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Development and Validation of a Nomogram for Predicting Presenteeism Risk Among Oncology Nurses: A Cross-sectional Study

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Abstract

Objectives

To develop and validate a predictive nomogram model for assessing the risk of presenteeism among oncology nurses.

Background

Presenteeism is prevalent among oncology nurses, which affects patient safety and nurse health. However, there is a lack of practical tools to identify individuals at high risk of presenteeism.

Methods

A cross-sectional study was conducted between May 2025 and September 2025, involving 458 oncology nurses. Participants completed structured questionnaires assessing demographic and occupational factors. A nomogram was constructed to evaluate high presenteeism risk. Model performance was assessed using receiver operating characteristic curves, calibration plots, and decision curve analysis.

Results

Eight predictors were used to construct the nomogram: nursing experience, hospital level, overtime frequency, monthly income, job satisfaction, psychological capital, perceived social support, and challenge-hindrance stress. The nomogram exhibited strong discrimination, with an AUC of 0.864 (95% CI: 0.824–0.904) in the training set and 0.879 (95% CI: 0.823–0.934) in the validation set. Calibration plots demonstrated good agreement between predicted and observed probabilities (Hosmer–Lemeshow P = 0.915 and 0.243, respectively). Decision curve showed favorable clinical utility across a range of threshold probabilities.

Conclusion

This nomogram model demonstrates high predictive accuracy and clinical applicability for identifying oncology nurses at high risk of presenteeism.

Implications

The model offers nursing managers a practical tool for early identification of vulnerable nurses, enabling targeted interventions such as workload adjustments, stress management programs, and social support enhancement to reduce presenteeism and improve both nurse well-being and patient safety.

1. Introduction

Nurses serve as the cornerstone of healthcare systems, providing continuous, holistic, and emotionally care across diverse clinical settings[1, 2]. Among various nursing contexts, oncology nursing is

particularly challenging due to the complex nature of cancer care. Oncology nurses are frequently confronted with patients undergoing life-threatening diagnoses, prolonged treatment courses, and end-of-life situations, which demand continuous emotional engagement, ethical decision-making, and compassion[3]. These sustained pressures place oncology nurses at heightened risk for fatigue, burnout, and presenteeism [4]. Presenteeism refers to a phenomenon where employees are physically present at work but are unable to perform at their full capacity due to physical or mental health issues [5]. This concept first gained prominence in occupational health research in the late 1990s, as scholars began to recognize that productivity loss is not solely caused by absenteeism, but also by employees who are "present but unwell"[6, 7]. Unlike absenteeism, which is visible and measurable, presenteeism is a covert phenomenon that often goes unnoticed yet poses significant risks to performance and safety. It is report that nearly 50% of nurses worldwide experience varying degrees of presenteeism, varying by department type, workload, and institutional climate[8]. Furthermore, recent studies indicated presenteeism not only compromised nurses' physical and mental health, but also leaded to higher rates of clinical errors, suboptimal patient outcomes, and long-term productivity loss [9–11]. Given the critical role of oncology nurses and the negative impact of presenteeism, early identification of its risk factors is essential.

Presenteeism is typically assessed using self-report instruments, such as the Stanford Presenteeism Scale (SPS-6) and the Work Productivity and Activity Impairment Questionnaire (WPAI) [7, 12, 13]. These scales allows for the efficient identification of individuals whose productivity may be impaired due to physical or mental health conditions, even when they are physically present at work. Particularly SPS-6, it have been applied across diverse populations and industries, due to its brevity and ease of administration. However, most studies to date have focused on identifying prevalence rates or associated factors, while few have attempted to develop predictive tools. As a result, these tools are rarely employed for strategic decision-making in clinical settings, particularly in identifying at-risk staff for timely organizational support or intervention.

Presenteeism is a multifactorial and dynamic phenomenon, shaped by a complex interplay of personal, professional, and organizational factors [14]. Prior research has identified a range of individual-level predictors, including age, chronic health conditions, sleep quality, and psychological resilience, as well as work-related conditions such as excessive workload, irregular shift patterns, job dissatisfaction, and role ambiguity[15–17]. In addition, psychosocial elements like burnout, lack of perceived organizational support, and inequitable work environments have been strongly linked to higher levels of presenteeism among nurses[18, 19]. These overlapping factors highlight the need for integrated models that consider both personal vulnerabilities and workplace stressors. Notably, a recent study by Wu et al. (2025) developed a risk prediction model for presenteeism among intensive care unit (ICU) nurses using a nomogram-based approach, demonstrating its feasibility and clinical utility in high-stress nursing environments[20]. This work underscores the potential value of prediction tools in identifying at-risk nurses and informing tailored interventions. However, existing predictive models in nursing have been narrow in scope, often developed for general nursing populations or high-acuity departments such as emergency or intensive care units. While valuable, these models may not adequately reflect the unique stressors and emotional burdens faced by oncology nurses, whose work involves not only complex

technical care but also intense emotional labor. The absence of predictive tools tailored to this vulnerable group represents a critical gap in both research and practice.

Given these gaps, this study aims to develop and validate a predictive model for presenteeism risk among oncology nurses through a cross-sectional design. By identifying key demographic, occupational, and psychological predictors, we seek to build a clinically relevant, evidence-based tool that can facilitate early identification of at-risk individuals. Ultimately, such a model could guide targeted interventions to mitigate presenteeism, improve nurse well-being, enhance patient safety, and promote a sustainable oncology nursing workforce.

