Impact of work hours and sleep on well-being and burnout for physicians-in-training: the Resident Activity Tracker Evaluation Study

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OBJECTIVE The Resident Activity Tracker Evaluation (RATE) is a prospective observational study evaluating the impact of work hours, sleep and physical activity on resident well-being, burnout and job satisfaction.

BACKGROUND Physician burnout is common and its incidence is increasing. The impact of work hours and sleep on resident well-being and burnout remains elusive. Activity trackers are an innovative tool for measuring sleep and physical activity.

METHODS Residents were recruited from (i) general surgery and orthopaedics (SURG), (ii) internal medicine and neurology (MED) and (iii) anaesthesia and radiology (RCD). Groups 1 and 2 do not enforce restrictions on the duration of being on-call, and group 3 had restricted the duration of being on-call to 12 hours. Participants wore FitBit trackers for 14 days. Total hours worked, daily sleep, sleep on-call and daily steps were recorded. Participants completed validated surveys assessing self-reported well-being (Short-Form Health Survey), burnout (Maslach Burnout Inventory), and satisfaction with medicine.

RESULTS Surgical residents worked the most hours per week, followed by medical and RCD residents (SURG, 84.3 hours, 95% CI, 80.2–88.5; MED, 69.2 hours, 95% CI, 65.3–73.2; RCD, 52.2 hours, 95% CI, 48.2–56.1; $p < 0.001$). Surgical residents obtained fewer hours of sleep per day (SURG, 5.9 hours, 95% CI, 5.5–6.3; MED, 6.9 hours, 95% CI, 6.5–7.3; RCD, 6.8 hours, 95% CI, 5.6–7.2; $p < 0.001$). Nearly two-thirds of participants (61%) scored high burnout on the Maslach depersonalisation subscore. Total steps per day and well-being, burnout and job satisfaction were comparable between groups. Total hours worked, daily sleep and steps per day did not predict burnout or well-being.

CONCLUSIONS Work hours and average daily sleep did not affect burnout. Physical activity did not prevent burnout. Work hour restrictions may lead to increased sleep but may not affect resident burnout or well-being.

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INTRODUCTION

Residents' work hours are restricted to <80 hours per week in the USA[1] and 48 hours per week in Europe.[2] The premise underlying work-hour restrictions is that sleep loss and fatigue negatively impact residents' performance during clinical duties and their well-being. The National Sleep Foundation recommends adults obtain 7–9 hours of sleep per night.[3] Long work hours and on-call periods may lead to chronic sleep deprivation, which worsens physicians' performance during several clinical tasks.[4] However, the most comprehensive studies on work hours and medical errors have yielded conflicting results.[5–7] Health care professionals have called for further research into whether or not sleep deprivation affects physician performance and well-being, in order to develop evidence-based policies that protect patients and physicians from harm.[8,9]

Sleep deprivation may or may not contribute to job burnout, a psychological work-related syndrome characterised by depersonalisation, emotional exhaustion and feelings of decreased personal accomplishment.[10] Job burnout is common among physicians and its incidence is increasing.[11] Physician burnout is associated with self-reported suboptimal patient care,[12] longer recovery time and lower patient satisfaction.[13] Burnout among physicians is associated with alcohol abuse[14] and suicide.[15] The relationship between work demands, sleep, performance and burnout is inherently complex and challenging to study. Previous studies on burnout among residents did not measure actual daily sleep.[16–20] The few prior studies that investigated sleep in residents used brief sampling periods,[21] only assessed junior residents,[22] did not evaluate burnout[21,22] or did not measure work hours comprehensively.[23] Intuitively, physical activity is associated with improved well-being and may or may not prevent burnout; however, few studies have measured physical activity during residency. Contemporary wearable activity trackers, such as the FitBit Charge HR (FitBit Inc, San Francisco, CA), can measure both sleep and steps ('somno-actigraphy') with accuracies comparable to the reference standards of polysomnography[24] and pedometry.[25] A recent study found the FitBit Charge 2 to have 96% sensitivity for detecting sleep compared with polysomnography.[26]

