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Who reports insufficient and disturbed sleep? Results from a representative population-based health survey in Hong Kong

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ABSTRACT

Objectives To highlight the prevalence of sleep problems and identify associated risk factors among a representative sample recruited from the general population of Hong Kong.

Design, setting and participants Participants included 12 022 individuals (aged 15 or above) who took part in the Population Health Survey 2014/15, a territory-wide survey conducted by the Department of Health of the Government of the Hong Kong Special Administrative Region.

Primary and secondary outcome measures Outcomes were the prevalence of (1) insufficient sleep (<6 hours sleep per day) and (2) any sleep disturbance (difficulty initiating sleep, intermittent awakenings, early awakening) ≥3 times per week in the past 30 days. Multivariable logistic regression identified associations between sleep problems and sociodemographic, clinical and lifestyle factors.

Results 9.7% of respondents reported insufficient sleep and 10.5% reported sleep disturbances ≥3 times a week. Female gender, monthly household income <$12 250 (Hong Kong dollar), lower education level, mental health condition and physical health condition were significantly associated with both insufficient and disturbed sleep (all p<0.05). Unemployment, homemaker, insufficient physical activity, current/former smoking status and harmful alcohol consumption were associated with sleep disturbances only (all p<0.01).

Conclusions Sleep problems are highly prevalent in Hong Kong. As such problems are associated with a range of health conditions, it is important to facilitate improvements in sleep. Our results show that harmful alcohol consumption, insufficient physical activity and current smoking are modifiable risk factors for sleep disturbances. Public health campaigns should focus on these risk factors in order to promote a healthy lifestyle and ultimately reduce sleep disturbances. Targeted interventions for high-risk groups may also be warranted, particularly for those with doctor-diagnosed physical and mental health conditions.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ The study data are from a recent, territory-wide health survey with a large representative sample and high data completion rate, all of which increase the reliability of results.
⇒ Multiple individual factors were considered, including sociodemographics, illness status and lifestyle.
⇒ The cross-sectional design has the potential to cause bias due to reverse causality.
⇒ Study variables were self-reported by respondents, which could have introduced bias as well as under-reporting.
⇒ Data on sleep were limited to the 30 days preceding the survey. Further studies with longer follow-up periods on sleep are therefore required to confirm the study results.

INTRODUCTION

Sleep is a normal and important physiological function as it enables the body and mind to recover. However, sleep problems are increasingly recognised as a serious public health concern.[1] Such problems can include insufficient sleep, too much sleep and sleep disturbances (eg, difficulty in falling or staying asleep, early morning awakenings).[2] In addition to being detrimental to well-being and quality of life, a growing body of literature has found that poor sleep is strongly associated with the increased risk of a number of adverse health outcomes. These outcomes include cardiovascular issues,[3] obesity,[4] hypertension,[3] development of type 2 diabetes and cancer.[4] Sleep deprivation can also impair the immune system, which can increase susceptibility to infectious diseases and reduce response to vaccines.[5] In addition to higher healthcare costs, a recently published meta-analysis reported that sleep problems can increase the likelihood of work absenteeism by up to 23%.[6]

A particular concern is that sleep issues are likely to become even more common due to

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a rise in 24-hour 'round-the-clock' societies with a corresponding increase in shift work, longer commute times as well as higher use of mobile phones and computers later in the evening.[1 7] To inform the development of public health interventions and policy, valid and reliable data from nationally representative samples should be routinely collected in order to assess the prevalence of sleep problems among populations, detect any changes in such problems over time and identify associated risk factors. By knowing these risk factors, policymakers, employers and individuals can develop targeted measures to improve sleep. For example, it has been shown in a systematic review that employer-sponsored interventions can improve sleep and sleep-related outcomes such as reduced absenteeism and better overall quality of life.[8] These interventions included educational programmes that emphasised sleep hygiene or fatigue management, timed napping before or after work, increasing daytime activity, modifying workplace environments and screening for sleep problems.[8]

The current study reports on sleep among the general population of Hong Kong, a region that has become known as one of the most sleep-deprived places in the world with a number of local studies reporting a high prevalence of sleep problems (range: 11.9% to 61.2%).[9–18] These figures are alarming, particularly as such problems have been associated with negative outcomes, as described above. However, it is important to note that the generalisability of much of this research is limited, which could result in errors in the estimates of the prevalence rates. For example, the majority of these studies included small sample sizes or only recruited particular participant groups that were not randomly selected from the general population (eg, adolescents or elderly people only).[11–15 18] Furthermore, the two studies that included the largest (N=9851 and N=5001), and most representative samples, analysed data collected in 1998[9] and 2007,[10] which are likely out of date. This study therefore aimed to (1) highlight the prevalence of insufficient and disturbed sleep among a more recent representative sample obtained from the Hong Kong Population Health Survey 2014/15 (PHS 2014/15), and (2) identify associated risk factors.

