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Concurrent Trajectories of Objectively Measured Insufficient Recovery and Workload Among a Cohort of Shift Working Hospital Employees: Quantitative Empirical Research

Annina Ropponen[1,2] | Maria Hirvonen[1] | Tero Kuusi[3] | Mikko Härmä[1]

[1]Finnish Institute of Occupational Health, Helsinki, Finland | [2]Division of Insurance Medicine, Department of Clinical Neuroscience, Karolinska Institutet, Stockholm, Sweden | [3]ETLA Economic Research, Helsinki, Finland

Correspondence: Annina Ropponen (annina.ropponen@ttl.fi)

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ABSTRACT

Aim: To investigate concurrent changes in short shift intervals (< 11 h) and workload among hospital employees.

Design and Data Sources: This cohort study of 1904 employees in one hospital district in Finland utilised data on employees' working hours for short shift intervals and workload based on the patient classifications aggregated to a 3-week period level across 2 years, 2018–2019. The data was analysed by group-based trajectory modelling and multinominal regression models.

Results: The seven trajectories model had the best fit to the data—Group 1: very few short shift intervals that are decreasing and low workload (15.0%); Group 2: a low amount of short shift intervals that are decreasing and stable low workload (14.2%); Group 3: moderate amount of short shift intervals that are slightly increasing and low workload (25.1%); Group 4: a low amount of short shift intervals that are slightly decreasing and stable low workload that is slightly increasing (12.1%): Group 5: a moderate amount of both short shift intervals and workload (19.8%): Group 6: short shift intervals that are clearly decreasing, with higher than the average workload decreasing (5.6%); Group 7: moderate amount of short shift intervals and very high workload (8.3%).

Conclusions: Only a minority of hospital employees were found to have both high workloads and insufficient recovery possibilities, but the time-related increases in objective workload were not compensated by better recovery possibilities in working hours. For shift scheduling, it is noteworthy that older employees might seek to work at units in which the workload is lower, which could be considered to support workability.

Reporting Method: Record.

Patient or Public Contribution: No Patient or Public Contribution.

1 | Introduction

In Finland, and also in many other countries, the healthcare sector operates around the clock, 365 days per year with irregular shift work, that is, shift work with a non-standard schedule that includes varying start and finish times, shift lengths and rest periods between shifts (Sallinen and Kecklund 2010). Irregular shift systems with short shift intervals (< 11 h) have become more common, especially in the service sector (Ferguson et al. 2023; Peršolja 2023). Irregular shift work among nurses shows associations with various health outcomes such as heart diseases, cancer and pregnancy complications (Kader, Bigert, et al. 2022; Kader, Selander, et al. 2022; National Toxicology 2021), probably due to associations with insufficient sleep and recovery and circadian disruption (Sallinen and Kecklund 2010). Earlier studies among nurses have indicated that short shift intervals, as an indicator of insufficient rest between shifts, have been associated with, for example, shorter sleep length and shiftwork disorder (Vedaa et al. 2019; Waage et al. 2021). Short shift intervals may be due to the shortage of personnel (Smiley et al. 2018a, 2018b; Tursunbayeva 2019), as there might be a need to adjust the shift schedule to ensure required staffing and it may consequently lead to an excessive workload. Furthermore, as nurses and practical nurses carry a lot of responsibility for the care of the patients (Cho, Bretthauer, and Schoenfelder 2023; Najafpour et al. 2023; Peutere, Pentti, et al. 2023), research on insufficient recovery and workload in healthcare is especially merited. In Europe, the Working Time Directive (2003/88/EC) rules that employees in all EU countries must be given at least 11 consecutive hours of daily rest, while this regulation has widely been tested in the research of working hours in healthcare (Garde et al. 2019; Härmä et al. 2022; Ropponen et al. 2022; Shiri et al. 2021; Vedaa et al. 2019, 2017). However, on national and local levels, this is often not followed based on collective agreements. Hence, a lack of knowledge exists for associations between working hour characteristics and objective workload, and such an assessment is needed to understand this development.

