

Quality of life and educational benefit among orthopedic surgery residents: a prospective, multicentre comparison of the night float and the standard call systems

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Background: Given recent evolving guidelines regarding postcall clinical relief of residents and emphasis on quality of life, novel strategies are required for implementing call schedules. The night float system has been used by some institutions as a strategy to decrease the burden of call on resident quality of life in level-1 trauma centres. The purpose of this study was to determine whether there are differences in quality of life, work-related stressors and educational experience between orthopedic surgery residents in the night float and standard call systems at 2 level-1 trauma centres.

Methods: We conducted a prospective cohort study at 2 level-1 trauma hospitals comprising a standard call (1 night in 4) group and a night float (5 14-hour shifts [5 pm–7 am] from Monday to Friday) group for each hospital. Over the course of a 6-month rotation, each resident completed 3 weeks of night float. The remainder of the time on the trauma service consists of clinical duties from 6:30 am to 5:30 pm on a daily basis and intermittent coverage of weekend call only. Residents completed the Short Form-36 (SF-36) general quality-of-life questionnaire, as well as questionnaires on stress level and educational experience before the rotation (baseline) and at 2, 4 and 6 months. We performed an analysis of covariance to compare between-group differences using the baseline scores as covariates and Wilcoxon signed-rank tests (nonparametric) to determine if the residents' SF-36 scores were different from the age- and sex-matched Canadian norms. We analyzed predictors of resident quality of life using multivariable mixed models.

Results: Seven residents were in the standard call group and 9 in the night float group, for a total of 16 residents (all men, mean age 35.1 yr). Controlling for between-group differences at baseline, residents on the night float rotation had significantly lower role physical, bodily pain, social function and physical component scale scores over the 6-month observation period. Compared with the Canadian normative population, the night float group had significantly lower SF-36 scores in all subscales except for bodily pain. There were no differences noted between the standard call group and Canadian norms at 6 months. No differences in educational benefits and stress level were measured between the 2 groups. Lack of time for physical activity was only significant in the night float group. Regression analysis demonstrated that the increased number of hours in hospital correlated with significantly lower SF-36 scores in almost all domains.

Conclusion: Our study suggests that the residents in the standard call group had better health-related quality of life compared with those in the night float group. No differences existed in subjective educational benefits and stress level between the groups.

Contexte : Compte tenu de l'évolution récente des directives concernant le repos des résidents après des gardes cliniques et l'insistance mise sur leur qualité de vie, de nouvelles stratégies sont nécessaires pour la mise en œuvre des horaires de garde. Le système d'équipes de garde de nuit (night float) a été utilisé par certains établissements comme stratégie visant à soulager le fardeau des heures de garde pour la qualité de vie des résidents dans des centres de traumatologie de niveau 1. L'objectif de cette étude était de déterminer s'il y avait des différences dans la qualité de vie, les facteurs de stress liés au travail et la formation de résidents en chirurgie orthopédique entre les systèmes d'équipes de nuit et le système habituel de garde sur appel dans 2 centres de traumatologie de niveau 1.

Méthodes : Dans 2 hôpitaux de traumatologie de niveau 1, nous avons effectué une étude prospective de cohorte comportant 1 groupe de service de garde standard (1 nuit sur 4) et 1 groupe d'équipes de nuit (5 périodes de 14 heures [17 h à 7 h] du

lundi au vendredi) dans chaque hôpital. Au cours d'un stage de 6 mois, chaque résident a effectué 3 semaines en équipe de nuit. Le reste du temps passé dans le service de traumatologie comportait les tâches cliniques quotidiennes de 6 h 30 à 17 h 30 et les heures de garde, en fin de semaine uniquement, par intermittence. Les résidents ont rempli le questionnaire Short Form-36 (SF-36 – formulaire abrégé 36) au sujet de leur qualité de vie globale ainsi que des questionnaires sur leur niveau de stress et leur expérience en termes de formation avant le début du stage (point de référence), puis à 2, 4 et 6 mois. Nous avons effectué une analyse de covariance pour comparer les groupes en utilisant les résultats au point de référence comme covariables et le test des rangs signés de Wilcoxon (non paramétrique) pour déterminer si les résultats du SF-36 étaient différents des normes canadiennes appariées pour l'âge et le sexe. Nous avons analysé les éléments prédictifs de la qualité de vie des résidents au moyen de modèles mixtes multifactoriels.

