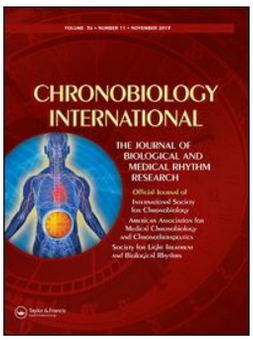

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Working time dimensions and well-being: a cross-national study of Finnish and German health care employees

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ABSTRACT

Health care professionals often face irregular working hours and high work pace. We studied associations of the five working time dimensions duration (weekly working hours), timing (shift work and weekend work), on-call work, working time autonomy, and work tempo (deadline and performance pressure) with well-being among health care employees in Finland and Germany. We used data on working time dimensions and indicators of well-being (work-life conflict, poor perceived health, sleep difficulties, and fatigue) from a cohort of 5050 hospital employees (Working Hours in the Finnish Public Sector Study 2015, WHFPS) and 1450 employees in the health care sector in Germany responding to the German BAuA-Working Time Survey in 2015 (BAuA-WTS). Findings from logistic regression analyses showed that high work tempo was associated with increased work-life conflict (WHFPS: odds ratio [OR] = 3.64, 95%CI 3.04–4.36 and BAuA-WTS: OR = 2.29, 95%CI 1.60–3.27), sleep difficulties (OR = 1.75, 95%CI 1.43–2.15 and OR = 1.33, 95%CI 1.03–1.71) and fatigue (OR = 2.13, 95%CI 1.77–2.57 and OR = 1.64, 95%CI 1.29–2.10) in both datasets. Weekend work was associated with increased work-life conflict (OR = 1.48, 95%CI 1.27–1.72 and OR = 1.61, 95%CI 1.12–2.32); and high working time autonomy with decreased work-life conflict (control over the timing of breaks: OR = 0.65, 95%CI 0.55–0.78 and OR = 0.52, 95%CI 0.33–0.81). The associations between other working time dimensions and well-being were less consistent. These results suggest that tight deadlines, performance pressure, weekend work and lack of working time autonomy are linked to impaired well-being among health care employees.

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Introduction

An increasing number of employees are required to work at diverse and irregular times. For example, the expansion of operating hours in the service sector has increased the need for working nonstandard hours (Arlinghaus et al. 2019), including work outside Monday to Friday and 8:00 to 17:00 or 18:00 schedule (Costa 2016). A sector in which nonstandard working hours have been common for a long time is the health care sector. Nursing staff, in particular, often face long and/or irregular working hours (Bae and Fabry 2014; Wu et al. 2013) and high work pace (Baethge et al. 2016). High working time demands, such as high work tempo, night work, and frequent interruptions, are associated with increased risk of fatigue (Härmä et al. 2019), errors and accidents (Bae and Fabry 2014; Caruso 2014) and may pose a threat to health care quality and performance (Baethge et al. 2016).

Working time can be characterized by five temporal (i.e. time-related) dimensions, including working time duration, timing of work, working time autonomy, work tempo (Adam 1995; Anttila et al. 2015; Fagan 2001) and demanded working time flexibility, such as on-call work. As described below, these dimensions have been suggested to be relevant for employee well-being, although we are not aware of studies that would have analyzed all the dimensions in a single analytic setting.

Working time duration

In the health care sector, long working hours, often defined as at least 48 hours per week, and irregular working hours are common (Caruso 2014). Long working time duration has been linked to physiological and psychological impairments in various outcomes (Joyce et al. 2010), including increased risk of shortened sleep (Bannai

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and Tamakoshi 2014), symptoms of depression (Theorell et al. 2015), psychosomatic symptoms (Müller et al. 2018) and work-life conflict (Karhula et al. 2017). Very long working hours, such as more than 55 hours per week, may also increase the risk of stroke (Kivimaki et al. 2015).

Timing of work

Atypical timing of work, such as shift work and weekend work, is also common in the health care sector. Working on non-day schedule and especially on an irregular shift schedule might adversely affect employee health (Moreno et al. 2019). A recent review (Kecklund and Axelsson 2016) suggested an increased risk of occupational injuries, type 2 diabetes, weight gain, coronary heart disease, stroke, and some forms of cancer among shift workers. Shift workers were also more likely to experience work-life conflict than day workers (Eurofound 2017; Karhula et al. 2017). Fewer studies have focused on working on weekends which, however, is a prevalent working time dimension; over half of the European Working Conditions Survey respondents worked at least one Saturday per month and 30% at least one Sunday per month (Eurofound 2017). Working on Sundays or weekends has been associated with increased risk of one or more health impairments (Wirtz et al. 2011) and with work-life conflict (Karhula et al. 2017; Wirtz et al. 2011).

On-call work

On-call work refers here to on-call time in the workplace to be ready to take up work right away, and, on-call work at home requiring employees to be in the workplace within a certain amount of time after being called. Although on-call work is relatively common among health care staff, it has received less research attention than shift work and long working hours. Physicians´ on-call work has been associated with higher levels of sleeping problems and work-family interference (Heponiemi et al. 2014). In the IT sector, impairments of well-being and less engagement in leisure time activities were found among employees with on-call work, regardless of whether employees were actually contacted during the on-call period or not (Bamberg et al. 2012). Moreover, a review by Nicol and Botterill (2004) found that on-call work was associated with poorer mental health and increased sleep disturbances. According to another recent review by Hall et al. (2017), working on-call at home was associated with decreased sleep quantity, and in most cases, sleep quality.

Working time autonomy

Refers to employee's possibilities of control over the duration, position, and distribution of their worktime. In the European Union, only 44% of employees have some control over their working hours (Eurofound 2017). Low working time control has been associated with, for example, stress (Ala-Mursula et al. 2002), work-home interference (Nijp et al. 2012), poor-perceived health (Ala-Mursula et al. 2002), sleep disturbances (Salo et al. 2014) and sickness absence (Ala-Mursula et al. 2002).

