BMC Nursing

RESEARCH Open Access

Patterns and predictors of mental workload in intern nursing students: a latent profile analysis

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Abstract

Background Intern nursing students are facing considerable psychological burdens, which impact their mental well-being and career progression. Although numerous studies have explored the psychological status of intern nursing students and its influencing factors, the majority of these investigations have primarily focused on single-factor linear relationships. To date, there has been limited research analyzing the individual differences among intern nursing students.

Objective This study aimed to investigate the mental workload patterns of intern nursing students and identify the factors that predict these patterns.

Methods A total of 320 intern nursing students were recruited for this study via convenience sampling, 302 of whom completed the survey. A pattern of intern nursing students' mental workload was identified through a latent profile analysis of 6 items on the NASA-Task Load Index scale. The analysis of latent profiles was performed using Mplus 8.7 software, while χ2 test and logistic regression analysis were carried out using SPSS 27.0 software.

Results Three patterns of mental workload of intern nursing students were identified as "low MWL-high self-rated (n = 45, 14.9%)", "moderate MWL (n = 152, 50.33%)", and "high MWL-low self-rated (n = 105, 34.77%)". Age and monthly income of 3000–5000 RMB were the main predictors of low MWL-high self-rated pattern. In contrast, long internships, passive coping strategies, college degree and monthly income < 3000 RMB were predictors of moderate MWL pattern.

Conclusion This study provided novel insights into the mental workload patterns among intern nursing students. The findings highlighted the heterogeneity of MWL and provide evidence-based guidance for nursing administrators to identify groups of intern nursing students with high mental workload and to develop targeted psychological interventions and management strategies.

Clinical trial number Not applicable.

Keywords Mental workload, Intern nursing students, Predictors, Latent profile analysis

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Background

Mental workload (MWL) is a complex and multifaceted concept that has garnered considerable attention in the fields of human factors and ergonomics. It involves evaluating the mental demands placed on individuals during various tasks, which can be assessed through different definitions, measurement techniques, and practical applications. However, despite its importance in understanding how mental demands affect performance and well-being, a universally accepted definition of MWL remains elusive. This lack of consensus highlights the challenges researchers face in accurately capturing the nuances of MWL and its implications in real-world settings [1]. One perspective defines it as the information processing capacity required for tasks involving perception, cognition, and psychological activities such as communication, calculation, decision-making and research [2]. In essence, MWL reflects the limited cognitive resources engaged in activities like understanding, anticipating, decision-making, communication and memory recall during task performance [3]. In recent years, researchers have proposed various theoretical models to further explore and clarify the concept.

Clinical practice plays a vital role in the education and training of intern nursing students, requiring them to apply their professional knowledge and operational skills in real-world settings [4, 5]. As the largest professional group in the healthcare industry, nurses are facing a pressing shortage, highlighting the importance of intern nursing students as the future workforce [6]. Their MWL warrants closer attention, as the unique demands of nursing work often expose intern nursing students to high MWL levels. This can negatively affect both their well-being and patient outcomes, ultimately compromising the quality of care [7, 8]. A systematic review and meta-analysis reported an average MWL score of 65.24 among nurses, with a high prevalence rate of 54%, particularly evident in developing countries and emergency departments [3]. Elevated MWL levels not only contribute to job burnout but also indirectly impact care quality by increasing the risk of patient safety incidents [9]. Nurses, who are at the center of patient care, play a key role in detecting, stopping, and correcting errors that threaten patient safety, providing safe care and improving the quality of healthcare services. Due to this critical role of nurses, the current MWL of intern nursing students and their influencing factors are very important, because they are future nurses. Understanding the MWL of intern nursing students can help them to better adapt to their future work environment and enhance their sense of identity and resilience to the nursing profession. This is especially important for nurses working in high-pressure environments.

Research suggested that MWL is influenced by various factors, including age, gender, and educational level [10]. Coping strategies, which are intrinsic factors, play a significant role in shaping individuals' MWL. These strategies are essentially personal cognitive and behavioral adjustments employed to manage changes and pressures in daily life [11]. Positive coping strategies can effectively alleviate stress among intern nursing students, whereas passive or negative coping strategies often heighten psychological pressure, increasing the risk of burnout and fostering negative emotions [12].

