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Original research article

Assessing the quality of life of shift-working nurses based on their chronotypes

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Abstract
Introduction: Nurses' quality of life (QoL) may be influenced by chronotype, reflecting individual circadian preferences.
Objective: To assess the agreement between subjective chronotype perception and MEQ classification, examine associations with age, gender, and shift work, validate the Czech NQOLS, and evaluate the effects of chronotype and ward type on QoL.
Methods: A single-center cross-sectional study was conducted among nurses from several departments of a Czech university hospital. Chronotype was assessed using the Morningness-Eveningness Questionnaire and QoL using the NQOLS.
Results: A strong association was found between subjective chronotype perception and MEQ classification (χ^2 = 280.613; p < 0.001), with higher accuracy in morning types. Chronotype was significantly associated with age, showing increased morningness after 30 years (χ^2 = 39.402; p < 0.001), while gender and night shifts showed no effect. Factor analysis confirmed seven reliable NQOLS dimensions (α = 0.693–0.881). The highest QoL scores were in the social domain and the lowest in sleep. Chronotype significantly affected only sleep quality (p < 0.001). ICU nurses reported lower emotional, work-related and social QoL than nurses in other wards.
Conclusion: The study confirms strong agreement between perceived and measured chronotype, an age-related shift toward morningness, lower QoL among ICU nurses, and very good reliability of the Czech NQOLS.

Keywords: Chronotype; Morningness-Eveningness Questionnaire; Nurse; Nursing quality of life scale; Quality of life

Introduction

Nurses are an essential part of the healthcare system as they provide continuity of care, health promotion, and direct patient care at all stages of the treatment process. Although their role is irreplaceable, nursing is considered one of the most stressful professions. Prolonged exposure to job-related stressors can adversely impact nurses' physical and mental health, reducing their overall quality of life and occupational well-being (Babapour et al., 2022). A review of quality-of-life assessment tools reveals a wide range of questionnaires adapted to different populations and health conditions. Currently, more than 1,000 tools are available to measure health-related quality of life, many of which have been developed specifically to assess patients with chronic diseases (Fičko et al., 2022). While research in this area has mostly focused on populations with various diseases, studies involving healthy individuals, including the working population, are rather sparse. Nurses are a specific group of healthcare workers who are continuously exposed to psychologically challenging situations, particularly contact with human suffering and death. The nursing profession is associated with high emotional demands that can negatively affect nurses' quality of life (Babapour et al., 2022).

Although night shifts are known to be detrimental to human health, they are an inevitable part of work in many professions, including nursing. However, people's responses to night work can vary considerably depending – among other things – on their chronotype, or their individual preference for daytime activity and sleep. Research shows that individuals with an evening chronotype tolerate circadian rhythm disruptions caused by night shifts better than those with a morning chronotype (Ritonja et al., 2019). Yet, the evening chronotype is also associated with adverse health outcomes, including higher overall mortality (Knutson and von Schantz, 2018), a higher incidence of psychiatric disorders (Jones et al., 2019), and an increased risk of cardiometabolic diseases (Yu et al., 2015). Thus, chronotype appears to be an important factor influencing how disruption of circadian rhythms due to shift work impacts an individual's health and quality of life.

The aim of this prospective study was to explore the relationship between nurses' subjective perception of their chronotype and their chronotype as assessed by a validated questionnaire, and to examine whether chronotype is associated with selected demographic and work-related characteristics, including age, gender, and shift type. Furthermore, the study aimed to evaluate the psychometric properties of the Nursing Quality of Life Scale (NQOLS) in a sample of Czech nurses and

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to determine whether individual dimensions of quality of life differ according to chronotype or shift type.

Materials and methods

Design

A single-center cross-sectional study was performed.

Sample

The study was conducted from March to May of 2025. The sample consisted of participants from various departments of University Hospital Brno in the Czech Republic. The inclusion criteria were working as a general nurse, being at least 18 years old, and having one or more years of experience. The exclusion criteria were failing to answer questions that verify the inclusion criteria, holding a position other than general nurse, and refusing to participate in the study.

