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Insomnia mediates the longitudinal association between loneliness and burnout among nurses

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Burnout is common among nurses and undermines their health, well-being and job performance. The purpose of this two-wave longitudinal study was to analyze the relationships between loneliness and three dimensions of burnout (i.e. exhaustion, cynicism and professional efficacy) in this professional group and to test whether these relationships are mediated by insomnia. A total of 520 nurses were assessed at two time points, T1 and T2, six months apart, with a set of self-reported questionnaires including the De Jong Gierveld Loneliness Scale (DJGLS), the Athens Insomnia Scale (AIS) and the Maslach Burnout Inventory – General Survey (MBI-GS). Socio-demographic and work-related characteristics were also recorded. Structural Equation Modeling (SEM) was used to analyze the data. The findings indicate that loneliness was positively associated with cynicism and negatively with professional efficacy, with both direct and total effects being statistically significant. However, the direct effect of loneliness on exhaustion was not confirmed, while the total effect was significant. Insomnia emerged as a significant mediator in each of these relationships. The present study clearly demonstrates the significance of the subjective appraisal of social connections and sleep problems in the development of burnout syndrome among nurses.

Keywords Nursing, Burnout, Insomnia, Loneliness, Longitudinal study

Job burnout has been one of the most extensively studied work-related outcomes of job stress over the past 50 years[1]. For instance, a search combining the terms *"occupational stress"* and *"job burnout"* in the EBSCOhost database (PsycINFO and PsycEXTRA; 17/06/2024) yields 13,252 results. Both researchers and practitioners show considerable interest in this phenomenon due to its potentially serious negative consequences–at both the individual level (e.g., diabetes, cardiovascular diseases[2,3]) and the organizational level (e.g., absenteeism, employee turnover[4,5]).

Although scholars have not reached full consensus regarding the conceptualization of burnout, the classical approach defines it as a psychological syndrome that emerges as a prolonged response to chronic stressors on the job and is characterized by three key dimensions: exhaustion, cynicism, and lack of professional efficacy[6]. Exhaustion is a state of physical, emotional, and mental fatigue, leading to a sense of overload and a depletion of emotional and cognitive resources. Cynicism is a distant, indifferent, or negative attitude toward work, colleagues, or service recipients, often serving as a defense mechanism in response to emotional strain. Lack of professional efficacy denotes a reduced sense of competence, achievement, and effectiveness at work, typically accompanied by feelings of inadequacy and a diminished belief in one's ability to successfully perform job-related tasks. Within this framework, job burnout is perceived as a consequence of prolonged stress caused by dysfunctional interactions between the individual and their organizational environment[5], including "poor" interpersonal relationships with other members of the organization[7,8].

Nurses are particularly vulnerable to experiencing burnout syndrome due to the high demands of their job and sustained exposure to occupational stress, which may compromise their health, well-being and work performance[9–12]. Meta-analyses indicate that the prevalence of burnout in this professional group may reach as high as 56%[13,14], with particularly elevated levels observed during the COVID-19 pandemic[15]. Beyond its detrimental effects on nurses' own health, burnout can also undermine patient health and safety. For instance, a meta-analysis of 85 studies found that nurse burnout is associated with decreased quality of care, increased

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medical errors, higher rates of hospital-acquired infections, more frequent patient falls, and lower patient satisfaction[14]. In the light of these findings, a better understanding of the causes and mechanisms underlying the development of burnout among nurses appears to be well justified.

A wide range of factors, both situational and individual, have been identified as affecting the prevalence and severity of burnout[4,6,16]. However, loneliness, i.e. perceived social isolation, is definitely one of the under-researched potential contributors to burnout among nurses[17,18]. Loneliness is increasingly recognized as a global public health concern[19]. Numerous studies showed that it has harmful effects on various mental and physical health outcomes and significantly increases the risk of premature mortality[20–26]. However, the role of loneliness in the workplace and its impact on workers and employers have thus far received relatively little attention from researchers. A systematic review and meta-analysis by Bryan et al.[27] revealed that in various professions loneliness at work is associated with lower job performance, reduced job satisfaction, worse worker-manager relationships and elevated levels of burnout. The authors indicate, though, that the robustness of these findings remains questionable since most of the studies included were cross-sectional.

Another review by Wood et al.[28] focused on the evidence for an association between loneliness and burnout in nurses. Nevertheless, although the primary intent of this review was to explore the concept of loneliness, the authors surprisingly found that this concept has hardly been studied among nurses in the context of burnout. Therefore, they used the social support construct as a proxy for loneliness. Their analyses revealed that lower social support predicted higher levels of burnout in nurses, with social support explaining about a third of the variance in burnout. It needs to be noted here that social support and loneliness are closely related yet distinct phenomena[29–32]. The main difference between the two lies in the fact that the notion of social support emphasizes the importance of help provided through social relationships, whereas the loneliness concept calls attention to the role of pleasurable companionship and intimacy[29]. In turn, two recent pieces of research by Wood et al.[17,18] demonstrated that rates of loneliness and burnout among nurses are positively correlated, and highlighted the importance of social connectedness for improving nurse well-being. However, these studies were rather modest-scale, utilizing cross-sectional and qualitative data.

