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Perceived availability of breastfeeding-supportive scheduling in relation to sleep and psychological symptoms among nurses after returning to work: a cross-sectional study in China

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Abstract

Background: Returning to work while breastfeeding can create competing clinical, feeding and recovery demands for nurses. Quantitative evidence on perceived access to breastfeeding-supportive scheduling and nurses' health remains limited. We examined individual-level cross-sectional associations between perceived availability of breastfeeding-supportive scheduling and sleep and psychological symptoms among nurses who had returned to work and were still breastfeeding.

Methods: This cross-sectional secondary analysis included 824 nurses from the TARGET Nurses' Health Cohort in China during 2021-2025. Perceived availability of breastfeeding-supportive scheduling was measured using a single self-reported yes/no item. Poor sleep, defined as a Pittsburgh Sleep Quality Index score greater than 7, was the primary outcome. Modified Poisson regression with HC3 heteroscedasticity-consistent standard errors estimated prevalence ratios; marginal standardisation estimated adjusted prevalences and prevalence differences. Six anxiety, depression, sleep and stress measures were secondary outcomes, with Benjamini-Hochberg correction.

Results: Overall, 734 nurses (89.1%) perceived breastfeeding-supportive scheduling to be available. Poor sleep prevalence was 46.7% among these nurses and 62.2% among nurses who did not report availability. Among 820 complete cases, the adjusted prevalence ratio was 0.76 (95% confidence interval [CI], 0.63-0.92; P = 0.004), and the adjusted prevalence difference was −14.9 percentage points (95% bootstrap CI, −26.8 to −4.4). Adjusted prevalence ratios were 0.55 for both moderate-or-greater anxiety symptoms (95% CI, 0.36-0.84) and moderate-or-greater depressive symptoms (95% CI, 0.36-0.85); both Benjamini-Hochberg-adjusted P values were 0.007. In sensitivity analyses restricted by module-completion interval, prevalence ratios for poor sleep ranged from 0.74 to 0.79; the organisational-support model yielded a prevalence ratio of 0.80 (95% CI, 0.64-0.99).

Conclusions: Perceived availability of breastfeeding-supportive scheduling was associated with lower prevalence of poor sleep and psychological symptoms among nurses who continued breastfeeding after returning to work.

Implications for Nursing Management: Nurse managers should assess breastfeeding-related scheduling needs and perceived access to support when planning return-to-work arrangements. The findings support prospective evaluation of breastfeeding-supportive scheduling alongside supervisor and coworker support, with nurses' sleep and psychological well-being included as outcomes.

Background

Returning to paid work while breastfeeding can place competing demands on nurses. Milk expression and infant feeding must be coordinated with clinical responsibilities, shift work, unpredictable workloads and limited opportunities for breaks. A recent scoping review of nurses returning after maternity leave identified shift work, supervisor support, breastfeeding barriers, childcare and workplace engagement as

recurring influences [1]. A broader review similarly identified workload, work-family conflict and organisational support as central to return after maternity leave [2].

Evidence focused specifically on breastfeeding nurses has largely been qualitative. A systematic qualitative review identified breastfeeding resilience and support as facilitators and work pressure and role conflict as barriers; breastfeeding control was an analytical theme rather than a facilitator [3]. Studies from China have described fatigue, conflicting roles and the need for support and workable accommodations from managers and colleagues [4–6]. These studies provide detailed accounts of the return-to-work transition but do not quantify associations with nurses' sleep or psychological symptoms.

Scheduling is a plausible nursing-workforce focus because working-time arrangements are associated with sleep and psychological health. Shift-work demands and circadian characteristics have been associated with nurses' sleep quality and depressive symptoms, while adverse sleep timing among healthcare workers has been associated with poorer workplace well-being [7–9]. Reviews of electronic rostering, self-rostering and self-scheduling suggest potential advantages for autonomy and work-life fit, although definitions, implementation and certainty of evidence vary [10, 11]. Among breastfeeding employees, workplace support and accommodations have primarily been studied in relation to breastfeeding experience and continuation, not as established interventions for sleep or psychological health [12–14].

A Chinese multicentre study documented substantial work stress among nurses returning after childbirth and identified depressive symptoms among its correlates [15]. A latent-profile study subsequently identified heterogeneous stress patterns associated with sleep quality and depressive symptoms [16]. Evidence from U.S. working-mother samples has linked return-to-work experiences with work-family conflict, breastfeeding and maternal mental health [17, 18]. Longitudinal research among U.S. working mothers further suggested that schedule control may shape work-family processes after childbirth [19]. Few quantitative studies have examined perceived access to breastfeeding-supportive scheduling in relation to sleep and psychological symptoms specifically among nurses who continued breastfeeding after returning to work.