Résultats : Le groupe de garde standard comportait 7 résidents et le groupe des équipes de nuit, 9 résidents, soit un total de 16 résidents (tous masculins; âge moyen de 35,1 ans). Après contrôle des différences entre les groupes au point de référence, les résidents en équipe de nuit ont affiché des résultats significativement inférieurs au cours de la période d'observation de 6 mois pour les composantes suivantes de l'échelle : état physique lié à la fonction, douleur corporelle, vie sociale et état physique général. Comparativement à la population canadienne de référence, le groupe des équipes de nuit a affiché des résultats significativement inférieurs dans toutes les sous-échelles du SF-36, sauf pour la douleur corporelle. On n'a constaté aucune différence entre le groupe de garde standard et les normes canadiennes à 6 mois. Aucune différence en matière de bénéfice de formation et de niveau de stress n'a été observée entre les 2 groupes. Le manque de temps pour une activité physique n'a été significatif que pour le groupe des équipes de nuit. Une analyse de régression a montré que l'augmentation du nombre d'heures passées à l'hôpital était corrélée à des baisses significatives des résultats du SF-36 dans pratiquement tous les domaines.

Conclusion : Notre étude suggère que les résidents du groupe de garde standard avaient une meilleure qualité de vie en termes de santé que le groupe des équipes de nuit. Il n'y a eu aucune différence entre les 2 groupes sur le plan des avantages subjectifs pour la formation et le niveau de stress.

The Accreditation Council for Graduate Medical Education instituted resident work-hour restrictions effective July 1, 2003.¹ The council mandates that residents work no more than 80 hours per week. Comparatively, the Professional Association of Internes and Residents of Ontario (PAIRO) limits resident in-house call to a maximum of 1 night in 4 and requires that residents be home by noon postcall and have 2 complete weekends without required clinical duty in a 28-day period.² Given these limitations in resident work hours, novel strategies are required to optimize resident education to train competent surgeons. In addition, strategies that can improve resident well-being and quality of life are desired in training programs.

It has been previously demonstrated that orthopedic trauma rotations can have a profound impact on the well-being of residents. At our institution, Zahrai and colleagues³ evaluated the impact of orthopedic trauma rotations on resident quality of life using the Short Form-36 (SF-36) health survey. The authors demonstrated a significant decrease in the SF-36 role limitations (physical), general health scores and physical component summary after 2 months.³ The implementation of a night float system has been used by many programs to decrease the burden of call on resident quality of life and work hours. A recent systematic review⁴ on the effect of the night float system on surgical residents

showed that time to read, resident satisfaction and operative experience increased in several programs that implemented the night float system without an associated change in stress in surgical residents. Lefrak and colleagues⁵ analyzed the impact of the night float system on postgraduate year (PGY)-1 and PGY-3 surgical residents. They found that a higher percentage of the PGY-1 night float residents reported decreased satisfaction in terms of conference attendance, operative experience and attending teaching interactions than their daytime colleagues. In addition, PGY-3 residents reported better attending teaching but less operative experience than their daytime colleagues. Both PGY-1 and PGY-3 residents had less operative experience compared with the daytime residents.

Given that our orthopedic surgery residency program is currently the largest in Canada with 65 residents (as of July 1, 2009), the night float system is logistically feasible and can be studied. The purpose of the present study was to determine whether there were differences in quality of life, work-related stressors and educational experience between orthopedic surgery residents in the night float and the standard call systems at 2 level-1 trauma centres. We hypothesized that night float residents would have improved quality of life, decreased stress and superior educational benefits compared with the standard call residents.

METHODS

We conducted a prospective cohort study involving 16 orthopedic surgery residents on a trauma rotation at 2 level-1 trauma centres. After approval by the institutions' ethics review boards, survey questionnaires were given at start of rotation (baseline) and at months 2, 4 and 6 of the trauma rotation. Surveys required 20 minutes to complete. One research assistant analyzed all the surveys. Each resident was given a numeric code, and all identifiers were removed after analysis. Faculty and staff had no access to the surveys, and all results were kept anonymous and confidential.