While previous research has extensively explored the MWL of intern nursing students and its influencing factors, most studies have focused on single-factor analyses or linear relationships, which may oversimplify the complex nature of MWL. Moreover, there is a lack of research examining the heterogeneity among intern nursing studentsof their MWL patterns. Latent Profile Analysis (LPA) is person-centered and based on the latent variable model to estimate the relationship between exogenous and latent variables and to classify the latent traits of individuals on the basis of their scores on each entry, as well as to estimate the different proportions of different latent groups [13, 14]. This method can group similar individuals, enabling targeted interventions.

Therefore, this study aims to explore the latent profiles of intern nursing students' MWL using the LPA. Through an in-depth analysis of the characteristics of different latent profiles and their influencing factors, this study provides a solid foundation for developing effective management strategies and evidence-based interventions to address the mental health challenges faced by intern nursing students.

Methods

Participants

A total of 302 intern nursing students were recruited from five hospitals in Guangxi, spanning from November to December 2024. The inclusion criteria are as follows: (1) intern nursing students undergoing clinical practice at the hospital; (2) informed consent and voluntary participation in this study. The exclusion criteria are as follows: (1) those who terminated their internship prematurely; (2) individuals with severe mental illness or psychological disorders; (3) those who had experienced significant life events in the past six months. Additional exclusion criteria for the survey data included: (1) questionnaires completed in less than 3 min; (2) all responses marked with the same option.

Sample size

The sample size was calculated according to Kendall's principle that the sample size should be 10–20 times the number of independent variables for the nature of

the quantitative cross-sectional study [15]. The demographic questionnaire used in this study included 11 variables, and the Perceived Social Support Scale(PSSS) included 3 variables, the Simple Coping Style Questionnaire （SCSQ） included 2 variables and the NASA-Task Load Index （NASA-TLX） included 6 variables, for a total of 22 variables; thus, the sample size should be between 220 and 440 cases. To further enhance the robustness of the study, we considered possible cases of invalid questionnaires, assuming an invalidity rate of 10%. On the basis of this adjustment, the target sample size n = (220–440) × (1 + 10%) = 242–484 cases was finally calculated. Our study also conducted LPA of intern nursing students' MWL. Nylund-Gibson and Choi [16] has suggested that the minimum adequate sample size criterion for the LPA should be 300 cases. Hence, based on the above-described criteria and considering the probability of invalid questionnaires, 320 questionnaires were administered.

Measures

Demographics

The General Information Questionnaire was meticulously crafted by the research team, drawing upon an extensive literature review and insights gained from group discussions. This questionnaire includes 11 essential demographic and personal information items such as age, gender, educational, family location, only child, monthly income, student leader, nursing as first-choice major, internship duration, number of night shifts per week and the willing to work in nursing.

Perceived Social Support Scale (PSSS)

The Perceived Social Support Scale (PSSS), originally developed by Zimet et al. [17], has been adapted and refined for application in China by Jiang Qianjin [18], demonstrating good reliability and validity. It is structured around three core dimensions: family support, friend support and other support. Respondents rate their agreement with each of the 12 items on a 7-point Likert scale, ranging from "strongly disagree" at 1 point to "strongly agree" at 7 points. The total score for the scale spans from a minimum of 12 to a maximum of 84, with higher scores indicative of a greater perception of social support. The scale exhibits an impressive Cronbach's alpha coefficient of 0.84, affirming its internal consistency.

Simple Coping Style Questionnaire (SCSQ)

The Simple Coping Style Questionnaire (SCSQ) was created by Xie Yaning, a domestic scholar. It is grounded in a broad understanding of coping styles from both domestic and international theories, adjusted for the characteristics of the Chinese population. The scale is known for its high reliability, validity, simplicity, and ease of administration [19]. It comprises 20 items, divided into two sub-scales: positive coping (items 1–12) and negative coping (items 13–20). The responses are rated on a 4-point Likert scale, with "never adopt" scoring 1 and "often adopt" scoring 4. The positive coping score ranges from 12 to 48, with higher scores indicating a stronger inclination towards positive coping. The negative coping score ranges from 8 to 32, with higher scores indicating a stronger tendency towards negative coping. The scale's Cronbach's alpha coefficient is 0.90 [20].