We therefore examined whether perceived availability of department-provided breastfeeding-supportive scheduling was associated with poor sleep among nurses who had returned to work and remained breastfeeding. Secondary outcomes were moderate-or-greater anxiety and depressive symptoms and continuous sleep, anxiety, depression and perceived-stress scores.

Methods

Study design, setting and reporting

We conducted a cross-sectional secondary analysis of questionnaire data from the Chinese Nurses' Health Cohort TARGET, collected between February 2021 and October 2025. The source cohort recruited 64,114 nurses from 16 provinces across China, expanding the sample size and geographic coverage of

the Shandong Nurses' Health Cohort. The TARGET study protocol has been reported previously [20]. For the present analysis, linked electronic questionnaire modules provided information on breastfeeding support, sleep and psychological health among nurses who had returned to work and were still breastfeeding. No prospective outcome follow-up was used. Reporting followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement [21].

Participants and study size

Respondents were eligible if they reported current breastfeeding, had returned to work after maternity leave, reported no current weaning and had a valid response to the flexible-scheduling item. Sequential counts were 1,987 nurses meeting the breastfeeding criterion, 1,003 also indicating return to work and 824 meeting all remaining eligibility criteria. After application of the eligibility criteria, the final analytic sample comprised 824 distinct nurses, with one eligible observation per nurse. The available output did not disaggregate the reasons why the other 179 nurses failed the remaining criteria.

Eligibility was conditional on continued breastfeeding after return to work. Scheduling support and health may both influence whether breastfeeding continues; conditioning on this post-return state may therefore introduce selection or collider bias. The estimand applies to nurses who remained breastfeeding after returning to work, not to nurses who had stopped breastfeeding or to all postpartum nurses.

The study size was determined by the number of available cohort respondents meeting the eligibility criteria. All eligible nurses were included, and no post hoc power calculation was performed. Precision was assessed using 95% confidence intervals.

Exposure

The exposure was assessed using the item, ‘Does your department provide flexible scheduling to support breastfeeding?’ Responses were recorded as yes or no, with no as the reference category. This single self-reported item measured perceived availability of breastfeeding-supportive scheduling; it did not establish a formal department policy, actual use, schedule type or duration, implementation intensity, adherence, or objective roster records.

Supervisor breastfeeding support, coworker breastfeeding support and return-to-work training were analysed as related organisational-support measures. These variables may be confounders, co-manifestations of a broader supportive workplace or intermediates through which scheduling support is experienced. They were therefore excluded from the main adjustment set and added together only in Model 3, which was interpreted as an organisational-support sensitivity analysis rather than a direct-effect model.

Outcomes and instruments

The primary outcome was poor sleep, defined as a Pittsburgh Sleep Quality Index (PSQI) total score greater than 7. The PSQI comprises seven components scored from 0 to 3 and yields a total score from 0 to 21, with higher scores indicating poorer sleep [22]. The threshold followed the validated Chinese version [23]. The binary indicator was independently derived from the total score and matched the stored cohort indicator.

Anxiety symptoms were assessed using the seven-item Generalized Anxiety Disorder scale (GAD-7; range 0–21) [24], and depressive symptoms using the nine-item Patient Health Questionnaire (PHQ-9; range 0–27) [25]. Scores of at least 10 defined moderate-or-greater symptom levels according to the original scale severity conventions [24, 25]; these thresholds were not interpreted as clinical diagnoses. Perceived stress was assessed using the Chinese 10-item Perceived Stress Scale (PSS-10; range 0–40), with higher scores indicating greater perceived stress and no diagnostic threshold applied [26, 27].

Item-level scoring was recomputed for all instruments and matched stored total scores for all 824 eligible nurses. PSS-10 items 4, 5, 7 and 8 were reverse scored according to the PSS-10 scoring rules. Cronbach's alpha was 0.646 across the seven heterogeneous PSQI components, 0.960 for GAD-7 and 0.947 for PHQ-9. Alpha for PSQI is presented descriptively because its components represent distinct sleep domains. Cronbach's alpha was 0.621 for the PSS-10, indicating modest internal consistency; therefore, the PSS-10 analysis was considered exploratory.

Covariates

Covariates were selected based on substantive knowledge and data availability. The main adjustment set included age (per 5 years), education (bachelor's degree or higher versus secondary or associate education), clinical department, professional title (three levels), monthly income (no more than 6000, 6001–9000 or more than 9000 Chinese yuan), current shift schedule (day only versus evening, night or rotating shifts), months since return to work and survey year (categorical). Survey year was taken from the health-outcome module, with the breastfeeding-support and work-schedule modules used successively if unavailable. Age was derived from survey year and birth year; four values outside 18–65 years were treated as missing.