METHODS

Study design and setting

Data were derived from the PHS 2014/15. The PHS 2014/15 is a cross-sectional population-based study conducted by the Department of Health of the Government of the Hong Kong Special Administrative Region between December 2014 and October 2015. It is the most recent population health survey available. Systematic replicated sampling was applied to select a representative sample that covered the land-based non-institutional population (aged ≥15 years). Domestic helpers from outside of Hong Kong and visitors were excluded.[19] A total of 5435 of the 7205 households who were contacted agreed to be interviewed (household response rate: 75.4%). Of the recruited households, 12022 individuals completed the face-to-face interview, which recorded sociodemographic information and included measures of health-related quality of life, health status, lifestyle, injury prevention, preventive health practices and healthcare utilisation.

Outcome variables

The outcomes of interest for the current analysis were insufficient sleep (sleep quantity) and disturbed sleep (sleep quality). For sleep quantity, respondents were asked to report, on average, how many hours of sleep they had per day in the preceding 30 days. Insufficient sleep was defined as <6 hours of sleep on average per day, the definition adopted by a recently published local study.[17] For sleep quality, respondents reported how often they experienced each of the following sleep disturbances in the past 30 days: (1) difficulty initiating sleep (DIS), (2) intermittent awakenings or difficulty maintaining sleep (DMS) during the night and (3) early morning awakening (EMA) and unable to sleep again. Responses to each of the three items were recorded on a 4-point Likert scale (1=Not during the past 30 days, 2=Less than once a week, 3=Once or twice a week, 4=Three or more times a week). For analysis, disturbed sleep was defined as having DIS, DMS or EMA for at least three times a week over the past 30 days.[20]

Predictor variables

The selection of predictor variables was based on the results of previous studies. Sociodemographic variables included gender (male, female), age group (<35 years, 35–54 years, 55–74 years, 75 years or above), employment status (employed, unemployed, retired, homemaker, student), marital status (never married, married, divorced/separated, widowed), immigrant background (born in Hong Kong, immigrant living in Hong Kong for ≥7 years, immigrant living in Hong Kong for <7 years), educational background (no schooling/preprimary, primary, secondary, tertiary) and monthly household income. Income was classified as follows: (1) <50% of the Hong Kong median, (2) ≥50% of the Hong Kong median – Hong Kong median and (3) ≥Hong Kong median. This was based on the Hong Kong median household income in the second quartile of 2015 (HK$24 500 (Hong Kong dollar)). Clinical variables were doctor-diagnosed chronic conditions (excluding mental health conditions) and doctor-diagnosed mental health conditions. Finally, the following lifestyle variables were assessed: physical activity (sufficient as performing at least 150 min of moderate-intensity physical activity, 75 min of vigorous-intensity physical activity per week or an equivalent combination of moderate-intensity and vigorous-intensity physical activity achieving at least 600 MET-minutes, as recommended by the Global Physical Activity Questionnaire of the WHO[21]), smoking status (never, current, former) and alcohol consumption (never, former, non-harmful current, harmful current). Harmful alcohol consumption

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was defined as an Alcohol Use Disorders Identification Test score of ≥8 by WHO.[22]

Statistical analyses

Descriptive statistics (eg, number of respondents (N) and proportion (%)) were used to describe the characteristics of respondents. Any statistically significant differences between groups was checked by χ^2 tests. In addition to the analysis at the sample level, weighting factors were applied to estimate the results with respect to the distribution of gender and age group of the land-based non-institutional population of Hong Kong in the second quarter of 2015.[19] Univariate and multivariable logistic regressions were used to assess the single and adjusted effect of sociodemographic and lifestyle factors on the likelihood of insufficient sleep and disturbed sleep, respectively. A total of 64 respondents were excluded from the regression analyses due to small sample sizes. Those excluded were 28 individuals (0.2%) with a non-employment status (eg, long-term health condition, disability, occupational injury or those whom received financial assistance from the government) and 36 individuals (0.3%) who did not provide a response for monthly household income. Statistical analyses were performed using Stata V.13.0 (StataCorp LP, College Station, Texas, USA). All tests of significance were two-tailed and a p value of <0.05 was considered statistically significant.

Patient and public involvement

This study is a secondary data analysis so no patient and public involvement took place.