Sample size estimation

To determine the required sample size, the following formula suitable for cross-sectional studies was used: $(Z\alpha/2)^2 \times p \times (1\text{-}p)/d^2$. Assuming a 95% confidence interval (Z = 1.96), an estimated prevalence of the phenomenon of interest of 50% (p = 0.5), and a maximum allowable absolute estimation error of 4.1% (d = 0.041), the required sample size is approximately 550 participants. The value of p = 0.5 was chosen deliberately as a conservative estimate in situations where the actual prevalence of the studied phenomenon is unknown, as this value maximizes variability and, hence, the sample size required. This procedure follows the recommendations for sample size calculation in medical research (Charan and Biswas, 2013).

Measurement and data collection

Nurses from selected departments were invited to participate in the study. A total of 598 questionnaires were returned, of which 17 were excluded due to being insufficiently or incorrectly completed. Several questionnaires were filled out by hospital employees other than general nurses, and some were completed by nurses reporting less than one year of nursing experience; once again, these were excluded from the sample. In the end, 581 nurses were included in the study. The first part of the questionnaire contained 12 items addressing the participants' work schedules, lifestyles, and basic demographic information. Participants reported the amount of overtime worked in the last month and answered questions about caffeinated beverage consumption (frequency during the workday) and nicotine product use (regular/occasional/none). They also specified their current position (inpatient/outpatient ward nurse, head nurse, etc.), work schedule (fixed/rotational shifts, 12-hour day shifts), and employment type (full-time/part-time). Other information collected included years of nursing experience, presence of chronic diseases (hypertension, diabetes mellitus, etc.), age, gender, and highest level of education attained (secondary, bachelor's/master's degree, postgraduate).

Tools used

The *Morningness-Eveningness Questionnaire* (MEQ) is a 19-item self-assessment tool designed to identify a person's chronotype. For most questions, the respondent must choose just one option from four possible answers. Questions 1, 2, 10, and 18 are structured differently; instead of offering four options, the respondent is given a timeline on which to mark a specific time of day. Similarly, Question 17 offers a timeline. Here, however, the respondent is asked to mark the five consecutive work hours that best align with their perceived daily rhythms. The MEQ is evaluated by scoring individual items. Once again, the scoring is not uniform, but varies according to the type of question. Questions 1, 2, 10, 17, and 18 are scored 1–5; Questions 3, 4, 5, 6, 7, 8, 9, 13, 14, 15, and 16 are scored 1–4; Questions 11 and 19 are scored 0, 2, 4, or 6; finally, Question 12 is scored 0, 2, 3, or 5. The total score is obtained by adding the points assigned to each answer. The minimum score is 16 points, and the maximum is 86 points. The total score corresponds to one of five categories (86–70: definitely morning type; 69–59: moderately morning type; 58–42: neither type; 41–31: moderately evening type; 30–16: definitely evening type) (Horne and Ostberg, 1976). Permission to use a Czech version of the questionnaire was obtained directly from its author (Plháková, 2013).

The *Nursing Quality of Life Scale* (NQOLS) was used to assess nurses' quality of life. The scale contains 28 items divided into four domains: physical (eight items), emotional (eight items), working (six items), and social (six items). Respondents rate their satisfaction on a 4-point Likert scale: 1 = very dissatisfied, 2 = dissatisfied, 3 = satisfied, and 4 = very satisfied. A higher mean score indicates a better quality of life. The original version of the NQOLS was requested from the author (Sili et al., 2022) and translated and adapted (Wild et al., 2005). The process was broken down into the following steps: (1) forward translation from English to Czech language by two independent professional translators, resulting in a final Czech version, and (2) backward translation. Pilot testing was performed on 10 nurses in a selected hospital; these participants were not included in the study population.

Ethical aspects

The study was conducted in accordance with the Declaration of Helsinki and was approved by the Ethics Committee of the University Hospital Brno (No. 15 – 111224/EK). All participants gave their written informed consent and could withdraw from the study at any time without facing any penalties. Every participant in the study was an adult, aged at least eighteen years. Participants did not receive any financial or non-financial incentives.

