Prospective Cohort Study on Paramedic Fatigue: Impact of Workload and Shift Schedule

Amin Yazdani & Marcus Yung

Canadian Institute for Safety, Wellness, and Performance, Conestoga College, Canada

SUMMARY

Paramedics experience significant levels of fatigue that may affect their health and safety and the safety of the communities they serve. Through a 1-year prospective cohort study, combining ActiGraph watch data and ambulance call reports, we found possible relationships between workload (i.e., call volume), work arrangement (i.e., shift schedule), and sleep quality and duration.

KEYWORDS

Ambulance Call Reports, Sleep, Rural Paramedic Service

Introduction

Paramedics are at a high-risk for fatigue. Fatigue is a multidimensional construct and can lead to performance decrements which may endanger not only the health and safety of responders but also the safety of the public they serve (Yung et al., 2021). In a survey study of Ontario paramedic services, 55% of paramedic personnel reported being fatigued at work; fatigued paramedics were twice as likely to report injuries, three times more likely to engage in safety-compromising behaviours, and 1.5 times more likely to commit a medical error (Donnelly et al., 2020).

Fatigue may be attributed to work tasks (e.g., workload related to physical, cognitive, or psychosocial demands) and work arrangement (e.g., shift schedules, etc.). However, few studies have explored the relationships between work tasks/arrangement and sleep-related paramedic fatigue. This study explored these exposure-response relationships through a one-year prospective cohort study, gathering and analysing primary data (actigraphy sleep and activity measurements) and secondary data (administrative and daily ambulance call reports - ACR).

Method

Sixty-three primary and advanced care paramedics, from a large urban and large rural paramedic service, were recruited to participate in a prospective cohort study. Data was collected at three time periods, four months apart. During each collection period, participants wore a wrist-mounted ActiGraph device to monitor activity and sleep quality and duration, for 28 days, resulting in 84 days of actigraphy information from each participant. Participants also completed a sleep diary log to verify actigraphy data. For each participant, we gathered their administrative data to ascertain their shift schedule. We also analysed ACR data, which document daily events including workload factors (e.g., call volume, clinical procedures, total call time, transfer of care wait time, total drive time, and number of procedures). We estimated the daily emotional, physical, and mental demands of their calls using an “intervention demand matrix” (IDM), designed for this study, by retrospectively assigning workload demands to their performed clinical procedures.

For this presentation, we detail the development of the IDM and report on relationships between fatigue risk factors (workload- and work arrangement-related) and fatigue outcomes, determined by

ActiGraph sleep metrics (sleep efficiency, total sleep time, number of awakenings, awakening length, movement index, and fragmentation index). After linking fatigue risk factor data to actigraphy data, we performed logistic regression. We defined a "fatigue case" as a sleep event that met the following criteria: (1) ≤ 85% sleep efficiency, and (2) ≥ 6 average awakenings per night, and (3) >5 minutes average awakening length. We designated age, sex, BMI, job tenure, and chronotype as covariates in our models. We report preliminary univariate model results, both crude and adjusted.

Preliminary Findings

The IDM was developed, based on the NASA Task Load Index (TLX), to estimate physical, mental, and emotional demands of clinical procedures. Demand estimates were obtained for 64 commonly used procedures from frontline paramedics and management. We calculated winsorized means for each of the 64 procedures and assigned these demand estimates for each paramedic call. We calculated an average demand score (i.e., frequency weighted) and cumulative call demand score for physical, mental, and emotional demand dimensions.

We found statistically significant associations between workload factors and adverse sleep-related fatigue. Interestingly, we observed a u-shaped trend between call volume and fatigue, where paramedics with 2-3 calls per shift had 65% lower odds of being a fatigue case than paramedics with no calls per shift. We found a relationship between a one unit increase in the average mental, physical, and emotional demands of the intervention per shift and the risk of being a fatigue case, from 3-5% according to crude and adjusted models. We did not find a statistically significant relationship between shift type and sleep-related fatigue.

Table 1: Relationships between workload and work arrangement fatigue risk factors and fatigue case status.

Fatigue Risk Factor	Non-Cases (n)	Cases (n)	Crude OR (95%CI)	p-value	Adjusted* OR (95%CI)	p-value
Workload						
Call Volume						
No Calls (Ref)	282	30	1.00		1.00	
Low # of Calls (1 call)	89	9	0.95 (0.43 - 2.08)	0.90	1.15 (0.43 - 3.05)	0.79
Moderate # of Calls (2-3 calls)	135	5	**0.35 (0.13 - 0.92)**	0.03	0.76 (0.26 - 2.20)	0.61
High # of Calls (4+ calls)	16	3	1.76 (0.49 - 6.40)	0.39	**3.76 (0.88 - 15.97)**	0.07
Total Drive Time	240	17	0.99 (0.99 -1.01)	0.89	1.00 (0.99 - 1.01)	0.34
Transfer of Care Wait Time	240	17	1.00 (0.99 - 1.011)	0.31	**1.01 (1.00 - 1.02)**	0.02
Total Call Time	240	17	1.00 (1.00 - 1.004)	0.48	**1.01 (1.00 - 1.01)**	0.04
# of Interventions/Procedures Per Shift	240	17	**1.04 (1.01 - 1.07)**	0.01	**1.04 (1.01 - 1.08)**	0.02
Avg. Mental Demand of Interventions/Procedures Per Shift (FreqWt)	240	17	**1.03 (1.00 -1.10)**	0.05	1.02 (0.99 - 1.06)	0.09
Avg. Physical Demand of Interventions/Procedures Per Shift (FreqWt)	240	17	**1.05 (1.00 - 1.10)**	0.04	**1.05 (1.00 - 1.10)**	0.05
Avg. Frustration/Emotional Demand of Interventions/Procedures Per Shift (FreqWt)	240	17	**1.04 (1.00 - 1.09)**	0.05	1.03 (0.99 - 1.08)	0.18
Cumulative Mental Demand of Interventions/Procedures Per Shift	240	17	1.00 (0.99 - 1.01)	0.06	1.00 (1.00 - 1.01)	0.25
Cumulative Physical Demand of Interventions/Procedures Per Shift	240	17	1.01 (0.99 - 1.01)	0.06	1.01 (0.99 - 1.01)	0.15
Cumulative Frustration/Emotional Demand of Interventions/Procedures Per Shift	240	17	**1.01 (1.00 - 1.01)**	0.05	1.00 (0.99 - 1.01)	0.25
Work Arrangement						
Shift Type						
Rotating (Ref)	777	90	1.00		1.00	
Non-Rotating (incl. straight days/nights)	349	29	0.72 (0.46 - 1.11)	0.14	1.66 (0.70 - 3.91)	0.25

*Adjusted for Age, Sex, BMI, Job Tenure, Chronotype **Call volume includes zero call shifts. All other variables exclude zero calls.

Key Takeaways

- Mental, physical, and emotional workload demonstrated significant associations with adverse sleep-related fatigue.
- There may be a u-shaped trend between number of calls (call volume) and adverse sleep-related fatigue.
- Research findings may support better evidence-informed decision-making in designing optimal work schedules that accommodates paramedic operations in the safest manner possible.

References

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