Trauma rotations

Seven residents were assigned to the standard call system at one centre and 9 were assigned to the night float call system at the other centre. It should be noted that residents were not assigned randomly to each trauma centre as the schedules were already drafted in advance of the study. Furthermore, residents often prefer to start at one site versus the other owing to differences in the didactic curriculum at the 2 centres. A typical workday when not on call was from 6:30 am to 5:30 pm. Patient load varied depending on the subspecialty service. The standard call schedule system was a 1 night in 4 schedule where residents are relieved of clinical duties at noon on the postcall day in accordance with PAIRO rules. The night float system involved 5 14-hour shifts (5 pm to 7 am) from Monday to Friday. Over the course of a 6-month rotation, each resident completed 3 weeks of night float. The remainder of the time on the trauma service consisted of clinical duties from 6:30 am to 5:30 pm on a daily basis. Residents in the standard call system performed 1–2 weekend days of call per month and no call during weekdays unless they were the designated night shift resident. There was no junior support for residents in the night float or standard call groups. Whereas the impact of the call schedule on particular elective services was not measured, residents did participate in the care of nontrauma patients during daytime hours as per the attending surgeon's schedule. We measured the overall effect on quality of life over a 6-month span regardless of the specific daytime activities carried out at either hospital.

Assessment of quality of life

General health-related quality of life was our primary outcome measure and was assessed using the SF-36,⁶ which includes 1 multi-item scale measuring each of the 8 health concepts: physical function, physical role limitations, bodily pain, social functioning, mental health, emotional role limitations, vitality/energy and general health. We tabulated the scores for each of the 8 domains as well as the physical and mental component summary scores.⁷

Assessment of educational experience

General questions regarding educational experience were investigated as per the questionnaire generated by Lefrak and colleagues.⁵ We chose operative experience, attending teaching interactions, number of consults, time spent on private study or reading and perception of the overall clinical experience as educational end points. The survey was designed to obtain information from residents on these educational parameters during a 1-week period. We also asked the residents to compare their perception of the overall educational benefit and opportunity to improve clinical decision-making in their current rotations to that of previous rotations. Finally, we asked the residents to report if they had been in the hospital for more than 80 hours in the previous week. Whereas the original questionnaire presented answer choices in 5 distinct categories, we collapsed the various categories to create dichotomous variables to facilitate data analysis. We recorded the number of hours worked per week and the number of operative cases performed per week as continuous variables.

Assessment of stress and work-related problems

We measured overall stress, stress of being a resident and stress of combining a personal and professional life before, during and after the rotation⁸ (Appendix 1, available at cma.ca/cjs) using a 5-point Likert scale (0–4). Residents were also asked to rate 15 work-related stressors as generated by Rudner⁸ (Appendix 2, available at cma.ca/cjs) on a 5-point Likert scale (0–4). An inventory developed by Nelson and Henry⁹ at the University of Minnesota, and a modified version generated by Smith and colleagues (revised scale),¹⁰ both having over 100 questions, yielded the top 10 individual problems identified by residents. Our survey included these 10 problems as well as an additional 3 that we believed were useful for our study (Appendix 3, available at cma.ca/cjs). The residents ranked the 13 items on a 5-point Likert scale (0–4).

Statistical analysis

We compared baseline demographic characteristics between the standard call and night float cohorts using Fisher exact tests for categorical characteristics and Student *t* tests for continuous factors. Fisher exact tests were used because of the small cell sizes for some comparisons. We compared the SF-36 domains, component summary scores, educational experiences, stress levels, work-related and individual problems at 2, 4 and 6 months across both call cohorts over 6 months of observation using linear mixed models. We performed an analysis of covariance (ANCOVA) in which the scores were compared between call groups using the baseline scores as covariates, controlling for any differences in scores between the cohorts at

baseline. Unlike traditional ANCOVA models, these mixed models have increased statistical power. Each model examined the differences in scores over time and between groups and evaluated whether a group-by-time interaction was statistically significant (i.e., whether observed differences in scores between groups changed over time). For dichotomous data in the education questionnaire, formal statistical analyses examining differences are not presented since all associations (i.e., over time and over group) were not statistically significant owing to the small sample size and homogeneity of responses.

We used single-sample *t* tests (parametric) and Wilcoxon signed-rank tests (nonparametric) to determine if the residents (overall and by call group) differed from age- and sex-matched Canadian norms at baseline and separately at 6-month follow-up.¹¹ Owing to the relatively small sample, we considered differences from the Canadian norms to be significant only if the nonparametric Wilcoxon signed-rank test had a $p < 0.05$.