High work tempo

Is quite common in Europe and the highest work intensity is reported in the health care sector (Eurofound 2017). Work tempo is a well-known job demand (Karasek et al. 1998) but also a working time dimension that captures the pace or intensity of work. Unlike other working time dimensions which relate to how long, when, with how much control, and how variable one has to work, work tempo describes how fast work has to be done (Fagan 2001). A review by Stab and Schulz-Dadaczynski (2017) concluded that high workload, time pressure, and a high work pace are related to impairments of mental and physical health. Studies among hospital and nursing personnel linked high work pressure or tempo to a higher risk of ischemic heart disease (Allesoe et al. 2010), fatigue (Eriksen 2006), exhaustion (Naruse et al. 2012), and work-life conflict (Cho et al. 2014).

The current study

The evidence on working time dimensions is mostly limited to research focusing on one dimension at a time (Anttila et al. 2015) preventing comparisons of the relative importance of different working time dimensions in terms of health and well-being. To address this limitation, the aim of the current study was to investigate the individual and simultaneous effects of the five working time dimensions on different aspects of well-being among health care workers. These employees are crucial for the functioning and well-being of any society but often experience high demands in terms of various working time dimensions. Specifically, we tested the hypotheses that longer duration (dimension 1; weekly working hours), irregular timing (dimension 2; shift work and weekend work), on-call work (dimension 3), lower working time autonomy (dimension 4), and high work tempo (dimension 5; deadline and performance pressure) may be associated with

increased risk of work-life conflict, poor perceived health, sleep difficulties, and fatigue among employees in the health care sector. We used data from two independent large-scale cohort studies from two European countries, Finland, and Germany.

Methods

Datasets and samples

Working Hours in the Finnish Public Sector study (WHFPS)

We obtained data from WHFPS including survey data from the WHFPS in 2015 (n = 11 274, response rate 69%) and Titania® (CGI Finland Ltd, Helsinki, Finland) objective working hour data from the previous 12 months. The payroll-based daily working hour data was retrieved from the shift scheduling program Titania®, which is a Windows-compatible software that is used for shift planning and payroll in the majority of public sector organizations in Finland. A specific sampling software (by CGI Finland Ltd) was used to gather all the data from the saved rosters. We have earlier described and validated the used methodology to retrieve and analyze the daily payroll working hour data. The final sample included 5050 hospital employees whose survey responses were linked to payroll data of working hours from the 365 days prior to answering the questionnaire. To be included in the final sample, the employees had to have at least 150 working days in the payroll data during the previous 365 days prior to answering the questionnaire in 2015.

BAuA-Working Time Survey (BAuA-WTS)

The BAuA-WTS is a representative study of the German working population including all employees with a minimum working time duration of 10 paid hours a week. In this study, we used data from the first wave of the BAuA-WTS conducted in 2015 when a random sample of 20 000 employees took part in computer assisted telephone interviews (Häring et al. 2016). In this study, we only included employees in the health care sector (occupational class NACE Q86, n = 1 458).

Sociodemographic information of the participants in both samples are provided in Table 1. Although both samples were rather similar regarding average age (WHFPS 45.9 years and BAuA-WTS 46.5 years), several differences can be noted. The most common job titles were nurse (n = 2385), departmental secretary (n = 404), practical nurse (n = 285) and laboratory nurse (n = 268) in the WHFPS, and nursing associate professionals (n = 433) and medical assistants (n = 150) in the BAuA-WTS.

Table 1. Description of the study participants.

	WHFPS n = 5 050		BAUA-WTS n = 1 458	
	%	(n)	%	(n)
Age				
19 to 34	17.0	(778)	16.5	(241)
35 to 49	39.2	(1 818)	37.0	(540)
50 and older	43.8	(2 028)	46.4	(677)
Women	90.6	(4 197)	79.6	(1 160)
Education, high[a]	37.4	(1 720)	46.6	(675)
Married/cohabiting	77.9	(3 590)	71.7	(1 046)
Fulltime work contract	80.5	(3 729)	54.7	(657)

[a]higher than secondary level education.

Measures

Working time duration

WHFPS: Weekly working hours were obtained from the Titania® shift scheduling program from the previous 365 days prior to answering the WHFPS questionnaire in 2015. Full weeks on vacation or leave were excluded from the pay-roll data. However, the shorter leaves were not excluded. To ensure comparability between the two datasets, we also used a survey question of WHFPS "On average, how many hours do you use for your income-associated duties in a week (including normal working hours, overtime at work and at home, and secondary jobs)?"

BAuA-WTS: Weekly working hours were assessed with the question "How many hours do you actually work per week, on average in this occupational activity, including regular overtime work, extra work, emergency service, etc.?"

Timing of work

WHFPS: The work schedule was determined from the objective working hour data from Titania® shift scheduling program. The data were used to classify work schedules into three categories: a) day work with >80% morning shifts and no night shifts, b) 2-shift work with <80% morning shifts, >0% of evening and no night shifts, and c) 3-shift work with <80% morning shifts and >0% of evening and >0% of night shifts. For each shift type, the shift starting and ending times were defined as described by Härmä et al. (2015). Based on the Titania® working hour data, weekend work (Saturday and/or Sunday) was defined as at least 25% of all weekends at work.

