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Complete List of Authors:	Bergman, Elina; University of Turku, General Practice Löyttyniemi, Eliisa; University of Turku, Department of Biostatistics Myllyntausta, Saana; University of Turku, Department of Public Health Rautava, Paivi; Turku University Hospital, Clinical Research Centre; University of Turku Faculty of Medicine, Depatrment of Public Health Korhonen, Päivi; Turun Yliopisto, General Practice; Central Satakunta Health Federation of Municipalities
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PREDICTORS OF QUALITY OF LIFE AND WORK ABILITY AMONG FINNISH MUNICIPAL EMPLOYEES: A CROSS-SECTIONAL STUDY

Elina Bergman, MD[a], Eliisa Löyttyniemi, MSc[b], Saana Myllyntausta, MA[c], Päivi Rautava, MD, PhD[c d] and Päivi E. Korhonen, MD, PhD [a e]

[a] Institute of Clinical Medicine, Department of General Practice, University of Turku and Turku University Hospital, Turku, Finland. [b] Department of Biostatistics, University of Turku, Turku, Finland. [c] Department of Public Health, University of Turku, and Turku University Hospital, Turku, Finland. [d] Clinical Research Centre, Turku University Hospital, Turku, Finland. [e] Central Satakunta Health Federation of Municipalities, Harjavalta, Finland.

Corresponding author:

Elina Bergman

Address:

Department of General Practice, Joukahaisenkatu 3-5, FI-20014 TURUN YLIOPISTO, FINLAND

Telephone: +358 50 307 4436

E-mail: elkaro@utu.fi

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ABSTRACT

Objectives: Quality of life (QoL) and work ability are elementary parts in defining the well-being of an employed person. The aim of this study was to demonstrate the predictors of QoL and self-reported work ability among public sector employees, while taking into account several confounding factors, including sleep quality, occupational stress and psychosocial risk factors.

Methods: A cross-sectional study was conducted in Finland among 710 employees (89% women, mean age 49 [SD = 10] years) from ten municipal work units in 2015. Information about the participants was collected by physical examination, self-administered questionnaire and from medical history. QoL was assessed with the EUROHIS-QOL 8-item index and work ability with the Work Ability Score (WAS).

Results: The EUROHIS-QOL mean score among all participants was 4.07 (95% CI 4.03–4.11). QoL was positively associated with good sleep quality, cohabiting, university-level education, and lower BMI, and negatively associated with occupational stress, depression and/or anxiety and disease burden. Work ability was reported good or excellent by 80% of the participants and the WAS mean score among all participants was 8.31 (95% CI 8.21–8.41). Work ability was positively associated with good sleep quality, younger age, lower BMI and university-level education, and negatively associated with occupational stress and disease burden.

Conclusions: Occupational stress and self-reported sleep quality were powerful predictors of both QoL and work ability among Finnish public sector employees. These findings highlight the need for screening and handling of work stress and sleep problems in occupational and primary health care.

KEYWORDS

Quality of life, Work ability, Occupational health, Sleep quality, Occupational stress

STRENGTHS AND LIMITATIONS OF THIS STUDY

- Several aspects affecting the employees' quality of life and work ability could be taken into account.
- The participants completed all questionnaires at home before the examination was performed.
- Any causality cannot be determined due to the cross-sectional nature of the study.
- The initial response rate in the first part of the study in 2014 was only 32.5% and 84.9% of them attended this follow-up study in 2015.

INTRODUCTION

Quality of life (QoL) and other subjectively assessed metrics have in recent years become important outcomes evaluated in studies concerning diseases, therapies or care. Several assessment tools have been developed to measure well-being from the patient's point of view, and those tools have proven to be reliable in defining significant outcomes.[1–4] In our previous study, self-reported sleep quality was observed to be an even more powerful predictor of QoL than ideal cardiovascular health metrics among public sector employees.[5] Furthermore, the association between poor sleep quality and impaired QoL has been demonstrated among patients with sleep disorders and other medical conditions [6–9], and self-reported sleep quality has been shown to predict QoL in higher education students.[10] Poor sleep has also been associated with poorer work ability [11], and sleep problems have been linked to an increased rate of sickness absence.[12] Further, QoL seems to be closely related to work ability [13,14], but few studies have evaluated QoL and self-reported work ability simultaneously among apparently healthy, working-age individuals.

Based on our previous study, we focused in the present work first on self-reported sleep quality and its role in characterizing our study population. The aim of this study was to demonstrate the

predictors of QoL and self-reported work ability in a non-clinical sample of public sector employees, while taking into account several confounding factors, including psychosocial risk factors and occupational stress. We wanted to use short, subjective and user-friendly tools for the assessment of sleep quality, QoL, and work ability. We hypothesized that self-reported sleep quality would be a significant predictor of both QoL and work ability in this population of apparently healthy, active work force.

PARTICIPANTS AND METHODS

Participants

This cross-sectional study was part of the PORTAAT (PORi To Aid Against Threats) study conducted among employees of the city of Pori (83,497 inhabitants in 2014) in South-Western Finland in 2014 and 2015. The participating work units were selected by the chief of the Welfare Unit of Pori. Invitations to participate and information of the study were sent to employees via e-mail by the managers of the selected ten work units (total number of employees 2,570). The employees willing to participate contacted the study contact person at their work unit, who then sent their contact information to the study nurse. There were no exclusion criteria. A total of 836 employees (104 males, 732 females) participated in the study in 2014 and 710 of them (79 males, 631 females) attended the follow-up visit in 2015. The initial response rate in the first part of the study in 2014 was 32.5%, and 84.9% of these respondents attended the follow-up study in 2015. In the present work, we used the data from the year 2015 because complete information about psychosocial risk factors was available only from that year. The gender distribution of the study participants corresponds to the standard gender distribution of the employees of Pori. The participants' occupations included librarians, museum employees, janitors, IT workers, social workers, nurses, physicians, administrative officials, and general office staff.

Quality of life

QoL was assessed with the EUROHIS-QOL 8-item index.[15] This is a shortened version of the WHOQOL-Bref scale, a widely used instrument for the assessment of generic QoL.[16,17] The domains in both questionnaires are the general, physical, psychological, social and environmental aspects of QoL. The EUROHIS-QOL instrument has been validated in several European countries.[2] The participants of the present study answered the questions at home before the study visits. Every question was scored from 1 to 5 (1 for very poor and 5 for very good). All scores were then added together and divided by 8 (the sum of the questions) to obtain the EUROHIS-QOL mean score.[2]

Work-related measures

Work ability was assessed with the question "What is your current work ability compared to your lifetime best?". This is the first item of the widely used Work Ability Index (WAI) [3], referred to as the Work Ability Score (WAS). It has a 0–10 response scale, where 0 stands for "completely unable to work" and 10 stands for "work ability at its best". Work ability was considered poor for scores of 0–5, moderate for scores of 6–7, good for scores of 8–9, and excellent for a score of 10 points, based on the same values that have been used in the WAI.[18] Work-related stress was evaluated with Bergen Burnout Indicator 15 (BBI-15).[19] The BBI-15 measures three dimensions of burnout: exhaustion, cynicism, and reduced professional efficacy. Responses are rated on a 6-point Likert-type scale (1 = totally disagree, 6 = totally agree). In this work, we used the total score from all three dimensions, which can vary from 15 to 90, with higher scores indicating more severe burnout symptoms. Burnout symptoms are in this indicator classified as severe, moderate, mild, and no burnout, with specific threshold values according to gender and age.[19] We assessed burnout as a binary variable where all scores from mild to severe burnout were set to indicate the presence of burnout symptoms.

Sleep-related measures

Self-reported sleep quality was assessed with the question "During the past month, how would you rate your sleep quality overall?" (very good, good, poor, or very poor). This is the subjective sleep quality question used in the Pittsburgh Sleep Quality Index (PSQI).[4] In the analyses, the two lowest classes of sleep quality were combined and set to indicate poor sleep quality. Sleep duration was assessed with the question "During the past month, how many hours of sleep did you normally get at night?". The participants were asked to answer the question in a free field, and sleep duration was handled as a continuous variable in the analyses.

Psychosocial measures

Depressive symptoms were assessed with the Major Depression Inventory (MDI) questionnaire.[20] This inventory can be used as a diagnostic tool for major depression (according to DSM IV diagnostic criteria) as well as an assessment tool for severity of depressive symptoms.[20,21] To assess severity of depressive symptoms, a total score of 0–20 is considered as no symptoms, 21–25 as mild symptoms, 26–30 as moderate symptoms, and 31–50 as severe depressive symptoms. In this work, the diagnostic tool was used to determine whether a person had depression or not. Anxiety was assessed with the General Anxiety Disorder 7-item Scale (GAD-7).[22] In the GAD-7, a total score of 0–4 is considered as no anxiety, 5–9 as mild anxiety, 10–14 as moderate anxiety, and 15–21 as severe anxiety. A total score of 10 was used as a cut-off point when a binary variable for anxiety was used in our analyses. This cut-off is recommended by the developers of the GAD-7 questionnaire.[22]

Other measures

Smoking status was assessed by a questionnaire. Non-smoking was defined as having never smoked or having quit smoking >12 months ago. Height and weight were measured by a study nurse with subjects in standing position without shoes and outer garments. Weight was measured to the

nearest 0.1 kg with calibrated scales and height to the nearest 0.5 cm with a wall-mounted stadiometer. BMI was calculated as weight (kg) divided by the square of height (m^2). Information concerning diseases diagnosed by a physician, medication used regularly, marital status (cohabiting or not), working times (3-shift work or not) and education level (vocational school, college-level education, or university-level education) was gathered using self-administered questionnaires and medical records. Alcohol consumption was assessed using the 3-item Alcohol Use Disorders Identification Test (AUDIT-C) [23] with a cut-off of 5 points for harmful alcohol use in women and 6 points in men.[24,25] Disease burden was defined as having at least one chronic disease diagnosed by a physician.

Statistical analysis

Continuous variables are presented with means and standard deviations (SD) together with 95% confidence intervals (CI). Categorical variables are summarized with counts and percentages (%). Association between sleep quality and background variables was evaluated using a chi-square test or a one-way analysis of variance (ANOVA).

Association between QoL / work ability and background variables including sleep quality were examined first one by one (univariate approach), with one-way analysis of variance or with linear regression. A multivariable model was then built up, and age, gender and all factors with significant association with QoL and / or work ability in the univariate approach were entered into the model. The method used was linear model and assumptions were checked using studentized residuals.

All statistical tests were performed as 2-sided, with a significance level set at 0.05. The analyses were performed using an SAS System version 9.4 for Windows (SAS Institute Inc., Cary, NC, USA).

Patient and public involvement

Information events about the PORTAAT Study with guidance for the management of physical and psychosocial well-being were arranged for the employees of the selected work units. All participants

were given personalized lifestyle counselling at the study visits. The chief of the Welfare Unit of Pori has been informed regularly about the published study results. The participants of this study were not involved in the design or development of the study.

RESULTS

The study cohort consisted of 710 employees with a mean age of 49 years (SD 10, range 20 – 68), 89% of whom were female.

Characteristics of the participants and sleep quality

Table 1 displays the basic characteristics of the participants, classified according to their sleep quality. Sleep quality was reported very good by 14.5%, good by 62.1%, poor by 21.2%, and very poor by 2.1% of the participants. Poor and very poor sleep quality were combined and set to indicate poor sleep quality in the analyses. Self-reported sleep quality was negatively associated with disease burden, prevalence of depression and severity of depressive symptoms, anxiety, and work stress, and positively associated with QoL and work ability. Better sleep quality was associated with longer sleep duration ($p<0.0001$). There were only five participants with a previously diagnosed obstructive sleep apnoea and three with restless legs syndrome. During the past month, 14.8% of the participants had used sleep medication at least occasionally. The use of sleep medication was more common in women (15.1% in women vs. 12.6% in men, $p=0.038$).

Only 9 (1.3%) of the participants were diagnosed as depressive according to the MDI diagnostic tool. All of them were also classified as anxious (GAD-7 score > 10). These two psychosocial risk factors were combined for multivariable analyses.