RESULTS

Subjects

Total respondents sampled in the PHS 2014/15 were 12 022. After applying the statistical weights to project the estimates to the Hong Kong general population, 52.4% were women and those aged between 35 and 54 years formed the largest proportion among the age groups (36.3%) (table 1). For clinical factors, 39.1% reported a doctor-diagnosed chronic condition (excluding mental health condition) and 1.6% reported a doctor-diagnosed mental health condition. It was found that 87.3% had sufficient physical activity, 72.9% had never smoked cigarettes and 57.9% were categorised as being a non-harmful current drinker. Prolonged sleep duration was reported in 2.9% of the respondents (>9 hours of sleep on average per day).

Prevalence and predictors of insufficient sleep

The preceding 30-day weighted prevalence of insufficient sleep, as defined by reporting an average of <6 hours of sleep per day, was estimated to be 9.7% (online supplemental table 1). At the sample level (table 2), respondents with insufficient sleep were more likely to be women, older in age, retirees, homemakers, divorced or separated, immigrants living in Hong Kong for ≥7 years,

Table 1 Characteristics of study participants

	Sample level	Projected population of the second quarter of 2015*
	N=12 022	N=6 080 200
Gender		
Male	47.1%	47.6%
Female	52.9%	52.4%
Age group		
<35	28.6%	29.0%
35–54	35.4%	36.3%
55–74	27.5%	26.8%
75 or above	8.5%	8.0%
Employment status		
Employed	56.8%	58.4%
Unemployed	3.1%	3.1%
Retired	18.7%	17.7%
Homemaker	13.5%	13.2%
Student	7.7%	7.4%
Other	0.2%	0.2%
Marital status		
Single	29.7%	29.8%
Married	59.5%	60.0%
Divorced/separated	4.4%	4.2%
Widowed	6.3%	6.0%
Immigrant background		
Born in Hong Kong	60.7%	61.5%
Immigrant living in Hong Kong for 7 years or more	35.1%	33.8%
Immigrant living in Hong Kong for less than 7 years	4.3%	4.6%
Educational background		
No schooling/preprimary	4.6%	4.4%
Primary	16.6%	15.4%
Secondary	52.2%	51.9%
University or above	26.5%	28.3%
Monthly household income		
<HK$12 250	18.7%	17.8%
HK$12 250–24 499	24.6%	23.9%
≥HK$24 500	56.4%	58.1%
Unanswered	0.3%	0.3%
Doctor-diagnosed chronic condition (excluding mental health condition)		
Yes	39.9%	39.1%
No	60.1%	60.9%
Doctor-diagnosed mental health condition		
Yes	1.7%	1.6%

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Table 1 Continued

	Sample level	Projected population of the second quarter of 2015*
	N=12 022	N=6 080 200
No	98.3%	98.4%
Physical activity (defined by the Global Physical Activity Questionnaire)†		
Sufficient	87.2%	87.3%
Insufficient	12.8%	12.7%
Smoking status		
Never smoker	72.9%	72.9%
Former smoker	12.4%	12.3%
Current smoker	14.7%	14.8%
Alcohol consumption		
Never drinker	22.5%	21.8%
Former drinker	17.0%	16.7%
Non-harmful current drinker‡	57.1%	57.9%
Harmful current drinker‡	3.4%	3.5%

*Population weighting allocated by age group and gender of survey respondents was applied to sample level to estimate the results with respect to the land-based non-institutional population of Hong Kong in the second quarter of 2015.
†The figures on physical activity level are different from those published in the Report of Population Health Survey 2014/15, which only included respondents aged 18 or above for the calculation of physical activity level.
‡Harmful drinking is defined as Alcohol Use Disorders Identification Test scores of ≥8.
HK$, Hong Kong dollar.

have a lower education level (primary school or below), lower monthly household income, a diagnosis of a physical health condition, a diagnosis of a mental health condition, insufficient physical activity and not consume alcohol (all p values<0.05 from χ^2 tests).

The results of the multivariable analysis, where each variable is adjusted for all other variables in the model, are presented in table 3. Women had 1.37 times higher odds of reporting insufficient sleep when compared with men (OR 1.37, 95% CI 1.18 to 1.60, p<0.001). Those aged 75 years or above had a 1.53-fold increase in the odds of reporting insufficient sleep when compared with respondents below 35 years of age (OR 1.53, 95% CI 1.06 to 2.19, p=0.022). In terms of employment, retirees had 35% lower odds of having insufficient sleep than those who were employed (OR 0.65, 95% CI 0.52 to 0.81, p<0.001). Respondents who were divorced had a 1.37-fold increase in odds of insufficient sleep than people who were married (OR 1.37, 95% CI 1.06 to 1.78, p=0.017). Results for education showed that, when compared to those with tertiary education, those with no schooling/preprimary and primary education had significantly higher odds of reporting insufficient sleep (no schooling/preprimary: OR 1.83, 95% CI 1.33 to 2.52, p<0.001; primary: OR 1.73, 95% CI 1.38 to 2.17, p<0.001). Respondents with a monthly household income below HK$12 250 had 1.27 times higher odds of insufficient sleep than those with an income ≥HK$24 500 (OR 1.27, 95% CI 1.07 to 1.51, p=0.007). For clinical variables, it was found that respondents with doctor-diagnosed chronic conditions or mental health conditions had significantly higher odds of having insufficient sleep than those without such conditions (chronic conditions: OR 1.77, 95% CI 1.54 to 2.04, p<0.001; mental health conditions: OR 1.95, 95% CI 1.37 to 2.78, p<0.001).