BAuA-WTS: Work schedule was determined with a series of questions. First participants were asked "Are your working hours usually between 7 am and 7 pm?" If

not, "Do you work in shifts?", and if they did, they were asked if they worked fixed shifts (morning, evening, night) or alternating shifts. If they were working alternating shifts they were asked which type of shifts (2-shift, 3-shift). For the analyses, participants were grouped into day work, 2-shift, and 3-shift system.[1] To determine, if participants worked at least once a month on the weekend, they were asked "How many Saturdays a month do you work, on average?" and "How many Sundays and public holidays a month do you work, on average?"

On-call work

WHFPS: On-call work items were based on WHFPS survey responses to questions "Does your job include being on-call or standby at your workplace?" and "Does your job include being on-call or standby at home?" The employees answering "yes" then defined the number of days on on-call duty per month. Those with at least one on-call shift per month were classified to have on-call work.

BAuA-WTS: On-call work at the workplace and at home was assessed with the question "In your job, do you have on-call duties (staying at the workplace / staying at home)?" Afterward participants were asked to indicate the number of days of each type of on-call duty a month. Those with at least one on-call duty per month were classified to have on-call work.

Working time autonomy

WHFPS: We used two items from the Ala-Mursula scale: "How much control do you have over shift starting and ending times?" and "How much control do you have over taking breaks during work?" (Ala-Mursula et al. 2002). The answers "very much" and "much" were classified as good control, "some" to intermediate control, and "little" and "very little" to low control.

BAuA-WTS: Working time autonomy was assessed with the questions "How much control do you have over when you begin and end each work day?" and "How much control do you have over when you take a break?" The answer scale ranged from 1 (very low control) to 5 (very high control) and was grouped into low (1–2), medium (3), and high (4–5) for the analyses.

Work tempo

WHFPS: Deadline and performance pressure was surveyed with the FPS survey question: "How often have the following things disturbed or stressed you during the past 6 months: Time pressure and deadlines?" The answer alternatives "very seldom or never," "seldom" and "sometimes" were grouped to not having often deadline and performance pressure and the answers "quite often" and "often or continuously" were grouped to having often deadline and performance pressure.

BAuA-WTS: Deadline and performance pressure was assessed with the question "How often do you have to work under high deadline or performance pressure?" with the answer alternatives "often, sometimes, seldom and never." For the analyses, we used a dummy coding for "often."

Work-life conflict

WHFPS: The item for work-life conflict was: "How often do you feel that your work takes too much time or energy from your family-life or life?" adapted from (Mårdberg et al. 1991). The original five-point Likert-type scale ranging from never to very often was dichotomized that the answers "often" and "very often" were classified as having work-life conflict.

BAuA-WTS: Work-life conflict was assessed with the item "In the scheduling of working hours, I manage to make allowances for family and private interests." The original five-point Likert scale ranged from 1 (does not apply at all) to 5 (applies completely) and was dichotomized that answers 1 and 2 were classified as having a work-life conflict.

Perceived health

WHFPS: The item for perceived health was questioned as "What is your current health status?" with a 5-point Likert-type scale from good to poor (Blaxter 1987). When dichotomized, poor perceived health included the alternatives "poor" and "rather poor" and good perceived health the three alternatives "intermediate," "rather good," and "good."

BAuA-WTS: Perceived health status was measured with the question "How would you describe your general state of health?" to be answered on a five-point Likert scale from 1 (very good) to 5 (very bad). Answers 4 and 5 were classified as poor perceived health in this study.

Sleep difficulties

WHFPS: Sleep difficulties (difficulties to fall asleep, waking up several times per night, difficulties to maintain sleep including waking up far too early, waking up after the usual amount of sleep and still feeling worn out) during the last 4 weeks were asked with a scale from "not at all" to "every day" (Jenkins et al. 1988). The answers were dichotomized as having sleep difficulties if the frequency was at least 2–4 times per week.

BAuA-WTS: Sleep difficulties were assessed with a yes/no-answer to the item "sleep difficulties" following the introduction "Please tell me whether you have often had the following health complaints during work or on working days in the last 12 months."

Fatigue

WHFPS: Tiredness/fatigue was assessed with the question "How often you have had a) tiredness/fatigue during work time b) tiredness/fatigue on days off during the past four weeks?" The answers were dichotomized so that from "never" to "less than once a week" were regarded as having no fatigue and the answers from "at least once a week" to "every day" were regarded as having fatigue.

BAuA-WTS: Fatigue was assessed with a yes/no-answer to the item "general tiredness, faintness or fatigue" following the introduction "Please tell me whether you have often had the following health complaints during work or on working days in the last 12 months."

Ethical issues

The Finnish Institute of Occupational Health received written permission from all the WHFPS hospital districts to use the employers´ working time registries for research. All data were anonymized. The ethics committee of the Hospital District of Helsinki and Uusimaa (HUS) approved the WHFPS as part of the Finnish Public Sector study ethical approval (HUS 1210/2016). Answering to the FPS survey was voluntary and therefore a completed questionnaire acted as an informed consent. Similarly, participation in the BAuA-WTS telephone interview was voluntarily and the participation, therefore, acted as informed consent. In both studies, international ethical standards were conformed (Portaluppi et al. 2010), e.g., by informing the participants that their data would only be used anonymized and for research purposes. At all times a withdrawal from participation was possible.

Statistical methods

The statistical analyses were conducted with IBM SPSS Statistics 25 (IBM Corp., Armonk, NY, USA). One-way ANOVA and the Pearson Chi-square test were used to explore the group-level differences in working time dimensions. First, we conducted an unadjusted bivariate logistic regression analysis of each of the working time dimension and each well-being outcome and expressed the results in odds ratios (OR) and their 95% confidence intervals (95%CI). The reference categories were typical weekly working hours (35 to under 41), day work, weekend work less than once a month, intermediate control over starting and ending times and timing of breaks and having deadline and performance pressure seldom or not at all. Linear regression models expressing variance inflation factors were run to test for possible multicollinearity between the working time dimensions. Secondly, we included age, sex, educational level (up to vocational school vs. polytechnic or university degree), marital status (married/cohabiting vs. other life situation), full-time/part-time work and other working time dimensions simultaneously into adjusted multivariate logistic regression models. A p-value of <0.05 indicated a statistically significant result throughout the study.