Table 1

Characteristics of the participants according to self-reported sleep quality

	Total	Sleep quality			p-value
		Very good (n=103)	Good (n=441)	Poor (n=166)	
Age mean, years (SD)	49.0 (9.7)	47.5 (10.6)	49.1 (9.7)	49.8 (9.2)	0.072
Gender, n (%)					0.10
Female	631 (88.9)	85 (13.5)	397 (62.9)	149 (23.6)	
Male	79 (11.1)	18 (22.8)	44 (55.7)	17 (21.5)	
Education, n (%)					0.36
Vocational school	21 (3)	4 (19.1)	14 (66.7)	3 (14.3)	
College-level	361 (51.6)	53 (14.7)	232 (64.3)	76 (21.1)	
University-level	318 (45.4)	45 (14.2)	188 (59.1)	85 (26.7)	
Co-habiting, n (%)					0.64
Yes	575 (81.2)	83 (14.4)	353 (61.4)	139 (24.2)	
No	133 (18.8)	20 (15.0)	86 (64.7)	27 (20.3)	
3-shift work, n (%)					0.41
Yes	76 (10.9)	15 (19.7)	44 (57.9)	17 (23.4)	
No	620 (89.1)	87 (14.0)	386 (57.9)	147 (23.7)	
Smoking, n (%)					0.45
Yes	64 (9.0)	9 (14.1)	44 (68.8)	11 (17.2)	
No	645 (91.0)	94 (14.6)	396 (61.4)	155 (24.0)	
Harmful alcohol consumption, n (%)					0.55
Yes	101 (14.2)	18 (17.8)	59 (58.4)	24 (23.8)	
No	609 (85.8)	85 (14.0)	382 (62.7)	142 (23.3)	
Body mass index mean (95% CI)	26.8 (26.42 -27.13)	26.4 (25.50 - 27.25)	27.0 (26.54 - 27.46)	26.5 (25.72 - 27.24)	0.92
Disease burden[a], n (%)					0.0016
Yes	468 (65.9)	55 (11.8)	289 (61.8)	124 (26.5)	
No	242 (34.1)	48 (19.8)	152 (62.8)	42 (17.4)	

Depression (MDI), n (%)					0.016
Yes	9 (1.3)	0 (0.0)	3 (33.3)	6 (66.7)	
No	701 (98.7)	103 (14.7)	438 (62.5)	160 (22.8)	
MDI mean score (95% CI)	5.0 (4.57-5.43)	2.4 (1.75 - 2.97)	4.1 (3.59 - 4.51)	9.2 (8.09 - 10.27)	<0.0001
Level of anxiety (GAD-7), n (%)					<0.0001
No anxiety	534 (75.2)	92 (17.2)	343 (64.2)	99 (18.5)	
Mild anxiety	143 (20.1)	10 (7.0)	85 (59.4)	48 (33.6)	
Moderate anxiety	26 (3.7)	1 (3.9)	10 (38.5)	15 (57.7)	
Severe anxiety	7 (1.0)	0 (0.0)	3 (42.9)	4 (57.1)	
BBI15 mean total score (95% CI)	31.6 (30.82-32.41)	28.3 (26.43-30.23)	31.0 (30.05- 31.99)	35.4 (33.60-37.20)	<0.0001
Occupational stress (BBI15), n (%)					<0.0001
No stress	592 (89.4)	97 (16.4)	374 (63.2)	121 (20.4)	
Stress	70 (10.6)	3 (4.3)	38 (54.3)	29 (41.4)	
Sleep duration mean (95% CI)	7.00 (6.93 - 7.07)	7.50 (7.35 - 7.66)	7.17 (7.09 - 7.24)	6.23 (6.09 - 6.38)	<0.0001
EUROHIS mean score (95% CI)	4.07 (4.03 - 4.11)	4.38 (4.30 - 4.45)	4.09 (4.05 - 4.14)	3.83 (3.75 - 3.91)	<0.0001
WAS mean score (95% CI)	8.31 (8.21-8.41)	8.99 (8.78 - 9.20)	8.34 (8.22 - 8.46)	7.80 (7.55 - 8.04)	<0.0001
Level of work ability (WAS), n (%)					<0.0001
Poor	27 (3.8)	1 (3.7)	12 (44.4)	14 (51.9)	
Moderate	114 (16.1)	3 (2.6)	69 (60.5)	42 (36.8)	
Good	459 (64.9)	61 (13.3)	298 (64.9)	100 (21.8)	
Excellent	107 (15.1)	37 (34.6)	60 (56.1)	10 (9.4)	

[a] At least one chronic disease diagnosed by a physician, BBI15 = Bergen Burnout Indicator 15, CI = Confidence Interval, EUROHIS = EUROHIS-QOL 8-item index, GAD-7= General Anxiety Disorder 7-item Scale, MDI = Major Depression Inventory, SD = Standard deviation, WAS = Work Ability Score

Quality of life

As seen in Table 2, the EUROHIS-QOL mean score among all participants was 4.07 (SD 0.51) with no significant difference between genders (p=0.94). In the univariate approach, QoL was positively associated with good sleep quality, university-level education, co-habiting, lower BMI and younger age, and negatively associated with occupational stress, depression, anxiety and disease burden.

In the multiway analysis of co-variance, QoL was positively associated with good sleep quality, co-habiting, university-level education and lower BMI, and negatively associated with occupational stress, depression and/or anxiety and disease burden (Table 2).

Table 2

Predictors of quality of life in a univariate approach and in a multivariable model. EUROHIS means/slope together with 95% CI are based on model estimates.

	Univariate			Multivariable				
	EUROHIS total mean / slope	95% Confidence Interval	p-value	EUROHIS total model based mean / slope	95% Confidence Interval	F-value	DF	p-value
Age	-0.0040	(-0.0079, -0.00008)	0.046	-0.00028	-0.0042 - 0.0036	0.02	1	0.89
Gender			0.94			0.00	1	0.99
Female	4.07	4.03 - 4.11		3.54	3.38 - 3.69			
Male	4.07	3.96 - 4.18		3.54	3.36 - 3.72			
Education			0.036			4.17	2	0.016
Vocational school	3.83	3.61 - 4.05		3.37	3.11 - 3.62			
College-level	4.05	4.00 - 4.11		3.59	3.44 - 3.74			
University-level	4.11	4.05 - 4.16		3.66	3.51 - 3.81			
Co-habiting			0.011			5.72	1	0.017
Yes	4.09	4.05 - 4.13		3.59	3.43 - 3.75			
No	3.97	3.88 - 4.06		3.48	3.31 - 3.66			
Smoking			0.39					
Yes	4.02	3.89 - 4.14						
No	4.08	4.38 - 4.12						
Harmful alcohol consumption			0.33					
Yes	4.12	4.02 -4.22						
No	4.06	4.02 - 4.11						
Body mass index	-0.020	(-0.028, -0.012)	<0.0001	-0.018	(-0.025, -0.011)	23.91	1	<0.0001
Disease burden[a]			<0.0001			13.35	1	0.0003
Yes	3.99	3.95 - 4.04		3.47	3.31 - 3.63			
No	4.22	4.16 - 4.29		3.61	3.44 - 3.77			
Depression[b]			<0.0001					
Yes	3.07	2.74 - 3.39						

No	4.08	4.05 - 4.12						
Level of anxiety[c]			<0.0001					
No	4.19	4.16 - 4.23						
Mild	3.75	3.67 - 3.82						
Moderate	3.47	3.29 - 3.64						
Severe	3.66	3.32 - 4.00						
Depression and/or anxiety[bd]						13.92	2	<0.0001
No depression/ No anxiety				3.89	3.77 - 4.00			
Only anxiety				3.59	3.36 - 3.82			
Depression and anxiety				3.14	2.81 - 3.46			
Occupational stress[e]			<0.0001			39.30	1	<0.0001
Yes	3.63	3.51 - 3.74		3.35	3.18 - 3.53			
No	4.13	4.09 - 4.17		3.72	3.56 - 3.88			
3-shift work			0.089			0.55	1	0.46
Yes	4.16	4.02 - 4.10		3.56	3.37 - 3.74			
No	4.06	4.05 - 4.28		3.52	3.36 - 3.67			
Self-reported sleep quality			<0.0001			22.02	2	<0.0001
Very good	4.38	4.30 - 4.45		3.74	3.56 - 3.92			
Good	4.05	4.05 - 4.14		3.53	3.36 - 3.69			
Poor	3.83	3.75 - 3.91		3.34	3.18 - 3.51			

[a] At least one chronic disease diagnosed by a physician, [b] Defined by Major Depression Inventory (MDI) diagnostic tool (DSM IV), [c] General Anxiety Disorder 7-item Scale (GAD-7), [d] General Anxiety Disorder 7-item Scale (GAD-7), moderate or severe anxiety, [e] Bergen Burnout Indicator 15 (BBI15), at least mild occupational stress, CI = Confidence Interval, DF = Degrees of freedom, EUROHIS = EUROHIS-QOL 8-item index

Work ability

Work ability was reported excellent by 15.2%, good by 64.9%, moderate by 16.1% and poor by 3.8% of the participants. The WAS mean score among all participants was 8.31 (SD 1.37), and the median was 9.0 (Q1:8.0, Q3:9.0). There was no difference in work ability between genders (p=0.11). In the univariate approach, work ability was positively associated with good sleep quality, younger age, lower BMI, university-level education, female gender, and 3-shift work, and negatively associated with disease burden, depression, anxiety and occupational stress.

In the multiway analysis of co-variance, work ability was positively associated with good sleep quality, younger age, lower BMI, and university-level education, and negatively associated with occupational stress and disease burden (Table 3).

Table 3

Predictors of work ability in a univariate approach and in a multivariable model. WAS means/slope together with 95% CI are based on model estimates.

	Univariate			Multivariable				
	WAS estimate / slope	95% Confidence Interval	p-value	WAS model based estimate / slope	95% Confidence Interval	F-value	DF	p-value
Age	-0.019	(-0.029, -0.0090)	0.0002	-0.012	(-0.022, -0.0018)	5.34	1	0.021
Gender			0.027			3.36	1	0.067
Female	8.35	8.24 - 8.46		7.83	7.43 - 8.23			
Male	7.99	7.68 - 8.29		7.56	7.09 - 8.04			
Education			0.0079			4.74	2	0.0091
Vocational school	7.90	7.30 - 8.50		7.42	6.76 - 8.07			
College-level	8.18	8.04 - 8.32		7.70	7.32 - 8.09			
University-level	8.48	8.33 - 8.63		7.80	7.58 - 8.37			
Co-habiting			0.91			0.04	1	0.85
Yes	8.31	8.20 - 8.42		7.69	7.27 - 8.10			
No	8.30	8.06 - 8.53		7.71	7.26 - 8.18			
Smoking			0.19					
Yes	8.10	7.76 - 8.44						
No	8.33	8.23 - 8.44						
Harmful alcohol consumption			0.35					
Yes	8.43	8.18 - 8.40						
No	8.30	8.16 - 8.70						
Body mass index	-0.036	(-0.057, - 0.016)	0.0006	-0.023	(-0.042, -0.0041)	5.71	1	0.017
Disease burden[a]			<0.0001			12.23	1	0.0005
Yes	8.07	7.95 - 8.20		7.52	7.11 - 7.95			
No	8.77	8.60 - 8.93		7.87	7.44 - 8.30			
Depression[b]			0.0083					
Yes	7.11	6.22 - 8.01						

No	8.33	8.23 - 8.43						
Level of anxiety[c]			<0.0001					
No	8.55	8.44 - 8.66						
Mild	7.59	7.38 - 7.81						
Moderate	7.44	6.95 - 7.94						
Severe	8.00	7.03 - 8.97						
Depression and/or anxiety[bd]						1.73	2	0.17
No depression / No anxiety				8.02	7.72 - 8.31			
Only anxiety				7.67	7.07 - 8.27			
Depression and anxiety				7.41	6.57 - 8.25			
Occupational stress[e]			<0.0001			29.80	1	<0.0001
Yes	7.47	7.18 - 7.76		7.28	6.82 - 7.74			
No	8.47	8.37 - 8.57		8.12	7.70 - 8.54			
3-shift work			0.0040			3.75	1	0.053
Yes	8.74	8.43 - 9.05		7.84	7.36 - 8.33			
No	8.26	8.15 - 8.36		7.55	7.16 - 7.95			
Self-reported sleep quality			<0.0001			14.44	2	<0.0001
Very good	9.00	8.73 - 9.25		8.13	7.66 - 8.60			
Good	8.34	8.22 - 8.47		7.68	7.25 - 8.10			
Poor	7.80	7.59 - 8.00		7.29	6.86 - 7.72			

[a] At least one chronic disease diagnosed by a physician, [b] Defined by Major Depression Inventory (MDI) diagnostic tool (DSM IV), [c] General Anxiety Disorder 7-item Scale (GAD-7), [d] General Anxiety Disorder 7-item Scale (GAD-7), moderate or severe anxiety, [e] Bergen Burnout Indicator 15 (BBI15), at least mild occupational stress, CI= Confidence Interval, DF = Degrees of freedom, WAS = Work Ability Score

DISCUSSION

In this study, we managed to show that occupational stress, self-reported sleep quality, and disease burden were powerful predictors of both QoL and work ability in public sector employees. In addition, QoL was strongly associated with BMI and depression and / or anxiety. To our knowledge, few studies have evaluated QoL and work ability simultaneously among apparently healthy, working-age individuals, with information about a wide range of factors potentially influencing these two variables. However, although both QoL and work ability were assessed, we could not enter them in the same model because these factors are so closely related.

