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Title: Prevalence and severity of burnout in Hong Kong doctors: a cross-sectional study

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Abstract:

Objective: To estimate the prevalence and severity of burnout and explore the risk factors for burnout among medical graduates in Hong Kong (HK).

Design: Cross-sectional questionnaire survey

Setting: Hong Kong

Participants: Doctors who graduated from the University of Hong Kong between 1995 and 2014

Primary and secondary outcome measures: Burnout as measured by the Copenhagen Burnout Inventory (CBI), alcohol consumption as measured by the Alcohol Use Disorders Identification Test Version C, lifestyle behaviours (hours of sleep, hours of work, exercise, smoking, substance use), career satisfaction and sociodemographic characteristics were obtained by paper and electronic questionnaire.

Results: Response rate was 30.9% (496/1,607). The prevalence of personal burnout was 63.1%, 55.9% for work-related burnout and 35.4% for patient-related burnout. The mean CBI subscale scores were 57.4±21.4 (personal), 48.9±7.4 (work-related) and 41.5±21.8 (client-related). Factors associated with personal burnout and patient-related burnout included age (Coeff -0.437, 95% CI -0.779 to -0.095 and Coeff -0.596, 95% CI -0.965 to -0.228 respectively), setting of practice (Coeff -5.759, 95% CI -10.665 to -0.853 and Coeff -5.317, 95% CI -10.602 to -0.032 respectively) and regular exercise (Coeff -6.855, 95% CI -11.102 to -2.608 and Coeff -6.769,95% CI -11.333 to -2.205 respectively). Gender (Coeff 5.1, 95% CI 1.382 to 8.818), average hours of sleep per night (Coeff -5.200, 95% CI -7.139 to -3.262) and work hours per week (Coeff 0.226, 95% CI 0.099 to 0.353) were associated with personal burnout only. No factors were significantly associated with work-related burnout.

Conclusion:

Burnout is highly prevalent amongst HK doctors. Younger doctors, females and those working in the public sector appear to be at higher risk for burnout and may benefit from targeted interventions. Policy makers and health care authorities should consider measures to help reduce or prevent burnout by enabling adequate sleep, reducing work hours, and encouraging exercise.

Strengths and limitations of the study

- This is the first HK doctor burnout study using the CBI to measure burnout.

- The response rate was 30.9%, which is not unusual for many doctor studies; however, the results may be affected by substantial selection and response bias.
- This study represents only a proportion of early to mid-career HK doctors as only the graduates of one of the two medical schools in HK were sampled and foreign-trained doctors were not included.
- The survey was cross-sectional and therefore we are unable to determine if the associations are causally related.
- Further large-scale studies including later career doctors are needed to gain a more complete picture of burnout across the career span.

Introduction

The practice of medicine is a high stake, high-pressure profession with little room for error and little time for self-renewal. Burnout, a measurement of physical and psychological exhaustion, has been reported to be higher in physicians than the general population [1]. Physician burnout has a number of implications at both individual and institutional levels. At the individual level, burnout is predictor of well-being [2], self-rated health status [3], and mood disorders [4] in physicians. At the institutional level, burnout affects quality of health care with studies showing that doctors with burnout make more mistakes [5], have reduced professional work effort [6], and self-report suboptimal care to patients [4]. Burnout has also been associated with increased number of days absent from work [7], increased intention to leave their work [8], earlier retirement and reduced clinic hours [9].

The definition of burnout has evolved over time. Maslach described burnout as a prolonged response to chronic emotional and interpersonal stressors on the job across three dimensions: emotional exhaustion, depersonalisation, and reduced personal accomplishment. Her widely used Maslach Burnout Inventory (MBI) measures these dimensions [10], with it being the instrument of choice in 85.7% of studies on physician burnout prior to June 2018 [11]. However, inconsistencies in studies selecting the cut-off scores used to define burnout using these dimensions have resulted in a wide range of burnout prevalence ranging from 0-80.5% [11]. In addition, MBI only focuses on work related exhaustion, without considering legitimate factors outside of work such as family responsibilities and health issues [12]. One of the more recent definitions expands on the traditional definition so that those aspects not directly related to work are also measured: *burnout is a condition that results from severe stress relative to one's own emotional and cognitive reserves* [12]. These endpoints of fatigue and exhaustion are captured in the Copenhagen Burnout Inventory (CBI) that was introduced in 2005. The CBI also broadens the scope of burnout into three subscales: personal, work-related and client-related burnout. "Personal burnout is the degree of physical and

psychological fatigue and exhaustion experienced by the person'' [13]. Work-related burnout is defined as "the degree of physical and psychological fatigue and exhaustion that is perceived by the person as related to his/her work". Client-related burnout is defined as "the degree of physical and psychological fatigue and exhaustion that is perceived by the person as related to his/her work with clients" [13]. For physicians, client refers to the patient. CBI has yielded consistent, valid and reliable results measuring burnout in a wide range of workers in the human service sector, including physicians, across many different countries and using different languages [2, 3, 7, 13-16].

Many studies have looked at the factors associated with burnout measured by either the MBI or CBI in health professionals across different stages of training. Personal characteristics such as sex [2, 8, 16], age [15, 17, 18] , marital status [19, 20], having children [18], work demand [8, 18, 20], setting of practice [16] have been related to burnout. Career satisfaction has also been related to burnout [18, 20]. Lastly, lifestyle characteristics such as smoking [21], exercise [8, 22] , substance use such as alcohol use [23], and sleep [23, 24] have been correlated with burnout. In recognition of this problem, there is an international trend to examine and maintain physician well-being as demonstrated by the numerous dedicated support mechanisms and extensive resources which exist overseas [25, 26].

In Hong Kong, there has been one study of physician burnout focusing on doctors working in the public sector that used the MBI to identify a prevalence of burnout of 31.9% [17]. However, 48.9% of Hong Kong doctors work in the private sector [27], so there is large pool of doctors, with different demographics and scope of practice and lifestyle issues who have been overlooked. In addition, the more comprehensive and holistic CBI may be able to provide a more nuanced perspective of physician burnout. This study aims to provide data to fill these gaps by examining the prevalence and severity of burnout and the lifestyle behaviours of HK doctors including those working in both the private and public sectors. We also aim to explore the relationship between burnout and sociodemographic, lifestyle behaviour, and career satisfaction. Investigation into this area would provide important insight which can have significant implications for physician well-being, patient care and health service, and residency program curricula.

Methods

The target population comprised of all doctors who entered medical school at the University of Hong Kong between 1995 and 2014 who had a valid email address or postal address (N= 1607). Questionnaire administration took place between January 29, 2016 to April 15, 2016.

The sample size calculation was based on the assumption that a minimum of 10 participants is required for regression analysis. [28]. However, another study showed that there is better power to

detect a small effect size with 30 participants per variable [29]. In this study, 13 predictors were examined, and thus 390 participants were required.

Subjects were invited by email to complete an online survey via SoGO Survey, a third-party service, to ensure that respondents remained anonymous. Each participant was given a unique identifying number to avoid duplication of responses. Response rates were tracked by SoGO Survey.

During the sampling period, an initial invitation email was sent followed by a reminder email every 14 days with a maximum of 3 reminders sent. A total of 384 respondents completed the e-survey. In order to increase the sample size, hard copies of the survey were mailed to subjects who had a mailing address available. 112 hard copies of the surveys were returned. As an incentive, respondents were offered a coffee coupon if they provided an email contact in the survey. 496 graduates completed the survey with the subject recruitment flow chart shown in **Figure 1**.

Measurement instruments

The Copenhagen Burnout Inventory (CBI) was used to measure burnout. The CBI is a 19-item questionnaire which measures exhaustion and encompasses three different types of physical and psychological exhaustion: personal, work-related and patient-related. The six personal burnout questions relate to physical and emotional fatigue. The seven work-related burnout questions address the frustration and exhaustion associated with work. The patient-related burnout questions were developed to address symptoms of frustration and emotional exhaustion associated with the person's work involving clients (in this study it was with patients). All questionnaire items are assessed according to a five-point Likert scale: always or to a very high degree; often or to a high degree; sometimes or somewhat; seldom or to a low degree; and never/almost never or to a very low degree [7] with each of the answer assigned a certain number of points: 0, 25, 50, 75 and 100 respectively. The value of the burnout level is calculated as a mean value; therefore, every scale has value 0–100. A score of 50 points or more indicates a high degree of burnout. In our study, the Cronbach's alpha coefficients were 0.92 for the personal burnout subscale, 0.84 for the work-related subscale and 0.90 for the patient-related subscale. Hence, the CBI was a reliable measure with good subscale internal consistency.

The Alcohol Use Disorders Identification Test Version C (AUDIT-C) is an valid, effective and simple screening tool that has 3 questions related to at-risk drinking and is scored out of 12 [30]. At-risk drinking is defined as an AUDIT-C score > 3 in accordance to the HK Department of Health and Centre of Health Protection guidelines [31]. The higher the AUDIT- C score the more likely the

consumption pattern is consistent with a diagnosis of alcohol dependence. The scores were derived from the original questionnaire and modified to fit the scoring system of AUDIT-C.

Items on job satisfaction and lifestyle behaviours, were derived and adapted from existing doctor questionnaires [32, 33] and the local HK population health survey [34].

Data analysis

Descriptive statistics were used to summarize the characteristics, lifestyle behaviour and career satisfaction of the respondents. The prevalence and scores of CBI personal, work-related and patient-related domains were calculated. Prevalence of burnout was calculated by counting the number of doctors who had a CBI score $\geq$ 50. To evaluate the effect of sociodemographic factors, lifestyle behaviours and career satisfaction were analysed through univariate linear regression. If the factors were significantly associated with the CBI, these factors were included in the multivariable linear regression models using backward stepwise selection. The multicollinearity and residual normality assumption were examined by variance inflation factor and QQ-plot. The models satisfied these assumptions.