Marital status was descriptive only because 98.3% of nurses were married. Sensitivity analyses added body mass index, replaced age with nursing work years, or added supervisor support, coworker support and return-to-work training. Adjustment for current shift schedule was not interpreted as identifying a direct causal effect.

Statistical analysis

Characteristics were summarised as mean (standard deviation) or number (percentage). Absolute standardised differences (SMDs) described group differences without baseline significance testing. For categorical characteristics, Table 1 reports the largest absolute level-specific SMD.

For poor sleep, Poisson generalised linear models with a log link and HC3 heteroscedasticity-consistent sandwich standard errors estimated prevalence ratios and 95% confidence intervals [28, 29]. Prevalence ratios were selected rather than odds ratios because poor sleep was common and an odds ratio could overstate the relative association. Model 1 was unadjusted. Model 2 was the main covariate-adjusted model and estimated the individual-level covariate-adjusted cross-sectional association. Model 3 added the three organisational-support measures as a sensitivity analysis and was not interpreted as a direct-effect model. Model 2 predictions were marginally standardised to the analysis-sample covariate distribution to estimate adjusted prevalences and prevalence differences. Each of 2000 nonparametric bootstrap samples resampled nurses from the complete-case sample with replacement, refitted the full Model 2 and recomputed standardised predictions over the resampled covariate distribution; percentile confidence intervals were then calculated.

Moderate-or-greater anxiety and depressive symptoms were analysed using the same modified Poisson approach. Continuous PSQI, GAD-7, PHQ-9 and PSS-10 scores were analysed using linear regression with HC3 standard errors; estimates are adjusted mean differences in scale-score points. Benjamini-Hochberg correction was applied across the six secondary outcomes. Given the modest internal consistency of the PSS-10, its continuous-score analysis was interpreted as exploratory.

Complete-case analysis was used because only four nurses lacked plausible derived age values for the main model. Sensitivity analyses replaced age with nursing work years, categorised time since return, added body mass index, modelled age and time since return using natural cubic splines. Timing sensitivity analyses adjusted for the interval between completion of the breastfeeding-support and health-outcome questionnaires using log(1 + absolute interval in days) and restricted analyses to intervals of no more than 1, 7, 30, 90 or 365 days. We examined convergence, model rank, dispersion, fitted values, influence and generalised variance inflation factors. Descriptive overlap diagnostics used an exposure model with the Model 2 covariates to examine common support and exposure-by-covariate cell counts; these diagnostics did not alter the outcome models.

HC3 standard errors address heteroscedasticity under independence of observations; they do not account for correlation among nurses within the same hospital or department. Because suitable hospital- and department-level identifiers were unavailable, no multilevel or cluster-robust analysis was possible. Analyses used R version 4.5.0.

Results

Participant flow and characteristics

Of the 64,114 nurses in the source cohort, 1,987 met the breastfeeding criterion, 1,003 also indicated return to work and 824 met all remaining eligibility criteria, including no current weaning and a valid scheduling response. Four nurses had derived ages outside 18–65 years and were excluded only when complete-case adjusted models were fitted, leaving 820 complete cases: 730 reporting perceived availability and 90 not reporting it. The corresponding poor-sleep event counts were 340 and 56. No outcome values were missing; body mass index was missing for six respondents and derived work years for one.

Mean age was 31.9 years (standard deviation 3.6), 781 nurses (94.8%) had a bachelor's degree or higher and 714 (86.7%) worked day shifts only. Time since return was 1–3 months for 379 nurses (46.0%), 4–6 months for 309 (37.5%) and at least 7 months for 136 (16.5%). Overall, 734 nurses (89.1%) reported perceived availability of breastfeeding-supportive scheduling and 90 (10.9%) did not. The largest absolute SMDs were for supervisor support (0.868), coworker support (0.640), return-to-work training (0.414), shift schedule (0.387), monthly income (0.343) and time since return (0.341) (Table 1).

Table 1
Characteristics by perceived availability of breastfeeding-supportive scheduling

Characteristic	Overall N = 824	Not reporting perceived availability N = 90	Reporting perceived availability N = 734	Absolute SMD
Survey year				0.134
2021	168 (20%)	19 (21%)	149 (20%)	
2022	216 (26%)	21 (23%)	195 (27%)	
2023	285 (35%)	33 (37%)	252 (34%)	
2024	107 (13%)	9 (10%)	98 (13%)	
2025	48 (5.8%)	8 (8.9%)	40 (5.4%)	
Age, years	31.9 (3.6)	32.4 (3.2)	31.9 (3.6)	0.148
Unknown	4	0	4	
Highest education				0.118
Bachelor degree or higher	781 (95%)	83 (92%)	698 (95%)	
Secondary/associate degree	43 (5.2%)	7 (7.8%)	36 (4.9%)	
Marital status				0.055
Married	810 (98%)	89 (99%)	721 (98%)	
Not married	14 (1.7%)	1 (1.1%)	13 (1.8%)	
Department				0.319
Internal medicine	239 (29%)	22 (24%)	217 (30%)	
Surgery	157 (19%)	28 (31%)	129 (18%)	
Acute/critical/procedural care	140 (17%)	13 (14%)	127 (17%)	