NASA-Task Load Index (NASA-TLX)

The Chinese adaptation of the NASA-TLX was developed by Liang Liling and colleagues and is utilized for evaluating the MWL of nursing staff [21]. The scale contains six dimensions: mental demand, physical demand, temporal demand and effort, frustration and overall performance. Items were scored using a 20-point bipolar scale ranging from 0 to 100. For the overall performance dimension, the score of 0 represented the most successful performance of the task and the highest degree of self satisfaction. However, for the remaining five dimensions, the score of 0 represented the lowest level of task load. The total (mean) MWL score can be obtained by summing up the six dimensions, with higher scores representing higher MWL levels of nurses.

Data collection

This survey was conducted through the Questionnaire Star platform, a widely used and professional online questionnaire survey website in China (https://www.wjx.cn). The text containing the questionnaire, informed consent, and instructions was imported into the Questionnaire Star platform to produce an electronic questionnaire and generate links and QR codes. The questionnaire was sent to potential participants after consent was obtained from the hospitals to be investigated. Participants were recruited after they had read the informed consent and clicked the"agree" button. The survey was anonymous, and confidentiality and voluntariness were applied to ensure the reliability of the data. The questionnaires were screened for further to ensure a high-quality study by excluding the following: 1) questionnaires with fast response time (< 3 min) and regular or repeated answers (the presurvey results showed that the minimum time required to complete the questionnaire was a little over 3 min, and hence, < 3 min was proposed as one of the censoring criteria for the questionnaire); 2) questionnaires with duplicate IP addresses; and 3) questionnaires with contradictory sociodemographic characteristics.

Data analysis

The LPA was conducted to explore subgroups of MWL based on the responses to each item via Mplus 8.7 software. The one, two-, three-,and four-profile models were tested sequentially, starting from the one-profile model. In terms of the information index, the Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), adjusted Bayesian Information Criterion (aBIC), and entropy were applied to evaluate the classification accuracy. A lower value of AIC, BIC, and aBIC suggested a better model fit. A higher entropy value indicated a more accurate profile classification. An entropy of 0.8 or above was considered a good classification of the model. We also applied the Lo-Mendell-Rubin (LMR) and bootstrap likelihood ratio test (BLRT) to evaluate the change in model fit after adding a profile. LMR and BLRT with $P<0.05$ suggested that the current profile model performed better than the previous one. SPSS 27.0 software was used for data processing and analysis. The sociodemographic and work-related characteristics of intern nursing students were described in frequencies and percentages. Differences in population characteristics between different profiles were tested by $\chi 2$ and analysis of variance. Statistically significant independent variables were incorporated into multivariate logistic regression analysis. Statistical testing was two-sided with a level of significance of 0.05.

Results

Demographic characteristics of the participant

A total of 320 questionnaires were distributed and collected in this survey. After data screening, 302 valid questionnaires were obtained, with an effective response rate of 94.44%. The average age of the 302 intern nursing students was 20.56 ± 1.51 (range: 19–23) years. Among the participants, 82.1% were female, 64.9% had a college's degree, 72.8% were from rural areas, and 42.1% worked night shifts more than once per week. Additional general information is presented in Table 1.

Latent profiling and naming of intern nursing students' MWL

The findings of this study indicate that the MWL score among the 302 intern nursing students was (67.22 ± 24.19). LPA was conducted based on the average scores of the six dimensions of MWL, yielding a total of four latent profile models, as presented in Table 2. In this table, the AIC, BIC and aBIC values gradually decrease as the number of categories increases, with a reduced decrement from three to four categories. According to the entropy index, all models exceed the critical threshold of 0.8. The p value of the LMR value for the four-category model was >0.05, indicating no significant difference. Consequently, three categories were selected as the final number of latent categories. The average probability of belonging to each latent category ranges from 0.936 to 0.978, all exceeding 0.90, suggesting a high classification accuracy, as shown in Table 3.