The literature reviewed above clearly shows that the empirical evidence for the role of loneliness in shaping the intensity of burnout in the nursing profession is scarce and weak. In order to be able to work out successful interventions targeting burnout in nurses, these drawbacks have to be addressed by performing longitudinal studies on substantial samples, exploring links between appropriately measured loneliness and burnout. Although the exact mechanism through which loneliness negatively affects health and well-being is not well understood, it is believed to act via both direct and indirect pathways. One of the most commonly acknowledged mediators of the impact of loneliness on mental and physical health is sleep impairment, which impedes its restorative functions[20–26]. A systematic review and meta-analysis aiming to synthesize the research on the relationship between loneliness and sleep showed a medium-sized correlation between loneliness and sleep disturbance (defined as sleep quality and insomnia symptoms) across a wide array of measures and samples[33]. In this review loneliness was also found to be associated with inadequacy of sleep and dissatisfaction with it, but not sleep duration. There is, then, sufficient evidence to consider loneliness as a potential risk factor for sleep problems. However, the directionality of this relationships has not yet been fully established and it is possible that feelings of social isolation and sleep impairments mutually reinforce each other[23,33,34].

There is also a considerable body of evidence demonstrating the association of sleep disturbances with burnout among healthcare professionals[35–38]. Nurses typically work shifts and extended working hours, which may alter their circadian rhythm and sometimes lead to the abuse of caffeine and benzodiazepines[39,40]. Such functioning may result in changes in sleep architecture, reduction in the amount and deterioration of sleep quality[41] and, in the long term, insomnia[36]. Indeed, Huang and Zhao[42] reported that in the initial phase of the COVID-19 epidemic, the problem of insomnia was the most serious among healthcare workers compared to other professional groups. Insomnia weakens the employee's physical and mental strength[36], and also drains the personal resources needed to cope with stress[43], which may intensify the symptoms of physical and mental fatigue and consequently lead to burnout[44].

An additional problem may be difficulties in recovery[45], caused by irregular working patterns and variable sleep–wake cycles. According to the effort-recovery model[46], in order to maintain "good" health at work, an employee should balance the time devoted to work and rest[47]. Therefore, after intense work-related effort, there should be a break for regeneration, e.g. sleep. However, full recovery can occur only when no job-related demands arise during non-work time[45,46]. Insufficient time for regeneration (especially after a heavy or long-term workload) may cause employees to incur greater costs associated with coping with new demands (e.g. the need to put more effort into work or greater fatigue) and become more susceptible to stress, which may result in burnout[48]. In this context, it should be emphasized, however, that despite the fact that both the theoretical rationale and empirical evidence indicate that impaired sleep may be a factor contributing to the development of burnout among healthcare professionals, most of the studies investigating this issue use a cross-sectional design and preclude the disentangling of the possibly complex relations between the two phenomena.

Thus, in this research, our main aim is to shed more light on the relationships between loneliness, insomnia and burnout among nurses. In view of the relevant literature, we postulate that insomnia may act as mediator in the relationship between loneliness and dimensions of burnout and we test this assumption in a two-wave longitudinal study including a relatively large sample of nurses. More specifically, we hypothesize that:

H1 *Higher loneliness will be linked over time to higher exhaustion (H1a), higher cynicism (H1b), and lower professional efficacy (H1c);*

H2 *Insomnia will mediate the relationship between loneliness and burnout, such that higher loneliness will lead to higher insomnia, which in turn will increase exhaustion (H2a), increase cynicism (H2b), and reduce professional efficacy (H2c).*

Methods

Participants

The participants were 520 nurses, 480 (92.3%) women and 40 (7.7%) men. Respondents' ages ranged from 26 to 78 years (M = 51.21; SD = 10.15) and seniority from less than one year to 53 years (M = 25.26; SD = 11.77). Other socio-demographic and job-related characteristics of the respondents are presented in Table 1.

Procedures

The ethical approval for this project was granted by the Bioethical Committee of the Institute of Psychiatry and Neurology in Warsaw (21/2020). Recruitment took place in two stages. In the first stage, a request was sent to people managing the nursing departments (Nursing Directors or Chief Nurses) of ten hospitals in the Masovian Province in Poland. After an initial interview explaining the objectives of the study, seven hospitals joined the project. Consent to conduct a survey among nurses employed in these facilities was obtained after submitting an official letter to the directors. The further course of recruitment was agreed with the managing nurses in accordance with the assumptions of the project. Informed consent was obtained from all individuals taking part in the study. Participants were assessed at two time points, T1 and T2, six months apart. The first part of the study was carried out between May and July 2021.