Prevalence and predictors of disturbed sleep

Overall, 10.5% of respondents reported sleep disturbances, defined as having DIS, DMS or EMA for at least three times a week over the past 30 days (online supplemental table 1). The most common type of sleep disturbance among respondents was DMS (7.3%), followed by DIS (6.8%) and EMA (6.0%) (online supplemental table 2). Similar to respondents with insufficient sleep, it was found that women, those older in age, retirees, homemakers, divorced or separated, immigrant living in Hong Kong for ≥7 years, educated to primary level or below, lower monthly household income, having a doctor-diagnosed chronic condition, a mental health condition, insufficient physical activity and not consuming alcohol were potential predictors of sleep disturbances (all p values<0.05 from χ^2 tests, as shown in table 2).

From table 4, multivariable regression analyses showed that women had significantly higher odds of reporting disturbed sleep than men (OR 1.51, 95% CI 1.29 to 1.76, p<0.001). Respondents who were unemployed, or who were homemakers, had higher odds of having disturbed sleep than those who were employed (unemployed: OR 1.51, 95% CI 1.09 to 2.10, p=0.014; homemaker: OR 1.69, 95% CI 1.40 to 2.04, p<0.001). Respondents with an educational background lower than tertiary education also had higher odds of reporting sleep disturbances (no schooling/preprimary: OR 1.54, 95% CI 1.13 to 2.10, p=0.006; primary: OR 1.58, 95% CI 1.26 to 1.98, p<0.001; secondary: OR 1.20, 95% CI 1.01 to 1.44, p=0.044). In terms of monthly household income, respondents with an income below HK$12 250 had 1.25 times higher odds of disturbed sleep than respondents with an income ≥HK$24 500 (OR 1.25, 95% CI 1.06 to 1.48, p=0.008). Respondents with doctor-diagnosed chronic conditions or mental health conditions had significantly higher odds of reporting sleep disturbances than those without such conditions (chronic condition: OR 2.21, 95% CI 1.92 to 2.55, p<0.001; mental health condition: OR 3.06, 95% CI 2.23 to 4.19, p<0.001). Respondents with an insufficient physical activity level had a 1.27-fold increase in odds of reporting sleep disturbances when compared with those with sufficient physical activity levels (OR 1.27, 95% CI 1.08 to 1.50, p=0.005). It was also found that respondents who were current or former smokers had a greater

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Table 2 Characteristics of study subjects by insufficient sleep and disturbed sleep in the preceding 30 days

	Sufficient sleep† (N=10 836, 90.1%)	Insufficient sleep† (N=1186, 9.9%)	P value	Without any sleep disturbance‡ (N=10 733, 89.3%)	With any sleep disturbance‡ (N=1289, 10.7%)	P value
Gender			<0.001*			<0.001*
Male	48.1%	38.2%		48.4%	36.5%	
Female	51.9%	61.8%		51.6%	63.5%	
Age group			<0.001*			<0.001*
<35	29.6%	19.3%		29.9%	17.3%	
35–54	35.9%	31.5%		36.1%	29.6%	
55–74	26.7%	34.9%		26.4%	37.1%	
75 or above	7.8%	14.2%		7.5%	16.0%	
Employment status			<0.001*			<0.001*
Employed	57.6%	49.7%		58.6%	41.3%	
Unemployed	3.2%	2.4%		3.0%	4.0%	
Retired	18.1%	23.8%		17.6%	27.4%	
Homemaker	12.9%	18.8%		12.3%	23.3%	
Student	8.0%	4.9%		8.2%	3.4%	
Other	0.2%	0.5%		0.2%	0.5%	
Marital status			<0.001*			<0.001*
Single	30.7%	21.2%		31.1%	18.2%	
Married	59.3%	61.7%		59.2%	62.8%	
Divorced/separated	4.1%	7.0%		4.1%	6.7%	
Widowed	5.9%	10.0%		5.6%	12.2%	
Immigrant background			<0.001*			<0.001*
Born in Hong Kong	61.1%	57.2%		61.4%	54.5%	
Immigrant living in Hong Kong for 7 years or more	34.5%	39.8%		34.2%	42.2%	
Immigrant living in Hong Kong for less than 7 years	4.4%	3.0%		4.4%	3.3%	
Educational background			<0.001*			<0.001*
No schooling/preprimary	4.2%	8.9%		4.1%	9.3%	
Primary	15.6%	26.1%		15.4%	26.8%	
Secondary	52.9%	46.1%		52.8%	47.2%	
University or above	27.4%	19.0%		27.7%	16.8%	
Monthly household income			<0.001*			<0.001*
<HK$12 250	17.9%	26.3%		17.4%	29.3%	
HK$12 250–24 499	24.6%	24.6%		24.8%	23.3%	
≥HK$24 500	57.2%	48.7%		57.5%	47.1%	
Unanswered	0.3%	0.4%		0.3%	0.3%	
Doctor-diagnosed chronic condition (excluding mental health condition)			<0.001*			<0.001*
Yes	38.0%	57.4%		37.1%	63.3%	
No	62.0%	42.6%		62.9%	36.7%	
Doctor-diagnosed mental health condition			<0.001*			<0.001*
Yes	1.4%	3.8%		1.2%	5.7%	
No	98.6%	96.2%		98.8%	94.3%	