Work-hour regulations in residency programmes exist because too many hours working and too little sleep negatively affect residents' performance and well-being. However, studies on work hours and sleep in residents have yielded conflicting results and few prior studies have measured how much physician trainees sleep. The Royal College of Physicians and Surgeons of Canada concluded that insufficient evidence exists to mandate maximum weekly work hours.[27] Maximum weekly work hours are not enforced in Canada outside of Quebec. In British Columbia, residents are on-call for up to one in four nights for in-house calls and one in three nights for home calls. For shifts of up to 24 hours, residents may leave after 10:00h on the post-call morning or stay at their discretion.[28] The University of British Columbia's training environment provides a unique opportunity to investigate the impact of work hours on residents' sleep and burnout in a system without maximum weekly work-hour restrictions. The Resident Activity Tracker Evaluation (RATE) study was designed to evaluate the impact of work hours, sleep and physical activity on residents' well-being, burnout and job satisfaction using FitBit activity trackers. Understanding the impact of sleep and work hours on trainee physicians' mental and physical health is important for the development of Accreditation Council of Graduate Medical Education (ACGME) training guidelines.

METHODS

Residents were recruited by e-mail invitation from University of British Columbia (UBC) training programmes: surgery (SURG, general surgery and orthopaedics), medicine (MED, internal medicine and neurology) and specialties with duration of being on-call restricted to under 12 hours (RCD, anaesthesia and radiology). We selected specialties with diverse work hours to capture variation in training demands across residency programmes with on-call requirements. General surgery and orthopaedics were selected because they are the largest surgical training programmes. At UBC, internal medicine and neurology residents work on-call for 24-hour periods and radiology and anaesthesia residents work on-call for up to 12 hours. Residents rotating on their home service between September 2015 and June 2016 at the Vancouver General Hospital were eligible for inclusion. Participants wore FitBit activity trackers for 14 days. Institutional research ethics boards approved the study protocol.

Participants were instructed to wear FitBit activity trackers at all times on their non-dominant wrist. The FitBit Charge HR measures minutes asleep, steps taken, distance travelled, floors climbed and heart rate on a second-to-second basis. Residents completed a work schedule calendar indicating the time entering and leaving the hospital and on-call dates. The work schedule calendars were used to categorise time spent into four blocks: weekday working hours, after hours on-call, post-call time and free time. On-call time was defined by the period of time residents were assigned to be on-call according to the call schedule. For residents in the surgical and medical groups, on-call time could include regular weekday hours where residents were responsible for managing patients in the emergency room and responding to calls regarding ward patients. Post-call time started after leaving the hospital and ended the next work day or 08:00h on Saturday, Sunday or a holiday. Free time was the period outside of work that was not post-call. Participants' demographic information (age, gender, year of training and body mass index [BMI]) was collected. Participants completed the Short Form Health Survey (SF-12.2),[29] Maslach Burnout Inventory (MBI),[10] Epworth Sleepiness Scale (ESS),[30] Satisfaction with Medicine Scale (SMS),[31] and International Physical Activity Questionnaire (IPAQ).[32] For the MBI, emotional exhaustion scores ≥ 27, depersonalisation subscores ≥ 10 and personal accomplishment ≤ 33 were considered 'high' burnout based on normative data.[10,16] Excessive sleepiness was defined as >10 points on the ESS.[30] The SMS evaluates the frequency of satisfaction with medicine, regret over career choice or thoughts of giving up medicine.[31] The IPAQ uses self-reported time performing physical activities to estimate weekly metabolic equivalents (MET).[32] Participants who finished the study period with complete datasets, at least 12 of the 14 days, were allowed to keep their trackers. The FitBit Charge HR uses a movement detection-based algorithm to determine sleep. Data from the FitBit trackers were extracted for analysis using the FITABASE SOFTWARE PLATFORM (Small Steps Lab LLC, San Diego, CA).