In all instances, $p < 0.05$ was used to determine statistical significance.

RESULTS

The demographic characteristics of participants are provided in Table 1. All 16 residents included in the study were men with an average age of 35 years. Most residents were in PGY-4. There were no significant differences in age, sex or PGY between the standard call and the night float groups.

During the week before study enrolment, residents spent on average 77 hours in the hospital and performed about 8 operations (Table 2). There were no significant differences between the standard call group and the night float group in terms of number of surgical cases performed, consultations and hours worked. At baseline, most residents had attended fewer than 3 conferences or rounds and had fewer than 3 attending teaching interactions over the previous 7 days. An equal number of residents spent 0–2 hours studying compared with 3 or more (Table 2). Most

residents had 6 or more emergency or ward consults and reported working more than 80 hours in the hospital during that week. At 6-month follow-up, distributions of education-related experiences had changed modestly, with residents reporting fewer emergency or ward consults, hours studying and hours in the hospital but slightly more conferences or rounds attended and more teaching interactions. Night float residents reported more time to study at 6 months compared with the standard call group (Table 2).

In our mixed-model analysis, each model examined the differences in scores over time and between groups and evaluated whether a group-by-time interaction was significant. There were no significant differences in scores over time or in the group-by-time interaction for any of the outcomes measured. In all instances where a significant difference was found, the difference was attributable to the group effect (i.e., difference in the standard v. night float groups). Overall, residents on night float rotation had significantly lower role physical, bodily pain and social functioning SF-36 subscale scores after controlling for between-group differences at baseline ($p = 0.023$, $p = 0.032$ and $p = 0.036$; Table 3). The physical component scale scores in the night float group were significantly lower than their standard call peers ($p = 0.015$). It should be noted that, although we controlled for these differences in our analyses, the baseline scores for most measures were lower and considerably lower for general health, role physical, role emotional and social function in the night float group compared with the standard call group.

Compared with the Canadian age- and sex-specific norms for the SF-36 subscales and component scores, the 16 residents examined scored significantly lower on several subscales at baseline and 6 months (Table 4). However, after stratifying by call group, it became apparent that most differences were due to the night float call group. The standard call group differed significantly from the Canadian norms, only on the mental health and mental component scores at baseline (all $p < 0.05$), and although remaining lower, the differences were not significant at 6 months. In contrast, the night float group had significantly lower scores on most subscales and component summary scores both at baseline and 6 months compared with the Canadian norms (Table 4). Interestingly, the differences in physical function, role physical and physical component summary scale scores in the night float group only became significant at 6 months (all $p < 0.05$). Among the findings for the night float group, only bodily pain was not significantly different from the Canadian norms throughout the study period.

We found no significant differences in stress levels between the night float and standard call groups. In regards to work-related stressors, “concern regarding death of a patient” was the only significant work-related problem at 6 months for residents on the night float program ($p = 0.022$). Interestingly, among the potential individual problems

Table 1. Resident demographic characteristics

Characteristic	Overall, <i>n</i> = 16	Standard call, <i>n</i> = 7	Night float, <i>n</i> = 9	<i>p</i> value*
Sex, no.				1.00
Male	16	7	9	
Age, mean (SD) [range] yr	35.1 (5.3) [29–45]	33.9 (6.0) [29–45]	36.0 (4.8) [29–42]	0.44†
PGY, no.				0.48
PGY-2	2	0	2	
PGY-3	1	1	0	
PGY-4	13	6	7	

PGY = postgraduate year; SD = standard deviation.

*Fisher exact test used for all tests owing to small cell sizes, unless otherwise specified.

†Student *t* test.

examined, the night float residents considered “not having enough time for physical activities” as significantly more of a problem than the standard call group residents ($p = 0.049$).