Data analysis

To identify chronotypes, participants working as nurses were classified into categories using a Morningness-Eveningness Questionnaire. The NQOLS construct was validated by exploratory factor analysis using the Kaiser–Meyer–Olkin test of sampling adequacy and Bartlett's test of sphericity. Factors were extracted using principal components analysis with varimax rotation, resulting in seven scales that were assessed for internal consistency using Cronbach's alpha. The scales were tested for normality of distribution with the Shapiro–Wilk test, with data showing non-normal distributions. Therefore, nonparametric Spearman's correlation analysis (rho) was used to determine the dependencies among the scales. Pearson's chi-squared test of independence analysed the relationships between chronotype and categorical characteristics. Differences in NQOLS scale scores between groups were tested using nonparametric Mann–Whitney and Kruskal–Wallis tests. All statistical analyses were performed at a 5% significance level using IBM SPSS Statistics software version 27 (IBM Corp., Armonk, NY, USA).

Results

Most of the participants were women with a secondary education. Nurses were most often full-time employees working rotational shifts in inpatient wards (Table 1). As age increased, the proportion of morning chronotypes increased, while the proportion of intermediate and evening types decreased. Among nurses under 30 years of age, 79% were intermediate types and only 10% were morning types. This percentage rose to around 43% in older groups. The evening type was only minimally represented, with the highest proportion in the youngest group (10%). A chi-squared test confirmed a significant association between age and chronotype (χ^2 = 39.402; df = 6; p < 0.001), with age around 30 years representing the threshold for significant change in chronotype. Comparing chronotypes by sex revealed no statistically significant differences (χ^2 = 2.629; df = 2; p = 0.269). The analysis of the relationship between chronotype and working night shifts also did not yield statistically significant results (χ^2 = 4.222; df = 2; p = 0.121) (Table 2).

Table 1. Sample characteristics

Variable and Category	Absolute frequency (%)	Mean (SD)
Gender		
Men	29 (5)	
Women	552 (95)	
Age		
Under 30 years	91 (15.9)	
30–39 years	134 (23.4)	
40–49 years	194(33.9)	
50 or more years	153 (26.7)	
Education		
Secondary	284 (49.1)	
Bachelor's degree	216 (37.3)	
Master's degree / postgraduate	79 (13.6)	
Caffeine consumption (work days		
Yes	522 (89.8)	2.2 (1.1)
No	59 (10.2)	
Nicotine product use		
Regular	98 (16.8)	
Occasional	83 (14.2)	
None	402 (69.0)	
Position		
Nurse – inpatient ward	359 (61.8)	
Nurse – outpatient ward	170 (29.2)	
Head nurse	52 (9.0)	
Type of workplace		
ICU nurses	322 (55.4)	
General Ward nurses	178 (30.6)	
Ambulatory nurses	81 (14.0)	
Work schedule		
8-hour shifts	199 (34.2)	
12-hour rotational shifts	364 (62.5)	
12-hour day shifts	19 (3.3)	
Employment type		
Full-time (40 hrs/week)	420 (72.3)	
Part-time (30 hrs/week)	97 (16.7)	
Part-time (20 hrs/week)	52 (9.0)	
Part-time (10 hrs/week or less)	8 (1.4)	
Overtime (last month)		
No	238 (41.7)	
1–20 hrs	218 (38.2)	
>20 hrs	115 (20.1)	
		10.4 (12.0)
Work experience		
<10 years	149 (25.8)	
10–19 years	148 (25.6)	
20–29 years	154 (26.6)	
30 or more years	127 (22.0)	
Chronic disease		
Yes	166 (28.5)	
No	416 (71.5)	

There was a statistically significant association between the subjective perception of one's own chronotype and the objective classification using a validated methodology (χ^2 = 280.613; df = 6; p < 0.001). The subjective identification of a morning chronotype showed high agreement with the objective classification, with 89% of participants who rated themselves as "definitely morning" (n = 97) being actually classified as a morning type. On the other hand, the evening type tended to be overrated. For example, in the "definitely evening" group (n = 39), only 5% (n = 2) were objectively classified as evening types, while the majority (70%; n = 27) fell into the intermediate category (Chart 1). To examine the relationship between objectively classified chronotype and subjective self-assessment, Kendall's tau-c was used. The result showed a moderately strong relationship between the two variables (tau-c = –0.499; p < 0.001). This statistically significant finding proves that the subjective perception of being a morning person shows a higher degree of agreement with the objective classification than the perception of being an evening type, which is often overrated.