Occupational stress was identified as the strongest predictor of both QoL and work ability in this study. It is well known, that job strain is an important factor affecting employees' health and well-being.[26–28] Occupational stress is known to be associated, for example, with poor sleep quality [29], lower work ability [30] and mental health problems.[31] Furthermore, work stress was found to be associated with elevated mortality rates in patients with cardiometabolic disease in a large multicohort study.[32] Work stress has also been found to have a negative association with QoL in several studies.[26,27] The interesting finding in our study was that the association of occupational stress with QoL and WAS was strong, regardless of the fact that our study population had low rates of occupational stress. Only 10.6% of the participants in our study had at least mild occupational stress symptoms, and severe symptoms were very rare. It is thus possible that even low levels of occupational stress can have an important influence on a person's work ability and QoL. These results highlight the need for screening and handling of work stress among municipal employees.

As we hypothesized, self-reported sleep quality was also a powerful predictor of both QoL and work ability in this study. A negative association between poor sleep quality and QoL has previously been demonstrated among patients with sleep disorders and other medical conditions [6–9], and studies on shift workers have shown a clear association between sleep quality and QoL.[33,34] Furthermore, in a previous work on higher education students, Marques et al. showed that self-reported sleep

quality remained a significant predictor of most aspects of QoL, regardless of the presence of psychopathological symptoms, such as depression.[10] Sleep problems have in previous literature also been linked to poorer work ability and an increased rate of sickness absence.[11,12] In addition, Ng et al. have shown a positive association between good sleep quality and work ability among Hong Kong construction workers.[35] However, in this study we managed to show that self-reported sleep quality is a significant predictor of both QoL and work ability among apparently healthy employees not restricted to a specific occupation and working mainly in regular morning shifts. The associations remained significant also in the multivariable models, where many potential confounding factors could be taken into account.

Disease burden, higher BMI and lower educational level were negatively associated with both QoL and work ability in this study, as well as in previous literature. Chronic diseases are known to have a negative association with QoL [2] and with work ability.[36,37] Lower BMI has been linked to better QoL [38] and to better work ability [39,40], and higher education has been positively associated with QoL [41] and with work ability.[42] In our study, as well as in previous literature, older age was associated with poorer work ability [39,43], but no significant association was found between age and QoL. This finding is consistent with the Finnish reference values for the EUROHIS-QOL 8-item index.[44] Furthermore, cohabiting had a significant positive association with QoL in our study, as has previously been observed in a population based study in Sweden.[45] Cohabiting has previously been linked to better health and work ability, for example, in an unemployed population [46], but in our setting, where only active work force was studied, there was no significant association between cohabiting and work ability.

An interesting finding in our study was that depression and / or anxiety was a strong predictor of QoL but did not have a significant association with work ability in the multivariable model. Depression and anxiety are known to have a negative impact on QoL [47–49], but depression also affects a person's ability to work.[37,50] However, depression often leads to sickness absence, which

means that these people are not in the active work force. In our study, the prevalence of depression and anxiety was low, and most of the cases were relatively mild. Only 9 (1.3%) of the participants met the diagnostic criteria for major depression and 33 (4.6%) of the participants where categorized as moderately or severely anxious. It is known that not all depressive patients consider themselves unable to work.[50] These patients may benefit from the schedule and routine of work life and do not want to seek sick leave, while depression still affects their QoL. In the Finnish Current Care Guidelines for depression, sick leave is not recommended in mild depression and the need for sick leave in moderate depression should be evaluated individually.[51] According to these recommendations, those depressive patients whose work ability is not affected should remain in the active work force. Furthermore, as the prevalence of depression and anxiety in our study population was low, the generalizability of these results can be questioned.

In this study, 3-shift work was not significantly associated either with QoL or with work ability in the multivariable models. In the univariate approach, the work ability of the 3-shift workers was better ($p=0.0040$), but no significant difference was seen in QoL. Somewhat surprisingly, 3-shift work did not seem to have any adverse effects on the participants' well-being in our study. There was no difference in sleep quality or occupational stress compared to the regular morning shift workers. Almost all 3-shift workers in our study were women working as nurses or social workers. Their mean age was 45.6 years, which is 3.5 years younger than the mean age of the whole study population. In addition to the younger age, one possible explanation for their well-being is that they may have voluntarily chosen to work in shifts and feel that it is a suitable way of working for them. Those shift workers who have had health problems or difficulties with sleep due to shift work may have changed to day work.[52] Another unexpected result in this work was that harmful alcohol consumption did not have adverse effects on sleep quality, QoL or work ability. However, even though there were 101 (14.2%) participants that fulfilled the definition of "harmful drinking" in the AUDIT-C, heavy drinking was very rare in this predominantly female, active work force population. We assume that these

people may consume alcohol mainly during weekends, which diminishes the effects on everyday life and work.

We acknowledge some limitations of the study. We cannot determine the causality of the found associations because of the cross-sectional nature of the study. A possible healthy worker effect [53] can be present because only subjects in the active work force were studied. In addition, the initial response rate in the first part of the study in 2014 was only 32.5% (and 84.9% of them attended this follow-up study in 2015). It is known that response rates in e-mail surveys tend to be lower than in mail surveys [54], but it can nevertheless cause selection bias. It is possible that the healthiest part of the work force is also the most willing to attend voluntary health surveys, which may result in the possibility that our results reflect the situation in the mainly healthy section of the work force. The information about alcohol consumption was collected by self-assessment, which may be influenced by social desirability. In addition, we unfortunately do not have data of possible menopausal symptoms, which may have affected our results in women.

The strengths of our study are that we could take into account several aspects affecting the employees' QoL and work ability. All questionnaires were completed by the participants at home before the examination was performed. In this study, the approaches to sleep quality, QoL and work ability were all subjective, which emphasizes the importance of personal experience in evaluating these factors. We assessed self-reported sleep quality and work ability with single questions. This approach was chosen over longer questionnaires because a single question could also be used at a normal physician's appointment in primary or occupational health care for the evaluation of these factors. The self-reported sleep quality question we used was from the Pittsburgh Sleep Quality Index (PSQI), and it has previously been shown to be closely related with QoL.[10] With this question we showed a clear association of sleep quality with QoL and with work ability. However, it would be interesting to further assess this connection in a similar population with a more detailed questionnaire to determine whether the different components of sleep have different impacts on

QoL and work ability. The WAS score we used for the evaluation of work ability has been shown to have a strong association with the Work Ability Index and is reliable in evaluating work ability.[55] WAS has also been shown to predict disability pension and long-term sickness absence according to a Finnish register-based study.[56] The associations of self-reported sleep quality with both QoL and with work ability were clear and in line with previous literature even when studied with these simple tools.

CONCLUSIONS

In this paper we showed that occupational stress and self-reported sleep quality are powerful predictors of both QoL and work ability among Finnish public sector employees. According to our results, even a low level of occupational stress has a significant negative association with QoL and work ability. In addition, we found that even in this apparently healthy population one in four employees suffers from poor sleep quality. These findings highlight the need for screening and handling work stress and sleep problems in occupational and primary health care.

CONTRIBUTORS

EB, EL, SM, PR and PK contributed to the conception or design of the work, and to the acquisition, analysis or interpretation of data for the work. EB and PK drafted the manuscript. All authors critically revised the manuscript, gave final approval, and agreed to be accountable for all aspects of work ensuring integrity and accuracy.

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DECLARATION OF COMPETING INTERESTS

The authors declare that they have no competing interests.

ETHICAL APPROVAL

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The study protocol and consent forms were reviewed and approved by the Ethics Committee of the Hospital District of Southwest Finland (ETMK 43/180/2013).

INFORMED CONSENT

Written informed consent was obtained from all individual participants included in the study.

AVAILABILITY OF DATA

The datasets used and/or analysed during the current study are available from the corresponding author on request.

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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported
Objectives	3	State specific objectives, including any prespecified hypotheses
Methods		
Study design	4	Present key elements of study design early in the paper
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9	Describe any efforts to address potential sources of bias
Study size	10	Explain how the study size was arrived at
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding
		(*b*) Describe any methods used to examine subgroups and interactions
		(*c*) Explain how missing data were addressed
		(*d*) If applicable, describe analytical methods taking account of sampling strategy
		(*e*) Describe any sensitivity analyses
Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		(b) Give reasons for non-participation at each stage
		(c) Consider use of a flow diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest
Outcome data	15*	Report numbers of outcome events or summary measures
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
		(*b*) Report category boundaries when continuous variables were categorized
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses

Discussion		
Key results	18	Summarise key results with reference to study objectives
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	21	Discuss the generalisability (external validity) of the study results
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Factors associated with quality of life and work ability among Finnish municipal employees: a cross-sectional study

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FACTORS ASSOCIATED WITH QUALITY OF LIFE AND WORK ABILITY AMONG FINNISH MUNICIPAL EMPLOYEES: A CROSS-SECTIONAL STUDY

Elina Bergman, MD[a], Eliisa Löyttyniemi, MSc[b], Saana Myllyntausta, MA[c], Päivi Rautava, MD, PhD[c d] and Päivi E. Korhonen, MD, PhD [a e]

[a] Institute of Clinical Medicine, Department of General Practice, University of Turku and Turku University Hospital, Turku, Finland. [b] Department of Biostatistics, University of Turku, Turku, Finland. [c] Department of Public Health, University of Turku, and Turku University Hospital, Turku, Finland. [d] Clinical Research Centre, Turku University Hospital, Turku, Finland. [e] Central Satakunta Health Federation of Municipalities, Harjavalta, Finland.

Corresponding author:

Elina Bergman

Address:

Department of General Practice, Joukahaisenkatu 3-5, FI-20014 TURUN YLIOPISTO, FINLAND

Telephone: +358 50 307 4436

E-mail: elkaro@utu.fi

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ABSTRACT

Objectives: Quality of life (QoL) and work ability are elementary parts in defining the well-being of an employed person. The aim of this study was to demonstrate factors associated with QoL and self-reported work ability among public sector employees, while taking into account several confounding factors, including sleep quality, occupational stress and psychological symptoms.

Methods: A cross-sectional study was conducted in Finland among 710 employees (89% women, mean age 49 [SD = 10] years) from ten municipal work units in 2015. Information about the participants was collected by physical examination, self-administered questionnaire and from medical history. QoL was assessed with the EUROHIS-QOL 8-item index and work ability with the Work Ability Score (WAS).

Results: The EUROHIS-QOL mean score among all participants was 4.07 (95% CI 4.03–4.11). QoL was positively associated with good sleep quality, cohabiting, university-level education, and lower BMI, and negatively associated with occupational stress, depression and/or anxiety and disease burden. Work ability was reported good or excellent by 80% of the participants and the WAS mean score among all participants was 8.31 (95% CI 8.21–8.41). Work ability was positively associated with good sleep quality, younger age, lower BMI and university-level education, and negatively associated with occupational stress and disease burden.

Conclusions: Occupational stress and self-reported sleep quality were strongly associated with both QoL and work ability among Finnish public sector employees. These findings highlight the need for screening and handling of work stress and sleep problems in occupational and primary health care.

KEYWORDS

Quality of life, Work ability, Occupational health, Sleep quality, Occupational stress

STRENGTHS AND LIMITATIONS OF THIS STUDY

- Several aspects associated with the employees' quality of life and work ability could be taken into account.
- The participants completed all questionnaires at home before the examination was performed.
- Psychological symptoms were assessed with well-validated instruments.
- Any causality cannot be determined due to the cross-sectional nature of the study.
- The response rate of the study was moderate at most, which is a common limitation in e-mail surveys.

INTRODUCTION

Quality of life (QoL) and work ability are elementary outcomes in defining the well-being of an employed person. Both of these can be affected by numerous conditions, including physical and mental health [1,2], occupational stress [3,4], sleep quality [5,6] , psychosocial risk factors and environmental aspects. [7] Many of these can be measured reliably by evaluating the persons' perceptions about the condition with self-reported assessment tools. [1,8–13] In our previous study, especially self-reported sleep quality was strongly associated with QoL among public sector employees. [14]

QoL and work ability have been studied also previously in currently employed populations, but most of the studies have concentrated on a specific occupational group or employees suffering from a certain medical condition. [2,15,16] To our knowledge, there is a gap of information about factors associated with QoL and work ability, studied simultaneously among apparently healthy public sector employees. Public sector is a large employer sector in the Scandinavian countries, and it

would be important to recognize the factors associated with well-being of the employees in municipal work places.

The aim of this study was to demonstrate factors associated with QoL and self-reported work ability among public sector employees, while taking into account several confounding factors, including psychological symptoms, sleep quality and occupational stress. We wanted to use short, subjective and user-friendly tools for the assessment of QoL, work ability and sleep quality. These instruments could easily be used for screening also in occupational and primary healthcare.