Results

The majority of the WHFPS employees were shift workers whereas the BAuA-WTS data comprised of mainly day workers. The employees in the WHFPS cohort reported having more often weekend work and deadline and performance pressure but contrary to the employees in the BAuA-WTS, long working hours (41 or more hours per week) were very rare in the objective working hour data. However, in the WHFPS survey data, 15.2% of the respondents estimated working altogether at least 41 hours per week when also paid and unpaid overtime were included. The WHFPS respondents reported work-life conflict, and sleep difficulties more often than the employees in the BAuA-WTS, who, in turn, reported more often poor perceived health. In both datasets, exactly the same proportion reported having fatigue often. (Table 2.)

In the following, we only report the most important results based on the multivariate adjusted models with

Table 2. Frequencies of the working time exposure and well-being outcome variables.

	WHFPS n = 5 050		BAUA-WTS n = 1 458	
	%	(n)	%	(n)
Average weekly working hours[a]				
10 to under 35	11.8	(139)	36.1	(519)
35 to under 41	73.0	(856)	33.3	(479)
41 or more	15.2	(178)	30.6	(441)
Working time schedule[b]				
Day work	38.1	(1 679)	77.4	(1 060)
2-shift work	20.7	(910)	5.6	(76)
3-shift work	41.2	(1 813)	17.0	(233)
Weekend work[b]	89.8	(2103)	52.8	(715)
On-call work at workplace[a]	10.0	(453)	12.3	(179)
On-call work at home[a]	8.1	(364)	14.8	(216)
Control over starting and ending times[a]				
Low	63.6	(3 189)	58.0	(843)
Medium	23.2	(1 161)	16.9	(245)
High	13.3	(665)	25.1	(265)
Control over timing of breaks[a]				
Low	32.6	(1 633)	40.0	(581)
Medium	37.9	(1 799)	21.6	(313)
High	29.5	(1 476)	38.4	(558)
Often deadline and performance pressure[a]	84.1	(3 694)	63.7	(926)
Often work-life conflict[a]	36.9	(1 613)	20.6	(301)
Poor perceived health[a]	3.1	(141)	11.3	(165)
Often sleep difficulties[a]	70.3	(3 233)	41.6	(605)
Often fatigue[a]	58.6	(2 693)	58.6	(853)

[a]both datasets survey data.
[b]WHFPS objective working hour data, BAuA-WTS survey data.

Table 3. Overview on the confirmed and rejected hypotheses.

	Work-life conflict		Poor perceived health		Sleep difficulties		Fatigue	
	WHFPS	BAuA-WTS	WHFPS	BAuA-WTS	WHFPS	BAuA-WTS	WHFPS	BAuA-WTS
Dimension 1: Duration								
Short weekly working hours (-)	X	X	X	X	X	X	X	X
Long weekly working hours (+)	X	✓	X	X	X	X	X	X
Dimension 2: Timing								
2-shift work (+)	✓	X	✓	X	X	X	✓	X
3-shift work (+)	X	X	✓	X	X	✓	X	✓
Weekend work (+)	✓	✓	X	✓	X	✓	X	✓
Dimension 3: On-call work								
On-call work at workplace (+)	X	X	X	X	X	X	X	X
On-call work at home (+)	X	X	X	X	X	✓	X	X
Dimension 4: Autonomy								
Low control over starting and ending times (+)	X	X	X	X	X	X	✓	X
High control over starting and ending times (-)	✓	X	X	X	X	X	X	X
Low control over breaks (+)	X	✓	X	X	X	X	X	X
High control over breaks (-)	✓	✓	X	X	X	✓	✓	X
Dimension 5: Tempo								
Often deadline and performance pressure (+)	✓	✓	X	X	✓	✓	✓	✓

X = rejected hypothesis, ✓ = confirmed hypothesis based on adjusted logistic regression models (cf. Appendices 1 and 2).
+ = hypothesized increased risk, – = hypothesized decreased risk.

all working time dimensions simultaneously added in the models. See Table 3 for an overview on confirmed and rejected hypotheses. Complete results can be obtained from the tables in Appendix A and B and additionally, the results from multicollinearity testing are available from Supplementary material.

Long working time duration (dimension 1, ≥41 h/week) was associated with higher odds of work-life conflict in the BAuA-WTS (BAuA-WTS: OR = 2.17, 95%CI 1.47–3.20) and although objective working hour data pointed toward a significant relationship, the WHFPS survey data could not confirm this (WHFPS: OR = 1.48, 95%CI 0.78–2.84). However, compared to average weekly working hours (35–41 h/week), long working hours were not associated with an increased risk of having sleep difficulties or fatigue in either dataset.

As a measure of *timing of work* (dimension 2), 2-shift work was associated with higher odds for work-life conflict (OR = 1.54, 95%CI 1.22–1.95), fatigue (OR = 1.34, 95%CI 1.07–1.67), and both 2-shift and 3-shift work with higher odds for poor perceived health (ORs = 2.15 and 3.12) in the WHFPS, but not in the BAuA-WTS where we found an association between 3-shift work and both sleep difficulties (OR = 1.87, 95%CI 1.30–2.71) and fatigue (OR = 1.51, 95%CI 1.02–2.25). Weekend work was associated with higher odds for work-life conflict in both datasets (WHFPS: OR = 1.48, 95%CI 1.27–1.72; BAuA-WTS: OR = 1.61, 95%CI 1.12–2.32). In the BAuA-WTS, weekend work was also related to an increased risk for poor perceived health (OR = 1.90, 95%CI 1.21–2.97), sleep difficulties (OR = 1.46; 95% CI 1.10–1.95) and fatigue (OR = 1.50, 95%CI 1.13–2.00).