An exploratory factor analysis conducted according to the NQOLS methodology first identified four factors corresponding to the tool's four basic scales (i.e., emotional, physical, working, and social), which together explained 52.4% of the overall variability. Given the relatively low explained variability, a subsequent factor analysis was performed using a latent root criterion greater than one (i.e., eigenvalue >1). This analysis resulted in the extraction of seven factors that explained 65.7% of the variability. In addition to the original four factors, three new domains were identified that can be interpreted as separate scales focusing on nutrition, sexuality, and sleep (Table 3). Assessing the internal consistency of the seven NQOLS scales revealed their good-to-excellent reliability. The emotional scale (F1) had the highest Cronbach's alpha, at 0.881. This was followed by the sexual (F6; α = 0.880), nutritional (F5; α = 0.864), social (F3; α = 0.811), physical (F4; α = 0.816), and working (F2; α = 0.806) scales. The lowest value was observed for the sleep scale (F7; α = 0.693), though the reliability level was still acceptable. The overall internal consistency of all NQOLS items was very high (α = 0.905), confirming the overall reliability of the tool. Spearman's correlation analysis was used to examine the relationships between the NQOLS scales and the total score. Statistically significant positive correlations (p < 0.001) were found between all scales and the total score, with the strongest relationship observed for the emotional scale (rho = 0.769), followed by the physical (rho = 0.633) and social (rho = 0.620) scales. There were mostly weak to moderate statistically significant (p < 0.001) correlations between the scales. The strongest correlations were between the physical and nutritional scales (rho = 0.498), the work and social scales (rho = 0.460), and the emotional and physical scales (rho = 0.403) (Table 4).

Table 2. Chronotypes by gender, age, and work schedule

Variable and Category	Morning type, *n* (%)	Neither type, *n* (%)	Evening type, *n* (%)	*P*-value
Gender				
Men	12 (41.0)	14 (47.3)	3 (11.7)	$p = 0.269$
Women	218 (38.6)	279 (56.2)	28 (5.2)	
Age				
Under 30 years	9 (10.1)	70 (79.6)	9 (10.3)	
30–39 years	58 (42.7)	69 (53.7)	4 (3.6)	**$p < 0.001$**
40–49 years	82 (43.5)	91 (48.6)	12 (7.9)	
50 years or older	67 (44)	78 (53)	5 (3)	
Work schedule				
Rotational shifts	130 (34.6)	216 (59.7)	18 (5.7)	$p = 0.121$
Day shifts	82 (43.6)	92 (51.0)	16 (5.4)	

Note: n – absolute number, (%) – percentage

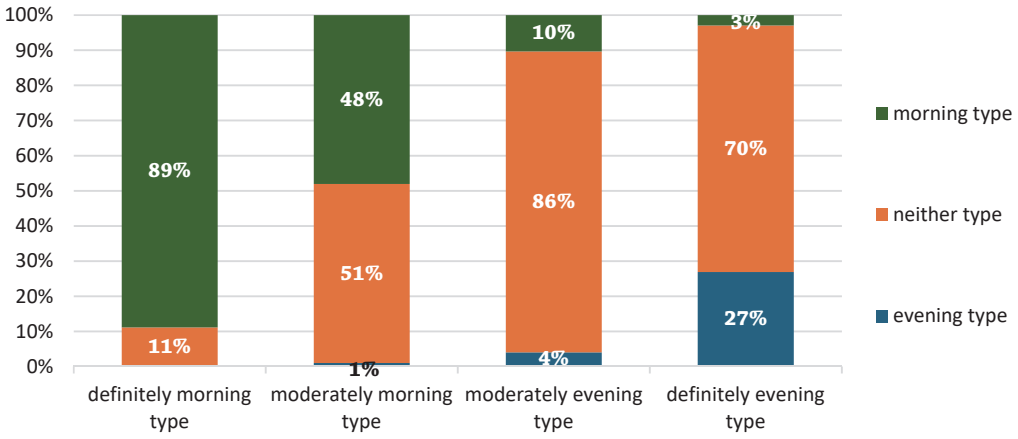

Chart 1. Objectively classified vs. subjectively perceived chronotypes

Table 3. Factor structure of the Nursing Quality of Life Scale and the proportions of explained variability