Measures

Professional burnout was assessed with the Maslach Burnout Inventory–General Survey (MBI-GS), a self-report tool developed by Schaufeli et al.[49] and validated for use in research in the Polish language by Chirkowska-Smolak and Kleka[50]. The questionnaire comprises sixteen items, scored from 0 to 6, divided into three subscales: exhaustion, cynicism (understood as a feeling of indifference towards one's job) and sense of professional efficacy. Each subscale is interpreted separately. High indices of exhaustion and cynicism and low professional efficacy indicate burnout syndrome. The McDonald's omega values for the individual subscales at each measurement point were as follows: Exhaustion T1 = 0.909 [95% CI 0.894–0.921]; Exhaustion T2 = 0.893 [95% CI 0.872–0.907]; Cynicism T1 = 0.836 [95% CI 0.808–0.860]; Cynicism T2 = 0.810 [95% CI 0.773–0.841]; Professional Efficacy T1 = 0.786 [95% CI 0.749–0.817]; Professional Efficacy T2 = 0.826 [95% CI 0.787–0.859].

Loneliness was measured by means of the De Jong Gierveld Loneliness Scale (DJGLS) devised by De Jong Gierveld and Kamphuis[51]. The Polish version was validated by Grygiel et al.[52] The scale consists of 11 items, to which interviewees respond by using a five-point scale ranging from 1 (yes!) to 5 (no!). It can be used to assess both the overall level of loneliness and its two dimensions: the emotional (6 items) and the social (5 items). After recoding the items that refer to the emotional aspects of loneliness, a higher total score denotes a more severe global sense of loneliness. McDonald's omega: T1 = 0.914 [95% CI 0.897–0.924]; T2 = 0.919 [95% CI 0.906–0.929].

The Athens Insomnia Scale (AIS) was used. The instrument was elaborated by Soldatos et al.[53] and validated in Polish by Fornal-Pawłowska et al.[54] This eight-item self-report questionnaire is grounded in the ICD-10 criteria and assesses symptoms of insomnia, such as difficulty initiating or maintaining sleep or poor quality of sleep, and their impact on daily functioning. To meet the criteria, symptoms must occur at least three times a week and persist for at least one month. Each item is rated on a scale from 0 (no problem at all) to 3 (very serious problem), with higher total score indicating greater insomnia severity. McDonald's omega: T1 = 0.852 [95% CI 0.825–0.874]; T2 = 0.860 [95% CI 0.839–0.879].

Variable	Category	n (%)
Marital status	Single	86 (16.5)
	Married	314 (60.4)
	Divorced	65 (12.5)
	Widowed	31 (6.0)
	In informal relationship	24 (4.6)
Place of residence	Rural area	81 (15.5)
	City with less than 100k inhabitants	91 (17.5)
	City with 100–500k inhabitants	57 (11.0)
	City with more than 500k inhabitants	291 (56.0)
Workplace	Emergency department/Admissions	18 (3.5)
	Hospital ward	349 (67.1)
	Emergency department + Hospital ward	15 (2.8)
	Work in several facilities (Hospital ward and/or Emergency department/Admissions and/or other place)	51 (9.9)
	Other place	87 (16.7)

Table 1. Characteristics of the sample (*N* = 520).

Data regarding socio-demographic and work-related characteristics of the participants were collected using a questionnaire prepared specifically for the purpose of this project.

Statistical analyses

There were no missing data in the dataset. Outliers were assessed via boxplots and casewise Mahalanobis distance ($p < 0.001$ threshold), with no observations exceeding the critical value. Preliminary analyses included descriptive statistics for the mean scores of the instruments used and their correlations and group differences. To examine group differences, non-parametric tests were conducted due to unequal group sizes. The Mann–Whitney U test was used for two-group comparisons, and the Kruskal–Wallis test for comparisons involving more than two groups. Effect sizes were also calculated: Glass's rank-biserial correlation (r_g) for the Mann–Whitney U test and epsilon squared (ε^2) for the Kruskal–Wallis test. The reliability of the scales and subscales was also assessed. Given that Cronbach's alpha (α) has been criticized for underestimating reliability when items are not tau-equivalent[55–57], we opted to use McDonald's omega (ω) coefficient, computed for each scale and subscale under a single-factor model[56]. Reliability was considered acceptable if the coefficient reached at least 0.70[55]. Estimates were supplemented with 95% Confidence Intervals (CI) calculated using bootstrapping with 1000 samples. The results are reported in Section "Measures". Additionally, we examined the potential impact of common method bias using Harman's single-factor test, with a variance explained by a single factor exceeding 50% indicating the presence of common method bias[58].