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Table 2 Continued

	Sufficient sleep† (N=10 836, 90.1%)	Insufficient sleep† (N=1186, 9.9%)	P value	Without any sleep disturbance‡ (N=10 733, 89.3%)	With any sleep disturbance‡ (N=1289, 10.7%)	P value
Physical activity			0.004*			<0.001*
Sufficient	87.5%	84.5%		87.7%	82.7%	
Insufficient	12.5%	15.5%		12.3%	17.3%	
Smoking status			0.236			0.004*
Never smoker	72.8%	73.4%		73.2%	70.0%	
Former smoker	12.3%	13.4%		12.1%	15.3%	
Current smoker	14.8%	13.2%		14.7%	14.7%	
Alcohol consumption			<0.001*			<0.001*
Never drinker	22.0%	27.2%		22.0%	26.8%	
Former drinker	16.9%	17.6%		16.8%	18.2%	
Non-harmful current drinker§	57.7%	51.6%		57.9%	50.0%	
Harmful current drinker§	3.4%	3.5%		3.2%	5.0%	

*Significant at 0.05 level by χ^2 test.
†Sufficient sleep was defined as ≥6 hours per night and insufficient sleep as <6 hours per night.
‡Sleep disturbance was defined as having difficulty in falling asleep, maintaining sleep or early morning awakenings for at least three times a week.
§Harmful drinking was defined as Alcohol Use Disorders Identification Test scores of ≥8.
HK$, Hong Kong dollar.

risk of sleep disturbances than never smokers (current smoker: OR 1.36, 95% CI 1.12 to 1.65, p=0.002; former smoker: OR 1.33, 95% CI 1.10 to 1.61, p=0.003). Finally, those who were harmful current drinkers had 2.11 times higher odds of sleep disturbances than those who had never consumed alcohol (OR 2.11, 95% CI 1.53 to 2.92, p<0.001).

DISCUSSION

Overall, 16.6% of respondents reported sleep problems. The estimated prevalence of insufficient sleep (<6 hours per night on average) and disturbed sleep (≥3 times a week) were 9.7% and 10.5%, respectively. Based on the estimate of the local population at the second quarter of 2015, this corresponds to 588 200 individuals (aged ≥15 years) with insufficient sleep and 640 100 individuals with sleep disturbances. These findings indicate that sleep problems are highly prevalent among the general population of Hong Kong. For other countries (Finland, Sweden, Italy and the Netherlands), population-based studies have reported insufficient sleep prevalence to be in the range of 12% to 43%[23–26] and for disturbed sleep to be in the range of 29.5% to 32.1%.[25 26] This suggests that Hong Kong has a lower prevalence of sleep problems when compared with other countries; however, caution should be used when comparing results due to the use of different methods to assess sleep problems. In addition, our prevalence estimate is slightly lower than that identified in a previous population-based local study conducted in 1998 (N=9851), where it was found that 11.9% of respondents reported sleep disturbances (either DIS, DMS or EMA) ≥3 times per week.[10] This suggests that sleep in Hong Kong has improved slightly over time, although the prevalence rate is still high. Our results differ from the other population-based study (N=5001) where the estimated prevalence of sleep disturbances was 39.4%.[9] However, this is likely due to differences in how sleep problems were measured and defined as the other study administered the 19-item Chinese version of the Pittsburgh Sleep Quality Index (PSQI). The PSQI items generate seven component scores where a total score of >5 (score range: 0–21) is a marker for sleep disturbance.[9] The PSQI functions as a more in-depth measure of sleep as it incorporates not only sleep duration and sleep disturbances, but also subjective sleep quality, sleep efficiency, daytime dysfunction and use of sleep medications.[27] The inclusion of these additional variables is likely to increase the prevalence rate.