2 | Background

Some previous studies have indicated that administrative data would be a feasible tool to add understanding and precision for the evaluation of workload in healthcare and also for nurses (Krutova et al. 2023; Rosenstrom et al. 2021). For example, studies on working hours with administrative payroll data to represent objective working hours (Garde et al. 2019; Harma et al. 2015) have shown that, for example, long working hours, several consecutive night shifts and short shift intervals (< 11 h) were associated with employee sickness absence (Ropponen et al. 2019) and sleep disturbances (Harma et al. 2018). However, studies that consider work unit level workload and working hours including short shift intervals in administrative data are scarce (Min, Min, and Hong 2019). Besides working hours, objective assessments of quantitative workload among nurses, operationalised, for example, as a nurse-to-patient ratio, ward overcrowding or 'undone work' have proposed important information (Dall'Ora et al. 2018; Griffiths, Maruotti, et al. 2018). These findings might be the reason why insufficient rest exists in healthcare. For instance, there may be insufficient rest when the workload is high, for example, due to ward overcrowding subsequently leading to a need to prolong working hours, but employees may also choose them, which is why short shift intervals may arise (Öster et al. 2023). Also, regarding workload, the question of an optimal period for assessment remains unclear (Peutere et al. 2021), and the studies have usually applied static time windows for exposure assessment (Ropponen et al. 2020). Another limitation of earlier studies has been the assessment of workload, which has been limited to hospital-level information restricting the generalisability of the findings to specific work units or hospital wards. Therefore, for workload, work unit level objective data would add to our understanding and provide information to develop tools for management by revealing how hospital wards differ in the number of personnel and working hours.

This study relies on the assumption that based on the current need for longer work careers (Vanroelen 2017) combined with increasing turnover rates, a higher number of temporary staff in hospitals (Park, Park, and Hwang 2019), ageing patients (Wittenberg et al. 2017) and overcrowded wards (Lucini et al. 2017), there is an urgent need to develop methods to assess workload in healthcare and among nurses. We further assume that although short shift intervals are not very common (Härmä et al. 2022; Larsen et al. 2020), they might be associated with loading peaks because they are indicative of insufficient rest due to the compromised recovery possibilities such as prolonging working hours due to double shifts or increased weekend work. The hypothesis was that a high amount of short shift intervals might appear at the same time as a high workload.

3 | The Study

3.1 | Aims and Objectives

We aimed to investigate concurrent changes of short (< 11 h) shift intervals and workload during the follow-up of 7 years among hospital employees in one hospital district in Finland. Another aim was to investigate the associations between work unit and working hour characteristics and the identified concurrent changes.

4 | Methods

4.1 | Design, Setting and Sampling

A retrospective cohort study was conducted utilising data on employees' working hours and the patient classifications of one hospital district in Finland. Working hour data daily were obtained from the shift scheduling program Titania, which is the payroll-based employer-owned digital program for scheduling working hours. The patient data were provided by the hospital district from their employer-owned registers. The data covered the full years from 2013 to 2019. In Finland, the public healthcare services cover all the people residing in the country (EU-healthcare.fi 2023). In 2013–2019, i.e., during the data of this study, hospital districts covering the neighbouring municipals, were the healthcare providers both for primary healthcare and specialised healthcare. Primary healthcare services are mainly provided at health and social services centers and specialised healthcare services usually at hospitals. This study included all the work units of one hospital district, for which we had the identification code to link the working hours (employee) and patient data. The lack of identification codes was due to the organisational changes, in which some units were either merged or separated and their codes were not entered into the administrative system to provide follow-up across time. Such changes are a natural development of a hospital district to ensure patient care and therefore are evident during the rather long, 7 year period of data collection.

In total, 5792 employees had complete working hour data. The detailed data processing protocol for the working hour data was the same as described earlier (Harma et al. 2015). In the next step, we included only those work units that were possible to identify from the patient data (n for employees = 4611) and had > 10 employees; further, the data was restricted to those who were nurses or practical nurses based on the job titles according to the International Standard Classification of Occupations (ISCO) 2010. In Finland, both nurses and practical nurses are registered professionals. Nurses and practical nurses were selected following the procedures of the earlier studies with administrative data to add comparability of the results (Krutova et al. 2023; Peutere, Pentti, et al. 2023; Peutere, Terho, et al. 2023). The selection based on work unit size (i.e., > 10 employees) and the restriction to nursing occupations was done to add reliability for working hours and workload assessments (i.e., within a unit with ≤ 10 employees, the workload peaks and variation might be larger) and the connection to patient–related work, as was done before (Krutova et al. 2023; Peutere, Terho, et al. 2023). That left us with the final sample of 1904 employees with complete data both for working hours and for patient data at the work unit level.