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
Satisfaction with one's emotional stability	0.795						
Satisfaction with one's mental efficiency	0.743						
Satisfaction with one's resistance in stressful situations	0.705						
Satisfaction with one's self-confidence	0.672						
Satisfaction with one's psychological autonomy	0.662						
Satisfaction with one's ability to solve problems	0.661						
Satisfaction with one's mood	0.653						
Satisfaction with one's capacity for self-control	0.633						
Satisfaction with one's professional role		0.854					
Satisfaction with one's type of work		0.840					
Satisfaction with what one is doing at work		0.811					
Satisfaction with how one's work is organized		0.673					
Satisfaction with one's financial situation		0.320					
Satisfaction with one's relationships with relatives			0.809				
Satisfaction with one's relationships with friends			0.771				
Satisfaction with one's family role			0.757				
Satisfaction with one's relationships			0.605				
Satisfaction with one's relationships with work colleagues		0.375	0.480				
Satisfaction with one's level of physical activity				0.855			
Satisfaction with one's physical mobility skills				0.849			
Satisfaction with one's physical well-being				0.630	0.351		
Satisfaction with one's image and physical appearance				0.507	0.420		
Satisfaction with the quality of one's nutrition					0.841		
Satisfaction with one's eating habits					0.837		

Table 3. *(continued)*

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
Satisfaction with the frequency of one's sexual relations						0.896	
Satisfaction with the quality of one's sexual relations						0.880	
Satisfaction with the amount of sleep one gets							0.829
Satisfaction with the quality of one's sleep							0.806
Eigenvalue	8.243	2.923	1.853	1.655	1.399	1.258	1.066
% of variance	29.439	10.438	6.618	5.910	4.996	4.493	3.808

Note: F1 – emotional scale, F2 – working scale, F3 – social scale, F4 – physical scale, F5 – nutritional scale, F6 – sexual scale, F7 – sleep scale

Table 4. Correlation matrix of the Nursing Quality of Life Scale

		Emotional scale	Physical scale	Working scale	Social scale	Nutritional scale	Sexual scale	Sleep scale	NQOLS
Emotional scale (F1)	Spearman's rho	1.000							
	N	576							
Physical scale (F2)	Spearman's rho	0.403*	1.000						
	N	573	579						
Working scale (F3)	Spearman's rho	0.362*	0.177*	1.000					
	N	574	577	580					
Social scale (F4)	Spearman's rho	0.392*	0.176*	0.460*	1.000				
	N	574	577	579	580				
Nutritional scale (F5)	Spearman's rho	0.299*	0.498*	0.140*	0.133*	1.000			
	N	575	579	579	579	582			
Sexual scale (F6)	Spearman's rho	0.273*	0.279*	0.213*	0.290*	0.251*	1.000		
	N	570	571	572	572	574	575		
Sleep scale (F7)	Spearman's rho	0.259*	0.289*	0.234*	0.169*	0.295*	0.133*	1.000	
	N	575	578	579	579	581	574	582	
NQOLS	Spearman's rho	0.769*	0.633*	0.588*	0.620*	0.529*	0.477*	0.452*	1.000
	N	563	563	563	563	563	563	563	563

Note: * statistically significant correlations at a significance level of $p = 0.001$, NQOLS – Nursing Quality of Life Scale

Analysis of the distribution of values for the individual NQOLS dimensions revealed that participants predominantly assessed their quality of life positively. The highest mean score was observed for the social scale (M = 3.20; SD = 0.46), indicating high satisfaction with social relationships. The working and sexual scales also received positive ratings. Emotional well-being was rated moderately positively (M = 2.85; SD = 0.45). Ambivalent attitudes were evident for the physical, nutritional, and sleep scales. The greater variance and wider interquartile ranges suggest inconsistent perceptions of these aspects of quality of life among participants. The overall quality of life score (M = 2.86; SD = 0.34) indicates a fairly high level of life satisfaction among the study participants (Table 5).