On-call work (dimension 3) was not associated with the outcomes in WHFPS. In BAuA-WTS on-call work at workplace was associated with lower odds for work-life conflict (OR = 0.51, 95%CI 0.32–0.81) and sleep difficulties (OR = 0.61, 95%CI 0.42–0.91). On-call work at home, however, was associated with higher odds for sleep difficulties (OR = 1.51, 95%CI 1.05–2.17).

Regarding *working time autonomy* (dimension 4), having high control over work's start and ending times was associated with lower odds for work-life conflict in the WHFPS (OR = 0.79, 95%CI 0.67–0.94). Also, in the WHFPS, both low and high control over work's start and ending times increased the risk of fatigue (low control: OR = 1.18, 95%CI 1.01–1.38; high control: OR = 1.30, 95%CI 1.05–1.61). High control over taking breaks was associated with lower odds for work-life conflict in both datasets (WHFPS: OR = 0.65, 95%CI 0.55–0.78; BAuA-WTS: OR = 0.52, 95%CI 0.33–0.81) and low control over taking breaks was associated with higher odds for work-life conflict in the BAuA-WTS (OR = 1.51, 95%CI 1.03–2.22). High control over taking breaks was also associated with lower odds for sleep difficulties in the BAuA-WTS (OR = 0.67, 95%CI 0.49–0.93). Furthermore, low as well as high control over breaks were related to a decreased risk of fatigue in the WHFPS compared to an intermediate level of control (low control: OR = 0.72, 95%CI 0.61–0.84; high control: OR = 0.78, 95%CI 0.66–0.92).

High work tempo (dimension 5) was associated with increased odds for work-life conflict (WHFPS: OR = 3.64, 95% CI 3.04–4.36; BAuA-WTS: OR = 2.29, 95%CI 1.60–3.27), sleep difficulties (WHFPS: OR = 1.75, 95%CI 1.43–2.15; BAuA-WTS: OR = 1.33, 95%CI 1.03–1.71) and fatigue (WHFPS: OR = 2.13, 95%CI 1.77–2.57; BAuA-WTS: OR = 1.64, 95%CI 1.29–2.10) in both of the national datasets. Work tempo was not related to poor perceived health in the datasets.

Discussion

The aim of this cross-national study in two health care sector cohorts from Finland and Germany was to shed light on the relative importance of five working time dimensions on different aspects of health and well-being of employees in the health care sector. Our main finding is that across the datasets and in line with our hypotheses, high work tempo (dimension 5), that is, deadline and performance pressure, was consistently associated with higher odds for work-life conflict, sleep difficulties, and fatigue in both datasets. In addition, in line with our hypotheses, weekend work as part of the timing of work (dimension 2), and high control over the timing of breaks as part of working time autonomy (dimension 4) were associated with increased work-life conflict in both datasets. The duration of work hours (dimension 1), and more specifically long weekly working hours were related to an increased work-life conflict in the BAuA-WTS data, but not in the WHFPS data. High control over starting and ending times (dimension 4) decreased work-life conflict in the WHFPS data but no other hypotheses regarding working time autonomy could be confirmed in either data set. Similarly, except for an increased risk of sleep difficulties in health care employees with on-call work at home in the BAuA-WTS data, no hypotheses regarding on-call work (dimension 3) could be confirmed. While findings on work-life conflict as well as on-call work, control over starting and end times, and work tempo were mostly consistent, the remaining findings were less consistent between both datasets.

The observed association between high work tempo and indicators of reduced well-being is in line with previous research on work tempo and work intensity, which also revealed negative relationships with mental and physical well-being (Stab and Schulz-Dadaczynski 2017). Long working time duration (dimension 1) was associated with work-life conflict only in the BAuA-WTS, in agreement with some other studies (Arlinghaus et al. 2019; Karhula et al. 2017). The difference between the two cohorts of this study may be partly due to the lower prevalence of long working hours in the WHFPS cohort of mostly shift workers compared to the German health care workers who were mostly day workers; the substantial cross-cultural differences in the experiences of work-life conflict (Ollier-Malaterre et al. 2013); and the more prominent full-time dual-earner model in the Nordic countries which is supported by public, low-cost day-care services and the general appreciation of well-balanced work and private life. In neither of the datasets, the hypotheses regarding sleep difficulties and fatigue were supported; although a recent review by Bae and Fabry (2014) found an association between long working hours with adverse outcomes, such as impaired sleep and increased fatigue.

The results regarding the timing of work (dimension 2) differed somewhat between the datasets. Shift work compared to day work was related to fatigue in both datasets. However, in the WHFPS the association was found for 2-shift work but not 3-shift work, and in the BAuA-WTS it was the other way around. In the WHFPS, 2-shift work was also associated with higher odds for work-life conflict and 3-shift work was associated with lower odds for good perceived health. In the BAuA-WTS, 3-shift work was associated with sleep difficulties. As 3-shift work includes night work, it is rather surprising that it was related to sleep difficulties and fatigue in the BAuA-WTS data, but not in the WHFPS. This may be due to the high occurrence of sleep difficulties in all studied working time schedules. Weekend work was consistently associated with higher odds for work-life conflict. Also, previous research (Karhula et al. 2017; Wirtz et al. 2011) shows that weekend work is associated with work-life conflict. Weekend work was also associated with poor perceived health, sleep difficulties and fatigue in the BAuA-WTS but not in the WHFPS. The lack of associations in the WHFPS data could be partly due to that approximately 90% of employees were involved in weekend work on a regular basis and, in turn, have compensative days of during weekdays. The German employees might be more often required to work involuntary overtime (Rosta and Aasland 2011) during weekends.

