

# sorder-in-female-shift-work- nurses-integrating-shift- workers.pdf

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# Factors affecting shift work sleep disorder in female shift work nurses: Integrating shift workers' coping with stress and transactional stress coping theory

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## Abstract

**Background:** Nurses have to work different and often irregular shifts to provide care. This puts nurses at health risks, such as sleep impairment.

**Design and methods:** The aim of this study was to test the comprehensive conceptual framework for predicting shift work sleep disorder of female nurses, we used a structural equation model analysis based on shift worker's coping and transactional stress coping theory. This study used a cross-sectional design. We collected the data from three public hospitals and three private hospitals in South Kalimantan, Indonesia, with a total sample of 201 female shift work nurses. Data were collected from February to April 2020. We were also granted permission by the director and the head nurse of these hospitals. After obtaining the informed consent forms, we distributed the online self-report questionnaire using Google Forms. Demographic data were evaluated using descriptive statistical analysis. We used a structural equation model analysis to test the comprehensive conceptual framework for predicting shift work sleep disorder of female shift work nurses.

**Results:** The model's effectiveness in predicting factors contributing to shift work sleep disorder was confirmed by the good statistical fit indicated by the comparative fit index, root-mean-square error of approximation, incremental fit index, and Tucker Lewis Index.

**Conclusions:** This study provides evidences that workload and interpersonal conflict contribute to occupational stress. Workload, interpersonal conflict, and the biological sleep clock influences shift work sleep disorder through mediators of coping strategies and stress.

## Keywords

Nurse, occupational stressors, coping, meaning-based coping, stress, structural equation model

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## Introduction

Sleep disorders (SDs) are conditions that change the usual way to sleep. They are considered a relevant public health issue because they can affect health and increase the risk of injury. Some of common SDs are insomnia (difficulty falling asleep throughout the night), sleep apnea, difficulty in breathing while sleeping), narcolepsy (extreme sleepiness during the day).<sup>1</sup> Shift work sleep disorder (SWSD) is a sleep impairment typified by sleepiness or insomnia due to the shift work schedule.<sup>2,3</sup> Rotating and often irregular shifts make nurses at high risk of sleep impairment. In effect, insomnia is often experienced by nurses who work

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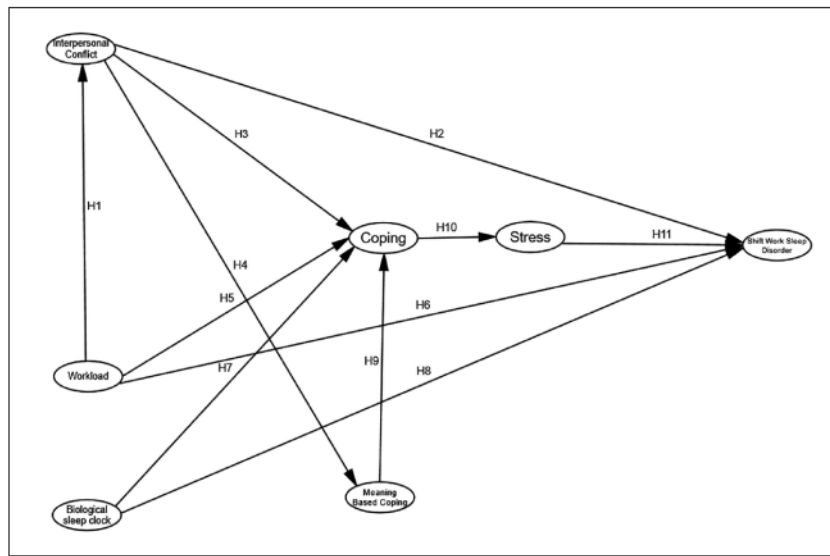
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**Figure 1.** Factors affecting shift work sleep disorder in nurses: Tested model.

on the night shift system in comparison with nurses who work a regular shift.<sup>4-7</sup> In addition, shift work sleep disorder among nurses is related to work accident and patient safety.<sup>8</sup>

