Original Article

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Upper Extremity Pain, Disability, Sleep Quality, and Professional Quality of Life Among Healthcare Workers Delivering Physical Therapy Modalities: A Cross-sectional Study

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Abstract

Aim: Healthcare workers delivering physical therapy modalities perform repetitive hand–arm movements under static loading, yet they are usually studied together with physiotherapists. This study aimed to evaluate the relationships among neck and upper extremity pain, upper extremity disability, sleep quality, and professional quality of life in this workforce.

Methods: This single-center, cross-sectional study was conducted between January 2024 and May 2024 at a tertiary training and research hospital; 65 healthcare workers delivering physical therapy modalities were analyzed. Pain, disability, sleep quality, and professional quality of life were assessed with the Numeric Rating Scale, QuickDASH, Pittsburgh Sleep Quality Index, and Professional Quality of Life Scale. Spearman correlation, with false discovery rate correction, and multivariable linear regression were used.

Results: Mean age was 27.8±8.9 years and 80.0% were female. The median pain score was 4 for both regions, and 58.5% had poor sleep quality. Upper extremity pain was correlated with disability (r=0.769) and with sleep quality (r=0.562). Pain, professional experience, sleep quality, and inappropriate posture were independent correlates of disability (adjusted R^2=0.665), whereas pain and shorter sleep duration were independent correlates of sleep quality (adjusted R^2=0.363).

Conclusion: Pain intensity was most consistently associated with both disability and sleep quality, whereas cumulative exposure and posture, rather than the modality applied, distinguished participants. An ergonomic review of the working day, combined with a brief sleep screen, may be warranted for this workforce.

Keywords: Occupational diseases, musculoskeletal diseases, upper extremity, sleep quality, burnout professional, physical therapy modalities

Introduction

Work-related musculoskeletal disorders (WRMSDs) are among the most frequent occupational health problems in healthcare; recent evidence syntheses place their burden at the upper end of the occupational spectrum. A 2025 meta-analysis of 40 studies involving 19,903 nurses reported a pooled prevalence of 84.3% [95% confidence interval (CI) 81.1-87.4], with the neck and shoulder being among the three most affected regions (1). Additionally, a continental meta-analysis of 68 studies involving 17,188 surgeons published in the same year reported pooled prevalences ranging from 62.8% to 77.6% depending on the region (2). Among physiotherapists, a global meta-analysis of 26 studies reported prevalences of 35.4% for the thumb, 26.4% for the neck, 20.8% for the shoulder, and 18.1% for the wrist and hand (3), and a study of physiotherapists in Madrid found that 98% reported at least one musculoskeletal symptom within the previous 12 months (4). Across these syntheses the risk factors are

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consistent: repetitive hand-arm movements, sustained static and non-neutral postures, insufficient recovery between tasks, and high workload intensity (5,6).

Healthcare workers whose daily work involves delivering physical therapy modalities—ultrasound, transcutaneous electrical nerve stimulation (TENS), extracorporeal shock wave therapy (ESWT), shortwave diathermy, and infrared therapy—have an exposure profile that differs from that of physiotherapists because their working day is composed almost entirely of short, repeated device applications with limited task variation. Despite this distinction, they are almost always pooled with physiotherapists rather than analyzed separately, and data specific to this group remain scarce (4). Upper extremity pain in this setting is unlikely to be an isolated peripheral problem: a systematic review with meta-analysis has established a bidirectional relationship between sleep problems and chronic musculoskeletal pain (6), sleep quality has been proposed as a mediator of work-related musculoskeletal discomfort (7), and a recent pilot study using the Pittsburgh Sleep Quality Index (PSQI) documented clinically relevant sleep impairment in rehabilitation staff (8). To our knowledge, no study has examined whether pain, upper extremity disability, sleep quality, and professional quality of life covary in this workforce, and which of these variables carry independent weight.

We hypothesized that, in this occupational group, higher intensity of upper extremity and neck pain would be associated with greater upper extremity disability and poorer sleep quality, and that psychosocial burden—characterized by higher burnout and compassion fatigue together with lower compassion satisfaction—would be independently associated with both outcomes after adjustment for pain and occupational exposure. The aim of this study was, therefore, to evaluate the relationships among upper extremity and neck pain, upper extremity disability, sleep quality, and professional quality of life, and to identify the independent correlates of disability and sleep quality among healthcare workers delivering physical therapy modalities. By distinguishing the variables that carry independent weight from those that do not, this study may help inform the design of targeted preventive programs in which ergonomic measures and psychosocial support are directed at the factors that matter for this workforce.

Materials and Methods

Compliance with Ethical Standards

This study was approved by the University of Health Sciences Türkiye, Bakirkoy Dr. Sadi Konuk Training and Research Hospital Clinical Research Ethics Committee (approval number: 2023-15-15, date: 07.08.2023). Data were collected at Istanbul Physical Medicine and Rehabilitation Training and Research Hospital. The study was conducted in accordance with the principles of the Declaration of Helsinki as revised in 2013, and written informed consent was obtained from all participants before data collection. All data for this study were collected primarily through self-administered questionnaires; no routinely recorded or retrospectively retrieved clinical data were used. The authors declare no conflict of interest, and the study received no financial support. The study was designed, conducted, and reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement for cross-sectional studies (9).

Study Design

This single-center, cross-sectional, observational study was conducted between January 2024 and May 2024 at the University of Health Sciences Türkiye, Istanbul Physical Medicine and Rehabilitation Training and Research Hospital. The unit operated on a fixed daytime schedule during the study period, and all staff worked day shifts only. The flow of participants from the eligible workforce to the analyzed sample is presented in Figure 1.

Participants

Personnel aged between 18 and 65 years who had been actively delivering physical therapy modalities for at least six months were eligible for participation. Individuals with a history of cancer, rheumatological disease, or neurological disease, those who had experienced major upper extremity trauma or undergone surgery within the previous three months, pregnant individuals, and those using psychiatric medications known to affect sleep were excluded from the study. All eligible personnel working in the unit during the study period were invited consecutively; 65 provided written informed consent and completed all questionnaires. The total number of eligible personnel employed during the study period could not be retrieved retrospectively; consequently, the participation rate could not be calculated, and volunteer bias could not be excluded, as acknowledged in the study limitations. All participants held the same clinical role within the physical therapy unit and applied the same range of therapeutic modalities; they differed only in educational background (two-year versus four-year higher-education programs). There were no missing data, and all analyses were carried out on the full sample of 65 participants.