The main analyses were conducted using Structural Equation Modeling (SEM), with observed variables being items of scales that served as indicators of latent variables. We employed the ULSMV estimator (Unweighted Least Squares Mean and Variance Adjusted), which, as demonstrated by Rhemtulla et al.[59], is appropriate for medium-sized samples when variables have four response categories (AIS), and remains acceptable for five (DJGLS) and seven categories (MBI-GS). All latent and observed variables were standardized. The structural model was estimated in R, version 4.2.3[60] using the lavaan package[61]. Model fit was evaluated on the basis of the following criteria: Comparative Fit Index (CFI) and Tucker-Lewis Index (TLI) values above 0.95, Root Mean Square Error of Approximation (RMSEA) below 0.05, p-value for Close Fit (Pclose) above 0.05, and Standardized Root Mean Square Residual (SRMR) below 0.08[62,63]. Convergent validity was assessed using Average Variance Extracted (AVE)[64], with a threshold of 0.50, while discriminant validity was evaluated using the Heterotrait-Monotrait (HTMT) ratio of correlations, which should not exceed 0.85[65,66]. Age and seniority were tested as covariates in preliminary SEM runs; however, their inclusion did not materially change the path coefficients, so they were not retained in the final model. Path coefficients between latent variables were examined to test the hypotheses. To verify mediation effects, indirect effect estimates were computed[67,68]. Statistical significance was set at $p < 0.05$, with CI not encompassing 0.

We assumed a statistical power of 0.80 and an effect size of 0.20, based on findings from previous studies involving our variables[28,69–73]. Using these assumptions, we calculated that a minimum sample size of 376 was required to detect the effect in our model[74,75]. Additionally, given our model's high degrees of freedom, the RMSEA index achieves a power of 0.80 for detecting poor fit with a sample size of n = 67[76,77].

Results
Preliminary analyses

Before conducting the analyses the data were pre-checked. No missing data were observed, and no significant outliers were identified. Descriptive statistics, reliability, and correlation analysis results are presented in Table 2. The findings indicated that each scale demonstrated good internal consistency. Correlation analysis revealed a positive association between loneliness and insomnia, exhaustion, and cynicism, as well as a negative correlation with professional efficacy. Furthermore, insomnia was positively correlated with exhaustion and cynicism, and negatively correlated with professional efficacy. These findings provide the foundation for testing more advanced hypotheses.

No significant differences were observed between women and men regarding loneliness (U = 8600; $p = 0.273$; $r_g = 0.104$), insomnia (U = 9490; $p = 0.904$; $r_g = 0.012$), exhaustion (U = 9084; $p = 0.572$; $r_g = 0.054$), and cynicism (U = 8977; $p = 0.494$; $r_g = 0.065$). The difference in professional efficacy was statistically significant (U = 7579; $p < 0.05$; $r_g = 0.211$), with men rating their professional efficacy higher than women (M = 4.38; Me = 4.58; SD = 0.97 vs. M = 4.02; Me = 4.00; SD = 1.02). No differences were noted between individuals with different marital statuses regarding loneliness (H = 3.46; df = 4; $p = 0.485$; $\varepsilon^2 = 0.007$), exhaustion (H = 4.20; df = 4; $p = 0.380$; $\varepsilon^2 = 0.008$) and cynicism (H = 5.78; df = 4; $p = 0.216$; $\varepsilon^2 = 0.011$). However, for insomnia (H = 14.16; df = 4; $p < 0.01$; $\varepsilon^2 = 0.027$) and professional efficacy (H = 9.94; df = 4; $p < 0.05$; $\varepsilon^2 = 0.019$) the result of the H-Kruskal–Wallis test was statistically significant, but the effect sizes were small, and the results of all pairwise comparisons using the Dwass-Steel-Critchlow-Fligner method were not statistically significant. Similarly, no differences were found between nurses employed in different workplaces (loneliness: H = 9.63; df = 9; $p = 0.381$; $\varepsilon^2 = 0.019$; insomnia: H = 14.06; df = 9; $p = 0.120$; $\varepsilon^2 = 0.027$; exhaustion: H = 13.99; df = 9; $p = 0.123$; $\varepsilon^2 = 0.027$; cynicism: H = 8.87; df = 9; $p = 0.450$; $\varepsilon^2 = 0.017$; professional efficacy: H = 6.36; df = 9; $p = 0.703$; $\varepsilon^2 = 0.012$).

Harman's single factor test showed that a single factor explained 24.49% of the variance in the items from all scales. This suggests that our results are not affected by common method bias.