Women are strongly represented in the health-care sector, and the majority of nurses in hospitals are women.<sup>9</sup> In Indonesia, the prevalence of sleep disorders among shift work nurses is 52.50%.<sup>10</sup> Many of them work in hospitals and account for the largest number of health care workers compared to other health shift workers, such as physicians, nutritionists, midwives, and clinical psychologists.<sup>11</sup> In conclusion, female nurses with irregular shifts tend to experience high level of stress and sleep disorders related to shift due to hormonal changes.<sup>12</sup> In addition to the gender, shift workers' coping with stress model showed that other factors affecting shift workers night rest include potential occupational stressors, non-occupational stressors, and personal factors, mediated by coping and stress.<sup>13</sup> A similar model found that SWSD was affected by the biological clock, sleep factors, and social factors.<sup>14</sup> However, very little theoretically based research has been conducted, particularly in a structural pathways model of the factors affecting shift work sleep disorder. We tested factors affecting shift work sleep disorder based on these models as well as coping strategies. We also highlight a new type of coping in the transactional stress called the meaning based coping. This response can promote personal growth and help nurses to find positive meaning in their caregiving experience, so it will improve the adaptive coping.<sup>15,16</sup>

The summary of the theoretical framework of factors affecting shift work sleep disorder among shift work

nurses, is depicted in Figure 1. The underlying hypothesis is that selected occupational stressors, workload, interpersonal conflict, and biological sleep clock (morningness-eveningness) influence SWSD among shift work nurses through coping strategies and stress. The final aims of this study were to evaluate factors that affect SWSD and also provide a conceptual framework for implementing corrective intervention among female shift work nurses.

## Methods

### Research design

This study used a cross-sectional design to investigate the risk factors SWSD in nurses through a structural equation model.

### Settings

Data were collected from February to April 2020 from three regional public hospitals and three private hospitals in South Kalimantan Province, Indonesia.

### Participants

Female shift work nurses were recruited by convenience sampling. We focused on female nurses because gender influenced the circadian regulation of sleep in humans. The other inclusion criteria were: minimum 3 months working experience, a diploma degree, age  $\leq 35$  years, no history of chronic disease such as hypertension, non-pregnant, and agreement to join this study. As a reward, the

participants who completed fulfill the questionnaire got a voucher (e-money for shopping).

### Outcome

The study outcome was the SWSD.

### Dependent variables

The study predictors were demographic variables (such as age, level of education, work experience, kind of employees, marital status, and number of children), workload, interpersonal conflict, biological sleep clock, coping, meaning-based coping, and perceived stress.

### Data sources/measurement

All the study variables were measured through validated questionnaires adapted and translated into Bahasa based on World Health Organization (WHO) guidelines.<sup>17</sup> The permission to adapt all the questionnaires was granted by the original authors. Three questions were used to assess SWSD based on previous study.<sup>18</sup> It was developed based on International Classifications of Sleep Disorder, second edition 3. We also assessed physical and mental fatigue using the brief self-rated fatigue scale (FS), is 10 items self-report questionnaires, using 5-point scale (1: never to 5: always). Higher score indicates higher fatigue.<sup>19</sup> Perceived stress was measured by a shortened version of perceived stress scale (PSS) created by Cohen.<sup>20,21</sup> The short PSS consist of item 2, 4, 5, and 6 in PSS. It is rated on a 5-point Likert type scale, ranging from 0 (never) to 4 (very frequently). Scores of items 4 and 5 are reversed. Higher scores indicated higher perceived stress. According to Lazarus and Folkman's theory,<sup>20</sup> we assessed Coping through emotional-focused (five items) and problem-focused (three items) domains of the Brief COPE (we did not consider the dysfunctional coping dimension). Items were scored with a 4-point scale; 1 (I have not been doing this at all) to 4 (I have been doing this lot).<sup>20</sup> Meaning-based coping consists of positive reinterpretation, human caring, and spiritual. Positive reappraisal was measured by using cognitive emotion regulation questionnaire (CERQ) in the related domain; this is a four-item scale to assess positive meaning to the event. Each item was scored on 1 ((almost) never) to 5 ((almost) always) Likert scale. Higher scores indicate positive reappraisal.<sup>22</sup> Human caring and spiritual were measured by cultural justifications for caregiving scale-revised (CJCS-R) 27. CJCS-R was used to measure caregivers' cultural motivation in providing caring, it is a 10 items self-report questionnaire on a 4-point scale (4 strongly agree to 1 strongly disagree). We adopted this questionnaire to measure motivation among shift work nurses in providing caring, which refers to human caring. The Workload was measured by the National Aeronautics