There are a number of explanations that could account for the high prevalence of insufficient and disturbed sleep. First, a high-stressed, 'round-the-clock' environment that is typical of many urban areas is not conducive to good sleep quality. Long working hours, which are very common in Hong Kong, have also been found to negatively impact sleep.[28] Another possible explanation is help-seeking among the Hong Kong Chinese. For example, a study of both adults (N=2231) and children (N=2186) found that the prevalence of help-seeking for

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Table 3 Factors associated with insufficient sleep in the preceding 30 days by multivariable logistic regression model

	Likelihood of having insufficient sleep	
	Adjusted OR (95% CI)	P value
Gender		
Male	Ref	
Female	1.37 (1.18 to 1.60)	<0.001*
Age group		
<35	Ref	
35–54	1.01 (0.81 to 1.27)	0.900
55–74	1.20 (0.92 to 1.56)	0.172
75 or above	1.53 (1.06 to 2.19)	0.022*
Employment status		
Employed	Ref	
Unemployed	0.70 (0.46 to 1.05)	0.085
Retired	0.65 (0.52 to 0.81)	<0.001*
Homemaker	1.00 (0.82 to 1.22)	0.981
Student	0.86 (0.62 to 1.19)	0.347
Marital status		
Married	Ref	
Never married	0.97 (0.79 to 1.20)	0.786
Divorced/separated	1.37 (1.06 to 1.78)	0.017*
Widowed	0.90 (0.71 to 1.16)	0.421
Immigrant background		
Born in Hong Kong	Ref	
Immigrant living in Hong Kong for 7 years or more	0.91 (0.79 to 1.04)	0.169
Immigrant living in Hong Kong for less than 7 years	0.85 (0.60 to 1.22)	0.389
Educational background		
No schooling/preprimary	1.83 (1.33 to 2.52)	<0.001*
Primary	1.73 (1.38 to 2.17)	<0.001*
Secondary	1.12 (0.94 to 1.34)	0.206
Tertiary	Ref	
Monthly household income		
<HK$12 250	1.27 (1.07 to 1.51)	0.007*
HK$12 250–24 499	1.08 (0.93 to 1.27)	0.318
≥HK$24 500	Ref	
Doctor-diagnosed chronic condition (excluding mental health condition)		
No	Ref	
Yes	1.77 (1.54 to 2.04)	<0.001*
Doctor-diagnosed mental health condition		
No	Ref	
Yes	1.95 (1.37 to 2.78)	<0.001*
Physical activity (defined by the Global Physical Activity Questionnaire)		
Sufficient	Ref	
Insufficient	1.12 (0.94 to 1.33)	0.199
Smoking status		
Never	Ref	
Current	1.07 (0.87 to 1.31)	0.519

Continued

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Table 3 Continued

	Likelihood of having insufficient sleep	
	Adjusted OR (95% CI)	P value
Former	1.10 (0.90 to 1.34)	0.350
Alcohol consumption		
Never	Ref	
Former	0.89 (0.73 to 1.08)	0.228
Non-harmful current†	0.93 (0.80 to 1.09)	0.400
Harmful current†	1.22 (0.85 to 1.77)	0.283

Sixty-four respondents were excluded in the regression analyses because of refusal to disclose monthly household income or unemployment due to long-term health condition, disability, occupational injury and recipient of Comprehensive Social Security Assistance.
*Significant at 0.05 level by multivariable logistic regression.
†Harmful drinking was defined as Alcohol Use Disorders Identification Test scores of ≥8.
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insomnia symptoms was only 40% for adults and 10% for children.[29] Furthermore, a study of local adolescents (N=290) reported that, although troubled by sleep difficulties, only 22% of those with symptoms tried to get help and only 32% used approaches to improve their sleep.[18] It was found that listening to music was the most commonly reported approach (9.5%) followed by relaxation (6.0%), reading (4.3%), earlier bedtimes (4.3%), drinking milk (3.4%), counting (2.6%), improving bedroom environment (1.7%), taking a hot bath (0.9%), exercising (0.9%) and reducing napping during the day (0.9%). It should be noted that a number of other evidence-based and theoretically sound approaches are either not among the strategies listed (eg, avoiding caffeine closer to bedtime, regular sleep schedules) or are not as commonly used (eg, exercise, reduced daytime napping), which emphasises the importance of increasing sleep hygiene education. Such education should actively promote knowledge of sleep and could be widely and easily delivered through various media channels.[30]