On-call work (dimension 3) only partly showed expected results. Contrary to our hypotheses, on-call work at workplace was associated with lower odds for work-life conflict in the BAuA-WTS. The WHFPS data did not show any significant results regarding on-call work at workplace or at home in these outcomes. Furthermore, in the BAuA-WTS on-call work at workplace was associated with lower odds for sleep difficulties. These findings suggest, that on-call work at workplace with the time included in the actual working hours, does not detrimentally affect their health and well-being. On-call work at home, on the other hand, was associated with higher odds for sleep difficulties in the BAuA-WTS. This is in line with a review by Hall et al. (2017) who also showed increased odds for sleep difficulties when having on-call work at home. Neither WHFPS nor BAuA-WTS showed associations between on-call work and fatigue. Also, previous smaller study among on-call workers demonstrated that on-call work exposure was not systematically related to fatigue (Ziebertz et al.

2015). Thus, complementing the rather scarce previous research regarding on-call work, our findings suggest that on-call work per se does not seem to negatively affect employees' health and well-being except for on-call work at home, which might negatively affect employees' sleep. However, in our study the inclusion criteria for on-call work were rather low with a cut point as at least one on-call duty per month. Further research could shed a light on whether a higher number of on-call duties impairs well-being.

Results concerning working time autonomy partly supported our hypotheses. High control over shift starting and ending times was associated with lower odds for work-life conflict in the WHFPS data, strengthening previous research (Nijp et al. 2012). However, this was not the case in the BAuA-WTS data. Previous research in the German health care sector suggests that there might be less control over working times and higher demand on uncompensated over time (Rosta and Aasland 2011). In neither of the datasets an association with perceived health was found. High control over the timing of breaks was associated with lower odds for work-life conflict in both datasets. High control over the timing of breaks was associated with lower odds for sleep difficulties in the BAuA-WTS, but not in the WHFPS. Our results showed no clear association with fatigue. In the WHFPS low as well as high versus intermediate control over the timing of breaks were associated with decreased fatigue. This could be due to employees with intermediate control being responsible for taking breaks themselves but not finding the time to actually go on breaks due to a high workload. However, further research would have to investigate this more closely. Taken together, these mixed findings line up with a review by Wendsche et al. (2017) which also found inconsistent effects of timing and organization of breaks on nurses' well-being, fatigue, and sleepiness.

Conclusively, our overall main finding was that work tempo was consistently – in both cohorts and independent of assessment methods in the exposure – and with highest odds associated with work-life conflict, sleep difficulties, and fatigue. This robust and strong association is in line with previous evidence as outlined by Stab and Schulz-Dadaczynski (2017) concerning employees in general, and hospital and nursing personnel in particular (Allesoe et al. 2010; Cho et al. 2014; Eriksen 2006; Naruse et al. 2012). Because in this study work tempo was analyzed simultaneously with all the other working time dimensions this underlines the importance of work tempo in explaining relationships with employees' well-being even more.

Strengths and limitations

This study contributes to the existing comparative research on working hours by investigating different working time dimensions within the same analytic setting and controlling for the other dimensions simultaneously. Although the dimensions are partly correlated, multicollinearity was not found a likely source of bias for the observed associations between the working time dimensions and well-being. Previous research has mainly studied one dimension, for example, length of working hours (Anttila et al. 2015). Also, while certain working time dimensions such as shift work have been studied extensively, previous research regarding other working time dimensions, such as on-call work is rather scarce. Thus, by investigating on-call work depending on the place where employees are staying (at home, at the workplace) during their on-call duty we could add on to the existing literature.

We were able to utilize a nationally representative working population survey (BAuA-WTS) and a dataset with objective working hour registry data (WHFPS). A strength of the WHFPS study is the objective assessment of shift schedules, which allowed us to determine the exact proportion of, for example, weekend work during the past 12 months. The methodology used to retrieve data and analyze the raw working hour data is previously validated (Härmä et al. 2015). Many other studies have used a single multiple-choice question to classify employees into different working time regimes, but the survey is more prone to recall bias than objective registry data (Härmä et al. 2017).

There are limitations to be noted as well. First, the analysis was conducted on two datasets that were not combined as the data protection requirements did not enable this. Therefore, differences in, for example, sample characteristics could not be tested. There were some minor differences in the questions or scales used in the BAuA-WTS and WHFPS surveys, but the chosen outcome variables were estimated to be similar enough to be analyzed in parallel. Further, some exposure data, more specifically working time duration and timing were assessed with different methods (objective working hour data vs. survey) in the two cohorts which on the one hand limits comparability, but on the other hand suggests robustness of findings when the results were in concordance. As the proportion of employees with recorded long working hours was very small in the WHFPS objective working hour data, we repeated the analysis using survey variables. The results

on working hours based on register and survey data were directionally consistent although not all results were statistically significant. Furthermore, as the 2-shift group in the BAuA-WTS included only 76 cases, findings from the WHFPS may be more reliable.

As an additional limitation, many outcome variables relied on single items or were otherwise non optimal measurements. For example, sleep difficulties were assessed with the Jenkins Sleep Scale (Jenkins et al. 1988) in the WHFPS data and with a single item in the BAuA-WTS which both had the deficit of using the term night-time sleep which is not an ideal expression when studying shift workers. Even though the survey questions covered quite similar insomnia symptoms as in the International Classification of Sleep Disorders (AASM, 2014), the results cannot be directly compared to those from studies using diagnostic criteria. The limit for having on-call work was at least once per month, which may have been too low a prevalence to detect changes in well-being outcomes. Further studies might merit from using higher frequency of on-call work as a cut point.