PARTICIPANTS AND METHODS

Participants

This cross-sectional study was part of the PORTAAT (PORi To Aid Against Threats) study conducted among employees of the city of Pori (83,497 inhabitants in 2014) in South-Western Finland in 2014 and 2015. The participating work units were selected by the chief of the Welfare Unit of Pori. Invitations to participate and information of the study were sent to employees via e-mail by the managers of the selected ten work units (total number of employees 2,570). The employees willing to participate contacted the study contact person at their work unit, who then sent their contact information to the study nurse. There were no exclusion criteria. A total of 836 employees (104 males, 732 females) participated in the study in 2014. The response rate in 2014 was 32.5%. Complete information about data collection from that year has been described earlier. [17] All the initial respondents were invited to the second part of the study in 2015, and 710 of them (79 males, 631 females) attended. In the present work, all the information is from the year 2015, and this data was chosen, because complete information about psychosocial risk factors was available only from that year. The gender distribution of the study participants corresponds to the standard gender distribution of the employees of Pori. The participants' occupations included librarians, museum

employees, janitors, IT workers, social workers, nurses, physicians, administrative officials, and general office staff. The involved employment sectors, reported according to the number of employees participating in the study in 2015 were Health and Welfare (275 employees), Social Work (198), Technical Services (143), Education and Culture (62) and Administration (32).

Quality of life

QoL was assessed with the EUROHIS-QOL 8-item index.[18] This is a shortened version of the WHOQOL-Bref scale, a widely used instrument for the assessment of generic QoL.[7,19] The domains in both questionnaires are the general, physical, psychological, social and environmental aspects of QoL. The EUROHIS-QOL instrument has been validated in several European countries.[1] The participants of the present study answered the questions at home before the study visits. Every question was scored from 1 to 5 (1 for very poor and 5 for very good). All scores were then added together and divided by 8 (the sum of the questions) to obtain the EUROHIS-QOL mean score.[1]

Work-related measures

Work ability was assessed with the question "What is your current work ability compared to your lifetime best?". This is the first item of the widely used Work Ability Index (WAI) [9], referred to as the Work Ability Score (WAS). It has a 0–10 response scale, where 0 stands for "completely unable to work" and 10 stands for "work ability at its best". Work ability was considered poor for scores of 0–5, moderate for scores of 6–7, good for scores of 8–9, and excellent for a score of 10 points, based on the same values that have been used in the WAI.[20] Work-related stress was evaluated with Bergen Burnout Indicator 15 (BBI-15).[13] The BBI-15 measures three dimensions of burnout: exhaustion, cynicism, and reduced professional efficacy. Responses are rated on a 6-point Likert-type scale (1 = totally disagree, 6 = totally agree). In this work, we used the total score from all three dimensions, which can vary from 15 to 90, with higher scores indicating more severe burnout symptoms. Burnout symptoms are in this indicator classified as severe, moderate, mild, and no burnout, with specific threshold values according to gender and age.[13] We assessed burnout as a

binary variable where all scores from mild to severe burnout were set to indicate the presence of burnout symptoms.

Sleep-related measures

Self-reported sleep quality was assessed with the question "During the past month, how would you rate your sleep quality overall?" (very good, good, poor, or very poor). In the analyses, the two lowest classes of sleep quality were combined and set to indicate poor sleep quality. Sleep duration was assessed with the question "During the past month, how many hours of sleep did you normally get at night?". The participants were asked to answer the question in a free field, and sleep duration was handled as a continuous variable in the analyses. Both of these questions are items from the well-validated Pittsburgh Sleep Quality Index (PSQI)[10], which has good internal consistency (α = 0.83) and test–retest reliability (r = 0.82; over an average of 19 days). [21,22]

Psychological symptoms

Depressive symptoms were assessed with the Major Depression Inventory (MDI) questionnaire.[23] This inventory can be used as a diagnostic tool for major depression (according to DSM IV diagnostic criteria) as well as an assessment tool for severity of depressive symptoms.[11,23] To assess severity of depressive symptoms, a total score of 0–20 is considered as no symptoms, 21–25 as mild symptoms, 26–30 as moderate symptoms, and 31–50 as severe depressive symptoms. In this work, the diagnostic tool was used to determine whether a person had depression or not. Anxiety was assessed with the General Anxiety Disorder 7-item Scale (GAD-7).[12] In the GAD-7, a total score of 0–4 is considered as no anxiety, 5–9 as mild anxiety, 10–14 as moderate anxiety, and 15–21 as severe anxiety. A total score of 10 was used as a cut-off point when a binary variable for anxiety was used in our analyses. This cut-off is recommended by the developers of the GAD-7 questionnaire.[12] The participants with severe depressive or anxious symptoms were referred to the occupational health care for further follow-up.

Other measures

Smoking status was assessed by a questionnaire. Non-smoking was defined as having never smoked or having quit smoking >12 months ago. Height and weight were measured by a study nurse with subjects in standing position without shoes and outer garments. Weight was measured to the nearest 0.1 kg with calibrated scales and height to the nearest 0.5 cm with a wall-mounted stadiometer. BMI was calculated as weight (kg) divided by the square of height (m^2). Information concerning diseases diagnosed by a physician, medication used regularly, marital status (cohabiting or not), working times (3-shift work or not) and education level (vocational school, college-level education, or university-level education) was gathered using self-administered questionnaires and medical records. Alcohol consumption was assessed using the 3-item Alcohol Use Disorders Identification Test (AUDIT-C) [24] with a cut-off of 5 points for harmful alcohol use in women and 6 points in men.[25,26] Disease burden was defined as having at least one chronic disease diagnosed by a physician.

Statistical analysis

Continuous variables are presented with means and standard deviations (SD) together with 95% confidence intervals (CI). Categorical variables are summarized with counts and percentages (%). Association between sleep quality and background variables was evaluated using a chi-square test or a one-way analysis of variance (ANOVA).

Association between QoL / work ability and background variables including sleep quality were examined first one by one (univariate approach), with one-way analysis of variance or with linear regression. A multivariable model was then built up, and age, gender and all factors with significant association with QoL and / or work ability in the univariate approach were entered into the model. The method used was linear model and assumptions were checked using studentized residuals.

All statistical tests were performed as 2-sided, with a significance level set at 0.05. The analyses were performed using an SAS System version 9.4 for Windows (SAS Institute Inc., Cary, NC, USA).

Patient and public involvement

Information events about the PORTAAT Study with guidance for the management of physical and psychosocial well-being were arranged for the employees of the selected work units. All participants were given personalized lifestyle counselling at the study visits. The chief of the Welfare Unit of Pori has been informed regularly about the published study results. The participants of this study were not involved in the design or development of the study.

RESULTS

The study cohort consisted of 710 employees with a mean age of 49 years (SD 10, range 20 – 68), 89% of whom were female.

Characteristics of the participants

Table 1 displays the basic characteristics of all the participants, also classified according to their sleep quality. Sleep quality was reported very good by 14.5%, good by 62.1%, poor by 21.2%, and very poor by 2.1% of the participants. Poor and very poor sleep quality were combined and set to indicate poor sleep quality in the analyses. Self-reported sleep quality was negatively associated with disease burden, prevalence of depression and severity of depressive symptoms, anxiety, and work stress, and positively associated with QoL and work ability. Better sleep quality was associated with longer sleep duration ($p<0.0001$). There were only five participants with a previously diagnosed obstructive sleep apnoea and three with restless legs syndrome. During the past month, 14.8% of the participants had used sleep medication at least occasionally. The use of sleep medication was more common in women (15.1% in women vs. 12.6% in men, $p=0.038$).

Only 9 (1.3%) of the participants were diagnosed as depressive according to the MDI diagnostic tool. All of them were also classified as anxious (GAD-7 score > 10). The measures from these two psychological symptoms were combined for multivariable analyses.

Table 1

Characteristics of all the participants and classified according to self-reported sleep quality

	All participants	Sleep quality			p-value
		Very good (n=103)	Good (n=441)	Poor (n=166)	
Age mean, years (SD)	49.0 (9.7)	47.5 (10.6)	49.1 (9.7)	49.8 (9.2)	0.072
Gender, n (%)					0.10
Female	631 (88.9)	85 (13.5)	397 (62.9)	149 (23.6)	
Male	79 (11.1)	18 (22.8)	44 (55.7)	17 (21.5)	
Education, n (%)					0.36
Vocational school	21 (3)	4 (19.1)	14 (66.7)	3 (14.3)	
College-level	361 (51.6)	53 (14.7)	232 (64.3)	76 (21.1)	
University-level	318 (45.4)	45 (14.2)	188 (59.1)	85 (26.7)	
Co-habiting, n (%)					0.64
Yes	575 (81.2)	83 (14.4)	353 (61.4)	139 (24.2)	
No	133 (18.8)	20 (15.0)	86 (64.7)	27 (20.3)	
3-shift work, n (%)					0.41
Yes	76 (10.9)	15 (19.7)	44 (57.9)	17 (23.4)	
No	620 (89.1)	87 (14.0)	386 (57.9)	147 (23.7)	
Smoking, n (%)					0.45
Yes	64 (9.0)	9 (14.1)	44 (68.8)	11 (17.2)	
No	645 (91.0)	94 (14.6)	396 (61.4)	155 (24.0)	
Harmful alcohol consumption, n (%)					0.55
Yes	101 (14.2)	18 (17.8)	59 (58.4)	24 (23.8)	
No	609 (85.8)	85 (14.0)	382 (62.7)	142 (23.3)	
Body mass index mean (95% CI)	26.8 (26.42 -27.13)	26.4 (25.50 - 27.25)	27.0 (26.54 - 27.46)	26.5 (25.72 - 27.24)	0.92
Disease burden[a], n (%)					0.0016
Yes	468 (65.9)	55 (11.8)	289 (61.8)	124 (26.5)	
No	242 (34.1)	48 (19.8)	152 (62.8)	42 (17.4)	

Depression (MDI), n (%)					0.016
Yes	9 (1.3)	0 (0.0)	3 (33.3)	6 (66.7)	
No	701 (98.7)	103 (14.7)	438 (62.5)	160 (22.8)	
MDI mean score (95% CI)	5.0 (4.57-5.43)	2.4 (1.75 - 2.97)	4.1 (3.59 - 4.51)	9.2 (8.09 - 10.27)	<0.0001
Level of anxiety (GAD-7), n (%)					<0.0001
No anxiety	534 (75.2)	92 (17.2)	343 (64.2)	99 (18.5)	
Mild anxiety	143 (20.1)	10 (7.0)	85 (59.4)	48 (33.6)	
Moderate anxiety	26 (3.7)	1 (3.9)	10 (38.5)	15 (57.7)	
Severe anxiety	7 (1.0)	0 (0.0)	3 (42.9)	4 (57.1)	
BBI15 mean total score (95% CI)	31.6 (30.82-32.41)	28.3 (26.43-30.23)	31.0 (30.05- 31.99)	35.4 (33.60-37.20)	<0.0001
Occupational stress (BBI15), n (%)					<0.0001
No stress	592 (89.4)	97 (16.4)	374 (63.2)	121 (20.4)	
Stress	70 (10.6)	3 (4.3)	38 (54.3)	29 (41.4)	
Sleep duration mean (95% CI)	7.00 (6.93 - 7.07)	7.50 (7.35 - 7.66)	7.17 (7.09 - 7.24)	6.23 (6.09 - 6.38)	<0.0001
EUROHIS mean score (95% CI)	4.07 (4.03 - 4.11)	4.38 (4.30 - 4.45)	4.09 (4.05 - 4.14)	3.83 (3.75 - 3.91)	<0.0001
WAS mean score (95% CI)	8.31 (8.21-8.41)	8.99 (8.78 - 9.20)	8.34 (8.22 - 8.46)	7.80 (7.55 - 8.04)	<0.0001
Level of work ability (WAS), n (%)					<0.0001
Poor	27 (3.8)	1 (3.7)	12 (44.4)	14 (51.9)	
Moderate	114 (16.1)	3 (2.6)	69 (60.5)	42 (36.8)	
Good	459 (64.9)	61 (13.3)	298 (64.9)	100 (21.8)	
Excellent	107 (15.1)	37 (34.6)	60 (56.1)	10 (9.4)	

[a] At least one chronic disease diagnosed by a physician, BBI15 = Bergen Burnout Indicator 15, CI = Confidence Interval, EUROHIS = EUROHIS-QOL 8-item index, GAD-7= General Anxiety Disorder 7-item Scale, MDI = Major Depression Inventory, SD = Standard deviation, WAS = Work Ability Score

Quality of life

As seen in Table 2, the EUROHIS-QOL mean score among all participants was 4.07 (SD 0.51) with no significant difference between genders (p=0.94). In the univariate approach, QoL was positively associated with good sleep quality, university-level education, co-habiting, lower BMI and younger age, and negatively associated with occupational stress, depression, anxiety and disease burden.

In the multiway analysis of co-variance, QoL was positively associated with good sleep quality, co-habiting, university-level education and lower BMI, and negatively associated with occupational stress, depression and/or anxiety and disease burden (Table 2).

Table 2

Factors associated with quality of life in a univariate approach and in a multivariable model. EUROHIS means/slope together with 95% CI are based on model estimates.