4.2 | The Instruments

From the whole study period, the working hour data included the start/end of all work shifts and absences including days off, sickness absences and other leaves, work unit, type of shift work and also occupation and age of employees, as been described in detail earlier (Harma et al. 2015). The working hour data was aggregated to a 3-week period level since 3 weeks is the period for planning the working hours in the Finnish healthcare sector (see, e.g., Ropponen et al. 2017). The average working hours are thus balanced for every 3 weeks, averaging the variability inside the periods. For each 3-week period, the following work shifts were classified based on the raw data: morning shifts (starting after 03:00 h and ending before 18:00 h); day shifts (starting after 08:00 h and ending before 18:00 h); evening shifts (≥ 3 h of work between 18:00 and 02:00 and not categorised as a night shift) and night shifts (≥ 3 h between 23:00 and 06:00 h), as has been described in detail earlier. These were further used to calculate the working hour characteristics for each 3-week period; time of day (i.e., shift work) based on the proportion of different shifts and the consecutive work shifts and recovery time between the shifts (for details, see Harma et al. 2015) across all years, 2013–2019. Since there were no major differences in working hour characteristics across years (Table 1), we restricted the analyses to two consequent years, 2018–2019. We also tested other years (data not shown), and there were no major differences in results. The full list and description of different working hour characteristics are shown in Table S1.

The measurement of the objective workload was based on the patient data including the Oulu patient classification (OPC) metric (Rauhala et al. 2007) together with the number of patients and employees' working hours at the work unit level. The detailed service activity of different work units (wards) was calculated, and the workload was defined as the ratio of human resources to the amount of activity. In the evaluation of the workload, the number of patients treated in the work unit during a given day, weighted by demandingness (intensity-of-care classification and diagnosis distribution), was compared to the resources used, that is, the working hours. In the workload measurement, the work tasks to be evaluated were classified (OPC), and statistical evaluations were performed. Then the workload assessment was carried out by utilising statistical modelling, where the organisation's resource use (especially work input) was explained by using the combination of patient and employee data in the work units based on the econometrics (see, e.g., Coelli et al. 2005). This enabled us to calculate patient classification estimates simultaneously for a very large number of different tasks. The workload of work units was defined as the patient classification-weighted number of patients treated there during a given day. For this study, the workload measurement/work units were applied to 3-week periods as working hour characteristics.

4.3 | Data Analysis

First, we calculated descriptive statistics for means with standard deviations (SD) for working hour characteristics. Next, we applied group-based multi-trajectory analysis (Nagin et al. 2018) to identify trajectories of short shift intervals and workload. Both measures were treated as continuous variables. Group-based multi-trajectory modelling (GBTM) is a form of finite mixture modelling to distinguish and describe subpopulations (clusters) existing within the studied population (Nagin et al. 2018). GBTM is a data-driven and person-centered approach that can identify patterns of development within heterogeneous data and further divide participants into qualitatively different latent groups without prior assumptions. Such a method enables one to consider the concurrent development in more than one factor and approximates the proportion of individuals following specific simultaneous trajectories of short shift intervals and workload and investigate the antecedents of these trajectories. A censored normal model of GBTM with linear distribution was used. Since total working hours were assumed to play a role both for short shift intervals and workload, weekly working hours were included in the models as time-varying covariate (data not shown). The goodness of model fit was judged by running the procedure several times with the number of trajectory clusters starting from one up to as long as the model converged. The goodness of fit was confirmed using the most parsimonious criteria of Bayesian Information Criterion (BIC), Akaike Information Criterion (AIC), and average posterior probability (APP) of cluster membership. We also set a priori the smallest group size for trajectory groups to 5%. Third, for the best-fitted model of trajectories, multinomial regression analyses were conducted to evaluate the relative influence of baseline factors for the identified clusters. In these regression models, the largest trajectory group was the reference group and the associations of factors of interest were tested for the other trajectory groups. All factors of interest, number of employees per work unit, amount (%) of employees who work part-time per work unit, mean age of employees per work unit, amount (%) of night work and variability of shift starting times were selected a priori based on earlier studies (Griffiths et al. 2020; Ropponen et al. 2019) and were added to the regression model at the same time. All analyses were performed with Stata/MP Statistical Software: Release 17 (StataCorp, College Station, Texas, USA). The additional Stata module 'traj' was required to conduct group-based trajectory analysis (Nagin et al. 2018).

TABLE 1 | Means of working hour characteristics within 3 week periods and productivity in the full sample.