Structural equation modeling

In the next step of the analyses, we developed a structural model according to the effects postulated in the hypotheses. The fit statistics are presented in Table 3.

The results confirm the good fit of the model. Therefore, no covariances between observed variables were included in the model. AVE values ranged from 0.502 for loneliness to 0.656 for exhaustion. Additionally, the HTMT values ranged from 0.132 for the relationship between exhaustion and professional efficacy to 0.760 for

	M	SD	Me	Skew	Kur	Pearson's r coefficient										
						1	2	3	4	5	6	7	8	9	10	11
1. Loneliness (T1)	2.22	0.65	2.18	0.16	−0.30	–										
2. Loneliness (T2)	2.21	0.66	2.18	0.08	−0.44	0.692***	–									
3. Insomnia (T1)	0.91	0.51	0.88	0.65	0.06	0.423***	0.304***	–								
4. Insomnia (T2)	0.81	0.50	0.75	0.65	−0.09	0.330***	0.341***	0.673***	–							
5. Exhaustion (T1)	2.58	1.37	2.40	0.32	−0.68	0.302***	0.232***	0.481***	0.323***	–						
6. Exhaustion (T2)	2.48	1.25	2.20	0.44	−0.30	0.258***	0.296***	0.434***	0.410***	0.683***	–					
7. Cynicism (T1)	2.06	1.25	2.00	0.58	−0.33	0.330***	0.218***	0.376***	0.226***	0.673***	0.469***	–				
8. Cynicism (T2)	2.11	1.19	2.00	0.49	−0.32	0.247***	0.311***	0.334***	0.331***	0.508***	0.646***	0.574***	–			
9. Professional Efficacy (T1)	4.20	1.08	4.33	−0.41	−0.30	−0.224***	−0.196***	−0.180***	−0.130**	−0.081	−0.104*	−0.207***	−0.166***	–		
10. Professional Efficacy (T2)	4.05	1.02	4.14	−0.30	−0.52	−0.240***	−0.292***	−0.190***	−0.186***	−0.131**	−0.124**	−0.226***	−0.292***	0.591***	–	
11. Age	51.21	10.15	54.00	−0.78	0.04	0.100*	−0.102*	−0.035	0.068	−0.092*	0.040	−0.094*	−0.005	0.034	−0.054	–
12. Seniority	25.26	11.77	27.54	−0.63	−0.52	0.065	0.073	−0.021	−0.057	0.116**	0.061	0.115**	0.017	−0.015	−0.031	0.932***

Table 2. Descriptive statistics, reliability, and Pearson's r correlation coefficients ($N = 520$). M, mean; SD, standard deviation; Me, median; Skew, skewness; Kur, kurtosis; ω, McDonald's omega; $*p < 0.05$; $**p < 0.01$; $***p < 0.001$.

χ^2	df	χ^2/ df	CFI	TLI	RMSEA	90% CI for RMSEA		Pclose	SRMR
						Lower	Upper		
1088.233***	550	1.979	0.970	0.967	0.043	0.040	0.047	0.998	0.053

Table 3. Model fit ($N = 520$). df, degrees of freedom; CFI, comparative fit index; TLI, Tucker-Lewis index; RMSEA, root mean square error of approximation; CI, confidence interval; Pclose, probability of close fit; SRMR, standardized root mean square residual. ***$p < 0.001$.
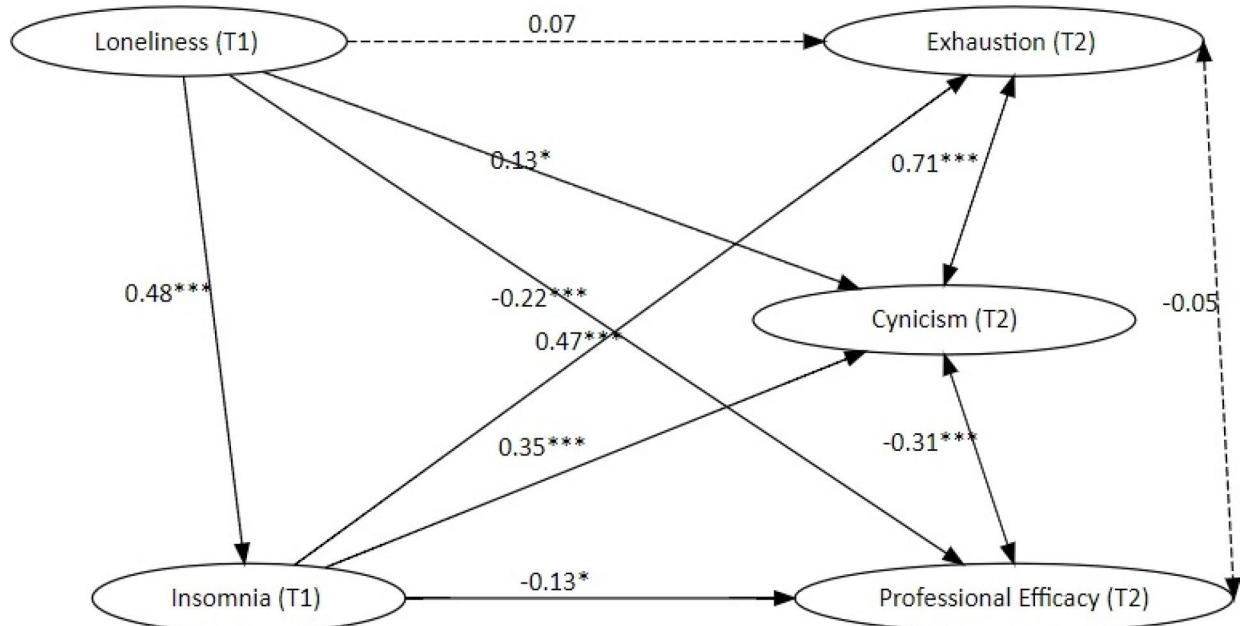
Fig. 1. Structural model of the links between loneliness, insomnia, and the three dimensions of burnout (exhaustion, cynicism, professional efficacy) ($N = 520$). *Note* The figure presents standardized coefficients. For clarity, only the latent variables are shown in the figure; *$p < 0.05$; ***$p < 0.001$.