	Univariate			Multivariable				
	EUROHIS total mean / slope	95% Confidence Interval	p-value	EUROHIS total model based mean / slope	95% Confidence Interval	F-value	DF	p-value
Age	-0.0040	(-0.0079, -0.00008)	0.046	-0.00028	-0.0042 - 0.0036	0.02	1	0.89
Gender			0.94			0.00	1	0.99
Female	4.07	4.03 - 4.11		3.54	3.38 - 3.69			
Male	4.07	3.96 - 4.18		3.54	3.36 - 3.72			
Education			0.036			4.17	2	0.016
Vocational school	3.83	3.61 - 4.05		3.37	3.11 - 3.62			
College-level	4.05	4.00 - 4.11		3.59	3.44 - 3.74			
University-level	4.11	4.05 - 4.16		3.66	3.51 - 3.81			
Co-habiting			0.011			5.72	1	0.017
Yes	4.09	4.05 - 4.13		3.59	3.43 - 3.75			
No	3.97	3.88 - 4.06		3.48	3.31 - 3.66			
Smoking			0.39					
Yes	4.02	3.89 - 4.14						
No	4.08	4.38 - 4.12						
Harmful alcohol consumption			0.33					
Yes	4.12	4.02 -4.22						
No	4.06	4.02 - 4.11						
Body mass index	-0.020	(-0.028, -0.012)	<0.0001	-0.018	(-0.025, -0.011)	23.91	1	<0.0001
Disease burden[a]			<0.0001			13.35	1	0.0003
Yes	3.99	3.95 - 4.04		3.47	3.31 - 3.63			
No	4.22	4.16 - 4.29		3.61	3.44 - 3.77			
Depression[b]			<0.0001					
Yes	3.07	2.74 - 3.39						

No	4.08	4.05 - 4.12						
Level of anxiety[c]			<0.0001					
No	4.19	4.16 - 4.23						
Mild	3.75	3.67 - 3.82						
Moderate	3.47	3.29 - 3.64						
Severe	3.66	3.32 - 4.00						
Depression and/or anxiety[bd]						13.92	2	<0.0001
No depression/ No anxiety				3.89	3.77 - 4.00			
Only anxiety				3.59	3.36 - 3.82			
Depression and anxiety				3.14	2.81 - 3.46			
Occupational stress[e]			<0.0001			39.30	1	<0.0001
Yes	3.63	3.51 - 3.74		3.35	3.18 - 3.53			
No	4.13	4.09 - 4.17		3.72	3.56 - 3.88			
3-shift work			0.089			0.55	1	0.46
Yes	4.16	4.02 - 4.10		3.56	3.37 - 3.74			
No	4.06	4.05 - 4.28		3.52	3.36 - 3.67			
Self-reported sleep quality			<0.0001			22.02	2	<0.0001
Very good	4.38	4.30 - 4.45		3.74	3.56 - 3.92			
Good	4.05	4.05 - 4.14		3.53	3.36 - 3.69			
Poor	3.83	3.75 - 3.91		3.34	3.18 - 3.51			

[a] At least one chronic disease diagnosed by a physician, [b] Defined by Major Depression Inventory (MDI) diagnostic tool (DSM IV), [c] General Anxiety Disorder 7-item Scale (GAD-7), [d] General Anxiety Disorder 7-item Scale (GAD-7), moderate or severe anxiety, [e] Bergen Burnout Indicator 15 (BBI15), at least mild occupational stress, CI = Confidence Interval, DF = Degrees of freedom, EUROHIS = EUROHIS-QOL 8-item index

Work ability

Work ability was reported excellent by 15.2%, good by 64.9%, moderate by 16.1% and poor by 3.8% of the participants. The WAS mean score among all participants was 8.31 (SD 1.37), and the median was 9.0 (Q1:8.0, Q3:9.0). There was no difference in work ability between genders (p=0.11). In the univariate approach, work ability was positively associated with good sleep quality, younger age, lower BMI, university-level education, female gender, and 3-shift work, and negatively associated with disease burden, depression, anxiety and occupational stress.

In the multiway analysis of co-variance, work ability was positively associated with good sleep quality, younger age, lower BMI, and university-level education, and negatively associated with occupational stress and disease burden (Table 3).

Table 3

Factors associated with work ability in a univariate approach and in a multivariable model. WAS means/slope together with 95% CI are based on model estimates.

	Univariate			Multivariable				
	WAS estimate / slope	95% Confidence Interval	p-value	WAS model based estimate / slope	95% Confidence Interval	F-value	DF	p-value
Age	-0.019	(-0.029, -0.0090)	0.0002	-0.012	(-0.022, -0.0018)	5.34	1	0.021
Gender			0.027			3.36	1	0.067
Female	8.35	8.24 - 8.46		7.83	7.43 - 8.23			
Male	7.99	7.68 - 8.29		7.56	7.09 - 8.04			
Education			0.0079			4.74	2	0.0091
Vocational school	7.90	7.30 - 8.50		7.42	6.76 - 8.07			
College-level	8.18	8.04 - 8.32		7.70	7.32 - 8.09			
University-level	8.48	8.33 - 8.63		7.80	7.58 - 8.37			
Co-habiting			0.91			0.04	1	0.85
Yes	8.31	8.20 - 8.42		7.69	7.27 - 8.10			
No	8.30	8.06 - 8.53		7.71	7.26 - 8.18			
Smoking			0.19					
Yes	8.10	7.76 - 8.44						
No	8.33	8.23 - 8.44						
Harmful alcohol consumption			0.35					
Yes	8.43	8.18 - 8.40						
No	8.30	8.16 - 8.70						
Body mass index	-0.036	(-0.057, - 0.016)	0.0006	-0.023	(-0.042, -0.0041)	5.71	1	0.017
Disease burden[a]			<0.0001			12.23	1	0.0005
Yes	8.07	7.95 - 8.20		7.52	7.11 - 7.95			
No	8.77	8.60 - 8.93		7.87	7.44 - 8.30			
Depression[b]			0.0083					

Yes	7.11	6.22 - 8.01						
No	8.33	8.23 - 8.43						
Level of anxiety[c]			<0.0001					
No	8.55	8.44 - 8.66						
Mild	7.59	7.38 - 7.81						
Moderate	7.44	6.95 - 7.94						
Severe	8.00	7.03 - 8.97						
Depression and/or anxiety[bd]						1.73	2	0.17
No depression / No anxiety				8.02	7.72 - 8.31			
Only anxiety				7.67	7.07 - 8.27			
Depression and anxiety				7.41	6.57 - 8.25			
Occupational stress[e]			<0.0001			29.80	1	<0.0001
Yes	7.47	7.18 - 7.76		7.28	6.82 - 7.74			
No	8.47	8.37 - 8.57		8.12	7.70 - 8.54			
3-shift work			0.0040			3.75	1	0.053
Yes	8.74	8.43 - 9.05		7.84	7.36 - 8.33			
No	8.26	8.15 - 8.36		7.55	7.16 - 7.95			
Self-reported sleep quality			<0.0001			14.44	2	<0.0001
Very good	9.00	8.73 - 9.25		8.13	7.66 - 8.60			
Good	8.34	8.22 - 8.47		7.68	7.25 - 8.10			
Poor	7.80	7.59 - 8.00		7.29	6.86 - 7.72			

[a] At least one chronic disease diagnosed by a physician, [b] Defined by Major Depression Inventory (MDI) diagnostic tool (DSM IV), [c] General Anxiety Disorder 7-item Scale (GAD-7), [d] General Anxiety Disorder 7-item Scale (GAD-7), moderate or severe anxiety, [e] Bergen Burnout Indicator 15 (BBI15), at least mild occupational stress, CI= Confidence Interval, DF = Degrees of freedom, WAS = Work Ability Score

DISCUSSION

In this study, we managed to show that occupational stress, self-reported sleep quality, and disease burden were strongly associated with both QoL and work ability in public sector employees. In addition, QoL was tightly associated with BMI and depression and / or anxiety. To our knowledge, few studies have evaluated QoL and work ability simultaneously among apparently healthy, working-age individuals, with information about a wide range of factors potentially influencing these two variables.

Occupational stress was the factor most strongly associated with both QoL and work ability in this study. It is well known, that job strain is an important factor affecting employees' health and well-being.[3,27,28] Occupational stress is known to be associated, for example, with poor sleep quality [29], lower work ability [4] and mental health problems.[30] Furthermore, work stress was found to be associated with elevated mortality rates in patients with cardiometabolic disease in a large multicohort study.[31] Work stress has also been found to have a negative association with QoL in several studies.[3,27] The interesting finding in our study was that the association of occupational stress with QoL and WAS was strong, regardless of the fact that our study population had low rates of occupational stress. Only 10.6% of the participants in our study had at least mild occupational stress symptoms, and severe symptoms were very rare. It is thus possible that even low levels of occupational stress can have an important influence on a person's work ability and QoL. These results highlight the need for screening and handling of work stress among municipal employees.

Self-reported sleep quality was tightly associated with both QoL and work ability in this study. A negative association between poor sleep quality and QoL has previously been demonstrated among patients with sleep disorders and other medical conditions [32–35], and studies on shift workers have shown a clear association between sleep quality and QoL.[36,37] Furthermore, in a previous work on higher education students, Marques et al. showed that self-reported sleep quality remained a significant predictor of most aspects of QoL, regardless of the presence of psychopathological

symptoms, such as depression.[5] Sleep problems have in previous literature also been linked to poorer work ability and an increased rate of sickness absence.[38,39] In addition, Ng et al. have shown a positive association between good sleep quality and work ability among Hong Kong construction workers.[6] However, in this study we managed to show that self-reported sleep quality is significantly associated with both QoL and work ability among apparently healthy employees not restricted to a specific occupation and working mainly in regular morning shifts. The associations remained significant also in the multivariable models, where many potential confounding factors could be taken into account.

Disease burden, higher BMI and lower educational level were negatively associated with both QoL and work ability in this study, as well as in previous literature. Chronic diseases are known to have a negative association with QoL [1] and with work ability.[2,40] Lower BMI has been linked to better QoL [41] and to better work ability [42,43], and higher education has been positively associated with QoL [44] and with work ability.[45] In our study, as well as in previous literature, older age was associated with poorer work ability [42,46], but no significant association was found between age and QoL. This finding is consistent with the Finnish reference values for the EUROHIS-QOL 8-item index.[47] Furthermore, cohabiting had a significant positive association with QoL in our study, as has previously been observed in a population based study in Sweden.[48] Cohabiting has previously been linked to better health and work ability, for example, in an unemployed population [49], but in our setting, where only active work force was studied, there was no significant association between cohabiting and work ability.

An interesting finding in our study was that depression and / or anxiety was strongly associated with QoL but did not have a significant association with work ability in the multivariable model. Depression and anxiety are known to have a negative impact on QoL [50–52], but depression also affects a person's ability to work.[2,53] However, depression often leads to sickness absence, which means that these people are not in the active work force. In our study population, depression and

anxiety were relatively rare conditions, and most of the cases were mild. Only 9 (1.3%) of the participants met the diagnostic criteria for major depression and 33 (4.6%) of the participants where categorized as moderately or severely anxious. It is known that not all depressive patients consider themselves unable to work.[53] These patients may benefit from the schedule and routine of work life and do not want to seek sick leave, while depression still affects their QoL. In the Finnish Current Care Guidelines for depression, sick leave is not recommended in mild depression and the need for sick leave in moderate depression should be evaluated individually.[54] According to these recommendations, those depressive patients whose work ability is not affected should remain in the active work force. Furthermore, as the prevalence of depression and anxiety in our study population was low, the generalizability of these results can be questioned.

In this study, 3-shift work was not significantly associated either with QoL or with work ability in the multivariable models. In the univariate approach, the work ability of the 3-shift workers was better (p=0.0040), but no significant difference was seen in QoL. Somewhat surprisingly, 3-shift work did not seem to have any adverse effects on the participants' well-being in our study. There was no difference in sleep quality or occupational stress compared to the regular morning shift workers. Almost all 3-shift workers in our study were women working as nurses or social workers. Their mean age was 45.6 years, which is 3.5 years younger than the mean age of the whole study population. In addition to the younger age, one possible explanation for their well-being is that they may have voluntarily chosen to work in shifts and feel that it is a suitable way of working for them. Those shift workers who have had health problems or difficulties with sleep due to shift work may have changed to day work.[55] Another unexpected result in this work was that harmful alcohol consumption did not have adverse effects on sleep quality, QoL or work ability. However, even though there were 101 (14.2%) participants that fulfilled the definition of "harmful drinking" in the AUDIT-C, heavy drinking was very rare in this predominantly female, active work force population. We assume that these people may consume alcohol mainly during weekends, which diminishes the effects on everyday life and work.