	2013	2014	2015	2016	2017	2018	2019
	Mean	**Mean**	**Mean**	**Mean**	**Mean**	**Mean**	**Mean**
Number of employees/work unit	26.6	27.3	27.3	28.2	29.5	31.4	33.1
Age of employees (years)/work unit	27.0	27.3	28.0	28.0	27.9	27.7	27.4
Part-time work (% of employees)/work unit	17.8	17.7	16.3	14.5	14.4	15.4	15.0
Weekly working hours (hours)	33.6	33.3	33.2	33.4	32.6	33.6	33.5
% of long (> 40 h) working weeks	18.5	16.9	15.3	16.6	18.3	20.0	19.7
% of long (> 48 h) working weeks	2.4	2.4	2.1	2.2	2.5	2.7	3.0
Shift length (hours)	8.2	8.1	8.1	8.1	8.2	8.2	8.2
% of long shifts (≥ 12 h)	2.9	2.0	2.2	2.2	2.4	2.5	2.5
Number of consecutive working days	3.9	3.9	3.9	3.8	3.8	3.8	3.8
Night shifts (%)	8.8	8.6	8.7	8.9	8.7	8.7	8.8
Number of consecutive night shifts	0.5	0.5	0.5	0.5	0.5	0.5	0.6
Number of consecutive evening shifts	0.6	0.6	0.5	0.6	0.6	0.6	0.7
Length of night shifts (hours)	10.6	10.5	10.6	10.6	10.5	10.6	10.6
Evening shifts (%)	13.7	13.8	13.7	13.5	14.1	14.4	14.2
Morning shifts (%)	67.7	67.6	66.1	65.3	65.7	65.2	64.7
Day shifts (%)	7.9	8.2	9.5	8.1	7.5	7.7	8.2
Time between shifts (hours)	13.7	13.8	13.7	13.9	13.8	13.9	14.0
% of short shift intervals (< 11 h)	8.0	8.0	7.8	9.0	9.0	9.0	8.2
Maximum of weekly recovery period (< 35 h, %)	40.4	40.2	39.7	39.5	40.3	39.8	39.5
% of weekend work	18.4	17.7	17.5	20.6	20.0	20.0	21.7
% of single days off	20.5	20.1	20.4	21.3	22.1	21.7	22.2
Variability of shift starting times	1.6	1.6	1.6	1.7	1.7	1.7	1.7
Variability of shift length	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Workload/work unit	1707.5	1714.1	1786.7	1877.3	1952.8	2184.4	2923.1

4.4 | Ethical Considerations

The study protocol was designed and performed according to the principles of the Helsinki Declaration. This study was fully based on administrative register data. Access to the data was based on permission from the hospital district. Although research using only register data does not need to undergo review by an ethics committee according to Finnish legislation (Medical Research Act), this study had the ethical vetting performed and approved by the Ethical Review Board of the Finnish Institute of Occupational Health, Helsinki, Finland (3/2020). None of the authors had access to any kind of identifying information.

5 | Results

Table 1 shows the working hour characteristics of the final sample ($n = 1904$). Since there were no major differences between different years, the two most recent years, 2018–2019, were selected for further analyses.

5.1 | Concurrent Changes of Short Shift Intervals and Workload—Clusters for Trajectories

The seven-cluster solution was best based on the goodness of fit statistics (Table 2).

The identified clusters (Figure 1) were named:

- Group 1 Very few short shift intervals that are decreasing and low workload (15.0%),
- Group 2 A low amount of short shift intervals that are decreasing and a stable low amount of workload (14.2%),
- Group 3 Moderate amount of short shift intervals that are slightly increasing and low workload (25.1%),

TABLE 2 | Goodness of fit statistics of group-based trajectory analysis models.

	Smallest group				
	N	**%**	**BIC**	**AIC**	**APP**
2-cluster model	879	14	−427699.99	−427634.83	0.77
3-cluster model	217	14	−406148.58	−406053.35	0.99
4-cluster model	214	14	−397663.51	−397538.21	1.00
5-cluster model	86	6	−386422.47	−386267.10	1.00
6-cluster model	229	6	−384087.57	−383902.13	0.72
7-cluster model*	**86**	**6**	**−377067.32**	**−376851.80**	**1.00**
8-cluster model	—	—	na	na	—

Note: The best model based on the fit statistics is indicated with an asterisk (*) and in boldface.
Abbreviations: AIC = Akaike Information Criteria, APP = average posterior probability, a priori level of ≥ 5% for the smallest cluster size, BIC = Bayesian information criterion, na = not assessed as the model does not converge.