Data Collection

During data collection, participants completed a structured questionnaire assessing sociodemographic characteristics, including age, sex, marital status, height, weight, smoking and alcohol use, years of professional experience, weekly working hours, and self-reported sleep duration. Body mass index was calculated from recorded height and weight. Sleep duration was recorded in ordinal bands: 1-4 hours, 5-6 hours, 7-8 hours, or more than 9 hours. For each of the five modalities routinely used in clinical practice—ultrasound, TENS, infrared therapy, shortwave diathermy, and ESWT—use was recorded as a binary variable based on participants' self-reports. Self-reported mean daily application time was recorded only for ultrasound and ESWT using ordinal bands (0-30 min, 30 min-1 h, 1-2 h, 2-3 h, 3-4 h, 4-5 h, or more than 5 h); no duration data were collected for TENS, infrared therapy, or shortwave diathermy. Participants also reported whether they took rest breaks during work, whether they remained in the same position for prolonged periods, and whether they maintained an appropriate body posture while working.

Assessment Tools

Upper extremity function was assessed using the QuickDASH questionnaire, an 11-item instrument evaluating functional difficulties, symptom severity, and the impact of upper extremity symptoms on daily activities (10). Scores range from 0 to 100, with higher scores indicating greater disability. The optional four-item work module was administered in addition to the main scale and was scored on the same 0-100 metric. The Turkish version of the QuickDASH has been shown to be valid and reliable (11).

Sleep quality was measured using the PSQI, which evaluates seven components: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction (12). Each component is scored from 0 to 3 and the global score ranges from 0 to 21; a global score greater than 5 indicates poor sleep quality. For the global score and for each component, higher scores denote poorer sleep. The Turkish validity and reliability study of the PSQI was conducted by Ağargün et al. (13).

Professional quality of life was assessed using the Turkish version of the Professional Quality of Life Scale, Revision IV (ProQOL R-IV) (14,15). The instrument comprises 30 self-report items that form three independent 10-item subscales—compassion satisfaction, burnout, and compassion fatigue—with each item rated on a six-point frequency scale ranging from 0 (never) to 5 (very often), giving subscale scores between 0 and 50. Items 1, 4, 15, 17, and 29 are reverse scored. The subscales are evaluated separately, and no total score is calculated. Higher compassion satisfaction scores indicate a more positive professional experience, whereas higher burnout and

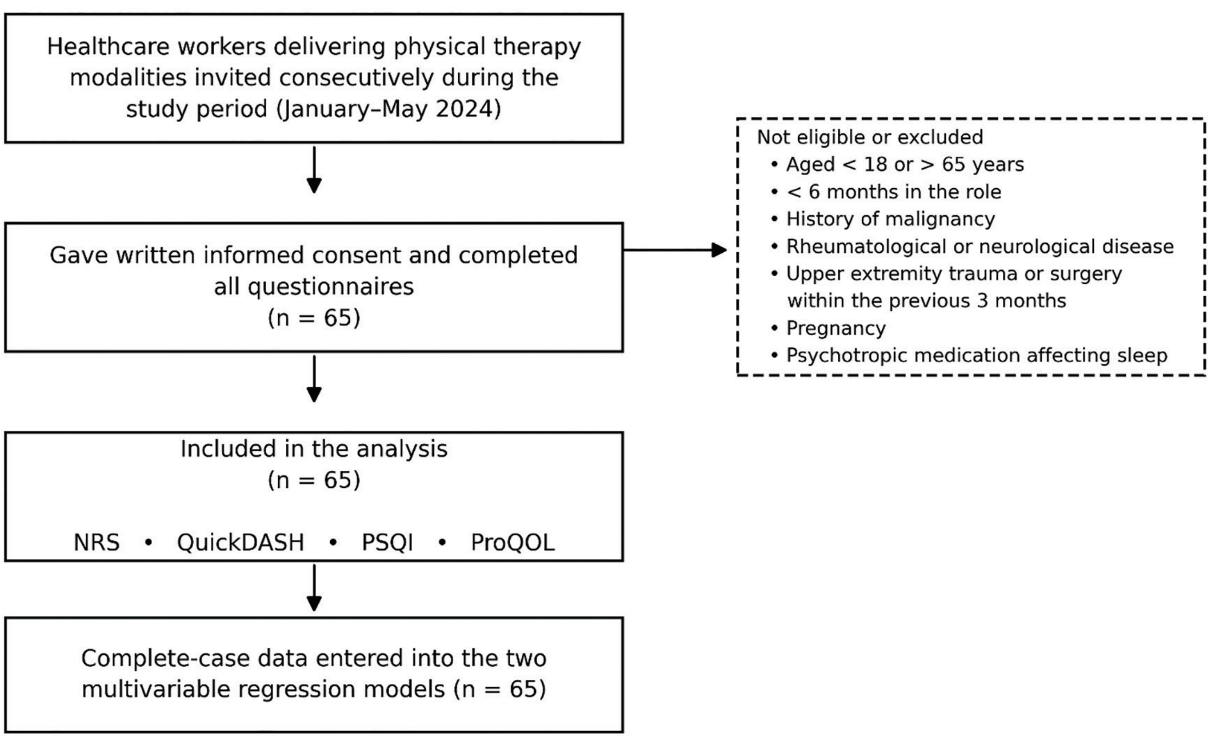

Figure 1. Flow of participants through the study
NRS: Numeric Rating Scale, PSQI: Pittsburgh Sleep Quality Index, ProQOL: Professional Quality of Life Scale, QuickDASH: Quick disabilities of the arm, shoulder and hand questionnaire

compassion fatigue scores indicate greater psychosocial burden. In the Turkish validation study, Cronbach's alpha coefficients were 0.82 for compassion satisfaction, 0.62 for burnout, and 0.84 for compassion fatigue (15).

Pain intensity was assessed using the Numeric Rating Scale (NRS), an 11-point integer scale ranging from 0 to 10, where 0 represented "no pain" and 10 represented "the most severe pain imaginable". Participants rated their mean pain intensity over the previous week separately for the upper extremity and the neck.