All significance tests were two tailed and findings with a p-value less than 0.05 were considered statistically significant. All statistical analyses were performed using Stata Version 15.0 (StataCorp LP, College Station, TX, USA).

Results

The response rate was 30.9%: 496 completed the survey of 1,607 medical graduates with valid email or address. After excluding 49 participants with missing data, 447 subjects were included in the analysis. The subject recruitment flow chart is shown in **Figure 1**.

As shown in **Table 1**, the prevalence of burnout within our sample was 63.1% for personal burnout, 55.9% for work-related burnout and 35.4% for patient-related burnout. The mean CBI subscale scores were 57.4±21.4 (personal), 48.9±7.4 (work-related) and 41.5±21.8 (patient-related).

The socio demographics, lifestyle behaviours and professional satisfactions are displayed in **Table 2.** The mean age was 34.1 ± 6.0 years with an age range of 24-46 years. 43.6% of the respondents were female. A majority of respondents indicated that they were satisfied with their current job position (80.7%) and with their career choice as a doctor (93.7%).

Table 3, **4**, and **5** shows the results of the regression analysis identifying the factors associated with personal, work-related and patient-related burnout. Being of younger age and female, working in

the public sector, sleeping fewer hours per night, working longer hours per week, and not having regular exercise were significantly associated with higher CBI personal scores. There were no factors shown to be related to CBI work-related scores. Being of younger age, working in the public sector and not having regular exercise were associated with higher patient-related CBI scores.

Discussion

This study found the prevalence of burnout subscales was between 35-63% and personal burnout, in particular, was very prevalent among doctors who graduated from a local HK university. The prevalence of burnout of doctors in our study is higher than those reported in Australia [16] and Canada [20]. When compared to doctors in Taiwan, HK doctors had only slightly lower prevalence of patient-related burnout, but higher prevalence of personal burnout and work-related burnout [15]. The prevalence of burnout reported by Siu et al.'s burnout study using MBI was 31.9%, which is lower than that found in all three domains in the present study [17]. Several other physician burnout studies have shown a similar trend of higher prevalence of personal burnout, followed by work-related then patient-related burnout [15, 16, 20]. With respect to the burnout scores, Hong Kong doctors' scores were in line with the global ranges for all three subscales. Previous studies on doctors of different specialities and levels of trainings around the globe had personal burnout scores ranging from 39-62 [2, 14-16, 20], work-related scores ranging from 33-58 [15, 16, 20] and patient-related scores ranging from 22-62 [15, 16, 20].

Compared to the general HK population, HK doctors sleep less [35], work longer hours [36], smoke less [37], but do more exercise [38]. Adequate rest such as adequate sleep duration and quality sleep are important factors to reduce stress and fatigue. In the current study, lower average number of hours of sleep was associated with higher personal burnout scores only. A study of nurses in Taiwan showed that lack of sleep was associated with higher burnout in all three subscales of the CBI [24]. A previous study of HK and Macau university students showed that sleep behaviours such as the quality and duration of sleep can have effects on physical and psychological health, such as mood [39]. It can be postulated that lack of sleep can lead to poor mood which may cause one to feel more physical and emotional exhaustion or that lack of sleep can directly lead to more physical and emotional exhaustion. Both of which can contribute to personal burnout. Doctors who had longer working hours per week had higher CBI personal scores in this study. Longer work hours typically means there is less time to spend with family and enjoy one's personal life leading to higher personal burnout [3, 8]. Studies have shown that longer work hours translate to more work-family conflicts and there is a dose-response relationship between more work-family conflict and personal burnout [8]. In a Taiwanese study of first year post-graduate doctors, all three dimensions of the CBI

were noted to be related to work hours [40]. However, measuring work demands is complicated as it encompasses more than just the number of working hours. Siu et al.'s earlier study on doctor burnout study did not show that working hours was associated with higher MBI burnout scores, but working in shifts was [17]. In other studies, number of nights on call per week [18], quantitative workload [20], working overtime [15], working in shifts [15], inadequate time off work [3] have also been shown to contribute to higher levels of burnout. Similar to the other HK burnout study, our study found that smoking and use of substance was low amongst the samples and did not show any correlation with burnout [17]. Although 24.8% of the respondents in our sample fell into the 'at-risk' category for alcohol use, this level of drinking did not appear to be correlated with burnout which was also similar to Siu et al HK doctor study and doctors in Taiwan [41]. In contrast, studies on U.S. physicians have shown that alcohol abuse and dependence can be related to burnout measured by MBI [23], which suggest that HK physicians are less likely to turn to alcohol as a coping mechanism when they are stressed. Nurses working in HK cope with their stresses by seeking support from friends and colleagues, using different cognitive strategies and through leisure activities [42] and the most common method of stress relief in the general HK population is exercise [37]. This likely similar in HK physicians. It is reassuring that most doctors perform regular exercise in HK, and exercise was found to be protective for personal and patient-related burnout. Siu et al. study's did not find that exercise was a stress relieving factor against burnout [17]. However, other countries have shown similar findings to this study and showed the positive effect of exercise on burnout in Taiwan [41], France [8], and the US [43].

The relationship between sociodemographic characteristics and burnout show that age, sex and setting of practice have an impact on burnout in HK physicians. Previous studies examining doctors' age and burnout scores have been inconsistent. Some studies have not shown significant relationships of the three dimensions of CBI on age [16]; but other studies, such as of medical professionals in Taiwan have found that older staff had significantly lower burnout scores than younger staff on all the three dimensions of the CBI [15]. Our study found that only personal burnout and patient-related burnout were associated with age. Doctors in this study were between the ages of 24 and 46. This younger cohort is at the stage of their life where they are looking for a spouse, getting married and having children. However, at the same time, they also need to complete their postgraduate training and develop their career paths. This tension between personal and professional responsibilities is termed work-home interference or work-family conflict and studies have shown that this has an effect on burnout, especially on personal burnout [44]. Younger physicians who are just starting out may also have a steep learning curve when it comes to interacting with patients. Although they have exposure to patients during medical school, students have a supervising physician to fill in the deficient areas. When the student graduates and become a

doctor, they take on a lot more responsibility and are required to perform tasks they may not be confident in yet, which may contribute to their increased patient-related burnout in their early career. A study of HK dentists found that patient-related stressors such as actually making and possibly making mistakes, having a medical emergency in the surgery, coping with difficult patients and dealing with high patient expectations were amongst their top 5 ranked stressors [45]. One can reasonably argue that these patient-related factors would also be present in younger, less experienced medical doctors contributing to the higher patient-related burnout scores. The relationship between age and the work-related burnout may depend on additional factors such as level of experience. For example, Siu et al.'s study of HK doctors found that young but moderately experienced doctors were most at risk for burnout [17]. A possible reason for this is that new yet younger doctors may not be given as much responsibility at work at the beginning. However, as experience increases so does responsibility and the corresponding increase in stress.

Many other studies using CBI have shown that female physicians are more at risk for personal burnout [2, 3, 8, 16, 46], which was similar to our findings. There may be several explanations for this. A French study showed that work-family conflict was the greatest risk factor for high personal burnout in female doctors [8]. Single female doctors have difficulty finding spouses which can be related to not having enough time to find a partner or other social barriers [47] whereas married women tend to have more domestic duties and child rearing responsibilities than men [3, 47]. In particular, gender roles remain strictly defined in China in which the husband bears the breadwinner role and the wife assumes the home maker role which adds to the disconnect between work and home, corresponding to the discrepancy between work-related burnout and personal burnout among women doctors [48].

We found that the public sector doctors in our study had significantly higher CBI personal and patient-related burnout scores. Possible reasons for this could be due to less autonomy in the public sector, longer hours and higher patient load which invariably can affect their feelings of being physically and emotionally exhausted during their non-working hours and while seeing patients. According to the 2015 Health Manpower Survey in HK, there were 46.9% of doctors working in the public sector and 48.9% of HK doctors working in the private sector [27], but there were almost 4.5 times more inpatient discharges in the public hospitals compared to private sector [49]. This may describe a much larger patient load in the public sector which inadvertently can lead to longer work hours and increased workload. In addition, burnout has been shown to double the risk of intent to leave the profession [8]. It is conceivable that the attrition rate in the public sector may be a reflection of the high burnout. Burnt out HK physicians may desire to leave the public sector and join the private sector or leave practice altogether. The attrition from the HK public sector increased from 4.4% to 5.9% per year during 2015-2018 [50] and the results of a survey in 2014 of Emergency

Physicians in HK, found that 65% considered to leave from their current working position in public A&E Department with unhealthy working environment and enormous work load being the biggest reasons [51].

Although 55.9% of participants had work-related burnout, work-related burnout was not correlated to any of the sociodemographic factors, lifestyle behaviours and career satisfaction items. Hong Kong is known for its hard-working culture where many professions in the city also experience long hours and stress. A survey in 2008 conducted on HK employees showed the average working week was 49.6 hours. 62.4% of people regularly work unpaid overtime and 51.7% of people work late into the evenings with 80% citing that the reason that they work late is because they have too much work to do [36]. It is possible that working professionals in HK have normalised a fast pace, high pressure working environment and therefore, may not experience work-related burnout like in other countries so the factors contributing to work-related burnout in HK doctors may also be different.

Finally, it is important to note that despite the high prevalence of burnout and high severity of burnout, burnout in all three dimensions were not correlated with career satisfaction and the majority of doctors are satisfied with their present job position and being a medical doctor.