We acknowledge some limitations of the study. We cannot determine the causality of the found associations because of the cross-sectional nature of the study. A possible healthy worker effect [56] can be present because only subjects in the active work force were studied. In addition, the initial response rate in the first part of the study in 2014 was only 32.5% (and 84.9% of them attended the study in 2015). It is known that response rates in e-mail surveys tend to be lower than in mail surveys [57], but it can nevertheless cause selection bias. It is possible that the healthiest part of the work force is also the most willing to attend voluntary health surveys, which may result in the possibility that our results reflect the situation in the mainly healthy section of the work force. However, the mean annual rate of sickness absence days did not vary significantly between the study participants and the non-participants on the included employment sectors. According to the records obtained from the city of Pori, the mean incidence of sickness absence days was 11 days per year among the study participants during the two year time period (2014 – 2015).[58] The mean sickness absence rate among all employees of the selected work units was 12 days according to the personnel report of the city of Pori in 2015. [59] The gender distribution in our study (89% females) resembles the distribution among employees of the city of Pori and is close to the gender distribution of the large Finnish prospective study on the public sector employees.[60] The information about alcohol consumption was collected by self-assessment, which may be influenced by social desirability. In addition, we unfortunately do not have data of possible menopausal symptoms, which may have affected our results in women.

The strengths of our study are that we could take into account several aspects associated with the employees' QoL and work ability. All questionnaires were completed by the participants at home before the examination was performed. In this study, the approaches to sleep quality, QoL and work ability were all subjective, which emphasizes the importance of personal experience in evaluating these factors. We assessed self-reported sleep quality and work ability with single questions. This approach was chosen over longer questionnaires because a single question could also be used at a normal physician's appointment in primary or occupational health care for the evaluation of these

factors. The self-reported sleep quality question we used was from the Pittsburgh Sleep Quality Index (PSQI), and it has previously been shown to be closely related with QoL.[5] With this question we showed a clear association of sleep quality with QoL and with work ability. However, it would be interesting to further assess this connection in a similar population with a more detailed questionnaire to determine whether the different components of sleep have different impacts on QoL and work ability. The WAS score we used for the evaluation of work ability has been shown to have a strong association with the Work Ability Index and is reliable in evaluating work ability.[61] WAS has also been shown to predict disability pension and long-term sickness absence according to a Finnish register-based study.[62] The associations of self-reported sleep quality with both QoL and with work ability were clear and in line with previous literature even when studied with these simple tools.

CONCLUSIONS

In this paper we showed that occupational stress and self-reported sleep quality are strongly associated with both QoL and work ability among Finnish public sector employees. According to our results, even a low level of occupational stress has a significant negative association with QoL and work ability. These findings highlight the need for screening and handling work stress and sleep problems in occupational and primary health care. We suggests that short, self-reported assessment tools could be used for this purpose.

CONTRIBUTORS

EB, EL, SM, PR and PK contributed to the conception or design of the work, and to the acquisition, analysis or interpretation of data for the work. EB and PK drafted the manuscript. All authors critically revised the manuscript, gave final approval, and agreed to be accountable for all aspects of work ensuring integrity and accuracy.

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DECLARATION OF COMPETING INTERESTS

The authors declare that they have no competing interests.

ETHICAL APPROVAL

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The study protocol and consent forms were reviewed and approved by the Ethics Committee of the Hospital District of Southwest Finland (ETMK 43/180/2013).

INFORMED CONSENT

Written informed consent was obtained from all individual participants included in the study.

AVAILABILITY OF DATA

The datasets used and/or analysed during the current study are available from the corresponding author on request.

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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported
Objectives	3	State specific objectives, including any prespecified hypotheses
Methods		
Study design	4	Present key elements of study design early in the paper
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9	Describe any efforts to address potential sources of bias
Study size	10	Explain how the study size was arrived at
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding
		(*b*) Describe any methods used to examine subgroups and interactions
		(*c*) Explain how missing data were addressed
		(*d*) If applicable, describe analytical methods taking account of sampling strategy
		(*e*) Describe any sensitivity analyses
Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		(b) Give reasons for non-participation at each stage
		(c) Consider use of a flow diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest
Outcome data	15*	Report numbers of outcome events or summary measures
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
		(*b*) Report category boundaries when continuous variables were categorized
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses

Discussion		
Key results	18	Summarise key results with reference to study objectives
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	21	Discuss the generalisability (external validity) of the study results
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Factors associated with quality of life and work ability among Finnish municipal employees: a cross-sectional study

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FACTORS ASSOCIATED WITH QUALITY OF LIFE AND WORK ABILITY AMONG FINNISH MUNICIPAL EMPLOYEES: A CROSS-SECTIONAL STUDY

Elina Bergman, MD[a], Eliisa Löyttyniemi, MSc[b], Saana Myllyntausta, MA[c], Päivi Rautava, MD, PhD[c d] and Päivi E. Korhonen, MD, PhD [a e]

[a] Institute of Clinical Medicine, Department of General Practice, University of Turku and Turku University Hospital, Turku, Finland. [b] Department of Biostatistics, University of Turku, Turku, Finland. [c] Department of Public Health, University of Turku, and Turku University Hospital, Turku, Finland. [d] Clinical Research Centre, Turku University Hospital, Turku, Finland. [e] Central Satakunta Health Federation of Municipalities, Harjavalta, Finland.

Corresponding author:

Elina Bergman

Address:

Department of General Practice, Joukahaisenkatu 3-5, FI-20014 TURUN YLIOPISTO, FINLAND

Telephone: +358 50 307 4436

E-mail: elkaro@utu.fi

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ABSTRACT

Objectives: Quality of life (QoL) and work ability are elementary parts in defining the well-being of an employed person. The aim of this study was to demonstrate factors associated with QoL and self-reported work ability among public sector employees, while taking into account several confounding factors, including sleep quality, occupational stress and psychological symptoms.

Methods: A cross-sectional study was conducted in Finland among 710 employees (89% women, mean age 49 [SD = 10] years) from ten municipal work units in 2015. Information about the participants was collected by physical examination, self-administered questionnaire and from medical history. QoL was assessed with the EUROHIS-QOL 8-item index and work ability with the Work Ability Score (WAS).

Results: The EUROHIS-QOL mean score among all participants was 4.07 (95% CI 4.03–4.11). QoL was positively associated with good sleep quality, cohabiting, university-level education, and lower BMI, and negatively associated with occupational stress, depression and/or anxiety and disease burden. Work ability was reported good or excellent by 80% of the participants and the WAS mean score among all participants was 8.31 (95% CI 8.21–8.41). Work ability was positively associated with good sleep quality, younger age, lower BMI and university-level education, and negatively associated with occupational stress and disease burden.

Conclusions: Occupational stress and self-reported sleep quality were strongly associated with both QoL and work ability among Finnish public sector employees. These findings highlight the need for screening and handling of work stress and sleep problems in occupational and primary health care.

KEYWORDS

Quality of life, Work ability, Occupational health, Sleep quality, Occupational stress

STRENGTHS AND LIMITATIONS OF THIS STUDY

- Several aspects associated with the employees' quality of life and work ability could be taken into account.
- The participants completed all questionnaires at home before the examination was performed.
- Psychological symptoms were assessed with well-validated instruments.
- Any causality cannot be determined due to the cross-sectional nature of the study.
- The response rate of the study was moderate at most, which is a common limitation in e-mail surveys.

INTRODUCTION

Quality of life (QoL) and work ability are elementary outcomes in defining the well-being of an employed person. Both of these can be affected by numerous conditions, including physical and mental health [1,2], occupational stress [3,4], sleep quality [5,6] , psychosocial risk factors and environmental aspects. [7] Many of these can be measured reliably by evaluating the persons' perceptions about the condition with self-reported assessment tools. [1,8–13] In our previous study, especially self-reported sleep quality was strongly associated with QoL among public sector employees. [14]

QoL and work ability have been studied also previously in currently employed populations, but most of the studies have concentrated on a specific occupational group or employees suffering from a certain medical condition. [2,15,16] To our knowledge, there is a gap of information about factors associated with QoL and work ability, studied simultaneously among apparently healthy public sector employees. Public sector is a large employer sector in the Scandinavian countries, and it

would be important to recognize the factors associated with well-being of the employees in municipal work places.

The aim of this study was to demonstrate factors associated with QoL and self-reported work ability among public sector employees, while taking into account several confounding factors, including psychological symptoms, sleep quality and occupational stress. We wanted to use short, subjective and user-friendly tools for the assessment of QoL, work ability and sleep quality. These instruments could easily be used for screening also in occupational and primary healthcare.

PARTICIPANTS AND METHODS

Participants

This cross-sectional study was part of the PORTAAT (PORi To Aid Against Threats) study conducted among employees of the city of Pori (83,497 inhabitants in 2014) in South-Western Finland in 2014 and 2015. The participating work units were selected by the chief of the Welfare Unit of Pori. Invitations to participate and information of the study were sent to employees via e-mail by the managers of the selected ten work units (total number of employees 2,570). The employees willing to participate contacted the study contact person at their work unit, who then sent their contact information to the study nurse. There were no exclusion criteria. A total of 836 employees (104 males, 732 females) participated in the study in 2014. The response rate in 2014 was 32.5%. Complete information about data collection from that year has been described earlier. [17] All the initial respondents were invited to the second part of the study in 2015, and 710 of them (79 males, 631 females) attended. In the present work, all the information is from the year 2015, and this data was chosen, because complete information about psychosocial risk factors was available only from that year. The gender distribution of the study participants corresponds to the standard gender distribution of the employees of Pori. The participants' occupations included librarians, museum

employees, janitors, IT workers, social workers, nurses, physicians, administrative officials, and general office staff. The involved employment sectors, reported according to the number of employees participating in the study in 2015 were Health and Welfare (275 employees), Social Work (198), Technical Services (143), Education and Culture (62) and Administration (32).

Quality of life

QoL was assessed with the EUROHIS-QOL 8-item index.[18] This is a shortened version of the WHOQOL-Bref scale, a widely used instrument for the assessment of generic QoL.[7,19] The domains in both questionnaires are the general, physical, psychological, social and environmental aspects of QoL. The EUROHIS-QOL instrument has been validated in several European countries.[1] The participants of the present study answered the questions at home before the study visits. Every question was scored from 1 to 5 (1 for very poor and 5 for very good). All scores were then added together and divided by 8 (the sum of the questions) to obtain the EUROHIS-QOL mean score.[1]

Work-related measures

Work ability was assessed with the question "What is your current work ability compared to your lifetime best?". This is the first item of the widely used Work Ability Index (WAI) [9], referred to as the Work Ability Score (WAS). It has a 0–10 response scale, where 0 stands for "completely unable to work" and 10 stands for "work ability at its best". Work ability was considered poor for scores of 0–5, moderate for scores of 6–7, good for scores of 8–9, and excellent for a score of 10 points, based on the same values that have been used in the WAI.[20] Work-related stress was evaluated with Bergen Burnout Indicator 15 (BBI-15).[13] The BBI-15 measures three dimensions of burnout: exhaustion, cynicism, and reduced professional efficacy. Responses are rated on a 6-point Likert-type scale (1 = totally disagree, 6 = totally agree). In this work, we used the total score from all three dimensions, which can vary from 15 to 90, with higher scores indicating more severe burnout symptoms. Burnout symptoms are in this indicator classified as severe, moderate, mild, and no burnout, with specific threshold values according to gender and age.[13] We assessed burnout as a

binary variable where all scores from mild to severe burnout were set to indicate the presence of burnout symptoms.

Sleep-related measures

Self-reported sleep quality was assessed with the question "During the past month, how would you rate your sleep quality overall?" (very good, good, poor, or very poor). In the analyses, the two lowest classes of sleep quality were combined and set to indicate poor sleep quality. Sleep duration was assessed with the question "During the past month, how many hours of sleep did you normally get at night?". The participants were asked to answer the question in a free field, and sleep duration was handled as a continuous variable in the analyses. Both of these questions are items from the well-validated Pittsburgh Sleep Quality Index (PSQI)[10], which has good internal consistency (α = 0.83) and test–retest reliability (r = 0.82; over an average of 19 days). [21,22]

Psychological symptoms

Depressive symptoms were assessed with the Major Depression Inventory (MDI) questionnaire.[23] This inventory can be used as a diagnostic tool for major depression (according to DSM IV diagnostic criteria) as well as an assessment tool for severity of depressive symptoms.[11,23] To assess severity of depressive symptoms, a total score of 0–20 is considered as no symptoms, 21–25 as mild symptoms, 26–30 as moderate symptoms, and 31–50 as severe depressive symptoms. In this work, the diagnostic tool was used to determine whether a person had depression or not. Anxiety was assessed with the General Anxiety Disorder 7-item Scale (GAD-7).[12] In the GAD-7, a total score of 0–4 is considered as no anxiety, 5–9 as mild anxiety, 10–14 as moderate anxiety, and 15–21 as severe anxiety. A total score of 10 was used as a cut-off point when a binary variable for anxiety was used in our analyses. This cut-off is recommended by the developers of the GAD-7 questionnaire.[12] The participants with severe depressive or anxious symptoms were referred to the occupational health care for further follow-up.