Statistical Analysis

Statistical analyses were performed using SPSS version 22.0 (IBM Corp., Armonk, NY, USA). The distribution of continuous variables was assessed using the Shapiro-Wilk test and visual inspection of histograms and Q-Q plots. Normally distributed variables are presented as mean ± standard deviation and non-normally distributed variables as median interquartile range (IQR); categorical variables are presented as frequency and percentage. Group comparisons were conducted using the independent samples t-test or the Mann-Whitney U test, depending on the data distribution. The chi-square test was used for categorical variables. Correlations were evaluated using the Spearman rank test; for dichotomous variables, this is equivalent to the point-biserial coefficient, and coding directions are given in the table footnotes. To control for multiple testing, the Benjamini-Hochberg false discovery rate correction was applied within each correlation table at q=0.05, and both unadjusted p values and adjusted q values are reported (16). Two-sided p-values below 0.05 were considered statistically significant.

Two multivariable linear regression models were constructed using the enter method, with the QuickDASH score and the PSQI global score as dependent variables. Candidate predictors were selected based on clinical relevance and bivariate associations at p<0.10; to limit overfitting, the number of predictors was capped at five per model, resulting in 13 participants per predictor. Neck pain and age were not entered because of collinearity with upper extremity pain (rho=0.66) and with years of professional experience (rho=0.85), respectively. Initial analysis showed that the residuals of the QuickDASH model were not normally distributed (Shapiro-Wilk p<0.001). A square-root transformation was applied to the dependent variable, correcting the distribution (p=0.136). The assumptions of linear regression, including normality of residuals, homoscedasticity, multicollinearity, and independence of observations, were assessed using residual plots and Q-Q plots, the Shapiro-Wilk test, the Durbin-Watson statistic, and variance inflation factor (VIF) and tolerance values. Cook's distance was used to screen for influential observations. Model fit was assessed using the F test, R^2, and adjusted R^2. Regression coefficients are reported as unstandardized B (with 95% CIs), standard errors, standardized β coefficients, t values, and p-values.

Since the sample size was limited to the available workforce at the study center, a post-hoc power analysis was performed using G*Power 3.1 (17). With 65 participants and a two-sided alpha of 0.05, the study had 80% power to detect a correlation of r≥0.34, which corresponds to a medium effect. For a regression model with five predictors, the same sample could detect an effect of $f^2 \geq 0.22$ ($R^2 \approx 0.18$). Each model included 13 participants per predictor, which is above the conventional minimum of ten. The study was therefore sensitive to moderate and large effects, whereas it may have been underpowered to detect weaker associations.

Results

Demographic and Occupational Characteristics

A total of 65 healthcare workers who delivered physical therapy modalities were analyzed. Their demographic and occupational characteristics are given in Table 1, and the modalities they applied, together with daily application durations, are given in Table 2. The mean age was 27.8±8.9 years (median 26, IQR 23-29; range 18-54). Fifty-two participants (80.0%) were female, and 30 participants (46.2%) had completed a four-year higher education program. The median duration of professional experience was 2 years (IQR 2-6; range 1-36) and the median weekly working time was 40 hours (range 24-45). Thirty-two participants (49.2%) reported sleeping 5-6 hours per night, another 32 (49.2%) reported 7-8 hours, and one participant (1.5%) reported sleeping 1-4 hours per night. Rest breaks during work were reported by 57 participants (87.7%), while 48 (73.8%) said they worked in the same position for prolonged periods, and only 31 (47.7%) said they maintained an appropriate body posture. The median NRS score was 4 for both upper extremity pain (IQR 2-5) and neck pain (IQR 3-6); both had a range of 1-9. Thirty-eight participants (58.5%) had a PSQI global score above 5, indicating poor sleep quality.

Bivariate Associations with Disability and Sleep Quality

Pain intensity was the variable most consistently associated with both outcome domains. Every association reported in this paragraph remained significant after correction for multiple testing (Table 3). Upper extremity pain correlated with the QuickDASH score (r=0.769), the QuickDASH work module score (r=0.764), and the PSQI global score (r=0.562). It was also associated with five PSQI components: subjective sleep quality (r=0.458), use of sleep medication (r=0.434), daytime dysfunction (r=0.433), sleep disturbances (r=0.420), and sleep latency

Table 1. Demographic and occupational characteristics of the participants (n=65)

Variable	Category	Value
Age (years)		27.8±8.9; median 26 (23-29); range 18-54
Sex, n (%)	Female	52 (80.0)
	Male	13 (20.0)
Marital status, n (%)	Married	21 (32.3)
	Single	44 (67.7)
Body mass index (kg/m^2)[a]		23.7±3.8
Educational attainment, n (%)	Two-year higher education program	35 (53.8)
	Four-year higher education program	30 (46.2)
Smoking, n (%)	Never	43 (66.2)
	Occasionally	15 (23.1)
	Frequently	7 (10.8)
Alcohol use, n (%)	Never	58 (89.2)
	Occasionally	6 (9.2)
	Frequently	1 (1.5)
Pain intensity (NRS, 0-10), median (IQR)	Upper extremity	4 (2.0-5.0); range 1-9
	Neck	4 (3.0-6.0); range 1-9
Self-reported sleep duration, n (%)	1-4 hours	1 (1.5)
	5-6 hours	32 (49.2)
	7-8 hours	32 (49.2)
Years of professional experience, median (IQR)		2 (2-6); range 1-36
Weekly working hours, median (IQR)		40 (40-40); range 24-45
Rest breaks during work, n (%)	Yes	57 (87.7)
	No	8 (12.3)
Prolonged working in the same position, n (%)	Yes	48 (73.8)
	No	17 (26.2)
Maintaining appropriate body posture, n (%)	Yes	31 (47.7)
	No	34 (52.3)
QuickDASH score, median (IQR)		17.5 (6.0-31.2)
QuickDASH work module score, median (IQR)		12.5 (6.2-31.2)
PSQI global score, median (IQR)		6 (4-9.0)
Poor sleep quality (PSQI >5), n (%)		38 (58.5)
ProQOL compassion satisfaction, median (IQR)		37 (31-44.0)
ProQOL burnout, median (IQR)		14 (9-19.0)
ProQOL compassion fatigue, median (IQR)		10 (5-19.0)

[a]Body mass index was calculated from the recorded height and weight values. Normality was assessed with the Shapiro-Wilk test. Normally distributed variables are presented as mean ± standard deviation, non-normally distributed variables as median (interquartile range), and categorical variables as n (%)
IQR: Interquartile range, NRS: Numeric Rating Scale, ProQOL: Professional Quality of Life Scale, PSQI: Pittsburgh Sleep Quality Index, QuickDASH: Quick disabilities of the arm, shoulder and hand questionnaire

(r=0.325). Neck pain followed the same pattern for the QuickDASH score (r=0.659), the work module (r=0.642), the PSQI global score (r=0.479), subjective sleep quality (r=0.417), sleep disturbances (r=0.423), and daytime dysfunction (r=0.430), but not for sleep latency. Since higher PSQI scores denote poorer sleep, these positive coefficients indicate that greater pain was associated with worse sleep across all affected components.