Future research should examine the burden that having various combinations of the different working time dimensions possibly pose to employee well-being. As a practical implication, the cross-national results suggest that health care workers' well-being could potentially be improved by increasing employees' control over taking breaks and by reducing long working hours and weekend work. However, our results also showed that high work tempo in terms of high pressure had the most consistent detrimental effect on health care employees' health and well-being. This issue should be the first one to address by employers. In practice, decreasing work tempo would require increase in personnel, which in turn, could reduce sickness absence and turnover rates.

Conclusion

Investigating five dimensions of working time simultaneously among German and Finnish health care employees showed that high work tempo was most clearly associated with adverse results in sleep, fatigue, and work-life conflict. Shift work, weekend work, and low control over taking breaks showed some detrimental associations with well-being outcomes whereas on-call work was hardly related to the health and well-being of health care employees. Thus, in improving working (time) conditions in the health care sector, employers should especially pay attention to the work tempo their employees are confronted with.

Note

1. A small group of participants in the BAuA-WTS (n = 67) worked "shifted working hours," thus outside 7 am and 7 pm but not in alternating shifts. These were excluded from the analysis, as no such group was available in the WHFPS.

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Appendix A. The different working time dimensions in relation to work-life conflict and good perceived health. Results from logistic regression analysis presented as odds ratios (OR) and 95% confidence intervals (CI).

		Work-life conflict[a]				Poor perceived health			
		WHFPS		BAuA-WTS		WHFPS		BAuA-WTS	
Dimension 1. Duration		Crude OR (CI)	Adjusted[b] OR (CI)	Crude OR (CI)	Adjusted OR (CI)	Crude OR (CI)	Adjusted OR (CI)	Crude OR (CI)	Adjusted OR (CI)
Weekly working hours									
Ref.cat. 35 to under 41 hours	10 to 35 h	1.26 (0.90–1.76)	1.14 (0.73–1.76)	**0.69** (0.49–0.97)	0.84 (0.52–1.34)	1.15 (0.39–3.39)	0.70 (0.22–2.27)	0.71 (0.48–1.06)	1.15 (0.66–2.02)
	≥ 41 h	**1.70** (1.05–2.75)	1.48 (0.78–2.84)	**2.19** (1.61–2.97)	**2.17** (1.47–3.20)	2.66 (0.78–9.01)	1.31 (0.30–5.81)	**0.67** (0.45–0.99)	1.22 (0.75–1.97)
Dimension 2. Timing									
Working time schedule[c]									
Ref.cat. day work	2-shift work	**1.78** (1.55–2.06)	**1.54** (1.22–1.95)	1.54 (0.90–2.65)	1.21 (0.61–2.41)	**2.32** (1.45–3.72)	**2.15** (1.11–4.14)	1.70 (0.79–3.69)	1.72 (0.84–3.52)
	3-shift work	1.17 (0.99–1.38)	1.04 (0.86–1.27)	**1.95** (1.41–2.69)	1.24 (0.82–1.87)	**3.49** (2.47–6.46)	**3.12** (1.85–5.26)	**2.31** (1.15–4.63)	0.73 (0.42–1.27)
Weekend work[d]	Yes	**1.53** (1.35–1.73)	**1.48** (1.27–1.72)	**2.68** (2.02–3.56)	**1.61** (1.12–2.32)	0.76 (0.55–1.07)	0.73 (0.49–1.06)	**1.26** (1.01–1.57)	**1.90** (1.21–2.97)
Dimension 3. On-call work									
On-call work at workplace[d]	Yes	0.86 (0.70–1.05)	0.80 (0.62–1.02)	1.00 (0.68–1.47)	**0.51** (0.32–0.81)	1.86 (0.91–3.83)	1.62 (0.68–3.88)	0.95 (0.59–1.55)	0.79 (0.44–1.41)
On call work at home[d]	Yes	0.98 (0.78–1.23)	0.90 (0.62–1.20)	**1.68** (1.21–2.33)	1.08 (0.71–1.64)	1.69 (0.78–3.64)	1.42 (0.59–3.44)	0.72 (0.47–1.10)	1.16 (0.69–1.96)
Dimension 4. Autonomy									
Control over starting and ending times	Low	1.22 (0.96–1.54)	1.16 (0.89–1.51)	**1.91** (1.31–2.80)	1.33 (0.84–2.10)	0.83 (0.40–1.68)	0.68 (0.41–1.49)	0.98 (0.56–1.70)	1.35 (0.78–2.36)
Ref. cat. intermediate	High	**0.59** (0.69–0.80)	**0.79** (0.67–0.94)	0.75 (0.47–1.19)	0.99 (0.58–1.70)	1.37 (0.88–2.11)	1.38 (0.86–2.26)	1.37 (0.92–2.06)	1.22 (0.65–2.31)
Control over timing of breaks	Low	**1.36** (1.18–1.57)	1.16 (0.99–1.36)	**1.68** (1.21–2.33)	**1.51** (1.03–2.22)	1.48 (1.00–2.18)	1.29 (0.84–1.98)	**1.59** (1.02–2.49)	0.84 (0.52–1.35)
Ref. cat. intermediate	High	**0.64** (0.54–0.75)	**0.65** (0.55–0.78)	**0.49** (0.33–0.71)	**0.52** (0.33–0.81)	0.88 (0.56–1.40)	0.94 (0.57–1.54)	**1.66** (1.13–2.44)	0.74 (0.45–1.23)
Dimension 5. Tempo									
Often deadline and performance pressure	Yes	**3.71** (3.13–4.39)	**3.64** (3.04–4.36)	**3.19** (2.34–4.38)	**2.29** (1.60–3.27)	**1.67** (1.12–2.49)	1.43 (0.92–2.22)	**0.62** (0.43–0.89)	1.33 (0.89–2.00)

[a]work-life conflict often/frequently.
[b]adjusted for age, sex, educational level, marital status (married/cohabiting vs. other life situation), full-time/part-time work, and the other working time variables.
[c]WHFPS: objective working hour data incl. 2-shift work, 3-shift work, fixed night work; BAuA-WTS: work outside 7am and 7pm.
[d]at least once a month.