the relationship between cynicism and exhaustion. Thus, it can be concluded that there are no issues with the validity of the model. The structural model is presented in Fig. 1.

Hypothesis 1 examined the relationships between loneliness and burnout. As shown in Table 4, Hypothesis 1a was not confirmed for the direct effect but was supported for the total effect. The effect of loneliness on cynicism (positive) and professional efficacy (negative) was statistically significant for both the direct paths and total effects, supporting H1b and H1c. Furthermore, the results indicate that loneliness was significantly associated with insomnia, which, in turn, was significantly related to exhaustion, cynicism, and professional efficacy. The indirect effect of loneliness on exhaustion via insomnia, as hypothesized in H2a, was confirmed. These findings suggest that the effect of loneliness on exhaustion was fully mediated by insomnia. Additionally, the indirect path from loneliness to cynicism through insomnia was statistically significant, confirming H2b. Similarly, the mediating role of insomnia in the relationship between loneliness and professional efficacy was confirmed, supporting H2c. However, while the mediation was full in the case of exhaustion, for cynicism and professional efficacy, it was only partial.

Discussion

Designing effective interventions through which to prevent or reduce burnout syndrome among nurses requires a good understanding of the factors underlying its development in this professional group and disentangling their interrelationships. Much is already known about the antecedents and possible causes of burnout[4,6,16]. However, to the best of our knowledge the present study is the first to explore the prospective associations between loneliness and burnout and to test the mediating role of insomnia in this relationship. We used a relatively large sample of Polish nurses and advanced statistical methods to verify our hypothesized model. The results support the notion that loneliness contributes to the intensification of burnout among nurses, with insomnia fully mediating the relationship between loneliness and exhaustion, and partially mediating its effects on cynicism and professional efficacy.

In accordance with our predictions, more severe loneliness turned out to be directly related to higher cynicism and lower professional efficacy. Instead, and contrary to our expectations, the direct effect of loneliness

Effect	Estimate	SE	95% CI		Z	Standardized coefficient
			Lower	Upper		
Loneliness → insomnia	0.543	0.060	0.427	0.660	9.113***	0.477
Insomnia → exhaustion	0.475	0.058	0.361	0.588	8.192***	0.467
Direct effect: loneliness → exhaustion	0.080	0.061	−0.039	0.200	1.316	0.069
Indirect effect: loneliness → insomnia → exhaustion	0.258	0.039	0.182	0.334	6.678***	0.223
Total effect: loneliness → exhaustion	0.338	0.059	0.224	0.453	5.784***	0.292
Insomnia → cynicism	0.334	0.062	0.213	0.455	5.411***	0.345
Direct effect: loneliness → cynicism	0.147	0.067	0.016	0.278	2.197*	0.133
Indirect effect: loneliness → insomnia → cynicism	0.182	0.038	0.108	0.255	4.837***	0.165
Total effect: loneliness → cynicism	0.329	0.056	0.219	0.438	5.875***	0.297
Insomnia → professional efficacy	−0.119	0.058	−0.233	−0.006	−2.055*	−0.129
Direct effect: loneliness → professional efficacy	−0.229	0.064	−0.355	−0.103	−3.559***	−0.218
Indirect effect: loneliness → insomnia → professional efficacy	−0.065	0.032	−0.127	−0.003	−2.054*	−0.062
Total effect: loneliness → professional efficacy	−0.294	0.056	−0.404	−0.184	−5.238***	−0.280