Other measures

Smoking status was assessed by a questionnaire. Non-smoking was defined as having never smoked or having quit smoking >12 months ago. Height and weight were measured by a study nurse with subjects in standing position without shoes and outer garments. Weight was measured to the nearest 0.1 kg with calibrated scales and height to the nearest 0.5 cm with a wall-mounted stadiometer. BMI was calculated as weight (kg) divided by the square of height (m^2). Information concerning diseases diagnosed by a physician, medication used regularly, marital status (cohabiting or not), working times (3-shift work or not) and education level (vocational school, college-level education, or university-level education) was gathered using self-administered questionnaires and medical records. Alcohol consumption was assessed using the 3-item Alcohol Use Disorders Identification Test (AUDIT-C) [24] with a cut-off of 5 points for harmful alcohol use in women and 6 points in men.[25,26] Disease burden was defined as having at least one chronic disease diagnosed by a physician.

Statistical analysis

Continuous variables are presented with means and standard deviations (SD) together with 95% confidence intervals (CI). Categorical variables are summarized with counts and percentages (%). Association between sleep quality and background variables was evaluated using a chi-square test or a one-way analysis of variance (ANOVA).

Association between QoL / work ability and background variables including sleep quality were examined first one by one (univariate approach), with one-way analysis of variance or with linear regression. A multivariable model was then built up, and age, gender and all factors with significant association with QoL and / or work ability in the univariate approach were entered into the model. The method used was linear model and assumptions were checked using studentized residuals.

All statistical tests were performed as 2-sided, with a significance level set at 0.05. The analyses were performed using an SAS System version 9.4 for Windows (SAS Institute Inc., Cary, NC, USA).

Patient and public involvement

Information events about the PORTAAT Study with guidance for the management of physical and psychosocial well-being were arranged for the employees of the selected work units. All participants were given personalized lifestyle counselling at the study visits. The chief of the Welfare Unit of Pori has been informed regularly about the published study results. The participants of this study were not involved in the design or development of the study.

RESULTS

The study cohort consisted of 710 employees with a mean age of 49 years (SD 10, range 20 – 68), 89% of whom were female.

Characteristics of the participants

Table 1 displays the basic characteristics of all the participants, also classified according to their sleep quality. Sleep quality was reported very good by 14.5%, good by 62.1%, poor by 21.2%, and very poor by 2.1% of the participants. Poor and very poor sleep quality were combined and set to indicate poor sleep quality in the analyses. Self-reported sleep quality was negatively associated with disease burden, prevalence of depression and severity of depressive symptoms, anxiety, and work stress, and positively associated with QoL and work ability. Better sleep quality was associated with longer sleep duration ($p<0.0001$). There were only five participants with a previously diagnosed obstructive sleep apnoea and three with restless legs syndrome. During the past month, 14.8% of the participants had used sleep medication at least occasionally. The use of sleep medication was more common in women (15.1% in women vs. 12.6% in men, $p=0.038$).

Only 9 (1.3%) of the participants were diagnosed as depressive according to the MDI diagnostic tool. All of them were also classified as anxious (GAD-7 score > 10). The measures from these two psychological symptoms were combined for multivariable analyses.

Table 1

Characteristics of all the participants and classified according to self-reported sleep quality

	All participants	Sleep quality			p-value
		Very good (n=103)	Good (n=441)	Poor (n=166)	
Age mean, years (SD)	49.0 (9.7)	47.5 (10.6)	49.1 (9.7)	49.8 (9.2)	0.072
Gender, n (%)					0.10
Female	631 (88.9)	85 (13.5)	397 (62.9)	149 (23.6)	
Male	79 (11.1)	18 (22.8)	44 (55.7)	17 (21.5)	
Education, n (%)					0.36
Vocational school	21 (3)	4 (19.1)	14 (66.7)	3 (14.3)	
College-level	361 (51.6)	53 (14.7)	232 (64.3)	76 (21.1)	
University-level	318 (45.4)	45 (14.2)	188 (59.1)	85 (26.7)	
Co-habiting, n (%)					0.64
Yes	575 (81.2)	83 (14.4)	353 (61.4)	139 (24.2)	
No	133 (18.8)	20 (15.0)	86 (64.7)	27 (20.3)	
3-shift work, n (%)					0.41
Yes	76 (10.9)	15 (19.7)	44 (57.9)	17 (23.4)	
No	620 (89.1)	87 (14.0)	386 (57.9)	147 (23.7)	
Smoking, n (%)					0.45
Yes	64 (9.0)	9 (14.1)	44 (68.8)	11 (17.2)	
No	645 (91.0)	94 (14.6)	396 (61.4)	155 (24.0)	
Harmful alcohol consumption, n (%)					0.55
Yes	101 (14.2)	18 (17.8)	59 (58.4)	24 (23.8)	
No	609 (85.8)	85 (14.0)	382 (62.7)	142 (23.3)	
Body mass index mean (95% CI)	26.8 (26.42 -27.13)	26.4 (25.50 - 27.25)	27.0 (26.54 - 27.46)	26.5 (25.72 - 27.24)	0.92
Disease burden[a], n (%)					0.0016
Yes	468 (65.9)	55 (11.8)	289 (61.8)	124 (26.5)	
No	242 (34.1)	48 (19.8)	152 (62.8)	42 (17.4)	

Depression (MDI), n (%)					0.016
Yes	9 (1.3)	0 (0.0)	3 (33.3)	6 (66.7)	
No	701 (98.7)	103 (14.7)	438 (62.5)	160 (22.8)	
MDI mean score (95% CI)	5.0 (4.57-5.43)	2.4 (1.75 - 2.97)	4.1 (3.59 - 4.51)	9.2 (8.09 - 10.27)	<0.0001
Level of anxiety (GAD-7), n (%)					<0.0001
No anxiety	534 (75.2)	92 (17.2)	343 (64.2)	99 (18.5)	
Mild anxiety	143 (20.1)	10 (7.0)	85 (59.4)	48 (33.6)	
Moderate anxiety	26 (3.7)	1 (3.9)	10 (38.5)	15 (57.7)	
Severe anxiety	7 (1.0)	0 (0.0)	3 (42.9)	4 (57.1)	
BBI15 mean total score (95% CI)	31.6 (30.82-32.41)	28.3 (26.43-30.23)	31.0 (30.05- 31.99)	35.4 (33.60-37.20)	<0.0001
Occupational stress (BBI15), n (%)					<0.0001
No stress	592 (89.4)	97 (16.4)	374 (63.2)	121 (20.4)	
Stress	70 (10.6)	3 (4.3)	38 (54.3)	29 (41.4)	
Sleep duration mean (95% CI)	7.00 (6.93 - 7.07)	7.50 (7.35 - 7.66)	7.17 (7.09 - 7.24)	6.23 (6.09 - 6.38)	<0.0001
EUROHIS mean score (95% CI)	4.07 (4.03 - 4.11)	4.38 (4.30 - 4.45)	4.09 (4.05 - 4.14)	3.83 (3.75 - 3.91)	<0.0001
WAS mean score (95% CI)	8.31 (8.21-8.41)	8.99 (8.78 - 9.20)	8.34 (8.22 - 8.46)	7.80 (7.55 - 8.04)	<0.0001
Level of work ability (WAS), n (%)					<0.0001
Poor	27 (3.8)	1 (3.7)	12 (44.4)	14 (51.9)	
Moderate	114 (16.1)	3 (2.6)	69 (60.5)	42 (36.8)	
Good	459 (64.9)	61 (13.3)	298 (64.9)	100 (21.8)	
Excellent	107 (15.1)	37 (34.6)	60 (56.1)	10 (9.4)	

[a] At least one chronic disease diagnosed by a physician, BBI15 = Bergen Burnout Indicator 15, CI = Confidence Interval, EUROHIS = EUROHIS-QOL 8-item index, GAD-7= General Anxiety Disorder 7-item Scale, MDI = Major Depression Inventory, SD = Standard deviation, WAS = Work Ability Score

Quality of life

As seen in Table 2, the EUROHIS-QOL mean score among all participants was 4.07 (SD 0.51) with no significant difference between genders (p=0.94). In the univariate approach, QoL was positively associated with good sleep quality, university-level education, co-habiting, lower BMI and younger age, and negatively associated with occupational stress, depression, anxiety and disease burden.

In the multiway analysis of co-variance, QoL was positively associated with good sleep quality, co-habiting, university-level education and lower BMI, and negatively associated with occupational stress, depression and/or anxiety and disease burden (Table 2).

Table 2

Factors associated with quality of life in a univariate approach and in a multivariable model. EUROHIS means/slope together with 95% CI are based on model estimates.

	Univariate			Multivariable				
	EUROHIS total mean / slope	95% Confidence Interval	p-value	EUROHIS total model based mean / slope	95% Confidence Interval	F-value	DF	p-value
Age	-0.0040	(-0.0079, -0.00008)	0.046	-0.00028	-0.0042 - 0.0036	0.02	1	0.89
Gender			0.94			0.00	1	0.99
Female	4.07	4.03 - 4.11		3.54	3.38 - 3.69			
Male	4.07	3.96 - 4.18		3.54	3.36 - 3.72			
Education			0.036			4.17	2	0.016
Vocational school	3.83	3.61 - 4.05		3.37	3.11 - 3.62			
College-level	4.05	4.00 - 4.11		3.59	3.44 - 3.74			
University-level	4.11	4.05 - 4.16		3.66	3.51 - 3.81			
Co-habiting			0.011			5.72	1	0.017
Yes	4.09	4.05 - 4.13		3.59	3.43 - 3.75			
No	3.97	3.88 - 4.06		3.48	3.31 - 3.66			
Smoking			0.39					
Yes	4.02	3.89 - 4.14						
No	4.08	4.38 - 4.12						
Harmful alcohol consumption			0.33					
Yes	4.12	4.02 -4.22						
No	4.06	4.02 - 4.11						
Body mass index	-0.020	(-0.028, -0.012)	<0.0001	-0.018	(-0.025, -0.011)	23.91	1	<0.0001
Disease burden[a]			<0.0001			13.35	1	0.0003
Yes	3.99	3.95 - 4.04		3.47	3.31 - 3.63			
No	4.22	4.16 - 4.29		3.61	3.44 - 3.77			
Depression[b]			<0.0001					
Yes	3.07	2.74 - 3.39						

No	4.08	4.05 - 4.12						
Level of anxiety[c]			<0.0001					
No	4.19	4.16 - 4.23						
Mild	3.75	3.67 - 3.82						
Moderate	3.47	3.29 - 3.64						
Severe	3.66	3.32 - 4.00						
Depression and/or anxiety[bd]						13.92	2	<0.0001
No depression/ No anxiety				3.89	3.77 - 4.00			
Only anxiety				3.59	3.36 - 3.82			
Depression and anxiety				3.14	2.81 - 3.46			
Occupational stress[e]			<0.0001			39.30	1	<0.0001
Yes	3.63	3.51 - 3.74		3.35	3.18 - 3.53			
No	4.13	4.09 - 4.17		3.72	3.56 - 3.88			
3-shift work			0.089			0.55	1	0.46
Yes	4.16	4.02 - 4.10		3.56	3.37 - 3.74			
No	4.06	4.05 - 4.28		3.52	3.36 - 3.67			
Self-reported sleep quality			<0.0001			22.02	2	<0.0001
Very good	4.38	4.30 - 4.45		3.74	3.56 - 3.92			
Good	4.05	4.05 - 4.14		3.53	3.36 - 3.69			
Poor	3.83	3.75 - 3.91		3.34	3.18 - 3.51			

[a] At least one chronic disease diagnosed by a physician, [b] Defined by Major Depression Inventory (MDI) diagnostic tool (DSM IV), [c] General Anxiety Disorder 7-item Scale (GAD-7), [d] General Anxiety Disorder 7-item Scale (GAD-7), moderate or severe anxiety, [e] Bergen Burnout Indicator 15 (BBI15), at least mild occupational stress, CI = Confidence Interval, DF = Degrees of freedom, EUROHIS = EUROHIS-QOL 8-item index

Work ability

Work ability was reported excellent by 15.2%, good by 64.9%, moderate by 16.1% and poor by 3.8% of the participants. The WAS mean score among all participants was 8.31 (SD 1.37), and the median was 9.0 (Q1:8.0, Q3:9.0). There was no difference in work ability between genders (p=0.11). In the univariate approach, work ability was positively associated with good sleep quality, younger age, lower BMI, university-level education, female gender, and 3-shift work, and negatively associated with disease burden, depression, anxiety and occupational stress.

In the multiway analysis of co-variance, work ability was positively associated with good sleep quality, younger age, lower BMI, and university-level education, and negatively associated with occupational stress and disease burden (Table 3).