Statistical analysis

Quantitative variables (age, BMI, training year, time wearing the tracker, work hours, sleep parameters, steps parameters, distance travelled, floors climbed, and SF12.2, MBI, ESS, IPAQ and SMS scores) were analysed with ANOVA. Between-group contrasts were evaluated when overall *F*-values were significant ($p < 0.05$). Categorical variables (gender, tracker history and self-reported call frequency) were analysed with Fisher's exact test. To identify predictors of MBI subscores A and B, SF12.2 scores and ESS scores, the following variables were included in a multivariable forward stepwise regression analysis: age, gender, junior or senior training level, total hours worked per week, total hours on-call per week, average daily sleep and daily steps. Slope p-values < 0.05 were considered significant and R^2 values were evaluated. All statistical analyses were conducted by the UBC Applied Statistics and Data Science Group using R 3.3 (R Core Team, Vienna, Austria).

RESULTS

A total of 59 residents completed the study, 10 from every specialty, except for nine from orthopaedics. Participants reported 809 calendar days of data and 98% of days participated (809/826). Sleep and steps activity were tracked for 778 days and included 244 on-call periods. Complete datasets, defined *a priori* as 12 days or more of sleep and step data, were obtained by 54 (91.5%) participants. The remaining five incomplete datasets had 5.9–11.2 days of data because of technical device issues (failure to charge the battery and data shedding from improper device syncing). Average wear time was 93% during the study. There were no differences in age and gender between the groups (Table 1). Calls were in-house for all specialties apart from orthopaedics. Ninety-three percent of residents had not owned an activity tracker before.

One-quarter of residents worked over 80 hours per week (SURG, 14/19, 73.7%; MED, 1/20, 5.0%; RCD, 0/20, 0%). Surgical residents worked significantly more hours than the other groups (SURG, 84.3 hours; MED, 69.2 hours; RCD, 52.2 hours week^{-1}; $p < 0.001$, Table 2). Hours worked per week ranged from 32 to 109. On-call shifts were significantly longer in the surgical and medical cohorts ($p < 0.001$). Actual call frequency was higher in the surgery group (SURG, 1 in 2.8; MED, 1 in 4.7; RCD, 1 in 4.9; $p < 0.001$).

Participants had less sleep on-call compared with during free time (1.56 versus 8.44 hours; $p < 0.001$). Surgical residents had fewer mean hours of daily sleep (Table 2; SURG, 5.90 hours; MED, 6.88 hours; RCD, 6.85 hours; $p < 0.001$). RCD participants had less sleep on-call than surgical and medical residents ($p < 0.001$). Participants finished being on-call at an average time of 14:20h, 11:09h

Table 1 Demographics and self-reported on-call requirements among the resident cohorts

	Surgical cohort	Medical cohort	RCD cohort	p-values
Number	19	20	20	
Number of residents in the programmes	55	161	85	
Age (SD)	28.2 (2.6)	28.1 (2.9)	29.3 (3.5)	0.37†
Gender, male, *n* (%)	12 (63)	15 (75)	12 (60)	0.617‡
Year of training (SD)	1.95 (1.1)	2.05 (1.0)	2.80 (1.1)*	0.031†
In-house call, *n* (%)	10/19 (53)	20 (100)	20 (100)	
Reported call frequency, *n* (%)				
>1 in 3	1 (5)*	0	0	<0.001‡
1 in 3	5 (26)*	0	0	
1 in 4	13 (68)*	10 (50)	9 (45)	
<1 in 4	0*	10 (50)	11 (55)	
Tracker wear-time, % (SD)	91.3 (6.2)	94.5 (4.0)	93.2 (4.8)	0.14†
Owned a tracker before, *n* (%)	1 (5.26)	1 (5.00)	2 (10.0)	1‡

RCD, restricted call durations, SD, standard deviation.
* Significant differences.
† The p-value was calculated with the use of ANOVA.
‡ The p-value was calculated with the use of a two-tailed Fisher exact test.