Limitations

Our study is subject to a number of limitations. Firstly, our response rate was only 30.9% and this could introduce a substantial response bias. On the one hand, physicians who suffer burnout maybe more likely to have interest in the topic and more likely to fill the survey; but, on the other hand, physicians who suffer burnout maybe more apathetic and less likely to fill the survey. Secondly, the age difference among respondents was only about 20 years and therefore cannot represent HK doctors in all age groups especially those who were older than 46 years of age. However, there was sufficient sampling from the spread of ages across the spectrum studied to make meaningful comparisons. Thirdly, as there are two medical schools in HK and foreign-trained doctors working in HK, this study cannot represent the entire population of HK doctors. Foreign-trained doctors account for about 8.5% of the practising doctors in HK [50]. We chose to sample from one medical school as graduates from this medical school represented approximately half the local graduates [52] , and for practical reasons as we had access to the electronic contact information for graduates. Although manpower surveys have noted that 48% of doctors work in the private sector, we only sampled 23% of private doctors. This maybe a reflection that recent graduates are more likely to work in the public sector. In addition, the survey was cross-sectional and therefore we are unable to determine if the associations are causally related. Lastly, many studies do not use the same burnout inventory, including the only other study on burnout published in HK, therefore direct comparisons cannot be made between different studies.

Future direction

The results from this study reflect a need to further understand burnout in HK doctors. Studies have shown that burnout and satisfaction were strongly associated with subsequent reduction in work effort [6], and burnout also has direct effects on patient care [53]. Across the world, medical communities are becoming more aware of physician well-being. At the core of the Charter on Physician Well-being is the notion that physicians who are well can better take care of their patients [25]. As such, by having such a charter, the goal is that governing bodies, policy makers, medical organisation and individual physicians can share responsibility to improve physician well-being. Starting from medical school, medical students should be supported in learning self-awareness of their own emotional states and needs. Recent recommendations for US graduate medical education sought to improve policies to improve trainee support for those who have children [54], which is important as work-home interference is seen as an important predictor of burnout. [55] In Canada, the Ontario Medical Association has a longstanding "Physician Health Program" to help medical students, residents, doctors and retired doctors struggling with substance use and mental health concerns. Other interventions, such as introduction of a stress management course to hospitals has shown to reduce malpractice claims and medication errors compared to hospitals without such course [56].

Contributors:

All authors participated in the interpretation of data, writing and critically reviewing the paper, and approved the final submitted manuscript. Amy PP Ng performed the literature review, contributed to the interpretation of the results and drafted the final manuscript. Julie Y Chen conceptualised the study and drafted the initial study protocol. Weng Yee Chin was responsible for drafting the study protocol, obtaining the grant, supervising the data collection and supervising the writing of the manuscript. Eric KF Wan conducted the statistical analyses, contributed to the interpretation of results and contributed to the final manuscript. Ms. Karina Chan was responsible for project coordination, data collection, preliminary data analysis, and preliminary data reporting. Nico Cheung assisted with statistical analysis.

Ethical approval

This study received approval by the Institutional Review Board of the University of Hong Kong/ Hospital Authority Hong Kong West Cluster (UW 15-405).

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Data sharing statement: Anonymised data is available through request to the corresponding authors

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Table 1. Prevalence of the personal, work-related and patient-related Copenhagen Burnout Inventory (CBI) Score

	Doctors (N=447)
Copenhagen Burnout Inventory (CBI) Score	57.4 ± 21.4
Burnout - personal	48.9 ± 7.4
Burnout – work-related	41.5 ± 21.8
Burnout – patient-related	
Copenhagen Burnout Inventory (CBI) Prevalence (Score (≥50))	
Burnout - personal	282 (63.1%)
Burnout – work-related	250 (55.9%)
Burnout – patient-related	158 (35.4%)

Notes:

All data are represented in mean ± SD or total (%), as appropriate.

No data shown for missing value.

Table 2. Descriptive statistics on socio-demographic, lifestyle behaviour, and career satisfaction

	Doctors (N=447)		Doctors (N=447)
Socio-demographic		**Lifestyle behaviour**	
Age	34.1 ± 6.0	Average sleep per night	6.6 ± 1.0
Gender (Female)	195 (43.6%)	Hours of work per week	54.7 ± 15.1
Marital status		Regular exercise	340 (76.1%)
Single, separated and divorced	201 (45.0%)	At-risk drinker	98 (24.8%)
Married	246 (55.0%)	Current Smoker	4 (0.9%)
Having children	177 (39.6%)	Substance use	6 (1.3%)
Setting of practice		**Career Satisfaction**	
Public	346 (77.4%)	Satisfied with present job position	359 (80.7%)
Private	101 (22.6%)	Satisfied with being a medical doctor	418 (93.7%)

Notes:

Current Smoker (Current smoker vs Non-smoker/ex-smoker)

Regular exercise (5 or more days per week for at least 10 minutes per day / Any vigorous and moderate physical activities)

At-risk drinkers were defined if the doctors had 3 or more in AUDIT-C score. The AUDIT-C score was calculated by the sum of score based on the frequency of drinking alcohol, the average number of standard drinks per day and the frequency of taking 5 or more drinkers on one occasion, ranging from 0 to 12. The frequency of drinking alcohol (Less than once per month/ Once per month/ 2 to 3 times per month or once per week/ 2 to 3 times per week/ 4 to 6 times per week or every day) ranks the score from 0 to 4 respectively; the average number of standard drinks per day (1-2 drinks/ 3-4 drinks/ 5-6 drinks/ 7-8 drinks/ 9 or more drinks) ranks the score from 0 to 4 respectively; the frequency of taking 5 or more drinkers on one occasion (Never/ Less than once per week/ Monthly/ Weekly/ Daily or almost daily) ranks the score from 0 to 4 respectively.

Private Practice (Private Solo/ Private Hospital/Non-government organization)

Public Practice (University/Government/Hospital Authority/Not applicable)

All data are represented in mean ± SD or total (%), as appropriate.

No data shown for missing value.

Table 3. Socio-demographic, lifestyle behaviour and career satisfaction associated with personal CBI score by regression analysis

Factor[a]	Personal CBI score (n = 447)					
	Univariate			Multivariable with Backward selection		
	Coeff.	95% CI	P-value	Coeff.	95% CI	P-value
Socio-demographic						
Age	-0.835*	(-1.159, -0.511)	<0.001*	-0.437*	(-0.779, -0.095)	0.012*
Female (Vs Male)	4.947*	(0.962, 8.932)	0.015*	5.100*	(1.382, 8.818)	0.007*
Married (Vs Single, separated and divorced)	-5.734*	(-9.697, -1.771)	0.005*	NA		
Having children	7.124*	(3.111, 11.137)	0.001*			
Private setting of practice (Vs Public)	-12.327*	(-16.943, -7.711)	<0.001*	-5.759*	(-10.665, -0.853)	0.022*
Health status						
Average sleep per night	-6.505*	(-8.497, -4.514)	<0.001*	-5.200*	(-7.139, -3.262)	<0.001*
Hours of work per week	0.361*	(0.233, 0.488)	<0.001*	0.226*	(0.099, 0.353)	0.001*
Regular exercise	-9.882*	(-14.452, -5.312)	<0.001*	-6.855*	(-11.102, -2.608)	0.002*
Current Smoker	5.117	(-16.002, 26.235)	0.634	NA		
At-risk drinker	-1.611	(-6.454, 3.232)	0.514			
Substance use	-16.402	(-33.621, 0.817)	0.062			
Career satisfaction						
Satisfied your present job position	-0.350	(-5.408, 4.708)	0.892	NA		
Satisfied with being a medical doctor	2.197	(-6.015, 10.409)	0.599			

CBI = Copenhagen Burnout Inventory; CI = Confidence Interval; Coeff = Coefficient

Notes:

Current Smoker (Current smoker vs Non-smoker/ex-smoker)

Regular exercise (5 or more days per week for at least 10 minutes per day / Any vigorous and moderate physical activities)

Private Practice (Private Solo/ Private Hospital/Non-government organization)

Public Practice (University/Government/Hospital Authority/Not applicable)

At-risk drinkers were defined if the doctors had 3 or more in AUDIT-C score. This AUDIT-C score was calculated by the sum of score based on the frequency of drinking alcohol, the average number of standard drinks per day and the frequency of taking 5 or more drinkers on one occasion, ranging from 0 to 12. The frequency of drinking alcohol (Less than once per month/ Once per month/ 2 to 3 times per month or once per week/ 2 to 3 times per week/ 4 to 6 times per week or every day) ranks the score from

0 to 4 respectively; the average number of standard drinks per day (1-2 drinks/ 3-4 drinks/ 5-6 drinks/ 7-8 drinks/ 9 or more drinks) ranks the score from 0 to 4 respectively; the frequency of taking 5 or more drinkers on one occasion (Never/ Less than once per week/ Monthly/ Weekly/ Daily or almost daily) ranks the score from 0 to 4 respectively.

* Significant with p-value < 0.05

[a] Variable in brackets is the reference category for independent variables

No data shown for missing value.