and Space Administration Task Load Index (NASA-TLX), which is a six item questionnaire for measuring mental demand, physical demand, temporal demand and frustration. The range of score was 1 (low) to 20 (High).<sup>20</sup> Interpersonal conflict was measured by the nursing stress scale (NSS) in the domain of conflict with physicians (five items) and with other nurses (five items) to measure stressful situations in the nurse's interaction with physicians and with other nurses or supervisors respectively. Each item scored 0 (never), occasionally (1), frequently (2), and very frequently (3), with a high score indicating more frequent conflict.<sup>23</sup> We used the reduced morningness-eveningness scale (rMES) to measure biological sleep clock, especially to assess circadian variations and preference for morning or evening activities. The rMES is a shortened version of the MES (item 1, 7, 10, 18, and 19). Items 1, 10, 18 are on 1–5 point scale, item 7 is on 1–4 scales, and item 19 is on 0, 2, 4, and 6 point scales, with a high score indicating morning type.<sup>24</sup>

### Study size

The statistical indices in a structural equation model (SEM) will perform adequately when the sample size is 200 or more or five cases per free parameter in the model 16–18.<sup>25–27</sup> We had 25 parameters, the minimum sample size was 125, but we recruited 201 nurses to prevent missing data. Previous study recommended that 60% response rate.<sup>28</sup> All participants were female nurses who had a shift work.

### Statistical methods

All the data were keyed in the Statistical Product and Service Solutions (SPSS) computer software version 22. Univariate analysis (chi-squared test) was used to investigate the frequency of each variable and their relationship with shift work sleep disorder. Our present study evaluated the reliability and validity of the scale. The internal consistency reliability was used to calculate the Cronbach's alpha for each questionnaire; previous studies suggest that Cronbach's alpha >0.5 is considered acceptable reliability. In this study, we had 11 hypotheses. To estimate the hypothesized model fit with the actual data, AMOS 20.0 was used for the structural equation model. Maximum likelihood was used to estimate loadings on the effect of the variable. We determined the standardized path ( $\beta$ ), the standard error (SE), and  $p$ -values which was significant at <0.05 was addressed to include or exclude the hypotheses. Direct, indirect, and total effects were calculated in the model using the standardized path ( $\beta$ ). The following fit indices were used to evaluate the hypothesized model fit with the actual data: standardized chi-square index ( $\chi^2/df$ ), root mean square error of approximation (RMSEA), goodness-of-fit indexed (GFI), comparative fit index (CFI), the Tucker-Lewis index (TLI), and

**Table 1.** Distribution of respondent characteristics (n = 201).

Variables	n (%)	Shift work sleep disorder		p-Value
		Yes	No	
Age in years	27.3 (3.82)			0.450
Mean (SD)				
Level of education				
Vocational	113 (56.20)	92	21	0.129
Bachelor of nursing	14 (7.00)	6	8	
Registered nurse	72 (35.80)	54	18	
Master	2 (1.00)	2	0	
Work experience (months)				
3–12	28 (13.90)	20	8	0.035*
13–24	30 (14.90)	25	5	
25–36	9 (4.50)	7	2	
37–48	17 (8.50)	15	2	
49–60	8 (4.00)	6	2	
>60	109 (54.20)	81	28	
Kind of employees				
Permanent	175 (87)	137	38	0.136
Temporary	26 (13)	17	9	
Marital status				
Single	59 (29.30)	41	18	0.091
Married	140 (69.70)	111	29	
Divorce	2 (1.00)	2	0	
Number of children				
0	73 (36.30)	54	19	0.062
1	58 (28.90)	45	13	
2	51 (25.30)	38	13	
3	15 (7.50)	13	2	
4	4 (2.00)	4	0	