Table 2 Summary of work hours, sleep and physical activity among the three cohorts of residents

	Surgical cohort	Medical cohort	RCD cohort	p-values
Total hours worked per week (SD)	84.3 (10.3)*	69.2 (8.2)*	52.2 (7.7)	<0.001†
Average duration of on-call periods, hours (SD)	28.3 (3.6)	24.7 (2.9)	11.3 (1.5)*	<0.001†
Mean duration of work day, hours (SD)	9.49 (1.4)	9.25 (1.0)	8.06 (1.9)*	0.0091†
Range in total hours worked per week	62.9–109	50.2–82.6	32.0–66.6	
Total hours on-call per week (SD)	60.8 (15.1)*	36.2 (6.72)	34.2 (8.38)	<0.001†
Average time of day leaving post-call	14:20	11:09	9:25	
Mean hours of sleep per day (SD)	5.90 (0.74)*	6.88 (0.74)	6.85 (0.99)	<0.001†
Mean hours of sleep on-call (SD)	1.86 (1.2)	2.40 (2.1)	0.446 (0.68)*	<0.001†
Mean hours of sleep post-call (SD)	7.12 (2.6)	8.89 (2.6)	7.93 (1.9)	0.081†

RCD, restricted call durations; SD, standard deviation.
* Significant differences.
† The p-value was calculated with the use of ANOVA.

and 09:25h in the surgical, medical and RCD cohorts, respectively. The amount of sleep obtained during the post-call period was similar between the groups ($p = 0.081$).

Surgical residents reached significantly higher scores on the Epworth Sleepiness Scale (ESS) than the other cohorts (Table 3; $p = 0.003$). A greater proportion of surgical residents had ESS scores in the excessive sleepiness range (SURG, 57.9%; MED, 15%; RCD, 5%; $p < 0.001$). Thirty-six participants (61%) had high burnout on the depersonalisation subscore (SURG, 63.2%; MED, 65.0%; RCD, 55.0%). One surgical participant (1.7%) had high burnout for emotional exhaustion. Maslach Burnout Inventory, SF12.2 and Satisfaction with Medicine Scale subscores were not significantly different between the groups (all p-values > 0.05).

Body mass index (BMI) and IPAQ scores were similar among the cohorts (Table 4). The total steps per day, total distance travelled, steps per hour and floors climbed per day were not significantly different between groups (all p-values > 0.05).

A regression analysis was performed to investigate the relationships between sleep, physical activity and self-reported health, burnout and sleepiness (Table 5). The total hours on-call per week significantly predicted Maslach Burnout A scores (R^2 = 9.88%) and the Epworth Sleepiness Scale Scores (R^2 = 23.0%).

DISCUSSION

We used prospective continuous recording of sleep and steps ('somno-actigraphy') to clarify the relationship between work hours, sleep, physical activity, burnout and well-being. Higher work hours

Table 3 Self-reported physical activity, health, sleepiness, burnout and satisfaction with medicine among the resident cohorts

	Surgical cohort	Medical cohort	RCD cohort	p-values
Maslach Burnout Inventory				
A, emotional exhaustion (SD)	22.8 (6.3)	19.8 (7.0)	20.2 (6.8)	0.32†
B, depersonalisation (SD)	19.5 (5.6)	20.6 (7.0)	18.8 (8.2)	0.71†
C, personal achievement (SD)	47.1 (4.4)	45.6 (5.9)	46.9 (6.6)	0.68†
Epworth sleepiness scale (SD)	10.5 (4.7)*	7.20 (3.8)	6.25 (2.9)	0.0027†
SF12.2 total score (SD)	99.2 (9.5)	104 (6.5)	104 (6.6)	0.11†
SF12.2 physical component score (SD)	55.3 (5.0)	55.6 (4.2)	54.4 (5.0)	0.72†
SF12.2 mental component score (SD)	44.0 (8.9)	48.4 (6.8)	49.1 (5.9)	0.07†
Satisfaction with medicine score				
A, satisfaction (SD)	4.4 (1.4)	5.1 (1.2)	4.6 (1.5)	0.23†
B, giving up (SD)	1.8 (1.2)	1.6 (0.9)	1.6 (0.9)	0.75†
C, regret decision (SD)	1.4 (1.0)	1.2 (0.4)	1.5 (0.7)	0.49†