Table 4. Socio-demographic, lifestyle behaviour and career satisfaction associated with work-related CBI score by regression analysis

Factor[a]	Work-related CBI score (n = 447)					
	Univariate			Multivariable with Backward selection		
	Coeff.	95% CI	P-value	Coeff.	95% CI	P-value
Socio-demographic						
Age	0.105	(-0.009, 0.219)	0.072			
Female (Vs Male)	0.142	(-1.240, 1.524)	0.840			
Married (Vs Single, separated and divorced)	1.213	(-0.161, 2.586)	0.083		NA	
Having children	-0.991	(-2.390, 0.408)	0.165			
Private setting of practice (Vs Public)	-1.079	(-2.715, 0.557)	0.196			
Health status						
Average sleep per night	-0.290	(-1.010, 0.430)	0.429			
Hours of work per week	0.041	(-0.004, 0.086)	0.076			
Regular exercise	-0.620	(-2.225, 0.986)	0.449		NA	
Current Smoker	-4.562	(-11.829, 2.705)	0.218			
At-risk drinker	0.402	(-1.270, 2.074)	0.637			
Substance use	0.058	(-5.899, 6.015)	0.985			
Career satisfaction						
Satisfied your present job position	-0.538	(-2.279, 1.203)	0.544		NA	
Satisfied with being a medical doctor	0.676	(-2.154, 3.506)	0.639			

CBI = Copenhagen Burnout Inventory; CI = Confidence Interval; Coeff = Coefficient

Notes:

Current Smoker (Current smoker vs Non-smoker/ex-smoker)

Regular exercise (5 or more days per week for at least 10 minutes per day / Any vigorous and moderate physical activities)

Private Practice (Private Solo/ Private Hospital/Non-government organization)

Public Practice (University/Government/Hospital Authority/Not applicable)

At-risk drinkers were defined if the doctors had 3 or more in AUDIT-C score. This AUDIT-C score was calculated by the sum of score based on the frequency of drinking alcohol, the average number of standard drinks per day and the frequency of taking 5 or more drinkers on one occasion, ranging from 0 to 12. The frequency of drinking alcohol (Less than once per month/ Once per month/ 2 to 3 times per month or once per week/ 2 to 3 times per week/ 4 to 6 times per week or every day) ranks the score from 0 to 4 respectively; the average number of standard drinks per day (1-2 drinks/ 3-4 drinks/ 5-6 drinks/ 7-8 drinks/ 9 or more drinks) ranks the score from 0 to 4 respectively; the frequency of taking 5 or more drinkers on one occasion (Never/ Less than once per week/ Monthly/ Weekly/ Daily or almost daily) ranks the score from 0 to 4 respectively.

* Significant with p-value < 0.05

[a] Variable in brackets is the reference category for independent variables

No data shown for missing value.

Table 5. Socio-demographic, lifestyle behaviour and career satisfaction associated with patient-related CBI score by regression analysis

Factor[a]	Patient-related CBI score (n = 447)					
	Univariate			Multivariable with Backward selection		
	Coeff.	95% CI	P-value	Coeff.	95% CI	P-value
Socio-demographic						
Age	-0.755*	(-1.088, -0.423)	<0.001*	-0.596*	(-0.965, -0.228)	0.002*
Female (Vs Male)	0.418	(-3.673, 4.509)	0.841			
Married (Vs Single, separated and divorced)	-3.807	(-7.870, 0.256)	0.066		NA	
Having children	6.271*	(2.164, 10.378)	0.003*			
Private setting of practice (Vs Public)	-8.999*	(-13.777, -4.221)	<0.001*	-5.317*	(-10.602, -0.032)	0.049*
Health status						
Average sleep per night	-2.540*	(-4.642, -0.438)	0.018*		NA	
Hours of work per week	0.119	(-0.015, 0.253)	0.082			
Regular exercise	-6.932*	(-11.643, -2.222)	0.004*	-6.769*	(-11.333, -2.205)	0.004*
Current Smoker	-2.980	(-24.521, 18.561)	0.786			
At-risk drinker	-1.296	(-6.224, 3.633)	0.606		NA	
Substance use	-5.101	(-22.724, 12.522)	0.570			
Career satisfaction						
Satisfied your present job position	-0.022	(-5.170, 5.125)	0.993		NA	
Satisfied with being a medical doctor	-1.125	(-9.490, 7.240)	0.792			

CBI = Copenhagen Burnout Inventory; CI = Confidence Interval; Coeff = Coefficient

Notes:

Current Smoker (Current smoker vs Non-smoker/ex-smoker)

Regular exercise (5 or more days per week for at least 10 minutes per day / Any vigorous and moderate physical activities)

Private Practice (Private Solo/ Private Hospital/Non-government organization)

Public Practice (University/Government/Hospital Authority/Not applicable)

At-risk drinkers were defined if the doctors had 3 or more in AUDIT-C score. This AUDIT-C score was calculated by the sum of score based on the frequency of drinking alcohol, the average number of standard drinks per day and the frequency of taking 5 or more drinkers on one occasion, ranging from 0 to 12. The frequency of drinking alcohol (Less than once per month/ Once per month/ 2 to 3 times per month or once per week/ 2 to 3 times per week/ 4 to 6 times per week or every day) ranks the score from

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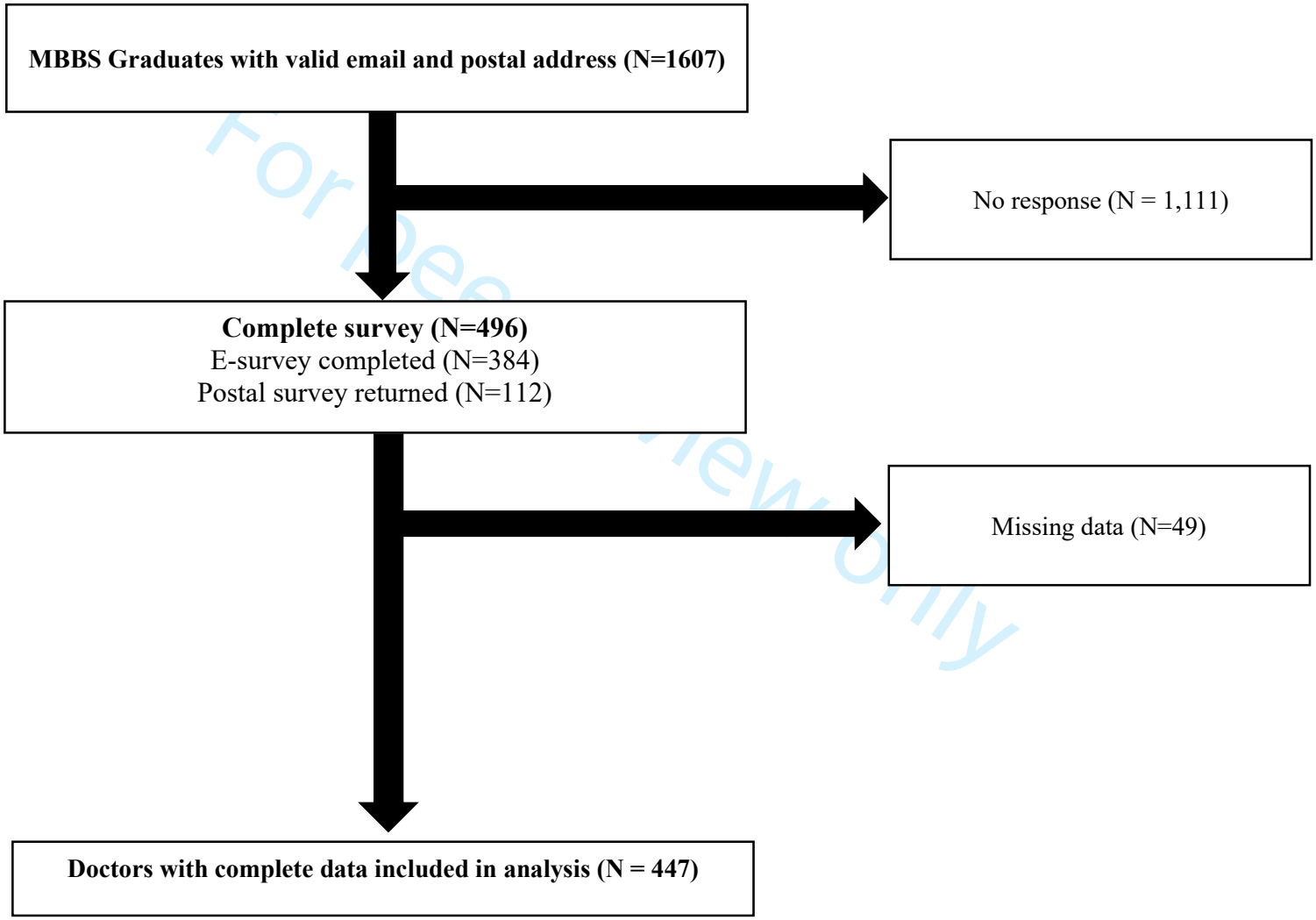
* Significant with p-value < 0.05

[a] Variable in brackets is the reference category for independent variables

No data shown for missing value.

Figure 1: Subject flow



STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	4-5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4-5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	4-5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5-6
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	5-6
Bias	9	Describe any efforts to address potential sources of bias	3-4
Study size	10	Explain how the study size was arrived at	4-5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	n/a
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6
		(*b*) Describe any methods used to examine subgroups and interactions	n/a
		(*c*) Explain how missing data were addressed	6
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	n/a
		(*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	4-5
		(b) Give reasons for non-participation at each stage	n/a
		(c) Consider use of a flow diagram	Fig 1.
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	6 & Table 2
		(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	6,7 & Table 1,3,4,5
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	n/a
		(*b*) Report category boundaries when continuous variables were categorized	5, Notes in Table 2, 3,4,5
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	n/a
Discussion			
Key results	18	Summarise key results with reference to study objectives	6-7
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	7-8
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	7-10
Generalisability	21	Discuss the generalisability (external validity) of the study results	10
Other information			
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	12

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

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.