Among the occupational and behavioral variables, longer professional experience was associated with greater use of sleep medication (r=0.459, q=0.001) and with a higher QuickDASH score (r=0.325, q=0.040). Participants

Table 2. Physical therapy modalities applied and daily application durations (n=65)

Variable	Category	n (%)
Modality applied	Ultrasound	59 (90.8)
	TENS	59 (90.8)
	Infrared therapy	59 (90.8)
	ESWT	13 (20.0)
	Shortwave diathermy	35 (53.8)
Daily ultrasound application time	Not applied	6 (9.2)
	0-30 min	3 (4.6)
	30 min - 1 h	5 (7.7)
	1-2 h	35 (53.8)
	2-3 h	14 (21.5)
	3-4 h	1 (1.5)
	4-5 h	1 (1.5)
Daily ESWT application time	Not applied	52 (80.0)
	0-30 min	2 (3.1)
	30 min - 1 h	2 (3.1)
	1-2 h	4 (6.2)
	2-3 h	3 (4.6)
	3-4 h	2 (3.1)

Values are presented as n (%). Participants could apply more than one modality, so percentages do not sum to 100. Ultrasound, TENS, and infrared therapy were applied by exactly the same 59 participants, so these three variables are mathematically identical and are analyzed as a single variable in Table 4. Daily application time was recorded only for ultrasound and ESWT, and as ordinal bands rather than continuous minutes
ESWT: Extracorporeal shock wave therapy, TENS: Transcutaneous electrical nerve stimulation

who did not maintain an appropriate working posture reported higher QuickDASH scores (r=0.374, q=0.013), and longer sleep duration was associated with a lower PSQI global score (r=-0.350, q=0.022). Weekly working hours, rest breaks, and prolonged working in the same position showed no association with any outcome once multiple testing was accounted for (Table 3).

Professional quality of life was linked to both outcomes in the expected directions (Table 3). Compassion fatigue correlated with the QuickDASH score (r=0.512), sleep disturbances (r=0.479), use of sleep medication (r=0.467) and the QuickDASH work module (r=0.419), all at q≤0.003. Burnout correlated with the QuickDASH score (r=0.368, q=0.014) and with the use of sleep medication (r=0.318, q=0.046). Neither subscale retained a significant association with the PSQI global score after correction; none of the associations involving compassion satisfaction remained significant.

With respect to the modalities, ultrasound, TENS, and infrared therapy were applied by exactly the same participants and were therefore analyzed as a single variable. No association between the use of any modality (or its daily application time) and any outcome remained significant after false discovery rate correction (Table 4). Likewise, none of the associations between sociodemographic variables and the outcomes survived correction; the associations shown in Table 5 are exploratory and hypothesis-generating.

Factors Independently Associated with Disability and Sleep Quality

In the model for upper extremity disability, four variables were independently associated with a higher square-root–transformed QuickDASH score: upper extremity pain (B=0.476, 95% CI 0.285 to 0.667; β=0.46, p<0.001); inappropriate working posture (B=0.854, 95% CI 0.171 to 1.537; β=0.19, p=0.015); the PSQI global score (B=0.166, 95% CI 0.034 to 0.299; β=0.22, p=0.015); and years of professional experience (B=0.051, 95% CI 0.009 to 0.094; β=0.20, p=0.019). Compassion fatigue was not independently associated with disability (p=0.114). The model explained 69% of the variance [R^2=0.691, adjusted R^2=0.665, F(5, 59)=26.37, p<0.001]. Residuals met the assumptions of linearity, homoscedasticity, and normality (Shapiro-Wilk p=0.136). The Durbin-Watson statistic was 1.81, the maximum Cook's distance was 0.212, and all VIFs remained below 1.7, with tolerance values above 0.60 (Table 6).

In the model for sleep quality, upper extremity pain (B=0.521, 95% CI 0.226 to 0.816; β=0.39, p<0.001) and shorter self-reported sleep duration (B=-1.648, 95% CI -2.767 to -0.530; β=-0.30, p=0.005) were the only independent correlates of the PSQI global score. Burnout (p=0.240), compassion fatigue (p=0.581), and educational background (p=0.217) were not significant. This model explained 41% of the variance (R^2=0.412, adjusted R^2=0.363, F(5, 59)=8.28, p<0.001). Assumption checks and collinearity diagnostics are reported in Table 7.

Participants who had completed a four-year program reported higher QuickDASH scores than those who had completed a two-year program (median 21.7 versus 14.2, p=0.018) and higher PSQI global scores (median 8.0 versus 6.0, p=0.033). The same group was also considerably older and more experienced (both p<0.001); therefore, the difference is confounded by cumulative occupational exposure rather than being attributable to education itself.

Discussion

This study simultaneously examined upper extremity and neck pain, upper extremity disability, sleep quality, and professional quality of life in an occupational group that has rarely been studied in its own right. Three findings stand out. First, pain intensity was the dominant correlate of both outcome domains and remained independently associated with both disability and sleep quality after

Table 3. Correlations between pain, work-related factors, professional quality of life, sleep quality, and upper extremity disability (n=65)

Part A. Sleep quality (PSQI global score and components)