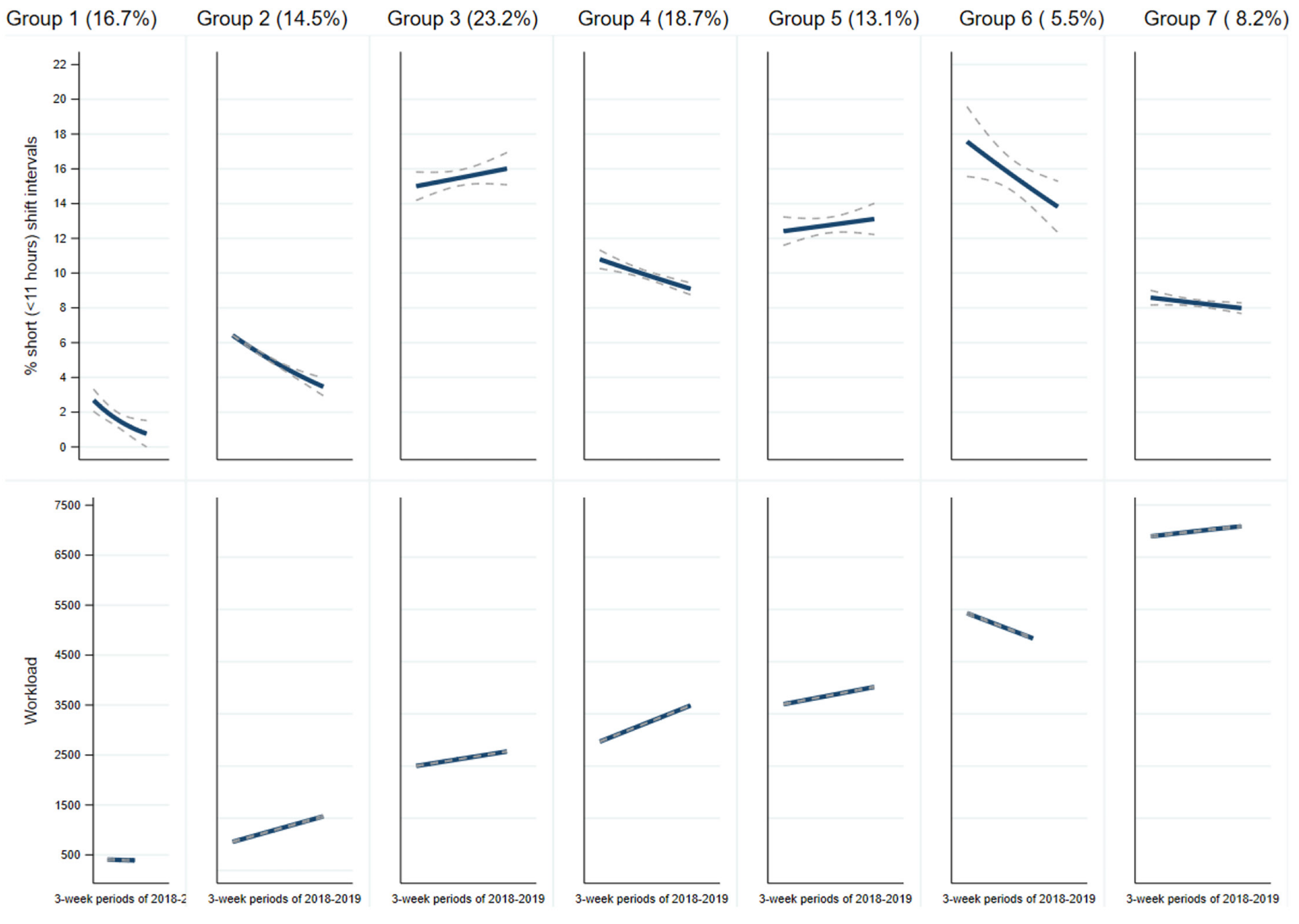

FIGURE 1 | Concurrent changes of short shift intervals (< 11 h) and workload in 3-weeks periods during 2018–2019.

- Group 4 A low amount of short shift intervals that are slightly decreasing and a stable low amount of workload that is slightly increasing (12.1%),
- Group 5 Moderate amount of both short shift intervals and workload (19.8%),
- Group 6 Short shift intervals that are clearly decreasing, while higher than the average workload is decreasing (5.6%),
- Group 7 Moderate amount of short shift intervals and very high workload (8.3%).