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Prevalence and severity of burnout in Hong Kong doctors up to 20 years post-graduation: a cross-sectional study

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Title: Prevalence and severity of burnout in Hong Kong doctors up to 20 years post-graduation: a cross-sectional study

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Abstract:

Objective: To estimate the prevalence and severity of burnout and explore the factors associated with burnout among Hong Kong medical graduates up to 20 years post-graduation.

Design: Cross-sectional survey

Setting: Hong Kong

Participants: Doctors who graduated from the University of Hong Kong between 1995 and 2014

Primary and secondary outcome measures: Burnout as measured by the Copenhagen Burnout Inventory (CBI), alcohol consumption as measured by the Alcohol Use Disorders Identification Test Version C, lifestyle behaviours (hours of sleep and work, exercise, smoking, substance use), career satisfaction and socio-demographic characteristics were obtained using paper or online questionnaires.

Results: Response rate was 30.9% (496/1,607). Prevalence of CBI burnout was 63.1% (personal), 55.9% (work-related) and 35.4% (patient-related). The mean CBI subscale scores were 57.4±21.4 (personal), 48.9±7.4 (work-related) and 41.5±21.8 (client-related). Factors associated with personal and patient-related burnout included age (Coeff -0.437, 95% CI -0.779 to -0.095 and Coeff -0.596, 95% CI -0.965 to -0.228 respectively), practice setting (Coeff -5.759, 95% CI -10.665 to -0.853 and Coeff -5.317, 95% CI -10.602 to -0.032 respectively) and regular exercise (Coeff -6.855, 95% CI -11.102 to -2.608 and Coeff -6.769,95% CI -11.333 to -2.205 respectively). Gender (Coeff 5.1, 95% CI 1.382 to 8.818), average hours of sleep per night (Coeff -5.200, 95% CI -7.139 to -3.262) and work hours per week (Coeff 0.226, 95% CI 0.099 to 0.353) were associated with personal burnout only. No factors were significantly associated with work-related burnout.

Conclusion:

Burnout is highly prevalent amongst Hong Kong medical graduates. Younger doctors, females and those working in the public sector appear to be at higher risk for burnout and may benefit from targeted interventions. Policy makers and healthcare authorities should consider measures to help reduce burnout by enabling adequate sleep, reducing work hours, and encouraging exercise.

Strengths and limitations of the study

- This is the first Hong Kong doctor burnout study using the CBI to measure burnout.
- The response rate was 30.9%, which is not unusual for many doctor studies; however, the results may be affected by substantial selection and response bias.

- This study represents only a proportion of early to mid-career HK doctors as only the graduates of one of the two medical schools in HK were sampled and foreign-trained doctors were not included.
- The survey was cross-sectional and therefore we are unable to determine if the associations are causally related.
- Further large-scale studies including later career doctors are needed to gain a more complete picture of burnout across the career span.

Introduction

Medicine is a high-stake, high-pressure profession with little time for self-renewal. Burnout, a measurement of physical and psychological exhaustion, has been reported to be higher in physicians than in the general population [1]. Physician burnout has a number of implications at both individual and institutional levels. At the individual level, burnout is a predictor of well-being [2], self-rated health status [3], and mood disorders [4] in physicians. At an institutional level, burnout affects the quality of healthcare. Studies show that doctors with burnout make more mistakes [5], have reduced professional work effort [6], have poorer patient-doctor communication [7], and self-report suboptimal care to patients [4]. Burnout has also been associated with increased days of work absenteeism [8], increased intention to leave their work [9], earlier retirement and reduced clinic hours [10]. Recently, burnout has also been correlated to physician leadership behaviours [11].

The definition of burnout has evolved over time. Maslach described burnout as a prolonged response to chronic emotional and interpersonal stressors on the job across three dimensions: emotional exhaustion, depersonalisation, and reduced personal accomplishment. Her widely used Maslach Burnout Inventory (MBI) measures these dimensions [12] and has been the instrument of choice in 85.7% of physician burnout studies prior to June 2018 [13]. However, inconsistencies in selecting the cut-off scores used to define burnout have resulted in a wide range of burnout prevalence ranging from 0-80.5% [13]. In addition, MBI only focuses on work-related exhaustion, without considering legitimate factors outside of work such as family responsibilities and health issues [14]. A more recent definition expands on the traditional definition so that aspects not directly related to work are also measured: *burnout is a condition that results from severe stress relative to one's own emotional and cognitive reserves* [14]. These endpoints of fatigue and exhaustion are captured in the Copenhagen Burnout Inventory (CBI) that was introduced in 2005. The CBI broadens the scope of burnout into three subscales: personal, work-related and client-related burnout. Personal burnout is "the degree of physical and psychological fatigue and exhaustion experienced by the person'' [15]. Work-related burnout is "the degree of physical and psychological fatigue and exhaustion that is perceived by the person as related to his/her work".

Client-related burnout is "the degree of physical and psychological fatigue and exhaustion that is perceived by the person as related to his/her work with clients" [15]. For physicians, client refers to the patient. CBI has yielded consistent, valid and reliable results measuring burnout in a wide range of workers in the human service sector, including physicians, and across many different countries and in different languages [2, 3, 8, 15-19].

Many studies have examined the factors associated with burnout measured by either the MBI or CBI in health professionals across different stages of training. Personal characteristics such as female sex [2, 9, 18], younger age [17, 20, 21], marital status [22, 23], having children [21], work demands [9, 21, 23] and practice setting [18] have been associated with burnout. Career satisfaction has also been related to burnout [21, 23]. Lifestyle characteristics such as smoking [24], exercise [9, 25] , substance use such as alcohol use [26], and sleep [26, 27] have been correlated with burnout. In recognition of this problem, there has been an international trend to examine and maintain physician well-being as demonstrated by numerous dedicated support mechanisms and resources which exist in many countries [28, 29].

In Hong Kong (HK), there has been one study of physician burnout examining public sector doctors aged 30.5 to 44 years old which found the prevalence of burnout as measured by the MBI to be 31.9% [20]. However, 48.9% of HK doctors work in the private sector [30], so there is large pool of doctors, with different demographics, scope of practice and lifestyle issues that have not been studied. In addition, the more holistic CBI may be able to provide a more nuanced perspective of physician burnout. This study aims to provide data to fill these gaps by examining the prevalence and severity of burnout in HK doctors working in both the private and public sectors up to 20 years post-graduation. We also aim to explore the relationship between burnout and socio-demographics, lifestyle behaviours, and career satisfaction. Investigation into this area may provide important insights which can have significant implications for physician well-being, patient care, health services, and residency program curricula.

Methods

The target population comprised of all doctors entering medical school at the University of Hong Kong between 1995 and 2014 and who had a valid email or postal address (N= 1607). Questionnaire administration took place between January 29, 2016 to April 15, 2016.

The sample size calculation was based on the assumption that a minimum of 10 subjects were required for regression analysis [31]. However, since another study showed that there is better power to detect a small effect size with 30 participants per variable, 390 participants were needed to examine the 13 predictors in this study [32].

Subjects were invited by email to complete an online survey via SoGO Survey, a third-party service often used for graduate surveys. To ensure respondents remained anonymous and to avoid duplicated responses, each participant was allocated a unique identifying number. Response rates were tracked electronically by SoGO Survey.

During the sampling period, an initial invitation email was sent followed by a reminder email every 14 days with a maximum of 3 reminders sent. As an incentive, respondents were offered a coffee coupon if they provided an email contact in the survey. Initially 384 responses were received using the online survey. In order to increase the sample size, paper questionnaires were subsequently mailed to graduates with available mailing addresses resulting in a further 112 responses. In total 496 graduates completed the survey. The subject recruitment flow chart is shown in **Figure 1**.

Measurement instruments

The Copenhagen Burnout Inventory (CBI) was used to measure burnout. The CBI is a 19-item questionnaire that measures exhaustion. It encompasses three types of physical and psychological exhaustion: personal, work-related and patient-related. There are six personal burnout questions related to physical and emotional fatigue, seven work-related burnout questions addressing frustration and exhaustion associated with work, and six patient-related questions developed to address symptoms of frustration and emotional exhaustion associated with a doctor's work involving patients. All items are assessed according to a five-point Likert scale: always or to a very high degree; often or to a high degree; sometimes or somewhat; seldom or to a low degree; and never/almost never or to a very low degree [8] with each of the answer assigned a certain number of points: 0, 25, 50, 75 and 100 respectively. The burnout level is calculated as a mean score; therefore, every scale has a value 0–100. A score of ≥50 indicates a high degree of burnout [17, 18, 23]. In this study, the Cronbach's alpha coefficients were 0.92, 0.85, and 0.90 for personal, work-related and patient-related subscales respectively providing evidence that the CBI was a reliable measure with good subscale internal consistency.

The Alcohol Use Disorders Identification Test Version C (AUDIT-C) is a valid, effective and simple screening tool that has 3 questions related to at-risk drinking and is scored out of 12 [33]. At-risk drinking is defined as an AUDIT-C score $\geq$ 3 in accordance to the HK guidelines [34]. The higher the AUDIT- C score the more likely the consumption pattern is consistent with alcohol dependence. The scores were derived from the original questionnaire and modified to fit the scoring system of AUDIT-C.

Items on job satisfaction and lifestyle behaviours were derived and adapted from existing doctor questionnaires [35, 36] and the local HK population health survey [37].

Data analysis

Descriptive statistics were used to summarize the characteristics, lifestyle behaviour and career satisfaction of the respondents. The prevalence and scores of CBI personal, work-related and patient-related domains were calculated. Prevalence of burnout was calculated by determining the proportion of respondents with CBI scores ≥50. Univariate linear regression was used to evaluate the effect of socio-demographic factors, lifestyle behaviours and career satisfaction. Factors that were significantly associated with the CBI were included in the multivariable linear regression models using a backward stepwise selection. Multicollinearity and residual normality assumption were examined using a variance inflation factor and QQ-plot. The models satisfied these assumptions.