Characteristic	Overall N = 824	Not reporting perceived availability N = 90	Reporting perceived availability N = 734	Absolute SMD
Maternal and child care	162 (20%)	18 (20%)	144 (20%)	
Outpatient/administration/other	126 (15%)	9 (10%)	117 (16%)	
Professional title				0.289
Nurse	81 (9.8%)	4 (4.4%)	77 (10%)	
Senior nurse	435 (53%)	41 (46%)	394 (54%)	
Supervisor/associate chief nurse	308 (37%)	45 (50%)	263 (36%)	
Monthly income				0.343
≤ 6000 CNY	508 (62%)	42 (47%)	466 (63%)	
6001–9000 CNY	242 (29%)	36 (40%)	206 (28%)	
> 9000 CNY	74 (9.0%)	12 (13%)	62 (8.4%)	
Shift schedule				0.387
Day shift only	714 (87%)	66 (73%)	648 (88%)	
Evening/night/rotating shift	110 (13%)	24 (27%)	86 (12%)	
Time since return to work				0.341
1–3 months	379 (46%)	38 (42%)	341 (46%)	
4–6 months	309 (38%)	26 (29%)	283 (39%)	
7 months or longer	136 (17%)	26 (29%)	110 (15%)	
Body mass index, kg/m²	23.2 (3.6)	23.0 (3.7)	23.3 (3.5)	0.060
Unknown	6	2	4	

Characteristic	Overall N = 824	Not reporting perceived availability N = 90	Reporting perceived availability N = 734	Absolute SMD
Supervisor breastfeeding support	784 (95%)	62 (69%)	722 (98%)	0.868
Coworker breastfeeding support	797 (97%)	72 (80%)	725 (99%)	0.640
Return-to-work training	734 (89%)	68 (76%)	666 (91%)	0.414

Values are mean (SD) or n (%). Absolute standardised differences (SMDs) compare nurses reporting versus not reporting perceived availability; for categorical characteristics, the largest absolute level-specific SMD is shown. Age and body mass index SMDs used available values (n = 820 and n = 818, respectively). Clinical department is a descriptive category and not a department-level clustering identifier. CNY, Chinese yuan; SD, standard deviation.

All 824 nurses had valid module timestamps. The health-outcome module preceded the breastfeeding-support exposure module for 785 respondents (95.3%), whereas the exposure module came first for only 39 (4.7%). Modules were completed on the same calendar day by 541 respondents (65.7%); 28 (3.4%) crossed a calendar year and 12 (1.5%) were separated by more than 365 days. The median absolute gap was 0.03 days (interquartile range 0.01–6.01); 575 (69.8%) were within 1 day, 728 (88.3%) within 30 days and 812 (98.5%) within 365 days. Same-day completion did not determine which construct preceded the other.

Poor sleep

In the full eligible sample, poor sleep was present in 343 of 734 nurses (46.7%) reporting perceived availability of breastfeeding-supportive scheduling and 56 of 90 nurses (62.2%) not reporting it. The unadjusted prevalence ratio was 0.75 (95% confidence interval [CI], 0.63–0.90; P = 0.002). Among 820 complete cases, the adjusted prevalence ratio was 0.76 (95% CI, 0.63–0.92; P = 0.004) (Table 2).

Marginal standardisation estimated adjusted poor-sleep prevalences of 46.6% (95% bootstrap CI, 43.0% to 50.3%) among nurses reporting perceived availability and 61.5% (95% bootstrap CI, 51.4% to 72.2%) among those not reporting it. The adjusted prevalence difference was − 14.9 percentage points (95% bootstrap CI, − 26.8 to − 4.4), and the marginal prevalence ratio was 0.76 (95% bootstrap CI, 0.63–0.91). In the organisational-support sensitivity model, the prevalence ratio attenuated to 0.80 (95% CI, 0.64–0.99; P = 0.039), with lower precision than in Model 2.