The largest group was 3, which had the most, but in general a moderate amount of short shift intervals and low workload (25.1%). Group 6 showed a decrease in both short shift intervals and workload, whereas group 7 had a moderate amount of short shift intervals together with a high workload. These might be indicative of changes in workload, which may provide better possibilities for recovery due to a decrease of short intervals.

5.2 | Baseline Characteristics in Association With Trajectory Group Membership

The regression analysis with the largest trajectory group 3: Moderate amount of short shift intervals that are slightly increasing and low workload as reference indicated that not all baseline factors were universally associated with the likelihood of belonging to the trajectory groups (Table 3). The number of employees in work units exhibited less likelihood of belonging to trajectory groups 1 and 4, but showed higher likelihood for group 2. Age was associated with an increased likelihood of belonging to the trajectories G1–G5, but less likelihood to trajectory G7. Part-time work was associated with less likelihood of belonging to trajectories 1, 5 and 6 only, whereas night work was associated with less likelihood in two trajectories (G2 and G5) and higher likelihood for trajectories G4 and G7. Also, variability of shift starting times showed associations both to less likelihood (trajectory groups G4 and G5) and higher likelihood (G2 and G6).

6 | Discussion

This retrospective study of one hospital district in Finland with over 1900 hospital employees and comprehensive administrative data of working hours and patient characteristics to evaluate workload aimed to investigate concurrent changes of short (< 11 h) shift intervals and workload. The findings in general indicate that insufficient recovery, as measured by the prevalence of short shift intervals, is not very prevalent in the Finnish healthcare sector, being in line with earlier findings of the larger Finnish and Danish samples (Härmä et al. 2022; Larsen et al. 2020). The data-driven analyses utilising group-based trajectory modelling for simultaneous changes detected seven clusters of various sizes. The observed trajectories do not confirm our hypothesis that a high amount of short shift intervals might appear at the same time as a high workload, indicating that time-related increases in objective workload are not compensated by better recovery possibilities in shift scheduling. As both short shift intervals and workload showed decreasing trends, the findings do not support the assumption that loading peaks or compromised recovery possibilities were significantly associated. The findings add to the previous knowledge, as studies with objective assessments of quantitative workload (Dall'Ora et al. 2018; Griffiths, Ball, et al. 2018) have not been done in association with detailed and objective working hour patterns.

6.1 | Register-Based Data of Short Shift Intervals and Workload Compared to Earlier Studies

Previous register studies on short shift intervals have focused on associations with wellbeing and health (Vedaa et al. 2016). These studies have indicated that short shift intervals are linked with cardiovascular diseases or symptoms (Kader, Selander, et al. 2022),

TABLE 3 | Relative-risk ratios (RR) with 95% confidence intervals (CI) for working hours and sample characteristics concerning concurrent trajectory groups of short shift intervals and workload (Trajectory group 3: Moderate amount of short shift intervals in slight increase and low workload as reference).

	G1		G2		G4		G5		G6		G7	
At baseline 2017	**RR**	**95% CI**	**RR**	**95% CI**	**RR**	**95% CI**	**RR**	**95% CI**	**RR**	**95% CI**	**RR**	**95% CI**
Number of employees/work unit	**0.89**	**0.85, 0.94**	**1.09**	**1.02, 1.16**	**0.79**	**0.75, 0.83**	0.98	0.90, 1.06	0.92	0.83, 1.02	0.95	0.81, 1.11
Age of employees (years)/work unit	**1.91**	**1.80,2.03**	**1.55**	**1.45, 1.65**	**1.21**	**1.15, 1.28**	**1.25**	**1.15, 1.36**	1.13	0.97, 1.32	**0.18**	**0.12, 0.28**
Part-time work (% of employees)/work unit	**0.67**	**0.61, 0.73**	0.96	0.87, 1.07	1.01	0.94, 1.08	**0.63**	**0.56, 0.70**	**0.83**	**0.71, 0.99**	0.81	0.52, 1.28
Night shifts (%)	0.97	0.93, 1.01	**0.94**	**0.90, 0.98**	**1.07**	**1.03, 1.10**	**0.76**	**0.72, 0.80**	0.98	0.93, 1.03	**3.47**	**2.75, 4.38**
Variability of shift starting times	**0.38**	**0.24, 0.57**	**3.40**	**2.14, 5.44**	**0.11**	**0.08, 0.16**	**0.13**	**0.08, 0.22**	**18.59**	**8.32, 41.50**	na	—