Variable		PSQI global	PSQI subjective sleep quality	PSQI sleep latency	PSQI sleep duration	PSQI habitual sleep efficiency
Upper extremity pain (NRS)	r	0.562	0.458	0.325	0.045	0.205
	p	<0.001	<0.001	0.008	0.720	0.102
	q	<0.001	0.001	0.040	0.870	0.249
Neck pain (NRS)	r	0.479	0.417	0.199	0.059	0.104
	p	<0.001	<0.001	0.111	0.639	0.410
	q	<0.001	0.003	0.250	0.847	0.644
Self-reported sleep duration	r	-0.350	-0.256	-0.235	-0.305	-0.032
	p	0.004	0.040	0.059	0.013	0.801
	q	0.022	0.125	0.159	0.056	0.914
Years of professional experience	r	0.135	0.065	0.013	0.052	-0.012
	p	0.282	0.606	0.918	0.683	0.923
	q	0.509	0.844	0.949	0.847	0.949
Weekly working hours	r	0.028	0.088	-0.020	0.038	-0.053
	p	0.822	0.485	0.876	0.766	0.676
	q	0.914	0.720	0.932	0.906	0.847
Taking rest breaks during work	r	-0.034	0.041	0.010	-0.051	-0.130
	p	0.789	0.747	0.935	0.684	0.302
	q	0.913	0.893	0.952	0.847	0.526
Prolonged working in the same position	r	-0.057	-0.005	-0.049	-0.140	-0.095
	p	0.651	0.966	0.696	0.266	0.449
	q	0.847	0.975	0.850	0.505	0.686
Maintaining appropriate body posture	r	0.125	0.137	0.068	0.092	0.136
	p	0.323	0.276	0.589	0.464	0.280
	q	0.530	0.509	0.830	0.700	0.509
ProQOL-compassion satisfaction	r	-0.251	-0.128	-0.236	-0.101	0.132
	p	0.043	0.310	0.058	0.422	0.294
	q	0.129	0.526	0.159	0.653	0.522
ProQOL-burnout	r	0.304	0.203	0.145	0.126	-0.196
	p	0.014	0.105	0.248	0.316	0.117
	q	0.056	0.249	0.479	0.526	0.258
ProQOL-compassion fatigue	r	0.303	0.239	0.013	-0.003	-0.175
	p	0.014	0.055	0.916	0.978	0.163
	q	0.056	0.158	0.949	0.978	0.346

Part B. Sleep quality (continued) and upper extremity disability

Variable		PSQI sleep disturbances	PSQI use of sleep medication	PSQI daytime dysfunction	QuickDASH	QuickDASH work module
Upper extremity pain (NRS)	r	0.420	0.434	0.433	0.769	0.764
	p	<0.001	<0.001	<0.001	<0.001	<0.001
	q	0.003	0.003	0.003	<0.001	<0.001
Neck pain (NRS)	r	0.423	0.282	0.430	0.659	0.642
	p	<0.001	0.023	<0.001	<0.001	<0.001
	q	0.003	0.085	0.003	<0.001	<0.001

Table 3. Continued

Part B. Sleep quality (continued) and upper extremity disability

Variable		PSQI sleep disturbances	PSQI use of sleep medication	PSQI daytime dysfunction	QuickDASH	QuickDASH work module
Self-reported sleep duration	r	-0.230	0.051	-0.306	0.025	-0.054
	p	0.066	0.686	0.013	0.842	0.671
	q	0.172	0.847	0.056	0.914	0.847
Years of professional experience	r	0.224	0.459	-0.085	0.325	0.281
	p	0.073	<0.001	0.500	0.008	0.023
	q	0.186	0.001	0.729	0.040	0.085
Weekly working hours	r	0.117	0.276	-0.127	0.165	0.164
	p	0.353	0.026	0.314	0.189	0.193
	q	0.563	0.093	0.526	0.381	0.381
Taking rest breaks during work	r	0.064	-0.036	-0.055	0.025	-0.080
	p	0.615	0.777	0.661	0.843	0.528
	q	0.846	0.909	0.847	0.914	0.754
Prolonged working in the same position	r	-0.031	0.238	-0.117	-0.024	0.019
	p	0.807	0.056	0.352	0.848	0.881
	q	0.914	0.158	0.563	0.914	0.932
Maintaining appropriate body posture	r	0.084	-0.026	0.053	0.374	0.251
	p	0.503	0.836	0.676	0.002	0.044
	q	0.729	0.914	0.847	0.013	0.129
ProQOL-compassion satisfaction	r	-0.163	-0.184	-0.202	-0.170	-0.200
	p	0.194	0.142	0.106	0.177	0.110
	q	0.381	0.305	0.249	0.367	0.250
ProQOL-burnout	r	0.269	0.318	0.272	0.368	0.265
	p	0.030	0.010	0.028	0.003	0.033
	q	0.100	0.046	0.097	0.014	0.107
ProQOL-compassion fatigue	r	0.479	0.467	0.214	0.512	0.419
	p	<0.001	<0.001	0.087	<0.001	<0.001
	q	<0.001	0.001	0.216	<0.001	0.003

r: Spearman rank correlation coefficient; p: unadjusted two-sided p value; q: Benjamini-Hochberg false discovery rate-adjusted p-value computed within this table. Higher PSQI and QuickDASH scores denote poorer sleep and greater disability, respectively. Dichotomous variables were coded 1= yes, 2= no (taking rest breaks, prolonged working in the same position, maintaining appropriate body posture); sleep duration was coded as an ordinal band (1= 1-4 h to 4= >9 h). A positive coefficient for maintaining appropriate body posture therefore indicates that participants who did NOT maintain an appropriate posture reported greater disability
NRS: Numeric Rating Scale, ProQOL: Professional Quality of Life Scale, PSQI: Pittsburgh Sleep Quality Index, QuickDASH: Quick disabilities of the arm, shoulder and hand questionnaire

adjustment. Second, the variables that carried independent weight for disability were cumulative rather than task-specific: years of professional experience and failure to maintain an appropriate working posture, with the latter reported by almost half of the sample. Third, psychosocial burden was clearly associated with both outcomes at the bivariate level, but it was not independently associated with either outcome once pain and workload were accounted for.