Table 2
Association between perceived availability of breastfeeding-supportive scheduling and poor sleep

Model	N	Prevalence ratio (95% CI)	P value
Model 1: unadjusted	824	0.75 (0.63 to 0.90)	0.002
Model 2: main covariate-adjusted association model	820	0.76 (0.63 to 0.92)	0.004
Model 3: organisational-support-adjusted sensitivity model	820	0.80 (0.64 to 0.99)	0.039

Poor sleep was defined as PSQI > 7. Model 2 adjusted for age, education, clinical department category, professional title, monthly income, current shift schedule, months since return to work and survey year. Model 3 added supervisor support, coworker support and return-to-work training as an organisational-support sensitivity analysis; it is not a direct-effect model. All effects compare nurses reporting perceived availability with those not reporting it as the reference group. HC3 standard errors do not account for hospital- or department-level clustering. CI, confidence interval; PSQI, Pittsburgh Sleep Quality Index.

Secondary outcomes

In the full eligible sample, moderate-or-greater anxiety symptoms occurred in 100 of 734 nurses (13.6%) reporting perceived availability and 24 of 90 nurses (26.7%) not reporting it. Moderate-or-greater depressive symptoms occurred in 105 nurses (14.3%) and 25 nurses (27.8%), respectively. Among 820 complete cases, adjusted prevalence ratios were 0.55 for moderate-or-greater anxiety symptoms (95% CI, 0.36–0.84; Benjamini-Hochberg-adjusted P = 0.007) and 0.55 for moderate-or-greater depressive symptoms (95% CI, 0.36–0.85; adjusted P = 0.007) (Table 3; Fig. 1).

Among complete cases, adjusted mean differences comparing nurses reporting perceived availability with those not reporting it were − 1.17 scale-score points for PSQI (95% CI, − 1.97 to − 0.36), − 2.65 for GAD-7 (95% CI, − 3.96 to − 1.34), − 3.21 for PHQ-9 (95% CI, − 4.79 to − 1.63) and − 2.60 for PSS-10 (95% CI, − 3.94 to − 1.25). All six secondary-outcome P values were below 0.01 after Benjamini-Hochberg correction; the PSS-10 finding was considered exploratory because its internal consistency was modest.

Table 3
Adjusted associations between perceived availability of breastfeeding-supportive scheduling and secondary outcomes

Outcome	Adjusted-model N	Effect measure	Adjusted effect (95% CI)	Raw P value	BH-adjusted P value
Moderate-or-greater anxiety symptoms (GAD-7 ≥ 10) Observed: 24/90 (26.7%) vs 100/734 (13.6%)	820	Prevalence ratio	0.55 (0.36 to 0.84)	0.006	0.007
Moderate-or-greater depressive symptoms (PHQ-9 ≥ 10) Observed: 25/90 (27.8%) vs 105/734 (14.3%)	820	Prevalence ratio	0.55 (0.36 to 0.85)	0.007	0.007
PSQI total score	820	Mean difference (scale-score points)	−1.17 (−1.97 to −0.36)	0.005	0.007
GAD-7 total score	820	Mean difference (scale-score points)	−2.65 (−3.96 to −1.34)	< 0.001	< 0.001
PHQ-9 total score	820	Mean difference (scale-score points)	−3.21 (−4.79 to −1.63)	< 0.001	< 0.001
PSS-10 total score	820	Mean difference (scale-score points)	−2.60 (−3.94 to −1.25)	< 0.001	< 0.001

All adjusted models used the Model 2 covariate set. Binary observed values were calculated in the full eligible sample (N = 824) and are ordered as not reporting perceived availability (n = 90) versus reporting perceived availability (n = 734). All adjusted models included 820 complete cases. Continuous outcomes are reported only as adjusted mean differences; observed means and standard deviations are not presented. All effects compare nurses reporting perceived availability with those not reporting it as the reference group; negative mean differences indicate lower scores among nurses reporting availability. Prevalence ratios were estimated using modified Poisson regression; adjusted mean differences are scale-score points estimated using linear regression. Both used HC3 standard errors. GAD-7 and PHQ-9 thresholds indicate moderate-or-greater symptoms, not diagnoses. Benjamini-Hochberg correction was applied across six secondary outcomes. The PSS-10 result is exploratory because internal consistency was modest. BH, Benjamini-Hochberg; CI, confidence interval.

Adjusted prevalence ratios compare nurses reporting perceived availability of breastfeeding-supportive scheduling with those not reporting it among 820 complete cases. Outcomes are poor sleep (PSQI > 7), moderate-or-greater anxiety symptoms (GAD-7 ≥ 10) and moderate-or-greater depressive symptoms (PHQ-9 ≥ 10). Models adjusted for age, education, clinical department category, professional title, monthly income, current shift schedule, months since return to work and survey year. Circles show prevalence ratios, horizontal bars show 95% confidence intervals and the dashed vertical line indicates the null value of 1.0. CI, confidence interval; GAD-7, seven-item Generalized Anxiety Disorder scale; PHQ-9, nine-item Patient Health Questionnaire; PSQI, Pittsburgh Sleep Quality Index.