Table 4. Estimates of the model's effects values ($N = 520$). SE, Standard error for estimate; CI, Confidence Interval; Z, Z statistics. *$p < 0.05$; ***$p < 0.001$.

on exhaustion was not significant. As for the positive relationship between loneliness and cynicism, it may be the case that loneliness predisposes a person to having a detached attitude towards clients/patients and the work environment, since lonely people suffer from biased social information processing. For example, it has been demonstrated that loneliness is associated with increased attention being paid to socially threatening stimuli, negative and hostile intent attributions, expectations of rejection or a tendency to evaluate characteristics and behaviors of others negatively[78]. These distorted social cognitions may elicit unfavorable reactions from others, thus reinforcing the feelings of loneliness and cynicism. Nevertheless, it is worth mentioning that insomnia is also associated with impaired cognitive performance, both generally and across multiple specific cognitive domains[79]. Moreover, sleep has far-reaching effects on social processes from basic social cognition to complicated social interactions[80]. This suggests that loneliness and insomnia may interact in their impact on cynicism in a very complex way, which merits further investigation. As for professional efficacy, it seems plausible to assume that for nurses who feel lonely it may be particularly challenging to maintain a satisfactory level of professional efficacy in a job that, by its very nature, demands frequent, intensive and often intimate contact with others. Furthermore, loneliness has been found to be related to negative self-evaluations and diminished self-efficacy[78].

However, all three intermediate effects tested in the model were confirmed. The mechanism through which loneliness impairs sleep is probably complex. One may speculate that loneliness leads to sleep disturbances both directly, by activating the stress response and causing physiological arousal, and indirectly, by negatively affecting health practices and health-promoting behaviors (e.g., alcohol and drug use, less exercise, less relaxation, poor nutrition and obesity)[21,23].

The associations between insomnia and the three components of job burnout are not uniform. In the case of exhaustion, a complete mediation effect can be observed — when insomnia is introduced as a mediator, the direct relationship between predictor and exhaustion becomes non-significant. This effect stems from the particularly strong association between insomnia and exhaustion. These findings are consistent with theoretical expectations as well as with prior studies[35–38]. For instance, a meta-analysis of 12 studies examining the relationship between insomnia and burnout among nurses reported a mean correlation coefficient of $r = 0.39$ between overall burnout levels and sleep disturbances[36]. Other studies involving this professional group have similarly demonstrated that insomnia is associated with two core components of occupational burnout–exhaustion ($r = 0.30$) and depersonalization ($r = 0.26$). Furthermore, it has been observed that insomnia increases the likelihood of experiencing job burnout by more than 2.5 times.

Several mechanisms may underlie the relationship between insomnia and exhaustion. First, sleep disturbances can induce an excessive activation of the hypothalamic–pituitary–adrenal (HPA) axis, resulting in elevated cortisol levels[81,82]. Chronic overactivation of the stress response system may, over time, contribute to the development of exhaustion[6,48]. Moreover, sleep disturbances can impair emotional self-regulation[83,84]. Deficits in emotion regulation heighten vulnerability to stress and increase the likelihood of responding to challenging work situations with negative emotions — a process that itself may be emotionally depleting[85,86]. Finally, chronic insomnia progressively depletes employees' personal resources and disrupts the recovery processes required to restore resources eroded by stress[43]. An insufficiency of resources with which to cope with which job demands directly contributes to the experience of exhaustion[5].

Significant mediating effects of insomnia were also observed for the other two components of job burnout, namely depersonalization and low professional efficacy. The weakest indirect effect was found for the third component–low professional efficacy. This relatively weak effect was primarily due to the low, albeit statistically significant, relationship between insomnia and low professional efficacy. In this case, a considerable proportion of the total effect was explained by the direct effect. It is possible that in professions with a strong social mission–such as nursing–where the core job tasks involve establishing and maintaining close emotional relationships

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with others, the sense of high professional competence is strongly linked to the ability to build and sustain these interpersonal bonds. Consequently, a sense of social isolation at work may undermine professional efficacy.

Theoretical and practical implications

The present study offers several important theoretical and practical contributions. First, the results reveal alternative mechanisms underlying the development of job burnout. The widely recognized and extensively studied Job Demands-Resources (JD-R) theory[87] identifies an imbalance between job demands present in the work environment and the resources available to employees to cope with these demands as the primary driver of burnout. However, the findings of the current study suggest that the onset of burnout can also be triggered by feelings of loneliness. Although loneliness is not directly associated with all components of burnout — including exhaustion, which is considered the core element of this construct — it leads to increased insomnia, which disrupts recovery processes[45] and, consequently, contributes to resource depletion — a central feature of job burnout[87].