The association between pain and upper extremity disability is consistent with evidence from comparable healthcare settings. The upper extremity is among the most frequently affected regions in physiotherapists (4), and prolonged hand-arm use has been linked to musculoskeletal complaints in operating room nurses (18). Our data add a quantitative gradient within a single workforce delivering device-based treatments: the correlation between pain intensity and QuickDASH was the strongest association in the entire dataset, and pain alone accounted for the largest share of explained variance in the regression model. This supports the view that repetitive manual tasks and device-based applications

Table 4. Correlations between physical therapy modalities, application durations, sleep quality, and upper extremity disability (n=65)

Part A. Sleep quality (PSQI global score and components)

Variable		PSQI global	PSQI subjective sleep quality	PSQI sleep latency	PSQI sleep duration	PSQI habitual sleep efficiency
Use of ultrasound/TENS/infrared therapy	r	-0.068	0.119	-0.075	-0.313	-0.395
	p	0.589	0.345	0.552	0.011	0.001
	q	0.755	0.571	0.755	0.188	0.056
Use of ESWT	r	0.278	0.018	0.167	0.254	0.193
	p	0.025	0.887	0.183	0.041	0.124
	q	0.188	0.964	0.381	0.188	0.282
Use of shortwave diathermy	r	0.030	-0.019	-0.006	-0.244	0.028
	p	0.814	0.879	0.962	0.050	0.828
	q	0.940	0.964	0.982	0.201	0.940
Daily ultrasound application time	r	0.069	0.035	0.073	-0.104	-0.264
	p	0.587	0.781	0.564	0.409	0.034
	q	0.755	0.930	0.755	0.638	0.188
Daily ESWT application time	r	0.263	-0.002	0.168	0.256	0.212
	p	0.035	0.988	0.181	0.040	0.091
	q	0.188	0.988	0.381	0.188	0.266

Part B. Sleep quality (continued) and upper extremity disability

Variable		PSQI sleep disturbances	PSQI use of sleep medication	PSQI daytime dysfunction	QuickDASH	QuickDASH work module
Use of ultrasound/TENS/infrared therapy	r	0.273	0.136	-0.147	-0.069	-0.155
	p	0.028	0.282	0.244	0.582	0.218
	q	0.188	0.521	0.469	0.755	0.435
Use of ESWT	r	0.117	0.226	0.235	0.256	0.297
	p	0.354	0.071	0.060	0.039	0.016
	q	0.571	0.221	0.201	0.188	0.188
Use of shortwave diathermy	r	0.199	-0.121	0.129	-0.046	-0.052
	p	0.111	0.338	0.304	0.715	0.683
	q	0.282	0.571	0.543	0.872	0.853
Daily ultrasound application time	r	0.198	0.202	0.010	-0.008	-0.091
	p	0.114	0.107	0.934	0.947	0.471
	q	0.282	0.282	0.982	0.982	0.714
Daily ESWT application time	r	0.085	0.193	0.234	0.237	0.287
	p	0.498	0.123	0.060	0.058	0.021
	q	0.733	0.282	0.201	0.201	0.188

r: Spearman rank correlation coefficient; p: unadjusted two-sided p value; q: Benjamini-Hochberg false discovery rate-adjusted p-value computed within this table. Higher PSQI and QuickDASH scores denote poorer sleep and greater disability, respectively. Modality use was coded 0= not used, 1= used; application time was coded as an ordinal band (0= not applied to 6= 4-5 h). No association in this table remained significant after false discovery rate correction; these analyses are exploratory and hypothesis-generating

ESWT: Extracorporeal shock wave therapy, PSQI: Pittsburgh Sleep Quality Index, QuickDASH: Quick disabilities of the arm, shoulder and hand questionnaire, TENS: Transcutaneous electrical nerve stimulation

Table 5. Correlations between sociodemographic variables, sleep quality, and upper extremity disability (n=65)

Part A. Sleep quality (PSQI global score and components)

Variable		PSQI global	PSQI subjective sleep quality	PSQI sleep latency	PSQI sleep duration	PSQI habitual sleep efficiency
Age	r	0.094	0.062	0.026	0.038	-0.022
	p	0.458	0.621	0.838	0.764	0.864
	q	0.763	0.861	0.943	0.932	0.943
Sex	r	-0.120	-0.050	-0.007	-0.101	-0.051
	p	0.343	0.691	0.953	0.422	0.684
	q	0.713	0.909	0.981	0.741	0.909
Height	r	-0.114	-0.099	-0.015	0.006	0.014
	p	0.365	0.434	0.903	0.962	0.914
	q	0.713	0.748	0.952	0.981	0.952
Weight	r	-0.083	-0.041	0.039	-0.068	0.153
	p	0.513	0.748	0.757	0.593	0.224
	q	0.778	0.932	0.932	0.847	0.691
Marital status	r	-0.146	-0.150	0.001	-0.056	0.020
	p	0.245	0.231	0.994	0.658	0.877
	q	0.691	0.691	0.994	0.890	0.943
Educational attainment	r	0.267	0.274	0.141	0.022	0.179
	p	0.032	0.027	0.262	0.864	0.154
	q	0.334	0.334	0.705	0.943	0.614
Smoking status	r	-0.185	-0.175	-0.094	0.003	0.145
	p	0.139	0.163	0.458	0.980	0.249
	q	0.599	0.628	0.763	0.989	0.691
Smoking amount	r	0.157	0.109	0.083	0.024	-0.153
	p	0.212	0.386	0.511	0.851	0.223
	q	0.691	0.729	0.778	0.943	0.691
Alcohol use	r	-0.064	0.086	-0.184	-0.028	0.121
	p	0.614	0.493	0.142	0.824	0.339
	q	0.861	0.771	0.599	0.943	0.713
Alcohol amount	r	0.068	-0.087	0.185	0.028	-0.120
	p	0.591	0.490	0.139	0.824	0.339
	q	0.847	0.771	0.599	0.943	0.713

Part B. Sleep quality (continued) and upper extremity disability

Variable		PSQI sleep disturbances	PSQI use of sleep medication	PSQI daytime dysfunction	QuickDASH	QuickDASH work module
Age	r	0.114	0.412	-0.137	0.374	0.319
	p	0.367	<0.001	0.275	0.002	0.010
	q	0.713	0.065	0.705	0.094	0.238
Sex	r	-0.041	0.092	-0.264	-0.113	-0.232
	p	0.747	0.468	0.033	0.371	0.063
	q	0.932	0.767	0.334	0.713	0.422
Height	r	-0.015	-0.102	-0.172	-0.133	-0.218
	p	0.906	0.418	0.171	0.290	0.080
	q	0.952	0.741	0.633	0.713	0.473

