measure depression and anxiety.<sup>32</sup> Their validity was supported by our previous findings on a positive association with weight misperception using the same sample.<sup>33</sup> Finally, although the associations had been adjusted for many

potential confounders including smoking, drug use and physical inactivity, residual confounding cannot be ruled out in observational studies.

**Conclusions**

Alcohol consumption was associated with medical services use in Chinese adolescents. More rigorous alcohol control policies and health promotion programmes are needed to reduce alcohol drinking and related harms in adolescents.

**Contributors:** SYH and THL conceived and designed the study. MPW and SYH analyzed the data. MPW, SYH and THL wrote the paper and approved the final version.

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**Declaration:** All authors have no relevant financial interest and any conflict of interest in this article.

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Table 1. Prevalence of medical consultation and hospitalisation by basic characteristics among students aged 11-17.

	N (%)	Medical consultation		Hospitalisation	
		%	$\chi^2$ P	%	$\chi^2$ P
Sex			<0.001		<0.001
Boys	15845 (47.6)	15.1		5.9	
Girls	17455 (52.4)	16.6		4.4	
Age			0.30		0.02
11-14	13812 (41.5)	16.1		5.5	
15-17	19488 (58.5)	15.7		4.9	
Highest parental education			<0.001		<0.001
Unknown	5749 (18.0)	14.1		4.4	
Uneducated or kindergarten	514 (1.6)	19.8		7.8	
Primary school	3885 (12.2)	15.4		4.6	
Form 1-3	7361 (23.1)	15.2		4.5	
Form 4-5	8082 (25.4)	16.0		5.3	
Form ≥6	6269 (19.7)	18.1		6.2	
Housing type			<0.001		<0.001
Public housing estate	13470 (42.6)	14.2		4.4	
Subsidised private housing	3121 (9.9)	15.2		5.1	
Private (owner)	10290 (32.5)	17.2		5.0	
Private (tenant)	2676 (8.5)	16.6		6.0	
Temporary	326 (1.0)	27.9		18.1	
Others	1771 (5.6)	18.0		7.2	
Feeling depressed			<0.001		0.05
No	28350 (85.1)	15.4		5.1	
Yes	2950 (14.9)	18.4		5.6	
Feeling anxious			<0.001		<0.001
No	30485 (91.6)	15.4		4.9	
Yes	2815 (8.5)	20.8		7.7	
Smoking			<0.001		<0.001
Never-smokers	25201 (76.1)	14.8		4.0	
Ever-smokers	7914 (23.9)	19.3		8.6	
Illicit drugs			<0.001		<0.001
Never-use	31111 (93.6)	15.1		4.6	
Ever-use	2130 (6.4)	26.4		13.2	
Physical activity			<0.001		0.05
Frequently	7448 (22.4)	15.9		5.6	
Sometimes	14668 (44.1)	15.2		4.9	
Never/rarely	11155 (33.5)	17.2		5.2	
Alcohol drinking			<0.001		<0.001
Non-drinker	24097 (72.4)	14.6		4.2	
<1 day/week	7014 (21.1)	17.5		5.8	
1-2 days/week	1285 (3.9)	22.1		11.8	
3-7 days/week	904 (2.7)	28.4		16.8	



Table 2. Associations of underage alcohol drinking with medical consultation and hospitalisation.

Alcohol drinking	Crude OR	Adjusted OR (95% CI)			
	(95% CI)	Model 1	Model 2	Model 3	Model 4
<b>Medical consultation</b>					
Non-drinker	1	1	1	1	1
<1 day/week	1.23 (1.14-1.33)***	1.24 (1.16-1.32)***	1.17 (1.08-1.26)***	1.14 (1.06-1.23)**	1.09 (1.00-1.19)*
1-2 days/week	1.66 (1.44-1.90)***	1.64 (1.44-1.86)***	1.40 (1.22-1.61)***	1.30 (1.13-1.50)***	1.26 (1.07-1.49)**
3-7 days/week	2.32 (2.00-2.69)***	2.24 (1.89-2.65)***	1.77 (1.46-2.15)***	1.70 (1.41-2.06)***	1.63 (1.36-1.95)***
P for trend <sup>†</sup>	<0.001	<0.001	<0.001	<0.001	<0.001
<b>Hospitalisation</b>					
Non-drinker	1	1	1	1	1
<1 day /week	1.41 (1.26-1.59)***	1.42 (1.27-1.59)***	1.20 (1.08-1.35)**	1.14 (1.02-1.28)*	1.12 (0.99-1.28)
1-2 days/week	3.10 (2.58-3.71)***	2.87 (2.30-3.59)***	1.95 (1.55-2.44)***	1.68 (1.32-2.14)***	1.64 (1.27-2.11)***
3-7 days/week	4.66 (3.87-5.61)***	4.09 (3.37-4.97)***	2.63 (2.12-3.28)***	2.38 (1.90-2.98)***	2.42 (1.93-3.05)***
P for trend <sup>†</sup>	<0.001	<0.001	<0.001	<0.001	<0.001

Model 1: Adjusted for sex, age, parental education, housing type, family structure and school clustering effects.

Model 2: Additionally adjusted for smoking, illicit drug use and physical activity.

Model 3: Additionally adjusted for peer smoking, parental smoking and secondhand smoke exposure.

Model 4: Among students who did not report feeling anxious or depressed, and adjusting for Model 3 variables.

\*P<0.05, \*\*P<0.01, \*\*\*P<0.001.

<sup>†</sup>P for trend by treating alcohol drinking as 0, 1, 2 and 3.

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Done
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	✓
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	✓
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	✓
Objectives	3	State specific objectives, including any prespecified hypotheses	✓
Methods			
Study design	4	Present key elements of study design early in the paper	✓
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	✓
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	✓
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	✓
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	✓
Bias	9	Describe any efforts to address potential sources of bias	✓
Study size	10	Explain how the study size was arrived at	✓
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	✓
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	✓
		(b) Describe any methods used to examine subgroups and interactions	✓
		(c) Explain how missing data were addressed	✓
		(d) If applicable, describe analytical methods taking account of sampling strategy	✓
		(e) Describe any sensitivity analyses	N/A
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	N/A
		(b) Give reasons for non-participation at each stage	N/A
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	✓
		(b) Indicate number of participants with missing data for each variable of interest	N/A
Outcome data	15*	Report numbers of outcome events or summary measures	✓
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	✓
		(b) Report category boundaries when continuous variables were categorized	✓
		(c) If relevant, consider translating estimates of relative risk into absolute risk for	N/A

		a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	✓
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	✓
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	✓
Generalisability	21	Discuss the generalisability (external validity) of the study results	✓
<b>Other information</b>			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	✓

\*Give information separately for exposed and unexposed groups.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).