Sensitivity analyses and diagnostics

The poor-sleep prevalence ratio rounded to 0.76 when nursing work years replaced age, time since return was categorised, body mass index was added, nonlinear terms were used or the log-transformed absolute module gap was included. Restrictions to modules completed within 1, 7, 30, 90 or 365 days yielded prevalence ratios from 0.74 to 0.79. The most restrictive 1-day analysis contained 575 eligible nurses but 572 complete cases and yielded a prevalence ratio of 0.79 (95% CI, 0.62-1.00). Its lower precision and the predominance of outcome-first completion mean that the time-window analyses cannot establish temporal ordering or rule out reverse causality (Additional file 1: Table S1).

The main model converged, its design matrix was full rank (18 columns; rank 18), dispersion was 0.53 and no observation exceeded the influence threshold. The maximum adjusted generalised variance inflation factor was 1.30, and the maximum fitted prevalence was 0.95. Covariate propensity-score ranges overlapped from 0.492 to 0.979; 14 nurses reporting perceived availability lay outside this common range. One Model 2 exposure-by-covariate cell contained fewer than five nurses: professional title of nurse in the group not reporting availability (n = 4). A separate descriptive marital-status cell contained one nurse. The organisational-support sensitivity model had one observation above the Cook's-distance threshold (4/n) and one fitted mean above 1 (maximum 1.071). Removing that observation yielded a prevalence ratio of 0.79 (95% CI, 0.64–0.98; P = 0.034), compared with 0.80 (95% CI, 0.64–0.99) in the full Model 3. Because log-link Poisson fitted means are not constrained to 0–1, Model 3 is interpreted only as a prevalence-ratio sensitivity analysis.

Discussion

Principal findings

Among nurses who continued breastfeeding after returning to work, those reporting perceived availability of breastfeeding-supportive scheduling had a lower prevalence of poor sleep. The adjusted absolute difference was − 14.9 percentage points, alongside lower prevalences of moderate-or-greater anxiety and depressive symptoms and lower continuous symptom scores. These results concern individual-level associations between a subjective workplace measure and self-reported health outcomes; they do not estimate the effect of a formal policy, an actual schedule change or an implemented intervention.

Comparison with previous research

The findings add quantitative evidence to the nurse-specific return-to-work and breastfeeding literature, which remains dominated by qualitative and descriptive studies. Chinese research has reported substantial work stress after nurses return following childbirth [15], while a latent-profile study found heterogeneous stress patterns associated with sleep quality and depressive symptoms [16]. Qualitative studies of breastfeeding nurses have described shift work, work pressure, role conflict, support needs and workable accommodations [1, 3–6]. The present analysis narrows the question to perceived availability of breastfeeding-supportive scheduling and linked, non-prospectively measured sleep and psychological symptoms among nurses who remained breastfeeding.

Evidence from U.S. working-mother samples supports the relevance of work-family processes but does not directly validate the present exposure or establish a scheduling-policy effect. A small mixed-methods study integrated experiences of work-family conflict, breastfeeding and perinatal mental health among working mothers [17], and a systematic review found that associations between postpartum return to work and maternal mental health varied with work, leave and social contexts [18]. Longitudinal research among working mothers suggested that schedule control may buffer work-family conflict processes [19]. These populations and exposures differ from the present nurse sample, so the studies provide contextual rather than direct confirmatory evidence.

Interpretation and organisational context

Potential explanations include greater perceived control, more predictable opportunities for milk expression and less conflict between lactation and patient-care duties. Shift-work demands and circadian characteristics may also matter. These pathways were not measured and remain explanatory hypotheses rather than tested mechanisms.

The poor-sleep prevalence ratio changed from 0.76 to 0.80 after supervisor support, coworker support and return-to-work training were added, and the confidence interval moved closer to the null. This attenuation suggests that the main association may partly reflect a broader supportive organisational environment rather than scheduling alone. Because the added measures could be confounders, co-manifestations or intermediates, Model 3 neither isolates a scheduling-specific contribution nor estimates a controlled direct effect.

Strengths and limitations

Strengths include the focus on a specific and understudied nursing population, complete outcome data, verification of item-level scale scoring, reporting of both relative and absolute estimates, multiplicity control for secondary outcomes and sensitivity analyses addressing alternative covariate specifications and questionnaire timing. These features improve reporting transparency but do not overcome the limitations of a cross-sectional secondary analysis.