Note: Statistically significant RR with 95% CI are indicated in boldface.

preterm birth (Kader, Bigert, et al. 2022), occupational accidents (Harma et al. 2020) and sickness absence (Ropponen et al. 2019). However, none of these studies have applied the 3-week period time window as we did in this study. Also, studies that used workload estimates based on daily register data of hospital admissions are rather rare, and those that did used operationalised workloads, for example, nurse-to-patient ratio, ward overcrowding or 'undone work' (Dall'Ora et al. 2018; Griffiths, Ball, et al. 2018; Griffiths, Maruotti, et al. 2018). Hence, this study adds to the earlier knowledge by introducing an objective measure for the evaluation of workload in hospitals at the work unit level, but also the period of 3-weeks, since until now, the period for the assessment has been unclear or static (Peutere et al. 2021; Vedaa et al. 2019) or based on survey data (Jin et al. 2023). We were able to test these across 3-week shift planning periods over two consecutive years and could investigate the changes both in short shift intervals and in workload concurrently.

6.2 | Influential Factors for Trajectory Group Membership

Besides the trajectories, we estimated the influential factors for trajectory group membership. In comparison to the largest group (3), we found rather inconsistent results. For instance, the number of employees in work units was associated with less likelihood of belonging to trajectory groups 1 and 4, but showed a higher likelihood for group 2. However, age was associated with an increased likelihood of belonging to trajectories with lower workload. Part-time work or night work as well as variability of shift starting times also showed association with higher or lower likelihoods of belonging to various trajectory groups, indicating complex interrelationships between various working hour characteristics, as has been shown before (Peutere et al. 2021; Rosenstrom et al. 2021). This might point towards the role of employees in terms of their number, age and work status for the working hour solutions and workload. This aligns with earlier research indicating that staffing solutions might be important (Musy et al. 2020). Furthermore, due to the challenges in the healthcare sector based on the increased need for care and economic challenges combined with a lack of personnel (Smiley et al. 2018a, 2018b; Tursunbayeva 2019), our results could be interpreted to indicate that staffing should be confirmed to support good working conditions in terms of workload and a reasonable amount of short shift intervals.

6.3 | Strengths and Limitations

No study is without limitations. Although we had access to objective working hour data and patient characteristics to estimate the short shift intervals (< 11 h) and workload, this data was from one hospital district only. Since we linked the data from two administrative sources, that is, from employer and patient records, the final sample of employees was 33% of the full sample. While this limitation affects the representativeness of the sample, it is important to note that we focused specifically on nurses and practical nurses. This adds to the homogeneity within the sample but may limit the generalisability of the results to other employee groups. Further studies with more comprehensive samples and data would be merited. Although we assume that these findings could be generalisable across hospital districts in Finland, they may be less generalisable to other countries as working hour characteristics have been shown to vary (Garde et al. 2019). Hence, further studies should confirm these results in larger contexts but also within a country for several types of hospitals. Another limitation might be related to the measure of workload, which constituted many detailed steps that were performed using principles of a qualitative study protocol and additionally required statistical modelling. Further studies should test the procedure and modelling with openly published syntaxes to indicate the full potential. Yet, we applied a data-driven approach to identify distinct groups without prior assumptions. Although two simultaneous trajectories were followed, further studies would be merited to investigate these further for the robustness of the results. However, as this study is among the first to test workload with short shift intervals to the best of our knowledge, we assume an indication of the feasibility of this kind of data.

7 | Conclusions

The findings indicate that only a small number of employees were found to have both high workloads and insufficient recovery possibilities, but the time-related increases in objective workload were not compensated by better recovery possibilities in working hours. Older age was associated with belonging to units with lower workload. The role of staffing, that is, the age of employees, whether working part-time or full-time and the number of employees, might be important to be considered in the staffing of hospitals both for assuring recovery from work and for retaining reasonable levels of workload.

Author Contributions

A.R., T.K. and M.Hä. contributed to the funding acquisition and conceived ideas; A.R. and M.Hi managed and analysed the data; A.R. led the writing; and all the authors contributed to the writing.

Ethics Statement

The authors have nothing to report.

Consent

The authors have nothing to report.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

Research data are not shared.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section.