The probabilities of scores on all the items for the three latent profiles of intern nursing students' MWL are shown in Fig. 1. Profile 1 accounts for 14.9% of the total sample, and the average score of the six dimensions in this profile is relatively low. This showed that the intern nursing students in this group demonstrated strong adaptability, handled tasks with ease, and exhibited a high level of professional identity and job satisfaction in their nursing practice. Therefore, this profile is named the "low MWL-high self-rated." This highlights the positive factors associated with this group of intern nursing students, encompassing their individual characteristics, educational foundation, work environment, and social and cultural influences. Profile 2 accounts for 50.33%, with this group of intern nursing students scoring between the other two profiles across all six dimensions, reflecting a moderate level of performance. This profile predominates among intern nursing students, suggesting that the majority are in a state characterized by "moderate pressure and balanced adaptation." Therefore, this profile is named the "moderate MWL." Profile 3 accounts for 34.77%, and this group has a higher score on the six dimensions. This showed that the intern nursing students in this group had faced considerable pressure in terms of mental demand, physical demand, and temporal demand, while also lacking sufficient confidence in their own abilities. Therefore, this profile is named the "high MWL-low self-rated."

Factors associated with intern nursing students' MWL

This differences between the three groups of intern nursing students in terms of age, educational, monthly income, internship duration, and negative coping strategies were statistically significant ($P<0.05$). However, the differences in terms of gender, family location, only child, student leader were not statistically significant ($P>0.05$). See Table 1 for details.

Multiple logistic regression analyses were conducted with the latent profiles of intern nursing students' MWL as the dependent variable, and statistically significant factors from the single-factor analysis were selected as the independent variables. The " high MWL-low self-rated " group was set as the reference group. The variables were assigned as follows: educational (college = 1, bachelor = 2); monthly income (< 3000 RMB = 1, 3000–5000 RMB = 2, > 5000 RMB = 3); and actual values were used for age, internship duration, and negative coping scores.

The results of the multivariate analysis revealed that in the comparison between the high MWL-low self-rated and the low MWL-high self-rated, older intern nursing

Table 1 Univariate analysis of general demographics of survey participants and latent categories of MWL

Characteristics		Overall (*n* = 302)	low MWL-high self-rated(*n* = 45)	Moderate MWL(*n* = 152)	high MWL-low self-rated(*n* = 105)	χ2 /F	*P*
Gender						1.821[1)]	0.402
	Male	54(17.9)	11(24.4)	27(17.8)	16(17.9)		
	Female	248(82.1)	34(75.6)	125(82.2)	89(82.1)		
Educational						12.849[1)]	**0.002**
	college	196(64.9)	32(71.1)	110(72.4)	54(51.4)		
	Bachelor	106(35.1)	13(28.9)	42(27.6)	51(48.6)		
Family location						3.372[1)]	0.185
	Rural	220(72.8)	30(66.7)	107(70.4)	83(79.0)		
	Urban	82(27.2)	15(33.3)	45(29.6)	22(21.0)		
Only child						0.519[1)]	0.771
	Yes	51(16.9)	9(20.0)	26(17.1)	16(15.2)		
	No	251(83.1)	36(80.0)	126(82.9)	89(84.8)		
Monthly income(RMB)						35.128[1)]	**<0.001**
	<3,000	140(46.4)	10(22.2)	64(42.1)	66(62.9)		
	3,000 ~ 5,000	123(40.7)	20(44.4)	69(45.4)	34(32.4)		
	>5,000	39(12.9)	15(33.3)	19(12.5)	5(4.8)		
Student leader						1.625[1)]	0.444
	Yes	138(45.7)	24(53.3)	65(42.8)	49(46.7)		
	No	164(54.3)	21(46.7)	87(57.2)	56(53.3)		
Nursing as first-choice major						5.032[1)]	0.081
	Yes	226(74.8)	30(66.7)	122(80.3)	74(70.5)		
	No	76(25.2)	15(33.3)	30(19.7)	31(29.5)		
Number of night shifts per week						2.19[1)]	0.334
	≤ 1	175(57.9)	22(48.9)	88(57.9)	65(61.9)		
	>1	127(42.1)	23(51.1)	64(42.1)	40(38.1)		
Willing to work in nursing						3.599[1)]	0.165
	Yes	254(84.1)	36(80.0)	124(81.6)	94(89.5)		
	No	48(15.9)	9(20.0)	28(18.4)	11(10.5)		
Age		20.56 ± 1.510	21.51 ± 0.815	20.50 ± 1.509	20.25 ± 1.510	12.128[2)]	**<0.001**
Internship duration		5.49 ± 1.195	5.09 ± 1.083	5.16 ± 1.169	6.15 ± 0.988	29.146[2)]	**<0.001**
Family Support		19.38 ± 4.803	19.91 ± 5.044	19.55 ± 4.874	18.92 ± 4.597	0.839[2)]	0.433
Friends Support		20.27 ± 4.255	20.91 ± 4.819	20.29 ± 4.241	19.88 ± 4.026	0.753[2)]	0.472
Other Support		18.68 ± 4.727	19.49 ± 4.775	18.63 ± 4.927	18.40 ± 4.406	0.852[2)]	0.427
Positive coping		18.17 ± 4.920	17.80 ± 5.451	18.53 ± 4.915	17.80 ± 4.693	0.837[2)]	0.434
Negative coping		20.36 ± 5.313	12.36 ± 2.197	18.94 ± 2.543	25.86 ± 3.017	445.377[2)]	**<0.001**