All significance tests were two tailed and findings with p-value <0.05 were considered statistically significant. All statistical analyses were performed using Stata Version 15.0 (StataCorp LP, College Station, TX, USA).

Results

A total of 496 completed surveys were received from a sample of 1,607 medical graduates giving a response rate was 30.9%. After excluding 49 participants with missing data, 447 subjects were included in the analysis. The subject recruitment flow chart is shown in **Figure 1**.

As shown in **Table 1**, the prevalence of burnout as measured by the CBI was 63.1% (personal burnout), 55.9% (work-related burnout) and 35.4% (patient-related burnout). The mean CBI subscale scores were 57.4±21.4 (personal), 48.9±7.4 (work-related) and 41.5±21.8 (patient-related).

Socio-demographics, lifestyle behaviours and professional satisfaction are displayed in **Table 2.** Mean age of the respondents was 34.1 ± 6.0 years (range 24 to 46 years), and 43.6% were female. A majority of respondents indicated they were satisfied with their current job position (80.7%) and with their career choice as a doctor (93.7%).

Table 3, **4**, and **5** show the results of the regression analysis identifying the factors associated with personal, work-related and patient-related burnout. Although the age range of the participants was limited to 22 years, age was still included in the regression analysis to try to differentiate early and mid-career doctors. Being of younger age and female, working in the public sector, sleeping fewer hours per night, working longer hours per week, and not having regular exercise were significantly associated with higher CBI personal scores. There were no factors shown to be related to CBI work-related scores. Being of younger age, working in the public sector and not having regular exercise were associated with higher patient-related CBI scores.

Discussion

This study found that burnout was very prevalent among doctors who graduated from a local HK university. The prevalence of the CBI burnout subscales ranged between 35-63% with symptoms of personal burnout being the most prevalent and severe. The mean age of our respondents was 34.1 years, as we only surveyed doctors up to 20 years post-graduation. In our study, the prevalence of burnout as measured by CBI was higher than those reported in Canadian physicians in all subscales [23] and, when compared to doctors in Taiwan, HK doctors had slightly lower prevalence of patient-related burnout, but higher prevalence of personal and work-related burnouts [17]. In the Canadian and Taiwanese studies, however, the mean age of the participants were approximately 10 years older than our current study population. When comparing to studies conducted amongst younger doctors, our study respondents had a higher prevalence of CBI burnout in all subscales than Australian physicians [18] and a higher prevalence of personal and work-related burnout, but similar patient-related burnout to Indian resident medical officers [38]. A study on French Emergency Physicians using the MBI found that the prevalence of burnout was 50.7% [39]. On the other hand, Siu et al. showed that prevalence of burnout using the MBI was 31.9% in HK doctors which is lower than all 3 subscales of burnout found in this study [20]. Other studies have shown a similar trend of higher prevalence of personal burnout, followed by work-related then patient-related burnout [17, 18, 23] in doctors. With respect to burnout severity, HK doctors' scores were in line with the global ranges for all three subscales: personal burnout scores ranging from 39-62 [2, 16-18, 23, 38], work-related scores ranging from 33-58 [17, 18, 23, 38] and patient-related scores ranging from 22-62 [17, 18, 23, 38].

Compared to the lifestyle characteristics of the general HK population, HK doctors sleep less [40], work longer hours [41], smoke less [42], but do more exercise [43]. Adequate sleep duration and quality of sleep are important factors to reduce stress and fatigue. In this study, less sleep was associated with higher personal burnout scores only. A study of Taiwanese nurses showed that lack of sleep was associated with higher burnout in all three subscales of the CBI [27]. A study of HK and Macau university students showed that quality and duration of sleep can affect physical and psychological health, such as mood [44]. It can be postulated that lack of sleep can lead to poor mood which can then lead to physical and emotional exhaustion, or that lack of sleep can directly lead to physical and emotional exhaustion. Both can contribute to personal burnout. Consistent with this, doctors with longer working hours had higher CBI personal scores in this study. Longer work hours typically means there is less time to spend with family and enjoy one's personal life leading to higher personal burnout [3, 9]. Studies have shown that longer work hours translate to

more work-family conflicts and there is a positive dose-response relationship between work-family conflict and personal burnout [9]. In a Taiwanese study of first year post-graduate doctors, all three dimensions of the CBI were related to work hours [45]. However, measuring work demands is complicated. Siu et al.'s HK doctor burnout study did not show that working hours was associated with higher MBI burnout scores, but working in shifts was [20]. Number of nights on call per week [21], quantitative workload [23], working overtime [17], working in shifts [17], inadequate time off work [3] have also been shown to contribute to more burnout.

Similar to Siu et al.'s HK study, we found that smoking and substance abuse was low amongst the samples and did not show any correlation with burnout [20]. Although 24.8% of the respondents in our sample fell into the 'at-risk' category for alcohol use, this level of drinking was not correlated with burnout which was also similar to Siu et al.'s HK study and a Taiwan study on doctors [46]. In contrast, studies on U.S. physicians have shown that alcohol abuse and dependence can be related to burnout[26]. These finding may suggest that HK physicians are less likely to turn to alcohol as a coping mechanism for stress. Nurses working in HK cope with stress by seeking support from friends and colleagues, using different cognitive strategies and through leisure activities [47], and the most common method of stress relief in the general HK population is exercise [42]. This is likely similar in HK physicians. It is reassuring that most doctors perform regular exercise in HK, and exercise was found to be protective for personal and patient-related burnout. Siu et al.'s study did not find that exercise was a stress relieving factor against burnout [20]. However, the positive effect of exercise on burnout have been seen in some studies in Taiwan [46], France [9], and the US [48], similar to the findings of this study.

The relationship between socio-demographic characteristics and burnout show that age, sex and doctor's practice setting is associated with burnout in HK physicians. Previous studies examining doctors' age and burnout scores have been inconsistent. A study on young Australasian fellows did not show significant relationships of the three dimensions of CBI with age [18]; but another study of medical professionals in Taiwan found that older doctors had significantly lower burnout scores than younger doctors on all three dimensions of the CBI. The mean age of the physicians in the Taiwanese study was 11 years older than the mean age of the present study. [17]. Our study found that only personal burnout and patient-related burnout were associated with age. Although the age range of the doctors in this study was small (ranging from 24 to 46 years), it is wide enough to a contrast between the doctors in their early and mid-careers. This is supported by at least one study showing that residents tend to have higher burnout scores compared to attending physicians [49]. The younger cohort are at a life stage where they may be looking for a spouse, getting married and having children. However, at the same time, they also need to complete their postgraduate training and develop their career paths. This tension between personal and professional responsibilities has

been termed 'work-home interference' and studies have shown that this has an effect on personal burnout [50]. Younger physicians who are just starting out may have a steep learning curve when it comes to patient interactions. Although they have exposure to patients during medical school, students have a supervising physician to fill in the deficient areas. When the student graduates and becomes a doctor, they take on more responsibility and are required to perform tasks they may not be confident in performing, which may contribute to increased patient-related burnout in their early career. A study of HK dentists found that patient-related stressors such as actually and possibly making mistakes, having a medical emergency, coping with difficult patients, and dealing with high patient expectations were amongst their top ranked stressors [51]. One can argue that these patient-related factors would also be relevant to younger, less experienced medical doctors contributing to higher patient-related burnout scores. The relationship between age and work-related burnout may depend on additional factors such as level of experience. Siu et al.'s study of HK doctors found that young but moderately experienced doctors were most at risk for burnout [20]. A possible reason for this is that new doctors may not have as much work responsibility at the beginning. However, as experience increases so does responsibility and the corresponding increase in stress.

Consistent with our findings, many studies using CBI have shown that female physicians are more at risk for personal burnout [2, 3, 9, 18, 52]. A French study showed that work-family conflict was the greatest risk factor for high personal burnout in female doctors [9]. Single female doctors have difficulty finding spouses which can be related to not having enough time to find a partner or other social barriers [53]. Married female doctors have more domestic duties and child rearing responsibilities than men [3, 53]. Furthermore, gender roles remain strictly defined in China where the husband bears the breadwinner role and the wife assumes the home maker role which adds to the disconnect between work and home, contributing to higher personal burnout among women doctors [54].

We found that public sector doctors in our study had significantly higher CBI personal and patient-related burnout scores. There were 46.9% of doctors working in the public sector and 48.9% of HK doctors working in the private sector in 2015 [30], but there were almost 4.5 times more inpatient discharges in the public compared to the private sector [55]. This describes a much larger patient load in the public sector, which can lead to longer work hours and increased workload. This invariably leads to more exhaustion during their non-working hours and while seeing patients. In addition, burnout has been shown to double the risk of intent to leave the profession [9]. It is conceivable that the increasing attrition rate in the public sector may be a reflection of the high burnout, which grew from 4.4% to 5.9% per year during 2015-2018 [56] . Burnt out HK physicians may desire to leave the public sector and join the private sector or leave practice altogether. The

results of a survey in 2014 of Emergency Physicians in HK found that 65% considered leaving the public Accident and Emergency Department, with unhealthy working environment and enormous work load cited as being the main reasons [57].

Although 55.9% of participants had work-related burnout, it was not correlated to any of the socio-demographic factors, lifestyle behaviours and career satisfaction items. HK is known for its hard-working culture where many professions in the city also experience long hours and stress. A survey in 2008 conducted on HK employees showed the average working week was 49.6 hours: 62.4% regularly worked unpaid overtime and 51.7% worked late into the evenings with 80% reporting that the reason that they work late was because they have too much work [41]. It is possible that working professionals in HK have normalised a fast pace, high-pressure working environment and therefore, may not perceive work-related burnout like in other countries, hence cultural and contextual factors contributing to the perception of work-related burnout in HK doctors may differ.