There were no other differences in terms of individual or work-related problems between the groups. Regression analysis demonstrated that the increased number of hours

Table 2. Educational experiences of residents in the 7 days prior to baseline and 6-month follow-up

Experience over the last 7 days	Overall		Standard call		Night float	
	Baseline	6 mo	Baseline	6 mo	Baseline	6 mo
Average number of hours spent in hospital per week, mean (SD) [range]	77.2 (8.9) [55–90]	81.9 (11.8) [55–100]	77.1 (9.1) [65–90]	86.4 (9.4) [70–100]	77.2 (9.4) [55–90]	78.3 (12.7) [55–100]
OR cases performed/assisted, mean (SD) [range] no.	7.6 (3.4) [2–12]	9.1 (3.0) [4–15]	9.3 (2.4) [6–12]	8.0 (3.3) [4–12]	6.2 (3.5) [2–12]	9.9 (2.7) [6–15]
Conferences attended, no. (%)						
0–3	9 (56.3)	4 (33.3)	2 (28.6)	2 (40.0)	7 (77.8)	2 (28.6)
≥ 4	7 (43.8)	8 (66.7)	5 (71.4)	3 (60.0)	2 (22.2)	5 (71.4)
Attending teaching interactions > 5 min in duration, no. (%)						
0–5	11 (68.8)	6 (50.0)	4 (57.1)	3 (60.0)	7 (77.8)	3 (42.9)
≥ 6	5 (31.3)	6 (50.0)	3 (42.9)	2 (40.0)	2 (22.2)	4 (57.1)
Consults seen in the ED or ward, no. (%)						
0–5	6 (37.5)	7 (58.3)	2 (28.6)	3 (60.0)	4 (44.4)	4 (57.1)
≥ 6	10 (62.5)	5 (41.7)	5 (71.4)	2 (40.0)	5 (55.6)	3 (42.9)
Average time spent studying/reading, no. (%) hr						
0–2	8 (50.0)	8 (66.7)	4 (57.1)	5 (100)	4 (44.4)	3 (42.9)
≥ 3	8 (50.0)	4 (33.3)	3 (42.9)	0 (0)	5 (55.6)	4 (57.1)
Current rotation provides better overall educational experience than previous rotations, no. (%)						
Strongly disagree to neutral	8 (50.0)	6 (50.0)	4 (57.1)	3 (60.0)	4 (44.4)	3 (42.9)
Agree/strongly agree	8 (50.0)	6 (50.0)	3 (42.9)	2 (40.0)	5 (55.6)	4 (57.1)
This rotation provides a better opportunity to improve my clinical decision-making and diagnostic skills compared with previous rotations, no. (%)						
Strongly disagree to neutral	6 (37.5)	6 (50.0)	2 (28.6)	3 (60.0)	4 (44.4)	3 (42.9)
Agree/strongly agree	10 (62.5)	6 (50.0)	5 (71.4)	2 (40.0)	5 (55.6)	4 (57.1)
This past week I worked in the hospital more than 80 hours, no. (%)						
Strongly disagree/disagree	5 (31.3)	3 (25.0)	3 (42.9)	1 (20.0)	2 (22.2)	2 (28.6)
Neutral to strongly agree	11 (68.8)	9 (75.0)	4 (57.1)	4 (80.0)	7 (77.8)	6 (71.4)

ED = emergency department; OR = operating room; SD = standard deviation.

Table 3. Baseline and 6-month quality of life outcomes by call group: results from mixed analysis of covariance models

Outcome, mean (SD)	Standard call		Night float		Group effect, p value
	Baseline	6 mo	Baseline	6 mo	
Physical functioning	92.86 (18.90)	100.00 (0.00)	81.11 (25.59)	80.00 (12.25)	0.12
Role physical	82.14 (37.40)	95.00 (11.18)	58.33 (50.00)	17.86 (37.40)	0.023
Bodily pain	84.43 (18.26)	87.20 (20.86)	80.56 (17.76)	61.71 (20.69)	0.032
General health	77.57 (24.25)	84.20 (16.50)	62.11 (17.47)	56.43 (24.89)	0.41
Vitality	51.43 (15.74)	51.00 (10.84)	51.67 (14.58)	48.57 (14.92)	0.20
Social functioning	80.36 (20.23)	90.00 (13.69)	69.44 (25.09)	53.57 (21.30)	0.036
Role emotional	71.43 (35.63)	100.00 (0.00)	40.74 (49.38)	19.05 (37.80)	0.07
Mental health	65.71 (7.61)	60.80 (11.45)	57.33 (22.63)	52.00 (15.49)	0.72
Physical component scale	52.01 (13.33)	56.15 (2.18)	46.16 (13.15)	39.32 (9.80)	0.015
Mental component scale	40.21 (7.61)	42.40 (6.23)	34.84 (14.06)	30.15 (10.71)	0.39

SD = standard deviation.

spent in hospital correlated with significantly lower general health, physical function, mental health, role emotional, social function and mental component summary scale scores (all $p < 0.05$; Table 5).