1)：χ2：2)：F。

Bold values indicates that *p* values are <0.5

Table 2 Fit results of LPA models for MWL among intern nursing students (*n* = 302)

Model	AIC	BIC	aBIC	Entropy	LMR	BLRT	Probability of class
1	11063.300	11107.825	11069.768	——	——	——	——
2	10409.197	10479.695	10419.437	0.942	0.000	0.000	0.189, 0.811
3	10118.466	10214.937	10132.479	0.879	0.000	0.000	0.149, 0.503, 0.348
4	10073.016	10195.460	10090.802	0.864	0.071	0.000	0.480, 0.103, 0.106, 0.311

students (OR = 2.314, *P*<0.05) was more likely to ascribe to the high MWL-low self-rated, whereas intern nursing students with short internship duration (OR = 0.359, *P*<0.05) and negative coping (OR = 0.066, *P*<0.05) or monthly income ranging from 3000 to 5000 (OR = 0.026, *P*<0.05) were more inclined to ascribe to the low MWL-high self-rated. In a comparison of the moderate MWL with the high MWL-low self-rated, intern nursing students who were short internship duration (OR = 0.447, *P*<0.05) was more likely to attribute to the high MWL-low self-rated, whereas intern nursing students with negative coping (OR = 0.311, *P*<0.05) and college diploma

Table 3 Presents the probability matrix for three potential characteristics of intern nursing students

Classification of latent profiles	Probability of belonging to profiles (percentage, %)		
	1	2	3
1	0.978	0.022	0.000
2	0.003	0.940	0.057
3	0.000	0.064	0.936

(OR = 4.097, $P<0.05$) or monthly income less than 3000 (OR = 0.311, $P<0.05$) were likely attribute to the moderate MWL. The specific results are shown in Table 4.

Discussion

For the first time, this study used the LPA technique to reveal in depth the structure of the underlying patterns of MWL in the Chinese intern nursing students population, validated the predictors associated with the different patterns of MWL. Two main findings emerged from the study. First, the MWL of intern nursing students can be categorized into three patterns: low MWL-high self-rated, moderate MWL and high MWL-low self-rated. These patterns showed significant differences in group heterogeneity and individual variability. The results are consistent with those of Shan Y et al.'s study of nurses [22]. The complexity of clinical nursing tasks, combined with staffing shortages, imposes a heavy MWL on nurses, raising the risk of occupational burnout and compromising the quality of care [23]. In China, the limited capacity of primary healthcare institutions and the concentration of premium healthcare resources in urban tertiary hospitals have driven patients to larger hospitals, exacerbating nurse-to-patient imbalances and staffing shortages. These conditions, coupled with high-intensity workloads, have significantly heightened the MWL on nurses, impacting both their mental health and the quality of care delivery. In the transition from theoretical nursing education to practical clinical training, intern nursing students frequently encounter high-pressure work environments and multifaceted clinical scenarios. These conditions often engender feelings of insecurity, self-doubt, and anxiety, thereby amplifying their MWL [24]. Second, the study identified five main predictors on intern nursing students'MWL patterns: age, educational, monthly income, internship duration and negative coping.