These findings are particularly relevant in the context of nurses' occupational functioning. Nursing is typically shift-based work, often performed at irregular hours, including night shifts. Such irregular schedules disrupt the sleep–wake cycle, contributing to sleep disturbances, chronic fatigue, and impaired recovery[88,89]. Long-term disruption of biological rhythms has been linked to difficulties in maintaining mental health, including an elevated risk of burnout[90,91]. The present results are also relevant to the current situation of Polish nurses in the labor market, in which working conditions are extremely challenging. According to the OECD report *Health at a Glance: Europe 2020*, Poland has one of the lowest nurse-to-population ratios in Europe, with only 5.1 nurses per 1000 residents. This figure is significantly below the EU average of 8.2 and far behind Norway, which leads with 17.7 nurses per 1,000 residents. Projections from the Supreme Chamber of Nurses and Midwives (2017) suggest that by 2030, this ratio could decline further to just 3.81. Another cause for concern is the relatively high average age of Polish nurses, which currently stands at 52.2 years. Nearly 52% of all nurses are over the age of 51, while those under 30 account for only 5.5% of the workforce. This aging workforce is largely the result of the emigration of younger, highly qualified Polish nurses to Western European countries, coupled with declining interest in nursing programs in Poland in recent years.

Our findings point to loneliness and insomnia as potential targets of interventions aiming to mitigate burnout and its harmful sequelae in the nursing profession. Researchers identify four main strategies of loneliness reduction interventions: improving social skills, enhancing social support, increasing opportunities for social contact, and addressing maladaptive social cognition[92]. Employers should be aware of the significance of social connectedness for nurses' well-being and make efforts to adapt these interventions to the occupational health setting and to build a supportive work environment[17,18,27,28]. In turn, for the amelioration of sleep problems, Membrive-Jiménez et al.[36] in their review of the literature found that both psychological interventions and modifications in nurses' working conditions may be beneficial. The former may include, for example, a rehabilitation program based on psychoeducation for stress management or a personal self-care program based on changing night-time habits and stress management. Among the latter, the authors recommend developing turnicity strategies that limit alterations in circadian rhythm, using warmer lights in hospital units during night shifts and, where possible, elimination of the fixed night shift.

Limitations

Several methodological limitations of this study need to be mentioned. First, the follow-up was relatively short. Studies with an observation period longer than half a year would provide stronger evidence supporting the hypothesized theoretical model. Our data do not allow for the inference of definite conclusions about the direction of the relationships observed or causality. Furthermore, because the sample was restricted to urban hospitals in the Masovian Province, caution is needed when extending results to nurses in rural regions or other countries. Next, all the components of our model were measured using self-report instruments. It cannot be ruled out either that some unmeasured variables may have influenced the strength of the associations between loneliness, insomnia and the dimensions of burnout.

Another limitation concerns the number of measurement points in the present study. When testing mediation models involving at least three constructs, it is recommended to conduct at least three measurement waves, ensuring that all study variables are assessed at each time point[93]. This approach allows for cross-lagged analyses, which enable the examination of relationships between variables over time while controlling for their prior values. In the current study, only two measurement waves were conducted, necessitating a decision regarding which mediator value (from the first or second measurement) should be included in the model tested. We selected the insomnia (as well as loneliness) values from the first measurement, as our primary interest was in examining the short-term relationship between loneliness and insomnia, as well as the delayed effects of these variables on job burnout—a process that develops gradually over an extended period.

Conclusions

The present study clearly demonstrates the significance of the subjective appraisal of social connections in the development of burnout syndrome among nurses. This indicates that alleviating nurses' loneliness through targeted interventions is one of the promising routes to improving their well-being. No less important is counteracting insomnia in the nursing profession, which emerged as a mediator of the effects of loneliness on burnout. Managers should take it into account and adapt nurses' working conditions so as to minimize the risk of sleep problems related to the performance of this stressful and demanding job.

Data availability

The data are available from the corresponding author upon request.

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Author contributions
P.Ś. and H.S.-J. devised the concept and procedures of the study. Ł.B., J.B. and J.J. consulted the concept and procedures of the study. J.J. supervised the data collection and prepared the database. Ł.K. and Ł.B. performed the statistical analysis. P.Ś., Ł.B., Ł.K. and H.S.-J. interpreted the data. P.Ś., Ł.B. and Ł.K. drafted the manuscript. All authors made revisions and approved the final version of the article.

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Declarations

Competing interests
The authors declare no competing interests.

Ethical approval
This study was performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments.

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