DISCUSSION

The main finding in this study is that residents on the night float service had substantially worse health-related quality of life compared with residents on a standard 1 night in 4 call service during a 6-month orthopedic trauma rotation, as measured by a validated and reliable outcome instrument. The residents in the former group also had lower health-related quality of life scores compared with the Canadian normative population. Over this 6-month period, there were no significant differences in educational benefit and stress levels between the 2 groups.

Given evolving guidelines regarding maximum allowable work hours and postcall relief of residents from all clinical duties, strategies that will maximize education and yield improved quality of life need to be explored. For these reasons, we elected to launch an experimental night float system at our institution. Our study showed no significant difference between the standard call group and the night float group in terms of operative experience, teaching quantity, study time and hours worked for the entire 6 months of the study. In our study, the night float system involved 5 14-hour shifts (5 pm to 7 am) from Monday to Friday. Over the course of a 6-month rotation, each resident completed 3 weeks of night float. The remainder of the time, the residents worked during normal daytime hours (6:30 am to 5:30 pm) with 1–2 weekend days of call per month. We postulate that the reason no difference was found in educational benefits among the groups was that the normal teaching schedule was only disrupted for 3 weeks during the 6-month study period. It is thus imper-

ative that programs implement additional faculty-run teaching and nighttime tutorials for longer durations or continuous night float schedules. This was indeed implemented by Lefrak and colleagues⁵ after initial analysis showed a compromise in surgical resident education. To minimize the loss of operative experience, night float schedules should only be considered at level-1 trauma centres with a high volume of emergent surgical cases.

We used the SF-36 as our primary outcome measure for quality of life in residents. Controlling for between-group differences at baseline, residents on the night float rotation had significantly lower role physical, bodily pain and social function subscale as well as physical component summary scores over the 6-month observation period. Physical function, role physical and physical component summary scale scores in the night float group became significantly different from Canadian norms at 6 months. We were certainly surprised by the significant deleterious effect of the night float system on our residents' health-related quality of life. The effects of night work on well-being, especially in nurses, are well reported in the literature. Night-shift workers tend to get less sleep than day-shift workers, and night-shift workers' sleep quality during the day is often poor.¹² Kunert and colleagues¹³ showed that night-shift nurses in comparison with day-shift nurses perceived a much higher level of fatigue and had poorer sleep quality. Certainly one plausible explanation for the poor quality-of-life scores in the night float group was the change in sleep habits that was experienced upon switching from regular work hours to night shifts and vice versa. In addition, the 14-hour shift without junior resident help may have also contributed to the findings.

In contrast, the standard call group differed significantly from the Canadian norms only on the mental health and mental component scores at baseline; however, the differences were not significant at 6 months. The findings of decreased quality of life in orthopedic residents during a

Table 4. Baseline and 6-month SF-36 quality of life estimates compared with Canadian norms

Outcome	Call system, time, mean difference (SD)					
	Overall		Standard call		Night float	
	Baseline	6 mo	Baseline	6 mo	Baseline	6 mo
Physical functioning	-8.39 (23.99)	-6.38 (14.06)	-2.60 (23.22)	8.33 (2.35)	-11.61 (25.16)	-12.69* (11.83)
Role physical	-24.05 (46.49)	-47.91* (47.06)	-14.06 (44.45)	3.63 (16.68)	-29.60 (49.26)	-70.00 (36.48)
Bodily pain	2.49 (17.75)	-11.45 (21.61)	2.56 (21.16)	0.00 (23.41)	2.46 (16.98)	-16.36 (20.60)
General health	-13.62* (21.10)	-15.18 (25.49)	-6.26 (27.19)	3.97 (17.19)	-17.71* (17.35)	-23.39 (24.79)
Vitality	-18.96‡ (14.68)	-19.95† (13.78)	-21.64 (15.77)	-18.60 (13.01)	-17.42† (14.78)	-20.53* (15.08)
Social functioning	-15.06* (23.19)	-23.16* (16.02)	-8.54 (21.35)	3.37 (14.62)	-18.68* (24.59)	-34.53* (21.02)
Role emotional	-36.50* (46.61)	-42.85* (49.26)	-20.59 (41.91)	13.43 (2.05)	-45.34* (49.05)	-66.97* (37.09)
Mental health	-17.84† (18.83)	-23.87† (14.99)	-13.00* (8.63)	-19.20 (15.29)	-20.53* (22.72)	-25.87* (15.61)
Physical component scale	-5.60 (13.54)	-8.90 (11.08)	-3.39 (15.78)	2.23 (1.87)	-6.84 (12.98)	-13.67* (9.72)
Mental component scale	-15.23‡ (12.03)	-17.93† (11.16)	-12.30* (7.64)	-9.50 (7.98)	-16.86† (14.06)	-21.55* (10.71)