Among the three MWL patterns, the low MWL-high self-rated pattern had the smallest percentage at 14.9%. Intern nursing students in this pattern lowered scores in both workload perception and self-evaluation, reflecting reduced MWL and favorable self-assessment. These findings indicate their ability to effectively handle work responsibilities, exhibit robust emotional regulation and psychological resilience, and maintain confidence in their professional performance and capabilities. The intern nursing students in this pattern display elevated levels of self-efficacy and a well-established professional identity, complemented by advanced learning and problem-solving skills. They skillfully integrate theoretical knowledge into clinical practice and continuously elevate their professional standards through systematic reflection and summarization. Additionally, they actively seek opportunities to accumulate practical experience, progressively

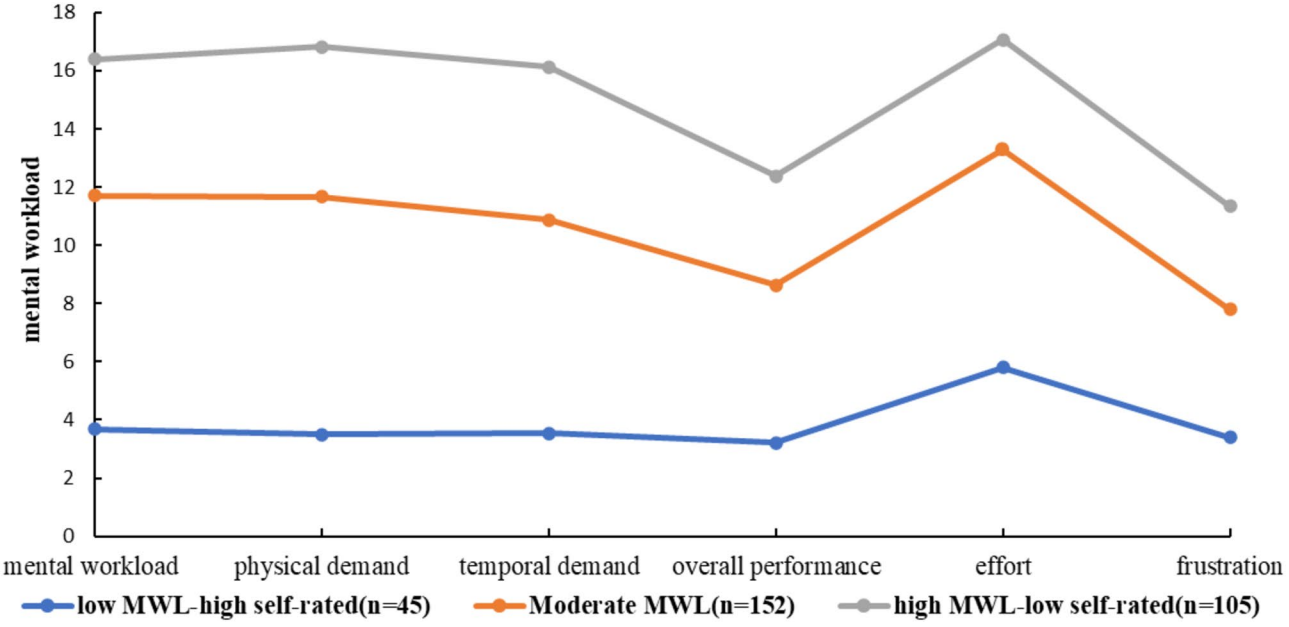

Fig. 1 Three subtypes of MWL based on the LPA results

Table 4 The results of the multinomial logistic regression analysis for the latent profiles of mental workload (MWL) among intern nursing students