\*p < 0.05.

incremental fit index (IFI). The standardized chisquare index ( $\chi^2/df$ ) value of 5 or less indicated good fit. Acceptable fit values for the GFI, CFI, TLI, IFI were 0.90 or greater and the RMSEA were 0.1 or less.<sup>29</sup>

### Ethical consideration

The procedure was reviewed and granted ethical clearance (number: 1903-KEPK) by the Institutional Review Board (IRB) at Nursing Faculty, Universitas Airlangga, Indonesia.

### Significance for public health

Sleep is public health issue with broad implications. Nurses have to work different and often irregular shifts to provide care. This puts nurses at health risk, such as of sleep impairment and it is considered as shift work sleep disorder. In addition, shift work sleep disorder among nurses is related to work accident and patient safety. Analysis of the factors affecting shift work sleep disorder

is needed which may be considered as potential target of intervention among female shift nurses.

## Results

Table 1 lists the characteristics of all participants. Our 201 participants' mean age (standard deviation; SD) was 27.27 (3.82). Most of participants were permanent employee (87%), and had work experience more than 60 months (54.20%).

Table 2 lists scores and consistency ratings for the used scales. It consists of total item, range, mean, and standard deviation and Cronbach's alpha for all variables. The Cronbach's alpha of every variable addressed was acceptable. Previous studies mentioned that Cronbach's alpha >0.5 was considered acceptable reliability<sup>30,31</sup>; thus, the scales met the structural equation model requirement.

In this study we evaluated reliability and validity of the scale (Table 1). Our present study showed the overall SWSD and brief self-rated fatigue scale (FS) (four items) indicated fit to the data. The results of the CFA indicated GFI 0.922; AGFI 0.832; CFI 0.906; RMSEA 0.1. The Cronbach's alpha for shift work sleep disorder 0.752. The Cronbach's alpha of short perceived stress scale (PSS), BRIEF COPE, and meaning based coping in this study presented 0.586, 0.783, 0.822, respectively. The Cronbach's alpha of the NASA Task Load Index (TLX) for this study was 0.840. Results of confirmatory factor analysis (CFA) indicated that only four structures showed a tolerable fit to the data. These were mental demand, physical demand, temporal demand, and frustration; the results demonstrated that goodness-of-fit indexed (GFI) 0.995; adjusted goodness-of-fit indexed (AGFI) 0.976; normed-fit index (NFI) 0.995; root mean square error of approximation (RMSEA) 0.01. We examined the reliability and validity of the nursing stress scale (NSS) to measure interpersonal conflict. Cronbach's alpha for this study was 0.761. Results of CFA indicated that four items in the domain conflict with physicians and four items in the domain conflict with other nurses demonstrated a tolerable fit to the data; the results showed that GFI 0.927; AGFI 0.862; CFI 0.885; RMSEA 0.1. In addition, we measured the reliability of the rMES. Cronbach's alpha for this study was 0.52.

Table 3 presented regression estimates. It reports  $\beta$  coefficients, SE, and the p-value. Ten paths were considered significant at  $p < 0.05$ , which are indicated by solid line and one path was non-significant at  $p > 0.05$ , which is indicated by broken line. In the model, interpersonal conflict ( $\beta = 0.392$ ,  $p < 0.05$ ; H2), workload ( $\beta = 0.647$ ,  $p < 0.05$ ; H6), biological sleep clock ( $\beta = 0.271$ ,  $p < 0.05$ ; H8), and stress ( $\beta = 0.370$ ,  $p < 0.05$ ; H11) had significantly positive path on shift work sleep disorder. Interpersonal conflict ( $\beta = -0.348$ ,  $p < 0.05$ ; H3) and biological sleep clock ( $\beta = 0.153$ ,  $p < 0.05$ ; H7) had significantly positive