In terms of risk factors, doctor-diagnosed mental health conditions were most strongly associated with both insufficient and disturbed sleep. Although we are unable to specify the causal relationship in this study, the available evidence seems to suggest that there is a complex bidirectional relationship between sleep disturbances and mental health problems that must be further explored.[31] Indeed, there is robust evidence that depression and anxiety are associated with an increased risk of developing sleep disturbances.[32 33] On the other hand, insomnia has been significantly associated with an increased risk of subsequent depression as well as anxiety, alcohol abuse and psychosis.[34] Research also shows that early treatment of sleep problems can potentially prevent or reduce depressive symptoms, again highlighting the importance of promoting sleep among the general population.[35]

In line with previous research, we also found a strong relationship between doctor-diagnosed chronic conditions and sleep problems.[9 33 36] Furthermore, potential indicators of low socioeconomic status (low education level, unemployment, income below HK$12 250) were all significantly associated with greater odds of disturbed sleep, which again reflects observations from other studies.[36 37] When compared with men, women were found to have a higher risk of both insufficient and disturbed sleep.[9–11 38] The reasons for this are varied and could include biological factors as well as increased vulnerability to mental health problems.[38] Those aged 75 years or above had a higher odds of reporting insufficient sleep when compared with respondents below 35 years of age, which might be the result of observed reductions in sleep time as people age.[39 40] Indeed, the variation of normal and disturbed sleep is much wider among elderly people[41] with a majority of older people reporting fewer hours of sleep than younger people.[42] Homemakers were also found to have greater odds of sleep disturbances, which is in line with the results of the two previous population-based studies conducted in Hong Kong.[9 10] For lifestyle, we found that harmful current alcohol consumption, current or former smoking status and insufficient physical activity were all significantly associated with an increased risk of sleep disturbances. However, we cannot determine the causal relationships among these variables. For example, it is unclear if alcohol disrupts sleep or if those with sleep difficulties consume more alcohol as a sleeping aid.[9] For physical activity, cross-sectional studies have reported that frequent exercise is associated with better sleep quality[43] whereas no physical activity is associated with poorer sleep.[36] Furthermore, a systematic review and meta-analysis of randomised trials found that formal exercise training programmes had a positive impact on sleep quality in middle aged and older adults with sleep problems.[44] Such findings suggest that physical activity could be independently associated with sleep, however, it has been emphasised that further prospective studies are required to confirm this association.[33]

Strengths and limitations

A key strength of this study is that it includes a large sample of individuals randomly selected from the general

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Table 4 Factors associated with disturbed sleep in the preceding 30 days by multivariable logistic regression model

	Likelihood of having disturbed sleep	
	Adjusted OR (95% CI)	**P value**
Gender		
Male	Ref	
Female	1.51 (1.29 to 1.76)	<0.001*
Age group		
<35	Ref	
35–54	0.87 (0.70 to 1.09)	0.232
55–74	1.03 (0.80 to 1.34)	0.798
75 or above	1.20 (0.85 to 1.70)	0.292
Employment status		
Employed	Ref	
Unemployed	1.51 (1.09 to 2.10)	0.014*
Retired	0.97 (0.78 to 1.20)	0.776
Homemaker	1.69 (1.40 to 2.04)	<0.001*
Student	0.76 (0.53 to 1.08)	0.129
Marital status		
Married	Ref	
Never married	0.92 (0.74 to 1.14)	0.428
Divorced/separated	1.23 (0.95 to 1.60)	0.111
Widowed	1.09 (0.87 to 1.37)	0.437
Immigrant background		
Born in Hong Kong	Ref	
Immigrant living in Hong Kong for 7 years or more	0.94 (0.82 to 1.08)	0.369
Immigrant living in Hong Kong for less than 7 years	1.01 (0.72 to 1.41)	0.969
Educational background		
No schooling/preprimary	1.54 (1.13 to 2.10)	0.006*
Primary	1.58 (1.26 to 1.98)	<0.001*
Secondary	1.20 (1.01 to 1.44)	0.044*
Tertiary	Ref	
Monthly household income		
<HK$12 250	1.25 (1.06 to 1.48)	0.008*
HK$12 250–24 499	0.99 (0.84 to 1.15)	0.858
≥HK$24 500	Ref	
Doctor-diagnosed chronic condition (excluding mental health condition)		
No	Ref	
Yes	2.21 (1.92 to 2.55)	<0.001*
Doctor-diagnosed mental health condition		
No	Ref	
Yes	3.06 (2.23 to 4.19)	<0.001*
Physical activity (defined by the Global Physical Activity Questionnaire)		
Sufficient	Ref	
Insufficient	1.27 (1.08 to 1.50)	0.005*
Smoking status		
Never	Ref	
Current	1.36 (1.12 to 1.65)	0.002*