Table 5. Quality of Life Scales

Quality of Life Scales	Mean (SD)	Median (IQR)	Min–Max
Emotional scale (F1)	2.85 (0.45)	3.00 (2.63–3.00)	1.75–3.75
Physical scale (F2)	2.59 (0.56)	2.75 (2.25–3.00)	1.25–4.00
Working scale (F3)	3.00 (0.46)	3.00 (2.80–3.20)	1.80–3.80
Social scale (F4)	3.20 (0.46)	3.20 (3.00–3.60)	2.00–4.00
Nutritional scale (F5)	2.59 (0.67)	2.50 (2.00–3.00)	1.00–4.00
Sexual scale (F6)	2.90 (0.73)	3.00 (2.50–3.00)	1.00–4.00
Sleep scale (F7)	2.57 (0.63)	2.50 (2.00–3.00)	1.00–4.00
Overall quality of life	2.86 (0.34)	2.90 (2.68–3.04)	2.00–3.60

Note: IQR – Interquartile range

NQoL domain scores differed among ICU nurses, general ward nurses, and ambulatory nurses (Table 6), with statistically significant differences observed in the emotional ($p = 0.028$), work-related ($p < 0.001$), and social ($p = 0.013$) domains. Higher emotional and work-related scores were found among general ward and ambulatory nurses (Me = 3.00) compared with ICU nurses (Me = 2.88), while the highest social domain score was observed in ambulatory nurses (Me = 3.40). No significant differences were identified in the physical, nutritional, sexual, or sleep domains, nor in the overall NQoL score ($p = 0.164$).

Table 6. Median scores of Quality of Life Domains (NQoL) according to type of workplace

	Emotional scale	Physical scale	Working scale	Social scale	Nutritional scale	Sexual scale	Sleep scale	NQOLS
ICU nurses	2.88	2.50	3.00	3.00	3.00	3.00	2.50	2.86
General Ward nurses	3.00	2.50	3.00	3.00	2.50	3.00	2.50	2.86
Ambulatory nurses	3.00	2.50	3.00	3.40	2.50	3.00	2.50	2.89
Asymp. Sig.*	**0.028****	**0.174**	**0.000****	**0.013****	0.823	0.608	0.501	0.164

Note: * Kruskal–Wallis test, statistically significant difference at a significance level of 5%, NQOLS – Nursing Quality of Life Scale

A statistically significant difference between chronotypes was found only for the sleep scale ($p < 0.001$). For all other scales, including the total NQOLS score, the differences between chronotypes were not statistically significant ($p > 0.05$) (Table 7). Analysis of differences in NQOLS scale scores between participants who also worked night shifts and those worked only day shifts revealed only slight differences that were not statistically significant (all $p > 0.05$). Therefore, overall, working at night did not significantly impact subjectively perceived quality of life or any of the assessed scales.

Table 7. Mean Quality of Life Scores by chronotype for NQOLS dimensions

	Emotional scale	Physical scale	Working scale	Social scale	Nutritional scale	Sexual scale	Sleep scale	NQOLS
Evening type	2.88	2.50	3.00	3.00	2.50	3.00	2.00	2.79
Neither type	2.88	2.50	3.00	3.20	3.00	3.00	2.50	2.86
Morning type	2.88	2.75	3.00	3.00	3.00	3.00	3.00	2.89
Asymp. Sig.*	0.677	0.756	0.647	0.242	0.997	0.453	**0.000***	0.259

Note: * Kruskal–Wallis test, statistically significant difference at a significance level of 5%, NQOLS – Nursing Quality of Life Scale

Discussion

The study yielded several interesting findings. First, the results revealed a statistically significant relationship between subjectively perceived chronotype and its objective classification according to a validated methodology. While participants generally correctly recognized morning types, they were more likely to subjectively overrate evening types. Second, the proportion of morning types increased with age, while the proportion of intermediate and evening types decreased. Age around 30 appears to be a threshold for significant chronotype change. Third, the Czech version of the NQOLS identified seven quality-of-life scales: emotional, physical, working, social, nutritional, sexual, and sleep. These scales showed good to excellent internal consistency. Fourth, quality-of-life ratings among nurses were predominantly positive. The social scale was the highest rated domain, while the greatest differences were found for the physical, nutritional, and sleep scales. Results also indicate that the type of workplace influences nurses' emotional, work-related, and social quality of life, with ICU nurses experiencing lower scores in these domains compared with general ward and ambulatory nurses. Only the sleep scale showed a statistically significant effect of chronotype, whereas night shifts did not significantly affect quality of life as assessed by the NQOLS.