**Table 2.** Scores and consistency ratings for the used scales.

Variable	Total item	Cronbach's alpha	Min–Max	Mean	SD
Workload	4	0.840	4–38	15.77	7.76
Interpersonal conflict	8	0.761	8–25	11.51	2.64
Biological sleep clock	3	0.522	4–15	10.47	2.62
Coping effort	7	0.783	12–28	24.75	2.86
Meaning based coping	10	0.822	23–44	36.64	4.37
Stress	3	0.586	0–9	4.24	1.65
Shift work sleep disorder	7	0.752	4–19	8.64	2.89

**Table 3.** Regression estimates.

Hypothesis	$\beta$	Standard error
H1: Work load $\rightarrow$ Interpersonal conflict	0.516*	0.063
H2: Interpersonal conflict $\rightarrow$ shift work sleep disorder	0.392*	0.082
H3: Interpersonal conflict $\rightarrow$ coping strategies	-0.348*	0.111
H4: Interpersonal conflict $\rightarrow$ meaning based coping	0.302*	0.080
H5: Work load $\rightarrow$ coping strategies	-0.070	0.075
H6: Work load $\rightarrow$ shift work sleep disorder	0.647*	0.060
H7: Biological sleep clock $\rightarrow$ coping strategies	0.153*	0.080
H8: Biological sleep clock $\rightarrow$ shift work sleep disorder	0.271*	0.080
H9: Meaning based coping $\rightarrow$ coping strategies	0.864*	0.078
H10: Coping strategies $\rightarrow$ stress	-0.676*	0.049
H11: Stress $\rightarrow$ shift work sleep disorder	0.370*	0.080

$\beta$ : standardized regression weight.

\*Significant estimates at 0.05 significance level.

path on coping strategies; however coping strategies were not affected by the variable of workload ( $\beta = -0.070$ ,  $p > 0.05$ ; H5). Additionally, workload had significantly positive path on interpersonal conflict ( $\beta = 0.516$ ,  $p < 0.05$ ; H1). Coping strategies had significantly positive path on stress ( $\beta = -0.676$ ,  $p < 0.05$ ; H10). Meaning-based coping was affected by interpersonal conflict ( $\beta = 0.302$ ,  $p < 0.05$ ; H4) and had significantly positive effect on coping strategies ( $\beta = 0.864$ ,  $p < 0.05$ ; H9).

According to Figure 2, eleven hypotheses (H1–H11) were examined. The statistical goodness of fit of the structural model, denoted by  $\chi^2 207.775$  ( $df = 112$ ,  $p = 0.00$ ); showed goodness-of-fit index (GFI) = 0.890, adjusted goodness-of-fit index (AGFI) = 0.850, comparative fit index (CFI) = 0.907, root-mean-square error of approximation (RMSEA) = 0.065, incremental fit index (IFI) = 0.909, Tucker Lewis Index (TLI) = 0.886, as shown in Figure 2. We had three adequacy indices that indicated the data were fit for hypothetical model.

Table 4 presented standardized total, direct, and indirect effects of the variables. It shows that workload exhibited

the strongest total effect on shift work sleep disorder and performed the strongest total direct effect on shift work sleep disorder.