RCD, restricted call durations; SD, standard deviation; SF12.2, Short Form Health Survey.
* Significant differences.
† The p-value was calculated with the use of ANOVA.

Table 4 Measures of physical activity among the resident cohorts

	Surgical cohort	Medical cohort	RCD cohort	p-values
BMI (SD)	24.2 (2.7)	22.2 (2.4)	24.0 (3.2)	0.059*
IPAQ, total METS (SD)	4264 (3543)	3615 (3236)	2993 (1572)	0.40*
Total steps per day (SD)	10 679 (2346)	9762 (2891)	9934 (2784)	0.53*
Steps per hour during work day (SD)	546 (276)	569 (171)	534 (147)	0.86*
Steps per hour on-call (SD)	492 (208)	499 (112)	405 (168)	0.15*
Steps per hour during free time (SD)	541 (296)	630 (306)	693 (251)	0.27*
Total daily distance, km (SD)	7.32 (1.7)	6.48 (2.0)	6.88 (2.0)	0.40*
Floors climbed (SD)	19.2 (13)	19.2 (16)	18.9 (9)	1*

BMI, body mass index; IPAQ, International Physical Activity Questionnaire; METS, metabolic equivalents; RCD, restricted call durations; SD, standard deviation.
* The p-value was calculated with the use of ANOVA.

Table 5 Regression analysis of the predictors of MBI subscores A and B, SF12.2 and ESS scores

	Maslach A		Maslach B		SF12.2		ESS	
Predictor	β (95% CI)	p-value	β (95% CI)	p-value	β (95% CI)	p-value	β (95% CI)	p-value
Age	−1.13 to 0.212	0.18	−1.13 to 0.375	0.32	−1.16 to 0.576	0.50	−0.327 to 0.481	0.70
Gender (female)	−0.312 to 7.12	0.07	−3.25 to 5.07	0.66	−6.47 to 3.10	0.48	−2.48 to 1.98	0.82
Level of training (senior)	0.303 to 8.53	0.36	−4.70 to 4.51	0.97	−5.40 to 5.18	0.97	−4.01 to 0.926	0.22
Total hours worked per week	−0.119 to 0.211	0.58	−0.048 to 0.321	0.15	−0.263 to 0.161	0.63	−0.045 to 0.153	0.28
Total hours on-call per week	−0.025 to 0.240	0.016*	−0.214 to 0.160	0.77	−0.289 to 0.141	0.49	0.065 to 0.190	<0.01*
Average daily minutes of sleep	1.01 to −1.11	0.24	−0.905 to 3.85	0.22	−3.56 to 1.91	0.55	−1.30 to 1.25	0.97
Average daily steps	−0.001 to 0.0004	0.40	−0.0007 to 0.0008	0.88	−0.0008 to 0.0009	0.92	−0.0007 to 0.0001	0.19

CI, confidence interval; ESS, Epworth Sleepiness Scale; MBI, Maslach Burnout Inventory; RCD, restricted call durations; SF12.2, Short Form Health Survey version 12.2.
* Variables included in the final regression model.