Table 5. Continued

Part B. Sleep quality (continued) and upper extremity disability

Variable		PSQI sleep disturbances	PSQI use of sleep medication	PSQI daytime dysfunction	QuickDASH	QuickDASH work module
Weight	r	0.020	-0.061	-0.247	-0.156	-0.130
	p	0.874	0.628	0.048	0.214	0.302
	q	0.943	0.861	0.340	0.691	0.713
Marital status	r	-0.183	-0.255	-0.027	-0.307	-0.292
	p	0.144	0.041	0.832	0.013	0.018
	q	0.599	0.340	0.943	0.257	0.259
Educational attainment	r	0.210	0.365	0.080	0.297	0.222
	p	0.093	0.003	0.527	0.016	0.076
	q	0.515	0.094	0.786	0.259	0.473
Smoking status	r	-0.204	-0.252	-0.138	0.023	0.074
	p	0.103	0.043	0.272	0.859	0.559
	q	0.540	0.340	0.705	0.943	0.822
Smoking amount	r	0.191	0.250	0.103	-0.024	-0.088
	p	0.127	0.045	0.412	0.849	0.487
	q	0.599	0.340	0.741	0.943	0.771
Alcohol use	r	-0.107	0.148	-0.041	0.123	0.131
	p	0.397	0.240	0.749	0.329	0.297
	q	0.735	0.691	0.932	0.713	0.713
Alcohol amount	r	0.115	-0.148	0.046	-0.116	-0.126
	p	0.363	0.241	0.716	0.358	0.316
	q	0.713	0.691	0.930	0.713	0.713

r: Spearman rank correlation coefficient; p: unadjusted two-sided p-value; q: Benjamini-Hochberg false discovery rate-adjusted p-value computed within this table. Higher PSQI and QuickDASH scores denote poorer sleep and greater disability, respectively. Categorical variables were coded as follows: sex, 1= female, 2= male; marital status, 1= married, 2= single; educational background, 2= two-year higher education program, 4= four-year higher education programme; smoking status and alcohol use, 1= yes, 2= no; smoking and alcohol amount, 0= never, 1= occasionally, 2= frequently. No association in this table remained significant after false discovery rate correction; these analyses are exploratory and hypothesis-generating
PSQI: Pittsburgh Sleep Quality Index, QuickDASH: Quick Disabilities of the Arm, Shoulder and Hand questionnaire

compromise upper extremity functional capacity in this occupational group. The median QuickDASH score of 17.5 indicates mild to moderate disability across the sample rather than isolated severe cases, and a recent synthesis of preventive strategies for musculoskeletal disorders in physiotherapy staff has emphasized that interventions are most effective when targeted before symptoms reach the level of functional loss (19).

Our findings on exposure point away from the device and towards the organization of the working day. Neither the type of modality applied nor its daily application time distinguished participants with respect to any outcome after adjustment for multiple testing, whereas years of professional experience and working posture did. The null findings may partly reflect the relatively homogeneous exposure profile, with almost all participants delivering the same three modalities and daily application times clustering within a narrow range; however, limited statistical power cannot be excluded. This cumulative pattern contrasts with two recent meta-analyses in which years of practice were inversely related to neck and shoulder WRMSD prevalence in nurses and surgeons (1,2). Two explanations are plausible. Those syntheses report symptom prevalence, whereas our outcome was functional disability; the two do not necessarily move together. In addition, a healthy worker survivor effect may operate in larger and more mobile workforces, where affected staff transfer out of the most demanding roles; in a single small unit with limited role mobility, such selective attrition is less likely, so cumulative exposure may remain visible. Analyses in industrial populations have similarly concluded that physical and organizational workload dimensions must

Table 6. Factors associated with upper extremity disability (square-root-transformed QuickDASH score): multivariable linear regression analysis (n=65)

Variable	B	SE	95% CI for B	Standardized β	t	p	VIF/tolerance
Upper extremity pain (NRS)	0.476	0.096	0.285 to 0.667	+0.46	4.98	<0.001	1.65/0.60
Years of professional experience	0.051	0.021	0.009 to 0.094	+0.20	2.42	0.019	1.29/0.77
PSQI global score	0.166	0.066	0.034 to 0.299	+0.22	2.52	0.015	1.43/0.70
ProQOL-compassion fatigue	0.032	0.020	-0.008 to 0.073	+0.13	1.61	0.114	1.27/0.79
Maintaining appropriate body posture (1= yes, 2= no)	0.854	0.341	0.171 to 1.537	+0.19	2.50	0.015	1.16/0.86

Model statistics: R^2=0.691; adjusted R^2=0.665; F(5, 59)=26.37; p<0.001. Durbin-Watson =1.81. Shapiro-Wilk test of residuals p=0.136. Maximum Cook's distance =0.212. The model included 5 predictors, corresponding to approximately 13.0 participants per predictor.
The dependent variable was square-root transformed because the residuals of the untransformed model were not normally distributed (Shapiro-Wilk p<0.001); after transformation the assumption was met. Candidate predictors were selected on the basis of clinical relevance and bivariate associations at p<0.10. To limit overfitting, the number of predictors was capped at five, corresponding to approximately 13 participants per predictor. Neck pain and age were not entered because of collinearity with upper extremity pain (rho=0.66) and with years of professional experience (rho=0.85), respectively. Variables were entered simultaneously (enter method)
B: Unstandardized regression coefficient, CI: Confidence interval, NRS: Numeric Rating Scale, ProQOL: Professional Quality of Life Scale, PSQI: Pittsburgh Sleep Quality Index, QuickDASH: Quick disabilities of the arm, shoulder and hand questionnaire, SE: Standard error, VIF: Variance inflation factor

Table 7. Factors associated with sleep quality (PSQI global score): multivariable linear regression analysis (n=65)

Variable	B	SE	95% CI for B	Standardized β	t	p	VIF/tolerance
Upper extremity pain (NRS)	0.521	0.147	0.226 to 0.816	+0.39	3.54	<0.001	1.20/0.83
Self-reported sleep duration	-1.648	0.559	-2.767 to -0.530	-0.30	-2.95	0.005	1.07/0.94
ProQOL-burnout	0.068	0.057	-0.047 to 0.183	+0.16	1.19	0.240	1.75/0.57
ProQOL-compassion fatigue	0.024	0.043	-0.063 to 0.111	+0.07	0.55	0.581	1.79/0.56
Educational attainment	0.390	0.312	-0.236 to 1.015	+0.14	1.25	0.217	1.18/0.85

Model statistics: R^2=0.412; adjusted R^2=0.363; F(5, 59)=8.28; p<0.001. Durbin-Watson =2.39. Shapiro-Wilk test of residuals p=0.204. Maximum Cook's distance =0.162. The model included 5 predictors, corresponding to approximately 13.0 participants per predictor.
Candidate predictors were selected on the basis of clinical relevance and bivariate associations at p<0.10, with the number of predictors capped at five to limit overfitting. Neck pain was not entered because of collinearity with upper extremity pain (rho=0.66). Variables were entered simultaneously (enter method)
B: Unstandardized regression coefficient, CI: Confidence interval, NRS: Numeric Rating Scale, ProQOL: Professional Quality of Life Scale, PSQI: Pittsburgh Sleep Quality Index, QuickDASH: Quick disabilities of the arm, shoulder and hand questionnaire, SE: Standard error, VIF: Variance inflation factor

be considered jointly rather than reduced to a single task descriptor (5,7). The practical implication is that ergonomic programs for this group should target rotation, scheduled recovery between applications, workstation height, and patient positioning rather than the individual device.