Variables	Low MWL-high self-rated						*P* value	Moderate MWL						*P* value
	ß	SE	Wald χ2	OR	95%CI			ß	SE	Wald χ2	OR	95%CI		
					Lower limit	Upper limit						Lower limit	Upper limit	
Age	0.839	0.41	4.224	2.314	1.04	5.152	**0.04**	0.227	0.198	1.310	1.255	0.851	1.852	0.252
Internship duration	-1.026	0.43	5.722	0.359	0.155	0.831	**0.017**	-0.806	0.257	9.855	0.447	0.27	0.739	**0.002**
Negative coping	-2.721	0.4	46.86	0.066	0.03	0.143	**<0.001**	-1.167	0.187	39.01	0.311	0.216	0.449	**<0.001**
Educational														
College	1.577	1.11	2.027	4.84	0.552	42.43	0.155	1.41	0.636	4.91	4.097	1.177	14.26	**0.027**
Monthly income														
<3,000	-4.425	1.64	7.291	0.012	0.000	0.297	**0.007**	-3.225	1.277	6.377	0.040	0.003	0.486	**0.012**
3,000–5,000	-3.654	1.59	5.314	0.026	0.001	0.579	**0.021**	-2.063	1.265	2.657	0.127	0.011	1.518	0.103

Bold values indicates that *p* values are <0.5

honing their clinical skills and comprehensive abilities, thereby demonstrating notable potential for professional advancement. Nursing educators should consider incorporating advanced pedagogical elements into the curriculum, such as in-depth case studies and interdisciplinary teamwork simulations, to further develop the clinical decision-making and problem-solving skills of intern nursing interns. Concurrently, hospital administrators are advised to establish structured incentive programs, including recognition schemes for high-performing intern nursing students, to cultivate their academic engagement and professional dedication, thereby facilitating their long-term career advancement in the nursing profession [25].

It was also found in this study that the moderate MWL pattern had the largest percentage of 50.33%. In this pattern, intern nursing students scored moderately in both dimensions. Intern nursing students in this pattern may experience mental workload due to multifaceted pressures, such as limited technical proficiency and time management challenges. They demonstrate a stronger inclination toward skill acquisition and competency development through practical application, as opposed to a reliance on theoretical learning alone. Over time, as they gain clinical experience and achieve incremental skill mastery, their psychological workload is expected to decline, paralleled by an improvement in their self-evaluation and professional self-assurance. Therefore, hospital administrators are encouraged to enhance traditional preceptor-based guidance by integrating a peer mentoring model, where exemplary nursing interns are selected to serve as peer mentors. These mentors can share practical experiences and provide tailored advice, offering guidance that is more aligned with the actual needs of their peers [26].

The results revealed that 34.77% of the intern nursing students were in high MWL-low self-rated pattern. In this pattern, intern nursing students'MWL scores were significantly highest than those of the other patterns. intern nursing students within this pattern may exhibit introverted characteristics influenced by either intrinsic dispositions or external environmental factors, making them especially sensitive to criticism and negative feedback. This introverted disposition often results in the internalization of stress when exposed to high-intensity clinical environments, manifesting as heightened anxiety and emotional volatility. Furthermore, their low self-assessment contributes to a deficit in confidence when encountering professional challenges, leading to an over-reliance on external validation and guidance, which ultimately restricts the development of autonomous decision-making and problem-solving skills. To mitigate these challenges, hospital administrators and clinical educators should guide intern nursing students

to reframe "high mental workload" as an inherent aspect of clinical practice, thereby fostering a more adaptive response to stress. Concurrently, they should offer structured stress management interventions, including mindfulness training, facilitated group discussions, and access to psychological counseling, to promote effective stress coping mechanisms. Encouraging reflective practice and systematic post-clinical debriefing can further enable interns to recognize their professional growth and achievements, thereby enhancing their self-efficacy and reinforcing their professional identity.