The exposure was a single self-reported perception item. It did not capture formal policy, actual use, schedule type, duration, implementation intensity, adherence or objective rosters. Self-report of both the workplace environment and health outcomes may have introduced common-method bias; nurses' current health could also have influenced how scheduling support was perceived or reported.

Temporal ordering is especially uncertain because the health-outcome module preceded the exposure module for 785 of 824 respondents (95.3%), whereas only 39 completed the exposure module first. Same-day completion for 65.7% and the short median absolute gap do not establish which construct came first. The 1-day-window analysis remained compatible with a smaller association or no association at its confidence-limit boundary, and no time-window analysis can rule out reverse causality.

Selection and residual confounding also limit interpretation. Only nurses who had returned to work and were still breastfeeding were included; because perceived support and health may both affect breastfeeding continuation, this restriction may create selection or collider bias. Unmeasured or incompletely measured factors included infant age, night feeding and infant waking, parity, feeding method, breastfeeding difficulties and milk supply, maternity-leave length, more detailed postpartum and return-to-work timing, family and childcare support, work hours, workload, staffing, and pre-existing sleep or mental-health problems. None of these factors should be regarded as controlled.

The reported coverage of 16 provinces describes the source cohort, rather than the geographic distribution of the analytical sample. A response rate could not be calculated because the number of invited nurses was unavailable. Hospital- and department-level identifiers were not available in the analytic dataset. Because perceived availability of breastfeeding-supportive scheduling may be correlated among nurses working within the same institution or department, we were unable to account for potential within-hospital or within-department clustering using multilevel models or cluster-robust standard errors. Consequently, the reported standard errors may be underestimated and the confidence intervals may be overly precise. The findings should therefore be interpreted as exploratory individual-level associations and not as estimates of the effect of an institutional scheduling policy. If hospital- or department-level identifiers can be recovered in future, the models should be re-estimated using cluster-robust standard errors or multilevel models to assess the robustness of the present findings.

The marked exposure-group imbalance and sparse covariate cells further limited overlap and precision for the group not reporting availability. GAD-7 and PHQ-9 thresholds represented symptom severity, not diagnoses. The PSS-10 had modest internal consistency in this sample, so the stress-score result is secondary and exploratory. Generalisability is limited to cohort respondents who continued breastfeeding after returning to work; the findings should not be extrapolated to nurses who had stopped breastfeeding or to all postpartum nurses.

Implications for nursing and future research

The findings justify prospective evaluation, not immediate attribution of benefit to a scheduling policy. Future multicentre studies should recruit nurses before or at return to work, record objective schedules

and actual use of defined accommodations, retain institution-level identifiers, and measure infant feeding and waking, caregiving support, prior health, workload and staffing. Evaluations should also document uptake, duration, implementation fidelity, coworker workload, equity, breastfeeding continuation, staff retention and patient-safety outcomes.

Conclusions

These findings provide preliminary evidence of an individual-level association between perceived availability of breastfeeding-supportive scheduling and lower prevalence of poor sleep and psychological symptoms among nurses who continued breastfeeding after returning to work. Prospective multicentre studies using objective scheduling information and institution-level identifiers are needed before causal or policy effects can be inferred.

Abbreviations

• BH
Benjamini-Hochberg
• BMI
body mass index
• CI
confidence interval
• CNY
Chinese yuan
• GAD-7
seven-item Generalized Anxiety Disorder scale
• HC3
heteroscedasticity-consistent type 3
• PHQ-9
nine-item Patient Health Questionnaire
• PR
prevalence ratio
• PSQI
Pittsburgh Sleep Quality Index
• PSS-10
10-item Perceived Stress Scale
• SD
standard deviation
• SMD
standardised difference
• STROBE
Strengthening the Reporting of Observational Studies in Epidemiology

Declarations

Ethics approval and consent to participate

The Chinese Nurses' Health Cohort was approved by the Ethics Committee of Qilu Hospital of Shandong University (approval No. KYLL-202210-060-4), and all participants provided electronic informed consent. The Shandong Nurses' Health Cohort was first registered in the Chinese Clinical Trial Registry on 8 February 2021 (registration No. ChiCTR2100043202), and the expanded Chinese Nurses' Health Cohort was registered on 25 June 2023 (registration No. ChiCTR2300072756).The study was conducted in accordance with the Declaration of Helsinki.

Consent for publication

Not applicable.