Finally, it is important to note that despite the high prevalence and severity of burnout, burnout was not correlated with career satisfaction in the current study, with the majority of respondents reporting good satisfaction with their present job position and in their choice of being a doctor.

Limitations

Our study has several limitations. Firstly, response rate was only 30.9%, which could introduce a substantial response bias: physicians who suffer burnout maybe more likely to have interest in this topic and more likely to fill the survey; but, on the other hand, they maybe more apathetic and less inclined to complete the survey. Secondly, the age range of the respondents was only 22 years and therefore does not represent HK doctors in all age groups especially those over 46 years. However, there was sufficient sampling from the spread of ages across the spectrum studied to make meaningful comparisons. Thirdly, as there are two medical schools and foreign-trained doctors working in HK who account for 8.5% of the practising doctors in HK [56], this study cannot represent the entire HK doctor population. We chose to sample from one medical school as graduates from this medical school represented approximately half the local graduates [58], and for practical reasons as we had access to their contact details. Although 48.9% of doctors work in the private sector, we only sampled 23% of private doctors [30]. This is likely a reflection that recent graduates are still in training which is done in the public sector in HK. The survey was cross-sectional and we are unable to determine if the associations are causally related. Lastly, many studies do not use the same burnout inventory therefore direct comparisons cannot be made between different studies.

Future direction

The results from this study indicates there is a need to further understand burnout in HK doctors. Studies have shown that burnout can lead to reduced work effort [6] and has direct effects on patient care [59]. Across the world, medical communities are becoming more aware of the importance of physician well-being. At the core of the Charter on Physician Well-being is the notion that well physicians can take care of their patients better [28]. As such, the goal is for governing bodies, policymakers, medical organisations and individual physicians to share the responsibility to improve physician well-being. Starting from medical school, medical students should be supported in learning self-awareness of their own emotional states and needs. Recent recommendations for US graduate medical education sought to improve policies to improve trainee support for those who have children [60], which is important as work-home interference is seen as an important predictor of burnout [61]. Other interventions, such as introduction of a stress management course in hospitals has shown to reduce malpractice claims and medication errors compared to hospitals without such courses [62].

Contributors:

All authors participated in the interpretation of data, writing and critically reviewing the paper, and approved the final submitted manuscript. Amy Ng performed the literature review, contributed to the interpretation of the results and drafted the final manuscript. Julie Chen and CS Lau conceptualised the study and Julie Chen drafted the initial study protocol. Weng Yee Chin was responsible for drafting the study protocol, obtaining the grant, supervising the data collection, supervising the writing of the manuscript and proof reading the final manuscript. Eric Wan conducted the statistical analyses, contributed to the interpretation of results and contributed to the final manuscript.

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Ethical approval

This study received approval by the Institutional Review Board of the University of Hong Kong/ Hospital Authority Hong Kong West Cluster (UW 15-405).

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Table 1. Prevalence of the personal, work-related and patient-related Copenhagen Burnout Inventory (CBI) Score

	Doctors (N=447)
Copenhagen Burnout Inventory (CBI) Score	
Burnout - personal	57.4 ± 21.4
Burnout – work-related	48.9 ± 7.4
Burnout – patient-related	41.5 ± 21.8
Copenhagen Burnout Inventory (CBI) Prevalence (Score (≥50))	
Burnout - personal	282 (63.1%)
Burnout – work-related	250 (55.9%)
Burnout – patient-related	158 (35.4%)

All data are represented in mean ± SD or total (%), as appropriate. No data shown for missing value.

Table 2. Descriptive statistics on socio-demographic, lifestyle behaviour, and career satisfaction

	Doctors (N=447)		Doctors (N=447)
Socio-demographic		**Lifestyle behaviour**	
Age	34.1 ± 6.0	Average sleep per night	6.6 ± 1.0
Gender (Female)	195 (43.6%)	Hours of work per week	54.7 ± 15.1
Marital status		Regular exercise	340 (76.1%)
Single, separated and divorced	201 (45.0%)	At-risk drinker	98 (24.8%)
Married	246 (55.0%)	Current Smoker	4 (0.9%)
Having children	177 (39.6%)	Substance use	6 (1.3%)
Setting of practice		**Career Satisfaction**	
Public	346 (77.4%)	Satisfied with present job position	359 (80.7%)
Private	101 (22.6%)	Satisfied with being a medical doctor	418 (93.7%)

Current Smoker (Current smoker vs Non-smoker/ex-smoker); Regular exercise (5 or more days per week for at least 10 minutes per day / Any vigorous and moderate physical activities); Private Practice (Private Solo/ Private Hospital/Non-government organization); Public Practice (University/Government/Hospital Authority/Not applicable); At-risk drinkers (>3 AUDIT-C score), AUDIT-C score was calculated by the sum of score based on the frequency of drinking alcohol, the average number of standard drinks per day and the frequency of taking 5 or more drinkers on one occasion, ranging from 0 to 12. The frequency of drinking alcohol (Less than once per month/ once per month/ 2 to 3 times per month or once per week/ 2 to 3 times per week/ 4 to 6 times per week or every day) were ranked 0 to 4 respectively; the average number of standard drinks per day (1-2 drinks/ 3-4 drinks/ 5-6 drinks/ 7-8 drinks/ 9 or more drinks) were ranked 0 to 4 respectively; the frequency of taking 5 or more drinkers on one occasion (never/ less than once per week/ monthly/ weekly/ daily or almost daily) were ranked 0 to 4 respectively. All data are represented in mean ± SD or total (%), as appropriate. No data shown for missing value.

Table 3. Socio-demographic, lifestyle behaviour and career satisfaction associated with personal CBI score by regression analysis

Factor[a]	Personal CBI score (n = 447)					
	Univariate			Multivariable with Backward selection		
	Coeff.	95% CI	P-value	Coeff.	95% CI	P-value
Socio-demographic						
Age	-0.835*	(-1.159, -0.511)	<0.001*	-0.437*	(-0.779, -0.095)	0.012*
Female (Vs Male)	4.947*	(0.962, 8.932)	0.015*	5.100*	(1.382, 8.818)	0.007*
Married (Vs Single, separated and divorced)	-5.734*	(-9.697, -1.771)	0.005*	NA		
Having children	7.124*	(3.111, 11.137)	0.001*			
Private setting of practice (Vs Public)	-12.327*	(-16.943, -7.711)	<0.001*	-5.759*	(-10.665, -0.853)	0.022*
Health status						
Average sleep per night	-6.505*	(-8.497, -4.514)	<0.001*	-5.200*	(-7.139, -3.262)	<0.001*
Hours of work per week	0.361*	(0.233, 0.488)	<0.001*	0.226*	(0.099, 0.353)	0.001*
Regular exercise	-9.882*	(-14.452, -5.312)	<0.001*	-6.855*	(-11.102, -2.608)	0.002*
Current Smoker	5.117	(-16.002, 26.235)	0.634	NA		
At-risk drinker	-1.611	(-6.454, 3.232)	0.514			
Substance use	-16.402	(-33.621, 0.817)	0.062			
Career satisfaction						
Satisfied your present job position	-0.350	(-5.408, 4.708)	0.892	NA		
Satisfied with being a medical doctor	2.197	(-6.015, 10.409)	0.599			

CBI = Copenhagen Burnout Inventory; CI = Confidence Interval; Coeff = Coefficient

* Significant with p-value < 0.05 [a] Variable in brackets is the reference category for independent variables No data shown for missing value.

Current Smoker (Current smoker vs Non-smoker/ex-smoker); Regular exercise (5 or more days per week for at least 10 minutes per day / Any vigorous and moderate physical activities); Private Practice (Private Solo/ Private Hospital/Non-government organization); Public Practice (University/Government/Hospital Authority/Not applicable); At-risk drinkers (≥3 AUDIT-C score), the AUDIT-C score was calculated by the sum of score based on the frequency of drinking alcohol, the average number of standard drinks per day and the frequency of taking 5 or more drinkers on one occasion, ranging from 0 to 12. The frequency of drinking alcohol (less than once per month/ once per month/ 2 to 3 times per month or once per week/ 2 to 3 times per week/ 4 to 6 times per week or every day) were ranked 0 to 4 respectively; the average number of standard drinks per day (1-2 drinks/ 3-4 drinks/ 5-6 drinks/ 7-8 drinks/ 9 or more drinks) were ranked 0 to 4 respectively; the frequency of taking 5 or more drinkers on one occasion (never/ less than once per week/ monthly/ weekly/ daily or almost daily) were ranked 0 to 4 respectively.

Table 4. Socio-demographic, lifestyle behaviour and career satisfaction associated with work-related CBI score by regression analysis

Factor[a]	Work-related CBI score (n = 447)					
	Univariate			Multivariable with Backward selection		
	Coeff.	95% CI	P-value	Coeff.	95% CI	P-value
Socio-demographic						
Age	0.105	(-0.009, 0.219)	0.072			
Female (Vs Male)	0.142	(-1.240, 1.524)	0.840			
Married (Vs Single, separated and divorced)	1.213	(-0.161, 2.586)	0.083		NA	
Having children	-0.991	(-2.390, 0.408)	0.165			
Private setting of practice (Vs Public)	-1.079	(-2.715, 0.557)	0.196			
Health status						
Average sleep per night	-0.290	(-1.010, 0.430)	0.429			
Hours of work per week	0.041	(-0.004, 0.086)	0.076			
Regular exercise	-0.620	(-2.225, 0.986)	0.449		NA	
Current Smoker	-4.562	(-11.829, 2.705)	0.218			
At-risk drinker	0.402	(-1.270, 2.074)	0.637			
Substance use	0.058	(-5.899, 6.015)	0.985			
Career satisfaction						
Satisfied your present job position	-0.538	(-2.279, 1.203)	0.544		NA	
Satisfied with being a medical doctor	0.676	(-2.154, 3.506)	0.639			

CBI = Copenhagen Burnout Inventory; CI = Confidence Interval; Coeff = Coefficient

* Significant with p-value < 0.05 [a] Variable in brackets is the reference category for independent variables No data shown for missing value.