The pain-sleep findings extend a well-characterized relationship to a new occupational group. A bidirectional association between sleep problems and chronic musculoskeletal pain has been established in a meta-analysis (6), and sleep quality has been proposed as a mediator between psychosocial burden and multisite musculoskeletal pain in healthcare workers (7,20). Our sample can be benchmarked directly against comparable staff: 58.5% had a PSQI global score above 5 and the median global score was 6, close to the mean of 7.0 recently reported in physiotherapists working in a physical medicine and rehabilitation clinic (8). Notably, that study also identified longer work tenure as a correlate of poorer sleep, replicating the association we observed between years of professional experience and use of sleep medication. Our data further demonstrate directional relationships within a single cohort: the PSQI global score was independently associated with upper extremity disability, while pain intensity was independently associated with the PSQI global score. This reciprocal specification should be interpreted with caution, since the PSQI global score is a predictor in one model and the outcome in the other, and the two models therefore do not provide independent confirmation of one another. A 2026 narrative review has described the neurophysiological and behavioral pathways through which the pain–sleep loop is maintained (21), and a pragmatic stepped framework for screening sleep dysfunction in musculoskeletal practice has recently been proposed (22); given that more than half of our sample screened positive, incorporating such a screen into occupational health assessment for this workforce is clinically justified. Longer self-reported sleep duration was independently associated with better sleep quality; however, because sleep duration was recorded in ordinal bands and 98% of the sample fell into just two of these bands, this association should not be overinterpreted.

The psychosocial findings require a more cautious reading than the bivariate results alone would suggest. Compassion fatigue was associated with upper extremity disability, sleep disturbances, and use of sleep medication, while burnout was associated with disability and use of sleep medication; all associations persisted after correction for multiple testing; however, neither subscale remained independently associated with the outcomes once pain intensity and workload were entered into the models. Two interpretations are compatible with this pattern. Psychosocial burden may act largely through pain rather than alongside it, which would be consistent with reports that sleep quality partially mediates the path from burnout to multisite musculoskeletal pain in healthcare workers (20). Cross-sectional studies published in 2025 report the same clustering in nursing staff, both between sleep quality and burnout symptoms (23) and between professional quality of life measured with the ProQOL and sleep quality (24). Alternatively, the present sample may have been too small to separate the two, particularly given that the burnout subscale showed only modest internal consistency in the Turkish validation study (15). Nonetheless, the association is real at the descriptive level and warrants attention in occupational health assessment, but our data do not support the stronger claim that burnout independently determines disability or sleep quality in this group. Prospective studies with formal mediation analysis are needed to distinguish these possibilities.

Study Limitations

This study has several limitations. The cross-sectional design does not allow causal or temporal inferences; our findings are equally compatible with pain impairing sleep, poor sleep amplifying pain and disability, or a third factor driving both. The study was conducted at a single center with 65 participants and could reliably detect only medium-sized effects (r≥0.34), so weaker but clinically relevant associations may have been missed and the findings describe this workforce rather than the occupational group in general. Participation was voluntary and the total number of eligible personnel could not be retrieved retrospectively; therefore, the participation rate could not be calculated, and volunteer bias cannot be excluded. All exposures and outcomes were self-reported, without clinical examination or objective measurement of workload, which may introduce recall and social desirability biases and may inflate associations between instruments completed in the same session; in addition, the NRS captures pain intensity but not duration or chronicity. All participants worked day shifts only, so shift work could not confound the sleep findings; by the same token, the results may not extend to rehabilitation staff working rotating or night schedules. Finally, the large number of bivariate comparisons increases the risk of type I error. A false discovery rate correction was applied. Because no association in the modality or sociodemographic tables survived correction, those analyses should be regarded as exploratory and hypothesis-generating.

Despite these limitations, this study has notable strengths. To our knowledge, it is the first study to examine upper extremity pain, disability, sleep quality, and professional quality of life together in healthcare workers whose daily work consists of delivering physical therapy modalities. All participants were assessed with validated Turkish instruments under standardized conditions, and complete data were available for all analyzed participants. Both regression models were specified with an a priori cap on predictors; assumptions, collinearity diagnostics, and influence statistics were reported in full. Correction for multiple testing was applied throughout, and reporting follows the STROBE statement, which should facilitate replication elsewhere.

Conclusion

In this single-center, cross-sectional sample of healthcare workers delivering physical therapy modalities, upper extremity and neck pain intensity was the variable most consistently associated with both upper extremity disability and sleep quality, and it remained independently associated with each after adjustment. Years of professional experience and failure to maintain an appropriate working posture were independently associated with greater disability, whereas neither the modality applied nor its daily application time distinguished between participants once multiple testing was accounted for. Burnout and compassion fatigue were associated with disability and sleep disturbance at the bivariate level but were not independently associated with the outcomes alongside pain and workload. These associations are cross-sectional and do not establish causality. They suggest, however, that occupational health assessment for this workforce should focus on the organization of the working day and working posture rather than on the individual device and that a brief sleep screen may be warranted, given that more than half of the participants reported poor sleep quality. Longitudinal multicenter studies are required before any preventive strategy for this group can be recommended with confidence.

Ethics

Ethics Committee Approval: This study was approved by the University of Health Sciences Türkiye, Bakirkoy Dr. Sadi Konuk Training and Research Hospital Clinical Research Ethics Committee (approval number: 2023-15-15, date: 07.08.2023).

Informed Consent: Written informed consent was obtained from all participants.

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Footnotes

Authorship Contributions

Concept: S.S., Design: S.S., Y.S.O., Data Collection or Processing: S.S., Y.S.O., Analysis or Interpretation: S.S., Y.S.O., Literature Search: S.S., Y.S.O., Writing: S.S., Y.S.O.

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