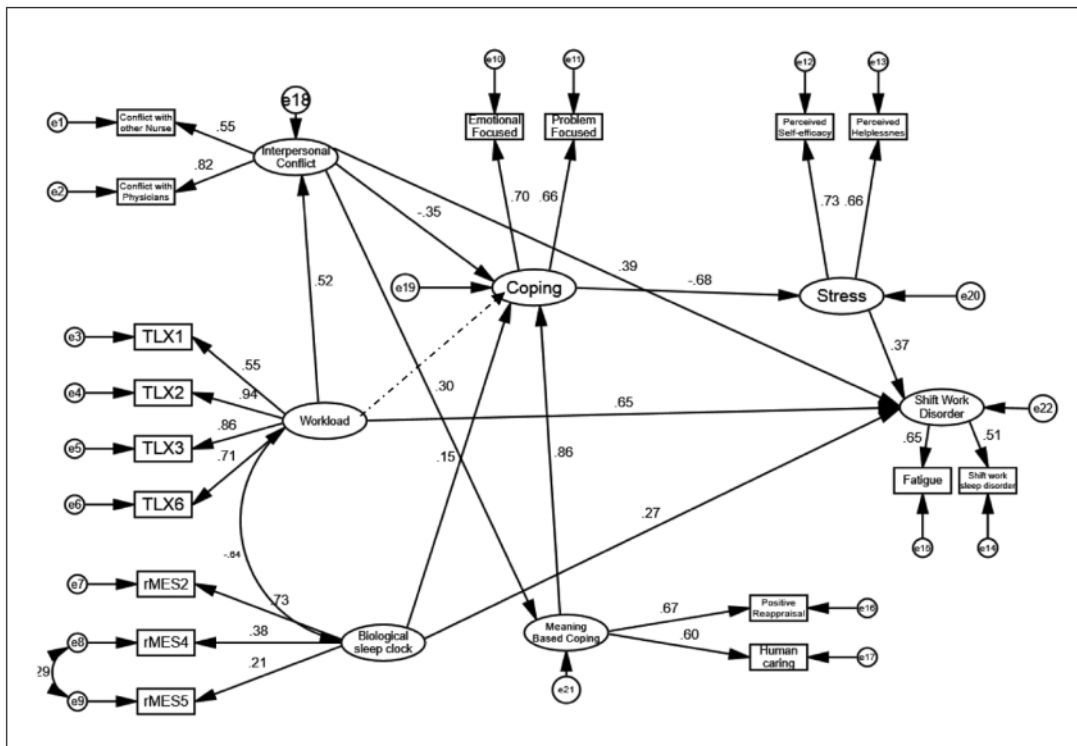
## Discussion

We tested the comprehensive conceptual framework for predicting shift work sleep disorder of female shift work nurses which include occupational stressors: workload and interpersonal conflict, and biological sleep clock as risk factors with coping strategies and stress as mediator; also meaning-based coping was another coping strategy to induce adaptive coping in a sample of female shift work nurses. Statistical results supported the hypothesis that risk factors influence shift work sleep disorder by mediating coping strategies and stress. Other results showed that meaning based coping positively influenced coping strategies, and workload positively influenced interpersonal conflict. Our results provided applicable evidence of the conceptual framework for predicting shift work sleep disorder among female shift work nurses.

Our findings showed that occupational stressors: workload and interpersonal conflict, biological sleep clock, and stress were predictors of shift work sleep disorder. In Table 4, our results showed that occupational stressors such as workload, caused direct effect on shift work sleep disorder. Moreover, occupational stressors: workload demonstrated to be the strongest predictor of sleep quality ( $\beta = 0.647$ ,  $p < 0.05$ ), as shown in Figure 2. Workload may be an important factor of shift work sleep disorder among female shift work nurses. This finding is consistent with previous study.<sup>32</sup>

There are several patient-handling tasks that are considered as producing high workload among nursing, such as transferring and lifting patients and working standing, and these were related to sickness absence.<sup>33</sup> In this study especially in South Kalimantan, nurses on night shift also extended their working hours because they have to wait for nurses on the day shift to conduct handover. Moreover, nurses conducted irregular shifts and changed their shift with other friends in a ward, due to personal reasons, such as family. Workload can negatively affect sleep because heavy workload will decrease sleep duration.<sup>34,35</sup>

In Table 3, our results showed that occupational stressor such as interpersonal conflict were a predictor of shift work



**Figure 2.** Path diagram of the confirmatory factor analysis. Significant pathways are represented with solid lines, and the others with broken lines. "e" indicates errors.

sleep disorder ( $\beta=0.392$ ,  $p<0.05$ ). Moreover, interpersonal conflict caused direct and indirect effect on shift work sleep disorder and also positively influenced meaning-based coping. In addition, interpersonal conflict was affected by workload, as shown in Figure 2. One of occupational stressor is interpersonal conflict. Obviously, nurses have to work with others health care profession, such as physicians,<sup>36</sup> and also work with supervisors and other nurses.<sup>37</sup>