led to decreased daily sleep and increased sleepiness. However, despite significant variation in works hours and average daily sleep, burnout rates were comparable among the groups, suggesting that other factors besides work hours contribute to physician burnout. Physical activity did not prevent physician burnout. Fewer work hours, more sleep and more physical activity should prevent burnout and improve physician performance. Work-hour restrictions are based on some of these assumptions; however, previous studies have not measured work hours, actual time asleep and burnout comprehensively. The absence of maximum weekly work hours in Canada combined with wearable activity trackers enabled us to study work hours and sleep in a training environment unrestricted by maximum weekly restrictions. To our knowledge, this is the first study to date to use wearable activity trackers to quantify sleep and physical activity during residency training across a broad range of specialties. The somno-actigraphy platform used in this study is an innovative method for evaluating physicians' work–life balance and well-being.

Although longer work hours led to decreased sleep, most residents did not reach the daily amount of sleep recommended by the National Sleep Foundation.[3] In this study, one-quarter of residents worked beyond the ACGME 80-hour work limit. Surgical and medical residents worked on-call periods averaging 26 hours where they obtained <2.5 hours of sleep. The present findings are consistent with prior studies demonstrating that a 20-hour reduction in work hours increased sleep by 6 hours per week among trainees[6] and that trainees obtain 2.8 hours of sleep per night on-call.[22] In our study, over half of surgical residents met criteria for excessive daytime sleepiness compared with only 10% of residents in the other groups. Trainees in the RCD cohort worked 32 hours per week less than surgical residents but only managed to sleep 1 hour more per day. This finding suggests that residents working fewer hours use their time outside of work to pursue activities other than sleep. Increased work hours may contribute to excessive sleepiness but restricting work hours may not lead trainees to obtain optimal quantities of sleep. The amount of sleep residents need to improve their performance and maximise learning remains unknown.

Sleep deprivation is known to impair performance on psychomotor tasks. Seventeen hours of wakefulness causes an equivalent impairment to a 0.05% blood alcohol level in healthy volunteers.[33] Studies have demonstrated worse physician performance on a variety of clinical tasks[34,35];

however, randomised trials investigating the impact of duty hour restrictions on medical errors have yielded conflicting results.[5–7] A recent study of attending community surgeons found no change in surgical complication rates after a night on-call where after-hours work was billed.[36] Other than one study that had limited measurements of residents' sleep and work hours,[6] these studies did not comprehensively quantify physician sleep. There are many reasons why physicians may not obtain sufficient sleep besides work hours and on-call time, such as engagement in research and education, family demands and hobbies. Sleep monitoring with activity trackers combined with prospective recording of complications can clarify the relationship between actual sleep duration and medical errors.

Despite significant variations in work hours and average daily sleep among the resident cohorts in this study, total work hours and daily sleep did not predict burnout rates. We analysed burnout rates categorically in cohorts that had highly variable work hours and average daily sleep and found no differences in burnout rates. We also investigated burnout quantitatively in relation to work hours and sleep per day and did not find a correlation. Investigations before and after maximum weekly work-hour restrictions have shown decreased burnout with work-hour restrictions[16,20,37] or no change.[17,18,38,39] Although we found no correlation between work hours, sleep and burnout, the total hours on-call per week predicted the Maslach Burnout Inventory emotional exhaustion subscore, suggesting the amount of time on-call contributes to burnout more than total hours at work. Regulating the amount of time trainees can be on-call may be more important than regulating the total hours at work. Mandated time off-call and minimum vacation time may be more important for physician well-being than maximum weekly work hours.