SD = standard deviation.
 * $p < 0.05$.
 † $p < 0.01$.
 ‡ $p < 0.001$.

standard call schedule at a level-1 trauma centre as reported previously by Zahrai and colleagues³ at our institution was not observed in this study. No rules regarding mandatory postcall relief for residents existed when the aforementioned study was conducted. In the present study, residents were relieved of all clinical duties no later than noon postcall. This may explain the lack of deleterious effects on resident quality of life during our standard 1 night in 4 call schedule.

We did find that increased number hours spent in hospital correlated with significantly lower general health, physical function, mental health, role emotional, social function and mental component summary scale scores, suggesting a benefit to shorter work hours on resident well-being.

Although the mean resident age between the 2 groups was not statistically significant, we acknowledge that the residents in this study were older than average residents in the same PGYs, owing to a proportion of residents having completed prior graduate degrees as well as some residents who were formerly family doctors and had re-entered residency.

We hypothesize that a residency based only on a night float system would likely limit or even potentially decrease a resident's preparedness for "real-world" practice. This, along with the deleterious effects seen on the health-related quality of life in association with the night float systems, should limit its use for the time being. The relation between the implementation of the night float system for a limited period (i.e., during a busy trauma rotation) and a resident's preparedness for real-world practice should be studied qualitatively in the future.

The strengths of this study are the prospective nature of following 2 demographically matched cohorts at 2 separate trauma centres. In addition, our study used a validated outcome instrument (SF-36) for its primary outcome measure and several other secondary outcomes, including measurements for education, stressors, work-related and individual problems. To the best of our knowledge, our study is the first to compare such call strategies in Canadian surgical residency education.

Limitations

There are also some limitations to our study. First, the

results of this study are specific to orthopedic surgery residents at our institution and thus their generalizability is limited. Second, although we attempted to control for our small number of residents statistically, our sample size was limited. The small sample size in this study may have precluded us from detecting a significant difference in the volume of surgical cases and consultations, thus making these variables potential confounders. The small sample size as well as the homogeneity of responses would make finding significant differences for the dichotomous variables in our education questionnaire unlikely. However, the total sample size of this study ($n = 16$) is quite substantial given the size of most orthopedic programs in Canada. Third, there is a possibility for selection bias as residents agreed to participate in the night float schedule at 1 centre. Last, given the nature of survey measurements used, recall bias should be noted as a possibility.

CONCLUSION

Our a priori hypothesis that the night float residents would have improved quality of life and superior educational benefits compared with the standard call residents was nullified based on the aforementioned findings. As a result, we abandoned the night float system at our institution. Although not formally measured, post-hoc interviews with faculty revealed that delivery of care had been affected — specifically cohesiveness, team spirit and continuity of care. Strategies such as fine-tuning of the night float schedule, decreasing the shift hours and having a junior and senior resident on call together should be tested in future studies. Similarly, the programs and governments should not only monitor the number of hours worked but also the distribution of those hours. Before implementing such a system at an institution, program directors should have the ability to measure the effects of systemic institutional changes on the well-being and education of residents. This will ensure an expedient response to any deleterious effects on education and resident quality of life.

Competing interests: None declared.

Contributors: Drs. Zahrai and Chahal contributed equally to this study. Dr. Schemitsch designed the study, reviewed the manuscript and approved the final version for publication. Dr. Stojimirovic acquired the data, reviewed the manuscript and approved the final version for publication.

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Table 5. Correlation between increased hours spent in hospital and SF-36 scores

SF-36 domain	p value for correlation between increased hours spent in hospital and lower scores on the SF-36
General health	0.006
Physical functioning	0.020
Role emotional	0.010
Social functioning	0.005
Mental health	0.012
Mental health component scale	0.012
SF-36 = Short Form-36 general quality-of-life questionnaire.	

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- La Société canadienne d'oncologie chirurgicale

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