Our findings showed that biological sleep clock is a significant predictor of shift work sleep disorder ( $\beta=0.271$ ,  $p<0.05$ ) as shown in Figure 2. Biological sleep clock causes direct and indirect effect on shift work sleep disorder. Shift workers who spent more time at night going against their internal biological sleep clock significantly associated with shift work sleep disorder.<sup>4</sup>

Interpersonal conflict, biological sleep clock, and meaning-based coping are significant predictors of coping strategies among female shift work nurses. Coping strategies as an approach to deal with stressors, is classified as problem-focused and emotional-focused.<sup>38</sup> Nurses utilized coping strategies to prevent distress and maintain health and well-being. In this study, it depicted the coping strategies utilized by female shift work nurses were acceptance

(accepting the situation), positive reframing (finding meaning in stressful event), religion (praying and meditating), active coping (adopting strategies to solve problems), emotional support (getting support from others), and humor (making situations fun) to deal with stressor such as interpersonal conflict and biological sleep clock and prevent shift work sleep disorder.

Meaning-based coping strongly affects coping strategies ( $\beta=0.864$ ,  $p<0.05$ ), as shown in Figure 2. This finding is consistent with previous study, which mentioned that meaning-based coping might lead adaptive coping in stressful conditions.<sup>39</sup> Meaning based coping consists of positive reappraisal, revised goals, spiritual/acceptance, or and positive events.<sup>40</sup> Previous study showed that caring from nurses increased the coping style to patients,<sup>41</sup> meanwhile, in this study, caring increases coping style among the nurses. This result implies that meaning-based coping is needed for female shift work nurses to increase coping strategies and prevent shift work sleep disorder.

Several limitations in this study should be considered. This study used cross-sectional design; therefore, the causal direction implied by the path in structural equation model must be interpreted carefully. This study limits the

**Table 4.** Standardized total, direct, and indirect effects of the variables.

Variable	Interpersonal conflict	Meaning based coping	Coping	Stress	Shift work sleep disorder
<b>Total effects</b>					
Work load	0.516	0.156	-0.045	0.030	0.861
Interpersonal conflict	-	0.302	-0.348	0.059	0.431
Biological sleep clock	-	-	0.153	-0.104	0.232
Meaning based coping	-	-	0.864	-0.585	-0.216
Coping	-	-	-	-0.676	-0.250
Stress	-	-	-	-	0.370
<b>Direct effects</b>					
Work load	0.516	-	-	-	0.647
Interpersonal conflict	-	0.302	-0.348	-	0.392
Biological sleep clock	-	-	0.153	-	0.271
Meaning based coping	-	-	0.864	-	-
Coping	-	-	-	-0.676	-
Stress	-	-	-	-	0.370
<b>Indirect effects</b>					
Work load	-	0.156	-0.045	0.030	0.214
Interpersonal conflict	-	-	-	0.059	0.039
Biological sleep clock	-	-	-	-0.104	-0.039
Meaning based coping	-	-	-	-0.585	-0.216
Coping	-	-	-	-	-0.250

generalization of the effect of occupational stressors: workload and interpersonal conflict, biological sleep clock, coping strategies and meaning based coping, and stress on shift work sleep disorder among female shift work nurses. Intervention studies are necessary to manage factors affecting shift work sleep disorder among female shift work nurses.

## Conclusion

Our results supported the hypothesis that selected occupational stressors: workload and interpersonal conflict, and biological sleep clock influences shift work sleep disorder among shift work nurses through coping strategies and stress. Coping strategies significantly mediated the effect of interpersonal conflict on stress and stress significantly mediated the effect of coping strategies and shift work sleep disorder. The clinical significance of our findings is that the effect of interpersonal conflict and biological sleep clock on shift work sleep disorder may be reduced by increasing coping and stress management.

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## Declaration of conflicting interests

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## Ethical

The procedure was reviewed and granted ethical clearance (number: 1903-KEPK) by the Institutional Review Board (IRB) at Nursing Faculty, Universitas Airlangga, Indonesia.

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