Availability of data and materials

The individual-level cohort data analysed during the current study are not publicly available because they contain sensitive health and occupational information. Access may be considered by the cohort data-governance group following scientific and ethical review. Aggregate analysis outputs and analysis code may be shared subject to institutional approval.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

Conceptualization, Methodology, Formal analysis, Investigation, Data curation, Visualization, Writing – original draft. Ya Li: Conceptualization, Methodology, Investigation, Data curation, Formal analysis, Writing – original draft, Writing – review & editing. Fangfei Lin: Investigation, Data curation, Validation, Writing – review & editing. Yingjuan Cao: Conceptualization, Methodology, Supervision, Project administration, Writing – review & editing. All authors read and approved the final manuscript.

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Declaration of AI-Assisted Technology Use

ChatGPT (GPT-6.0; OpenAI) was used solely to improve language and readability. The authors reviewed and revised all AI-assisted text and take full responsibility for the final manuscript.

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Figures

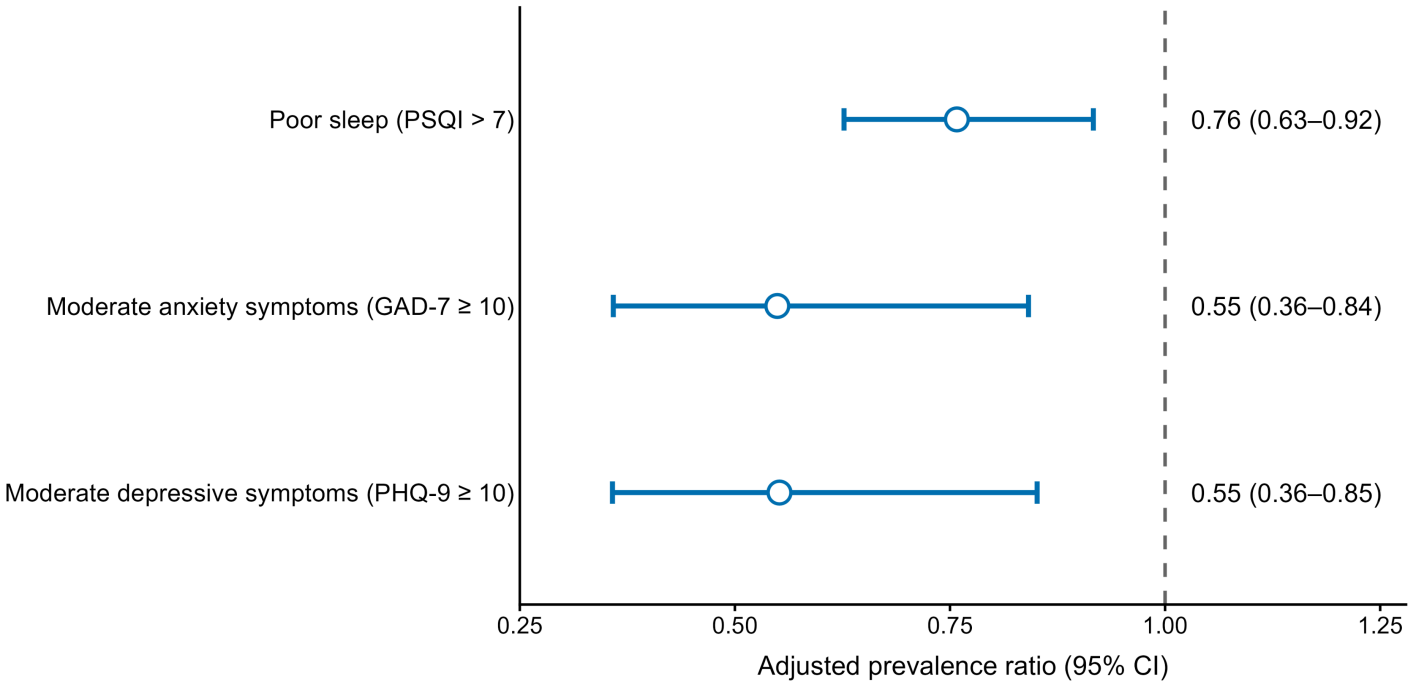


Figure 1

Adjusted prevalence ratios for binary outcomes

Adjusted prevalence ratios compare nurses reporting perceived availability of breastfeeding-supportive scheduling with those not reporting it among 820 complete cases. Outcomes are poor sleep (PSQI > 7), moderate-or-greater anxiety symptoms (GAD-7 ≥ 10) and moderate-or-greater depressive symptoms (PHQ-9 ≥ 10). Models adjusted for age, education, clinical department category, professional title, monthly income, current shift schedule, months since return to work and survey year. Circles show

prevalence ratios, horizontal bars show 95% confidence intervals and the dashed vertical line indicates the null value of 1.0. CI, confidence interval; GAD-7, seven-item Generalized Anxiety Disorder scale; PHQ-9, nine-item Patient Health Questionnaire; PSQI, Pittsburgh Sleep Quality Index.

Supplementary Files

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