The correlation between the subjective perception of one's chronotype and its classification using a questionnaire varied considerably in accuracy from person to person. Participants generally correctly identified morning types, but evening types were more likely to be overrated subjectively. These findings are consistent with previous studies highlighting a bias in chronotype self-assessment. People tend to overrate their evening type, possibly due to social and cultural factors that shape expectations about ideal sleep-wake patterns (Kantermann et al., 2007; Roenneberg et al., 2003). A Brazilian study examining chronotypes in adults using the MEQ and actigraphy identified three distinct chronotypes based on objective sleep parameters. The results showed that actigraphy reliably distinguished between morning, evening, and intermediate types, proving useful in assessing circadian preferences (Matuzaki et al., 2014).

Chronotypes have a dynamic nature that changes throughout life depending on age. Generally, the proportion of morning types increases with age, while evening and intermediate chronotypes are more common during adolescence and early adulthood. The age of around 30 appears to be a significant turning point when circadian preferences stabilize and subsequently shift toward a morning pattern (Kalra and Kour, 2025; Randler, 2008). This trend was confirmed by the present study, in which younger participants of all chronotypes reported later bedtimes than their older counterparts, likely due to

age-related changes in sleep-wake regulation. This age-related variability in chronotypes is supported by the available evidence. It was those with the morning type who showed the most significant change in bedtime over the lifespan. Linear regression analysis revealed a statistically significant negative correlation between age and bedtime across chronotypes ($p < 0.0001$). For example, the mean bedtime for morning types shifted from 23:38 at age 20 to 22:29 at age 80 ($\beta = -0.019$, SE = 0.002, $p < 0.00001$), illustrating a gradual shift of their circadian rhythm toward earlier activity with increasing age Gottlieb et al., 2022).

Original validation of the NQOLS (Sili et al., 2022) confirmed its four-scale structure, which encompasses physical, emotional, working, and social quality of life. All scales exhibited high internal consistency (omega = 0.84–0.92) and excellent model fit indices (CFI = 0.969; RMSEA = 0.055). This structure was confirmed in another study (Yousefnezhad et al., 2024), which identified the aforementioned four scales. The explained variability was 62%, and the reliability of each scale was very good (Cronbach's alpha = 0.81–0.89). Contrary to these findings, the present study, which used exploratory factor analysis, identified another three scales reflecting nutrition, sexuality, and sleep, in addition to the original four. More detailed factor distributions resulted in a 13.3% increase in explained variability (from 52.4% to 65.7%), and the overall internal consistency across all items was very high (Cronbach's alpha = 0.905). This suggests that the structure of the NQOLS scales may be more complex in different population samples than originally anticipated and highlights the importance of including additional domains to better identify the specific needs and aspects of quality of life of specific groups of healthcare workers.

The results of this study indicate that lower emotional, work-related, and social quality of life scores among ICU nurses can be understood in the context of the demanding nature of critical care environments. ICU nurses operate under sustained stress, high workloads, and frequent exposure to life-threatening situations, which have been linked to elevated levels of burnout and reduced well-being. A recent multicenter study found a high prevalence of burnout among ICU nurses, with a significant inverse relationship between burnout and multiple dimensions of quality of life, underscoring how psychological strain in these settings detrimentally affects nurses' overall well-being and life experience (Villagracia et al., 2025). These observations align with the idea that the structure of the NQoL scales may be more complex across different professional groups than originally anticipated. They also highlight the importance of including additional context-specific domains to better identify the unique needs and quality-of-life aspects of nurses working in high-intensity clinical environments.