Appendix B. The different working time dimensions in relation to sleep difficulties and fatigue. Results from logistic regression analysis presented as odds ratios (OR) and 95% confidence intervals (CI).

		Sleep difficulties[a]				Fatigue[b]			
		WHFPS		BAuA-WTS		WHFPS		BAuA-WTS	
Dimension 1. Duration		Crude OR (CI)	Adjusted[c] OR (CI)	Crude OR (CI)	Adjusted OR (CI)	Crude OR (CI)	Adjusted OR (CI)	Crude OR (CI)	Adjusted OR (CI)
Weekly working hours									
Ref.cat. 35 to under 41 hours	10 to 35 h	0.93 (0.66–1.32)	0.85 (0.55–1.32)	1.04 (0.81–1.34)	0.97 (0.68–1.38)	0.93 (0.67–1.28)	0.83 (0.55–1.26)	0.99 (0.77–1.27)	0.92 (0.64–1.32)
	≥ 41 h	1.02 (0.64–1.64)	1.03 (0.54–1.99)	1.11 (0.85–1.44)	1.11 (0.80–1.53)	1.08 (0.69–1.68)	1.00 (0.54–1.84)	1.30 (1.00–1.69)	1.25 (0.90–1.75)
Dimension 2. Timing									
Working time schedule[d]									
Ref.cat. day work	2-shift work	0.93 (0.78–1.12)	0.99 (0.79–1.23)	**1.80** (1.13–2.87)	1.12 (0.63–1.97)	**1.43** (1.25–1.43)	**1.34** (1.07–1.67)	1.31 (0.81–2.11)	0.80 (0.45–1.43)
	3-shift work	0.99 (0.86–1.15)	0.98 (0.77–1.25)	**2.46** (1.84–3.29)	**1.87** (1.30–2.71)	1.05 (0.89–1.24)	0.99 (0.82–1.19)	**2.00** (1.47–2.72)	**1.51** (1.02–2.25)
Weekend work[e]	Yes	1.02 (0.90–1.16)	1.04 (0.89–1.25)	**1.86** (1.49–2.32)	**1.46** (1.10–1.95)	**0.83** (0.74–0.93)	0.91 (0.79–1.05)	**1.96** (1.58–2.44)	**1.50** (1.13–2.00)
Dimension 3. On-call work									
On-call work at workplace[e]	Yes	0.97 (0.79–1.21)	0.91 (0.71–1.18)	0.97 (0.70–1.33)	**0.61** (0.42–0.91)	1.09 (0.90–1.33)	1.05 (0.83–1.33)	**1.65** (1.12–2.30)	1.33 (0.88–2.00)
On-call work at home[e]	Yes	0.96 (0.76–1.22)	0.92 (0.69–1.23)	**1.15** (1.15–2.06)	**1.51** (1.05–2.17)	1.13 (0.91–1.41)	1.03 (0.79–1.35)	1.34 (0.99–1.81)	1.01 (0.70–1.47)
Dimension 4. Autonomy									
Control over starting and ending times	Low	1.18 (0.94–1.47)	1.25 (0.98–1.59)	**1.38** (1.03–1.85)	1.26 (0.90–1.77)	**1.26** (1.09–1.45)	**1.18** (1.01–1.38)	**1.47** (1.10–1.96)	1.20 (0.86–1.67)
Ref. cat. intermediate	High	**0.84** (0.72–0.95)	0.85 (0.77–1.00)	0.82 (0.58–1.15)	1.13 (0.77–1.66)	**1.46** (1.21–1.77)	**1.30** (1.05–1.61)	0.84 (0.60–1.16)	1.06 (0.73–1.55)
Control over timing of breaks	Low	0.87 (0.77–1.01)	0.98 (0.83–1.15)	1.06 (0.80–1.39)	0.85 (0.62–1.17)	**0.74** (0.64–0.86)	**0.72** (0.61–0.84)	1.22 (0.92–1.62)	1.04 (0.75–1.44)
Ref. cat. intermediate	High	1.10 (0.94–1.28)	1.10 (0.93–1.33)	**0.60** (0.45–0.80)	**0.67** (0.49–0.93)	**0.69** (0.60–0.81)	**0.78** (0.66–0.92)	0.80 (0.60–1.06)	0.95 (0.68–1.31)
Dimension 5. Tempo									
Often deadline and performance pressure	Yes	**1.85** (1.53–2.25)	**1.75** (1.43–2.15)	**1.56** (1.25–1.95)	**1.33** (1.03–1.71)	**2.17** (1.82–2.59)	**2.13** (1.77–2.57)	**2.05** (1.65–2.55)	**1.64** (1.29–2.10)

[a]WHFPS: Jenkins Sleep Scale; any of the four items at least 2–4 times a week; BAuA-WTS: sleep difficulties (at night) on workdays often over the last 12 months.
[b]WHFPS: fatigue during work/free time at least once a week; BAuA-WTS: tiredness/fatigue on workdays often over the last 12 months.
[c]adjusted for age, sex, educational level, marital status (married/cohabiting vs. other life situation), full-time/part-time work and the other working time variables.
[d]WHFPS: objective working hour data incl. 2-shift work, 3-shift work, fixed night work; BAuA-WTS: work outside 7am and 7pm.
[e]at least once a month.