The high burnout rates observed in this study and others are concerning for both physician well-being and patient care. In our study, 61% of residents met the criteria for burnout. Other studies have reported a prevalence of burnout as high as 76%.[11,12,40] Burnout is associated with a deterioration in the quality of care provided, low morale and job absenteeism.[10] Burnout negatively impacts physicians and their patients.[12–15] Maslach et al. (1997) posit that individuals working with people, such as health care workers and physicians, are prone to burnout. The aetiology of burnout among physicians is multifactorial, and contributing factors include poor work–life balance, more nights on-call, private practice and litigation.[41] A survey-based study of American surgeons identified coping strategies surgeons utilised to promote personal wellness, such as finding meaning in work and protecting time away from work for family and friends.[42] A recent systematic review of burnout interventions among physicians found that both structural work environment interventions and individual focused interventions were successful at reducing burnout.[43] Strategies employed included shortening attending physicians' rotations,[44] stress management training[45] and workflow modifications.[46] The efficacy of burnout prevention programmes remains unclear.[43] A better understanding of physician burnout is necessary to develop evidence-based training policies. Residency training programmes should investigate the number of days and weeks per year residents need off work to remain well.

We explored the impact of physical activity on burnout, which has received limited attention in the literature, and found physical activity did not prevent burnout. A UK study of medical students reported lower burnout rates in students with higher International Physical Activity Questionnaire (IPAQ) scores,[47] a self-reported measure of weekly physical activity measured in metabolic equivalents.[32] In this study, average IPAQ scores were higher compared with the UK study (3552 METS versus 2500 METS). However, IPAQ scores were not correlated with burnout. Physical activity is clearly paramount for improving well-being; the World Health Organization (WHO) ranks a sedentary lifestyle as the fourth leading risk factor for mortality.[48] The WHO recommends 150 minutes of moderate to vigorous physical activity per week, which is equivalent to 8000 steps per day.[49] Although the average daily steps per day did not predict burnout, we found residents took approximately 10 000 steps per day across all specialties, indicating their activity level was consistent with WHO recommendations. The higher baseline physical activity in this study may have masked a potential relationship between physical activity and wellness.

Combined with knowledge of work hours, somno-actigraphy can further clarify the relationships between work, sleep and quality of life. The few studies that used ambulatory polysomnography to investigate sleep in residents used brief sampling periods,[21] only assessed junior residents,[22] did not evaluate burnout[21,22] or did not measure work hours comprehensively.[23] Our study is the first to record work hours, sleep, physical activity and self-reported burnout across a broad range of specialties. Work-hour restrictions have led to the implementation of alternative call schedules, such as night floats; however, their impact on sleep and resident wellness is unknown. Somno-actigraphy can clarify whether alternative call schedules are better for patient outcomes, physician performance and well-being. Combining somno-actigraphy with the prospective recording of complications can clarify the relationship between sleep deprivation and patient morbidity and mortality.

A number of limitations of this study are noteworthy. Although residents were instructed to carry on with their clinical duties and lives as usual, participants may have altered their behaviour knowing that their activities were being tracked and recorded (the Hawthorne effect). Survey outcomes are prone to recall bias and self-reporting inaccuracies. Although work hours were measured in detail, actual workload was not assessed. After-hours workload demands and after-hours support for clinical care may vary and should be investigated in future studies. Training demands are likely to vary substantially across institutions, depending on clinical volumes and the availability of support personnel. Therefore, findings from this single-centre study with a limited sample size conducted at a quaternary care institution within a universal health care system may not generalise to other teaching centres.

CONCLUSION

Medical specialties have variable after-hours 'on-call' demands. Although trainees' work hours are restricted in many countries, work hours among physicians in practice are not formally restricted. Residency training must prepare physicians to be competent practitioners in environments with heavy workloads, long hours and limited sleep. Other factors besides work hours and sleep may be the primary contributors to burnout. Further research into the risk factors for burnout, methods of prevention and interventions for treating burnout can guide medical education policies that prepare future clinicians to be resilient, healthy practitioners. Although restrictions on work hours, call-duty duration and sleep may impact physician errors, we cannot substantiate that such policies reduce burnout and improve residents' quality of life. Work-hour restrictions and increased amount of sleep alone may not prevent burnout or improve resident wellness. Mandating a minimum amount of time off-call may be more important for preventing burnout than regulating maximum weekly work hours.

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