Our findings suggest that chronotype does not have a statistically significant effect on overall quality-of-life scores, nor does shift work lead to a decrease in NQOLS scores. However, this contradicts several earlier studies that reported a link between the evening chronotype and lower quality of life and poorer sleep quality in shift-working nurses. A Turkish study of 267 nurses found that evening chronotypes were associated with more night shifts and lower quality of life than morning and intermediate chronotypes (Bülbül et al., 2023). Another study on Spanish nurses confirmed circadian rhythm disruption along with shift work characteristics significantly influences nurses' health and quality of sleep. Shift work was moderately positively correlated with overall health status ($r = 0.337$) and perceived quality of life ($r = 0.426$) (Debbia et al., 2021). A recent study (Weng and Chang, 2025) found that chronotype significantly influences the relationship between shift type and nurses' sleep quality. While morning and intermediate chronotypes showed better sleep quality when working day and evening shifts, evening types were better adapted to night shifts. These findings are complemented by a robust study (de Bruijn et al., 2025) that showed the evening chronotype to be associated with a 51% higher likelihood of working night shifts, as well as longer cumulative exposure to rotational shifts (8.3 vs. 5.1 years). Differences between our findings and those from previous studies may stem from differences in methods, sample characteristics, or the organization of rotational shifts.

Limitations of the study

The present study has several limitations that must be considered when interpreting the results. First, the single-center design of the study, which was conducted in only one Czech teaching hospital, limits the generalizability of the findings to other healthcare facilities. Since the MEQ and NQOLS tools used are based on subjective self-assessment, it would be appropriate to include objective chronotype measurements, such as those obtained through actigraphy. Another limitation is the non-inclusion of important variables, such as stress level or the level of workplace-related psychological burden. Additionally, data were only collected during the spring (March to May), which may have affected participants' perception of their daily rhythms or sleep due to changes in natural light. The results are only valid for nurses and cannot be generalized to other healthcare professionals, such as doctors or auxiliary staff.

Recommendations

- The results of the study underscore the significance of taking nurses' chronotypes into account when scheduling shifts, especially for those over 30 years old, to enhance sleep quality and overall well-being.
- The validated Czech version of the NQOLS is a reliable tool for assessing the quality of life of nurses in both clinical practice and research.
- Working in intensive care appears to be associated with a lower perceived quality of life among nurses.
- Although shift type (day vs. night shifts) did not significantly impact quality of life, the significant association between chronotype and sleep-related quality-of-life dimensions suggests that individualized scheduling strategies could be beneficial.
- Hospital management should use these findings to tailor schedules and support programs to department-specific demands, particularly in ICUs, by considering chronotype, workload, and stress levels to optimize nurses' well-being and performance.

Conclusion

The results confirmed that participants' perceptions of their chronotypes were highly consistent with chronotypes identified by the MEQ; this was particularly true for morning types. After age 30, participants shifted significantly towards the morning chronotype in their daily preferences. Participants rated the Czech version of the NQOLS as consistent across all seven quality-of-life dimensions. Most nurses viewed their quality of life positively, with the highest scores in the social functioning domain. Nurses working in intensive care units perceive their quality of life as lower than nurses in other clin-

ical settings. Neither chronotype nor shift pattern had a statistically significant effect on the overall quality-of-life score as assessed by the NQOLS; however, there was a significant relationship between chronotype and the sleep scale.

Author contributions

Hana Locihová: conceptualization, methodology, data curation, formal analysis, writing – review and editing, project administration, funding acquisition, supervision. *Kateřina Greplová:* conceptualization, methodology, data curation, formal analysis, visualization, writing – the original draft. *Jiřina Hosáková:* formal analysis, investigation, funding acquisition, writing – review & editing, supervision. *Monika Pačísková:* data curation, formal analysis, writing – original draft, visualization. All authors have read and approved the submitted manuscript.

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Ethical approval

The study was conducted in accordance with the Declaration of Helsinki and was approved by the Ethics Committee of the University Hospital Brno (No. 15 – 111224/EK). All participants gave their written informed consent and could withdraw from the study at any time without facing any penalties. Every participant in the study was an adult, aged at least eighteen years. Participants did not receive any financial or non-financial incentives.

Data sharing statement

Data supporting the results reported in this manuscript will be made available by the corresponding author upon reasonable request.

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Conflict of interest

The authors have no conflict of interest to declare.

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