Current Smoker (Current smoker vs Non-smoker/ex-smoker); Regular exercise (5 or more days per week for at least 10 minutes per day / Any vigorous and moderate physical activities); Private Practice (Private Solo/ Private Hospital/Non-government organization); Public Practice (University/Government/Hospital Authority/Not applicable); At-risk drinkers (≥3 AUDIT-C score), the AUDIT-C score was calculated by the sum of score based on the frequency of drinking alcohol, the average number of standard drinks per day and the frequency of taking 5 or more drinkers on one occasion, ranging from 0 to 12. The frequency of drinking alcohol (less than once per month/ once per month/ 2 to 3 times per month or once per week/ 2 to 3 times per week/ 4 to 6 times per week or every day) were ranked 0 to 4 respectively; the average number of standard drinks per day (1-2 drinks/ 3-4 drinks/ 5-6 drinks/ 7-8 drinks/ 9 or more drinks) were ranked 0 to 4 respectively; the frequency of taking 5 or more drinkers on one occasion (never/ less than once per week/ monthly/ weekly/ daily or almost daily) were ranked 0 to 4 respectively.

Table 5. Socio-demographic, lifestyle behaviour and career satisfaction associated with patient-related CBI score by regression analysis

Factor[a]	Patient-related CBI score (n = 447)					
	Univariate			Multivariable with Backward selection		
	Coeff.	95% CI	P-value	Coeff.	95% CI	P-value
Socio-demographic						
Age	-0.755*	(-1.088, -0.423)	<0.001*	-0.596*	(-0.965, -0.228)	0.002*
Female (Vs Male)	0.418	(-3.673, 4.509)	0.841			
Married (Vs Single, separated and divorced)	-3.807	(-7.870, 0.256)	0.066		NA	
Having children	6.271*	(2.164, 10.378)	0.003*			
Private setting of practice (Vs Public)	-8.999*	(-13.777, -4.221)	<0.001*	-5.317*	(-10.602, -0.032)	0.049*
Health status						
Average sleep per night	-2.540*	(-4.642, -0.438)	0.018*			
Hours of work per week	0.119	(-0.015, 0.253)	0.082		NA	
Regular exercise	-6.932*	(-11.643, -2.222)	0.004*	-6.769*	(-11.333, -2.205)	0.004*
Current Smoker	-2.980	(-24.521, 18.561)	0.786			
At-risk drinker	-1.296	(-6.224, 3.633)	0.606		NA	
Substance use	-5.101	(-22.724, 12.522)	0.570			
Career satisfaction						
Satisfied your present job position	-0.022	(-5.170, 5.125)	0.993		NA	
Satisfied with being a medical doctor	-1.125	(-9.490, 7.240)	0.792			

CBI = Copenhagen Burnout Inventory; CI = Confidence Interval; Coeff = Coefficient

* Significant with p-value < 0.05 [a] Variable in brackets is the reference category for independent variables No data shown for missing value.

Current Smoker (Current smoker vs Non-smoker/ex-smoker); Regular exercise (5 or more days per week for at least 10 minutes per day / Any vigorous and moderate physical activities); Private Practice (Private Solo/ Private Hospital/Non-government organization); Public Practice (University/Government/Hospital Authority/Not applicable); At-risk drinkers (≥ 3 AUDIT-C score), the AUDIT-C score was calculated by the sum of score based on the frequency of drinking alcohol, the average number of standard drinks per day and the frequency of taking 5 or more drinkers on one occasion, ranging from 0 to 12. The frequency of drinking alcohol (less than once per month/ once per month/ 2 to 3 times per month or once per week/ 2 to 3 times per week/ 4 to 6 times per week or every day) were ranked 0 to 4 respectively; the average number of

standard drinks per day (1-2 drinks/ 3-4 drinks/ 5-6 drinks/ 7-8 drinks/ 9 or more drinks) were ranked 0 to 4 respectively; the frequency of taking 5 or more drinkers on one occasion (never/ less than once per week/ monthly/ weekly/ daily or almost daily) were ranked 0 to 4 respectively.

Figure Legend:

Figure 1: Flow chart showing the sampling and response rates. MBBS = Bachelor of Medicine and Bachelor of Surgery.

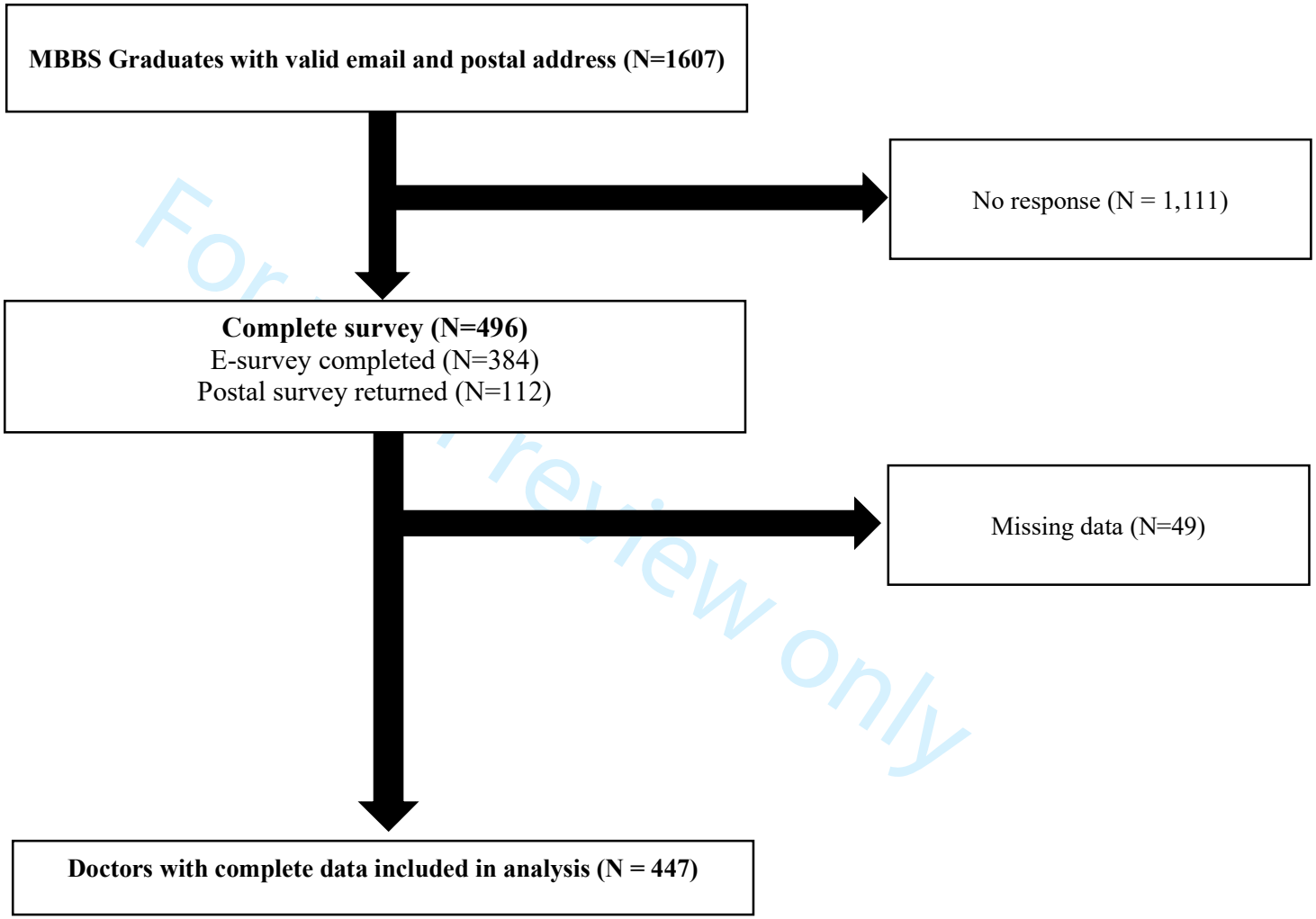

Figure 1: Flow chart showing the sampling and response rates. MBBS = Bachelor of Medicine and Bachelor of Surgery.

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	4-5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4-5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	4-5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5-6
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	5-6
Bias	9	Describe any efforts to address potential sources of bias	3-4
Study size	10	Explain how the study size was arrived at	4
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	n/a
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6
		(*b*) Describe any methods used to examine subgroups and interactions	n/a
		(*c*) Explain how missing data were addressed	6
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	n/a
		(*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	4-5
		(b) Give reasons for non-participation at each stage	n/a
		(c) Consider use of a flow diagram	Fig 1.
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	6 & Table 2
		(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	6,7 & Table 1,3,4,5
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	n/a
		(*b*) Report category boundaries when continuous variables were categorized	5, Notes in Table 2, 3,4,5
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	n/a
Discussion			
Key results	18	Summarise key results with reference to study objectives	6
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	2-3, 10
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	7-10
Generalisability	21	Discuss the generalisability (external validity) of the study results	10
Other information			
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	12

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

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.