Table 3

Factors associated with work ability in a univariate approach and in a multivariable model. WAS means/slope together with 95% CI are based on model estimates.

	Univariate			Multivariable				
	WAS estimate / slope	95% Confidence Interval	p-value	WAS model based estimate / slope	95% Confidence Interval	F-value	DF	p-value
Age	-0.019	(-0.029, -0.0090)	0.0002	-0.012	(-0.022, -0.0018)	5.34	1	0.021
Gender			0.027			3.36	1	0.067
Female	8.35	8.24 - 8.46		7.83	7.43 - 8.23			
Male	7.99	7.68 - 8.29		7.56	7.09 - 8.04			
Education			0.0079			4.74	2	0.0091
Vocational school	7.90	7.30 - 8.50		7.42	6.76 - 8.07			
College-level	8.18	8.04 - 8.32		7.70	7.32 - 8.09			
University-level	8.48	8.33 - 8.63		7.80	7.58 - 8.37			
Co-habiting			0.91			0.04	1	0.85
Yes	8.31	8.20 - 8.42		7.69	7.27 - 8.10			
No	8.30	8.06 - 8.53		7.71	7.26 - 8.18			
Smoking			0.19					
Yes	8.10	7.76 - 8.44						
No	8.33	8.23 - 8.44						
Harmful alcohol consumption			0.35					
Yes	8.43	8.18 - 8.40						
No	8.30	8.16 - 8.70						
Body mass index	-0.036	(-0.057, - 0.016)	0.0006	-0.023	(-0.042, -0.0041)	5.71	1	0.017
Disease burden[a]			<0.0001			12.23	1	0.0005
Yes	8.07	7.95 - 8.20		7.52	7.11 - 7.95			
No	8.77	8.60 - 8.93		7.87	7.44 - 8.30			
Depression[b]			0.0083					

Yes	7.11	6.22 - 8.01						
No	8.33	8.23 - 8.43						
Level of anxiety[c]			<0.0001					
No	8.55	8.44 - 8.66						
Mild	7.59	7.38 - 7.81						
Moderate	7.44	6.95 - 7.94						
Severe	8.00	7.03 - 8.97						
Depression and/or anxiety[bd]						1.73	2	0.17
No depression / No anxiety				8.02	7.72 - 8.31			
Only anxiety				7.67	7.07 - 8.27			
Depression and anxiety				7.41	6.57 - 8.25			
Occupational stress[e]			<0.0001			29.80	1	<0.0001
Yes	7.47	7.18 - 7.76		7.28	6.82 - 7.74			
No	8.47	8.37 - 8.57		8.12	7.70 - 8.54			
3-shift work			0.0040			3.75	1	0.053
Yes	8.74	8.43 - 9.05		7.84	7.36 - 8.33			
No	8.26	8.15 - 8.36		7.55	7.16 - 7.95			
Self-reported sleep quality			<0.0001			14.44	2	<0.0001
Very good	9.00	8.73 - 9.25		8.13	7.66 - 8.60			
Good	8.34	8.22 - 8.47		7.68	7.25 - 8.10			
Poor	7.80	7.59 - 8.00		7.29	6.86 - 7.72			

[a] At least one chronic disease diagnosed by a physician, [b] Defined by Major Depression Inventory (MDI) diagnostic tool (DSM IV), [c] General Anxiety Disorder 7-item Scale (GAD-7), [d] General Anxiety Disorder 7-item Scale (GAD-7), moderate or severe anxiety, [e] Bergen Burnout Indicator 15 (BBI15), at least mild occupational stress, CI= Confidence Interval, DF = Degrees of freedom, WAS = Work Ability Score

DISCUSSION

In this study, we managed to show that occupational stress, self-reported sleep quality, and disease burden were strongly associated with both QoL and work ability in public sector employees. In addition, QoL was tightly associated with BMI and depression and / or anxiety. To our knowledge, few studies have evaluated QoL and work ability simultaneously among apparently healthy, working-age individuals, with information about a wide range of factors potentially influencing these two variables.

Occupational stress was the factor most strongly associated with both QoL and work ability in this study. It is well known, that job strain is an important factor affecting employees' health and well-being.[3,27,28] Occupational stress is known to be associated, for example, with poor sleep quality [29], lower work ability [4] and mental health problems.[30] Furthermore, work stress was found to be associated with elevated mortality rates in patients with cardiometabolic disease in a large multicohort study.[31] Work stress has also been found to have a negative association with QoL in several studies.[3,27] The interesting finding in our study was that the association of occupational stress with QoL and WAS was strong, regardless of the fact that our study population had low rates of occupational stress. Only 10.6% of the participants in our study had at least mild occupational stress symptoms, and severe symptoms were very rare. It is thus possible that even low levels of occupational stress can have an important influence on a person's work ability and QoL. These results highlight the need for screening and handling of work stress among municipal employees.

Self-reported sleep quality was tightly associated with both QoL and work ability in this study. A negative association between poor sleep quality and QoL has previously been demonstrated among patients with sleep disorders and other medical conditions [32–35], and studies on shift workers have shown a clear association between sleep quality and QoL.[36,37] Furthermore, in a previous work on higher education students, Marques et al. showed that self-reported sleep quality remained a significant predictor of most aspects of QoL, regardless of the presence of psychopathological

symptoms, such as depression.[5] Sleep problems have in previous literature also been linked to poorer work ability and an increased rate of sickness absence.[38,39] In addition, Ng et al. have shown a positive association between good sleep quality and work ability among Hong Kong construction workers.[6] However, in this study we managed to show that self-reported sleep quality is significantly associated with both QoL and work ability among apparently healthy employees not restricted to a specific occupation and working mainly in regular morning shifts. The associations remained significant also in the multivariable models, where many potential confounding factors could be taken into account.

Disease burden, higher BMI and lower educational level were negatively associated with both QoL and work ability in this study, as well as in previous literature. Chronic diseases are known to have a negative association with QoL [1] and with work ability.[2,40] Lower BMI has been linked to better QoL [41] and to better work ability [42,43], and higher education has been positively associated with QoL [44] and with work ability.[45] In our study, as well as in previous literature, older age was associated with poorer work ability [42,46], but no significant association was found between age and QoL. This finding is consistent with the Finnish reference values for the EUROHIS-QOL 8-item index.[47] Furthermore, cohabiting had a significant positive association with QoL in our study, as has previously been observed in a population based study in Sweden.[48] Cohabiting has previously been linked to better health and work ability, for example, in an unemployed population [49], but in our setting, where only active work force was studied, there was no significant association between cohabiting and work ability.

An interesting finding in our study was that depression and / or anxiety was strongly associated with QoL but did not have a significant association with work ability in the multivariable model. Depression and anxiety are known to have a negative impact on QoL [50–52], but depression also affects a person's ability to work.[2,53] However, depression often leads to sickness absence, which means that these people are not in the active work force. In our study population, depression and

anxiety were relatively rare conditions, and most of the cases were mild. Only 9 (1.3%) of the participants met the diagnostic criteria for major depression and 33 (4.6%) of the participants where categorized as moderately or severely anxious. It is known that not all depressive patients consider themselves unable to work.[53] These patients may benefit from the schedule and routine of work life and do not want to seek sick leave, while depression still affects their QoL. In the Finnish Current Care Guidelines for depression, sick leave is not recommended in mild depression and the need for sick leave in moderate depression should be evaluated individually.[54] According to these recommendations, those depressive patients whose work ability is not affected should remain in the active work force. Furthermore, as the prevalence of depression and anxiety in our study population was low, the generalizability of these results can be questioned.

In this study, 3-shift work was not significantly associated either with QoL or with work ability in the multivariable models. In the univariate approach, the work ability of the 3-shift workers was better (p=0.0040), but no significant difference was seen in QoL. Somewhat surprisingly, 3-shift work did not seem to have any adverse effects on the participants' well-being in our study. There was no difference in sleep quality or occupational stress compared to the regular morning shift workers. Almost all 3-shift workers in our study were women working as nurses or social workers. Their mean age was 45.6 years, which is 3.5 years younger than the mean age of the whole study population. In addition to the younger age, one possible explanation for their well-being is that they may have voluntarily chosen to work in shifts and feel that it is a suitable way of working for them. Those shift workers who have had health problems or difficulties with sleep due to shift work may have changed to day work.[55] Another unexpected result in this work was that harmful alcohol consumption did not have adverse effects on sleep quality, QoL or work ability. However, even though there were 101 (14.2%) participants that fulfilled the definition of "harmful drinking" in the AUDIT-C, heavy drinking was very rare in this predominantly female, active work force population. We assume that these people may consume alcohol mainly during weekends, which diminishes the effects on everyday life and work.

We acknowledge some limitations of the study. We cannot determine the causality of the found associations because of the cross-sectional nature of the study. A possible healthy worker effect [56] can be present because only subjects in the active work force were studied. In addition, the initial response rate in the first part of the study in 2014 was only 32.5% (and 84.9% of them attended the study in 2015). It is known that response rates in e-mail surveys tend to be lower than in mail surveys [57], but it can nevertheless cause selection bias. It is possible that the healthiest part of the work force is also the most willing to attend voluntary health surveys, which may result in the possibility that our results reflect the situation in the mainly healthy section of the work force. However, the mean annual rate of sickness absence days did not vary significantly between the study participants and the non-participants on the included employment sectors. According to the records obtained from the city of Pori, the mean incidence of sickness absence days was 11 days per year among the study participants during the two year time period (2014 – 2015).[58] The mean sickness absence rate among all employees of the selected work units was 12 days according to the personnel report of the city of Pori in 2015. [59] The gender distribution in our study (89% females) resembles the distribution among employees of the city of Pori and is close to the gender distribution of the large Finnish prospective study on the public sector employees.[60] The information about alcohol consumption was collected by self-assessment, which may be influenced by social desirability. In addition, we unfortunately do not have data of possible menopausal symptoms, which may have affected our results in women.

The strengths of our study are that we could take into account several aspects associated with the employees' QoL and work ability. All questionnaires were completed by the participants at home before the examination was performed. In this study, the approaches to sleep quality, QoL and work ability were all subjective, which emphasizes the importance of personal experience in evaluating these factors. We assessed self-reported sleep quality and work ability with single questions. This approach was chosen over longer questionnaires because a single question could also be used at a normal physician's appointment in primary or occupational health care for the evaluation of these

factors. The self-reported sleep quality question we used was from the Pittsburgh Sleep Quality Index (PSQI), and it has previously been shown to be closely related with QoL.[5] With this question we showed a clear association of sleep quality with QoL and with work ability. However, it would be interesting to further assess this connection in a similar population with a more detailed questionnaire to determine whether the different components of sleep have different impacts on QoL and work ability. The WAS score we used for the evaluation of work ability has been shown to have a strong association with the Work Ability Index and is reliable in evaluating work ability.[61] WAS has also been shown to predict disability pension and long-term sickness absence according to a Finnish register-based study.[62] The associations of self-reported sleep quality with both QoL and with work ability were clear and in line with previous literature even when studied with these simple tools.

CONCLUSIONS

In this paper we showed that occupational stress and self-reported sleep quality are strongly associated with both QoL and work ability among Finnish public sector employees. According to our results, even a low level of occupational stress has a significant negative association with QoL and work ability. These findings highlight the need for screening and handling work stress and sleep problems in occupational and primary health care. We suggests that short, self-reported assessment tools could be used for this purpose.

CONTRIBUTORS

EB, EL, SM, PR and PK contributed to the conception or design of the work, and to the acquisition, analysis or interpretation of data for the work. EB and PK drafted the manuscript. All authors critically revised the manuscript, gave final approval, and agreed to be accountable for all aspects of work ensuring integrity and accuracy.

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DECLARATION OF COMPETING INTERESTS

The authors declare that they have no competing interests.

ETHICAL APPROVAL

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The study protocol and consent forms were reviewed and approved by the Ethics Committee of the Hospital District of Southwest Finland (ETMK 43/180/2013).

INFORMED CONSENT

Written informed consent was obtained from all individual participants included in the study.

AVAILABILITY OF DATA

The datasets used and/or analysed during the current study are available from the corresponding author on request.

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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported
Objectives	3	State specific objectives, including any prespecified hypotheses
Methods		
Study design	4	Present key elements of study design early in the paper
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9	Describe any efforts to address potential sources of bias
Study size	10	Explain how the study size was arrived at
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding
		(*b*) Describe any methods used to examine subgroups and interactions
		(*c*) Explain how missing data were addressed
		(*d*) If applicable, describe analytical methods taking account of sampling strategy
		(*e*) Describe any sensitivity analyses
Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		(b) Give reasons for non-participation at each stage
		(c) Consider use of a flow diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest
Outcome data	15*	Report numbers of outcome events or summary measures
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
		(*b*) Report category boundaries when continuous variables were categorized
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses

Discussion		
Key results	18	Summarise key results with reference to study objectives
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	21	Discuss the generalisability (external validity) of the study results
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.