The study revealed that age and monthly income were significant predictors of the demand low mWL-high self-rated pattern. Relevant studies indicated that older intern nursing students have accumulated more life experience and coping strategies, possess a more stable social support network, and are better able to manage stress and emotions, thereby reducing their MWL [27]. Due to the complexity of the clinical work environment, which demands rapid and precise emergency response capabilities, it poses a significant challenge for younger intern nursing students with limited experience [28, 29]. Moreover, intern nursing students with monthly income of 3000–5000 RMB exhibit lower MWL. Families within this income range are likely able to provide certain financial support, enabling these students to meet their basic living needs and alleviating economic pressures. Additionally, such families may offer emotional support, which assists the students in coping with the challenges encountered in clinical practice [30].

Intern nursing students with long internships, passive coping strategies, college degree and monthly income < 3000 RMB all tended to moderate MWL pattern. Intern nursing students with college degree might lack the skills and knowledge to handle complex clinical tasks, leading to increased psychological stress [31]. Extended internships subject students to a stressful work setting, causing physical exhaustion and frequently inadequate downtime, thus boosting MWL [32]. Additionally, passive coping can lead to the buildup of negative feelings, hindering the ability to effectively tackle challenges in the internship, and worsening MWL [33]. Intern nursing students from low-income families often bear significant family responsibilities, and this role conflict may make it difficult for them to balance clinical work with family life, thereby increasing their MWL [34]. Furthermore, due to financial hardships, they may experience feelings of guilt or an excessive sense of responsibility. This emotional burden can further impact their self-evaluation and exacerbate psychological stress, resulting in a prolonged state of moderate perceived load.

In light of this, school and hospital staff should prioritize intern nursing students who are younger, college degree, lower monthly income and passive coping strategies. Enhancing internship programs, offering financial support, promoting mental health training, and fostering effective coping skills can significantly lower their MWL and promote their well-being and career progression.

Limitations

The following limitations exist in this study. First, the survey population was limited to intern nursing students in five hospitals in Guangxi, China, so the results may be geographically limited and lack broad representation. Second, the outcome indicators were obtained via self-reports, which may lead to some bias. Finally, this study had a cross-sectional design. Future studies should consider multi-regional, large-sample studies to comprehensively examine how workload, educational structures, and regional healthcare policies in different hospitals influence the MWL patterns of intern nursing students. This will provide a robust scientific foundation for developing targeted intervention strategies.

Conclusion

This study used person-centered analysis to identify three MWL patterns of Chinese intern nursing students. In addition, this study further revealed the potential impact of these MWL patterns on intern nursing students, providing a more scientific and comprehensive basis for promoting the mental health and career development of intern nursing students. Subsequent studies can further explore how to develop individualized intervention strategies based on different MWL patterns to effectively reduce the MWL of intern nursing students, improve their professional quality and professional identity.

Abbreviations

MWL	Mental Workload
LPA	Latent Profile Analysis
PSSS	Perceived Social Support Scale
SCSQ	Simple Coping Style Questionnaire
NASA-TLX	NASA-Task Load Index
AIC	Akaike Information Criterion
BIC	Bayesian Information Criterion
aBIC	adjusted Bayesian Information Criterion
LMR	Lo-Mendell-Rubin
BLRT	Bootstrap likelihood ratio test

Acknowledgements

We sincerely thank Tingting Liao for data analysis and visualization, Lingfang Liu for theoretical guidance, Yao Du for questionnaire distribution and data collection, Mingjuan Guo for manuscript guidance, and Gaoye Li for research design and thesis supervision. We also acknowledge all participants and colleagues who supported this study in various ways.

Author contributions

Tingting Liao (Co-first author): Analyze data, make charts and article revision. Lingfang Liu: Provide theoretical guidance. Yao Du: Questionnaire distribution and data collection. Mingjuan Guo: Provided for the guidance to the paper. Gaoye Li: Research design and thesis guidance.

Funding
This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Data availability
The data that support the findings of this study are not openly available due to reasons of sensitivity and are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate
This study was approved by The First Affiliated Hospital of Guangxi Medical University. (Number: 2024-E0850). All participants received an explanation of the research' purpose and procedure, and informed consent was obtained from all participants included in this study before the interview. This study was conducted in accordance with the principles of the Declaration of Helsinki.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

Received: 9 February 2025 / Accepted: 28 April 2025
Published online: 13 May 2025

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