Continued

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Table 4 Continued

	Likelihood of having disturbed sleep	
	Adjusted OR (95% CI)	P value
Former	1.33 (1.10 to 1.61)	0.003*
Alcohol consumption		
Never	Ref	
Former	0.93 (0.77 to 1.12)	0.429
Non-harmful current†	1.00 (0.85 to 1.17)	0.992
Harmful current†	2.11 (1.53 to 2.92)	<0.001*

Sixty-four respondents were excluded in the regression analyses because of refusal to disclose monthly household income or unemployment due to long-term health condition, disability, occupational injury and recipient of Comprehensive Social Security Assistance.
*Significant at 0.05 level by multivariable logistic regression.
†Harmful drinking was defined as Alcohol Use Disorders Identification Test scores of ≥8.
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population of Hong Kong, which maximises generalisability. The statistical power is high due to a good survey response rate (75.4%) and data completion rate. In addition, we were able to assess the impact of a wide range of potential risk factors. A number of important limitations also need to be considered. First, the cross-sectional design prevents us from drawing causal conclusions. All study variables were self-reported, which could have introduced bias and led to under-reporting. For example, the full impact of mental health problems on sleep cannot be fully determined, or controlled for in multivariable analyses, as the number of respondents who reported such diagnoses were very small (n=201, 1.7%). This could be due to the stigma surrounding mental health in Hong Kong, which could deter people from accessing help or disclosing a doctor-diagnosed mental health condition. The findings obtained through self-reported sleep data could also be different from those using objective measures of sleep, such as actigraphy and polysomnography.[45] Furthermore, characteristics of non-responders were not examined so it cannot be determined whether those who chose to participate differed from those who did not take part. For example, it is possible that individuals with poorer health may have been more inclined to take part in the PHS, so the prevalence rates for a number of study variables (eg, doctor-diagnosed chronic conditions, sleep problems) could be overestimated. Finally, it is also important to note that respondents were only asked to report on sleep during the previous 30 days, so we are unable to assess (or control for) differences between those with the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) definition of insomnia where symptoms must be present for >3 months and those with temporary sleep difficulties.

Implications for future research

Future research should examine the associations identified in the current study using a longitudinal design in order to identify causal associations, bidirectional associations and examine the interactions among risk factors. Qualitative studies should also be conducted to explore the associations found in more depth, for example, to identify why exactly homemakers are more likely to report poor sleep, which aspects of chronic conditions have the largest impact on sleep as well as local understanding of sleep problems, treatment preferences and perceived barriers and facilitators to service access. It is also recommended that the economic impacts of poor sleep in Hong Kong are identified as, to our knowledge, this has not yet been investigated.

Moreover, it is important to note that the current COVID-19 pandemic is likely to have a negative impact on the factors that influence sleep quality (eg, mental health, physical activity). Worldwide, people have been exposed to a very worrying situation of an unknown duration, have experienced substantial changes to their daily life and are likely to be anxious about their health as well as the future repercussions of the pandemic.[46] It is also important to note that good sleep quality helps to strengthen and maintain the immune system,[5] hence any pandemic-induced sleep disturbances could compromise recovery from COVID-19.[47] Further research, both quantitative (longitudinal) and qualitative, should be done to investigate any changes in sleep quality during the pandemic. Such studies will be especially important in order to guide the development and implementation of population-based approaches to help manage sleep problems as well as inform pandemic management.

Public health implications

It is a public health imperative to develop campaigns and interventions that promote and improve sleep, particularly during the COVID-19 pandemic. Indeed, it has been suggested that increasing sleep duration could be a more acceptable and an easier means by which to achieve good individual and societal health when

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compared with other health-promoting behaviours, such as healthy eating and increased physical activity.[4] Such campaigns could include messages adapted from cognitive–behavioural therapy for insomnia guidelines, for example, keeping a regular night-time and wake-up schedule, not napping during the day, avoiding caffeine or alcohol later in the evening, exercising in the afternoon or early evening.[48]

CONCLUSION

To summarise, sleep problems are highly prevalent in Hong Kong. Doctor-diagnosed mental health conditions, lower education level, doctor-diagnosed chronic conditions, female gender and low-income were found to be significantly associated with both insufficient sleep and sleep disturbances. Furthermore, unemployment, being a homemaker, insufficient physical activity level, current or former smoking status and harmful alcohol consumption were associated with sleep disturbances only. Therefore, it can be said that there are different risk factors for the duration and quality of sleep and that harmful drinking, lack of physical activity and current smoking are modifiable risk factors for sleep disturbances. The findings from this study are also particularly timely as the COVID-19 pandemic has the potential to exacerbate sleep problems. Therefore, there is a pressing need to monitor sleep patterns among populations and continue to conduct research that enables the development of evidence-based strategies to promote and improve sleep.

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