2. Methods

2.1 Aims

This study aimed to develop and validate a clinical prediction model for presenteeism risk among oncology nurses.

2.2 Study design and participants

The reporting of this study adheres to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for cross-sectional studies[21]. Participants were recruited from oncology departments of 8 hospitals located in Sichuan provinces across southwestern China between May 20, 2025 and September 31, 2025. Inclusion criteria were as follows: (1) registered nurses with valid clinical qualifications, (2) currently working full-time in an oncology department, (3) having at least one year of oncology-related clinical experience, and (4) voluntarily agreeing to participate and providing informed consent. Nurses were excluded if they were on long-term leave, undergoing standardized training, or not directly involved in patient care during the survey period. A total of 480 oncology nurses were invited to participate. After excluding incomplete and invalid questionnaires, a final sample of 458(95.4%) was included in the analysis.

2.3 Data Collection

Data were collected via a structured, anonymous online questionnaire using a secure web-based survey platform (www.wjx.cn). The link to the questionnaire was distributed by oncology nursing department managers in each participating hospital through internal communication channels such as WeChat or email. Before formal data collection, a pilot test was conducted with 30 oncology nurses to evaluate the clarity and comprehensibility of questionnaire items. Minor adjustments were made based on their feedback. The average time to complete the survey was approximately 15–20 minutes. To enhance data quality, questionnaires with logical inconsistencies, excessive missing values, or completion times less than 5 minutes were excluded.

2.4 Presenteeism, candidate predictor variables and instruments

2.4.1 Demographic and work-related characteristics

Participants provided information on their age, gender, marital status, educational background, years of nursing experience, professional title, hospital level, shift pattern, overtime frequency, monthly income and health condition.

2.4.2 Presenteeism

The level of presenteeism was measured using the Stanford Presenteeism Scale-6 (SPS-6), which assesses the degree to which health conditions interfere with work tasks[7]. The six items are rated on a 5-point scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The total score ranges from 6 to 30, with higher scores indicating greater productivity loss due to presenteeism. Based on previous studies and distributional characteristics of the presenteeism scores in this sample, the total scores were dichotomized using the median value of 17 as the cutoff point[20]. Participants with a total score ≥ 17 were classified into the high presenteeism group, whereas those scoring < 17 were placed in the low presenteeism group. The Chinese version of the scale has been validated in previous nursing studies. In this study, the Cronbach's α is 0.819.

2.4.3 Psychological capital

Nurses' psychological resources were assessed using the Psychological Capital Questionnaire for Nurses (PCQN), which developed by Wang [22]. The PCQN consists of 30 items and six sub-dimensions: hope (7 items), cooperative communication (6 items), emotional intelligence (5 items), responsibility (4 items), resilience (4 items) and confidence (4 items). It is a 6- item Likert- type scale with responses from 1 = strongly disagree to 6 = strongly agree that evaluates the psychological capital of nurses. The total score is 30 ~ 180 points, the higher the score, the higher the psychological capital of nurses. In this study, the Cronbach's α is 0.972.

2.4.4 Perceived social support

The Perceived Social Support Scale (PSSS), originally developed by Zimet [23]. The scale consisted of 12 items rated on a 7-point Likert scale. It evaluates support from family, friends, and significant others. Higher scores reflect greater perceived support. The scale has demonstrated solid reliability in Chinese healthcare research (Cronbach's α = 0.939).

2.4.5 Challenge-and hindrance-related self-reported stress

Challenge-and Hindrance-related Self-reported Stress Scale (C-HSS) was originally developed by Cavanaugh et al. (2000) to assess individuals' perceived work stressors from two distinct sources [24]. It is now widely used to assess dual sources of occupational stress among Chinese working populations. The scale consists of 11 items across two dimensions: Challenge stress (6 items) and Hindrance stress (5 items). Each item is rated using a 5-point Likert scale, where 1 represents"no stress at all,"and 5 indicates "very high stress." Higher scores reflect a greater perception of stress. In this study, the Cronbach's α is 0.932.

2.5 Statistical Analysis

All statistical analyses were performed using R software (version 4.5.1). Continuous variables were described as means and standard deviations, while categorical variables were expressed as frequencies and percentages. Group comparisons between high and low presenteeism groups were conducted using independent samples t-tests for continuous variables and chi-square tests for categorical variables.

To develop the predictive model, the dataset was randomly divided into a training cohort (70%) and a validation cohort (30%). Least Absolute Shrinkage and Selection Operator (LASSO) regression was applied in the training set to reduce model complexity and select the most relevant predictors of presenteeism. Ten-fold cross-validation was used to determine the optimal penalty parameter (λ) that minimized prediction error. Subsequently, the selected variables from LASSO regression were entered into a binary logistic regression model to estimate adjusted odds ratios (ORs) and 95% confidence intervals (CIs). A nomogram was constructed based on the selected variables to visualize individual risk estimates.

The model's discriminative ability was assessed by calculating the area under the receiver operating characteristic curve (AUC) in both training and validation sets. Calibration of the model was evaluated using the Hosmer-Lemeshow goodness-of-fit test and calibration plots, comparing predicted versus observed probabilities. Decision curve analysis (DCA) was conducted to assess the clinical utility of the nomogram by quantifying the net benefit across a range of threshold probabilities. A two-sided p-value < 0.05 was considered statistically significant for all analyses.

2.6 Ethical considerations

Approval was obtained from Medical Ethics Committee, Sichuan Nursing Vocational College (Number: 2024011, Date: September 15, 2024). Adhering to the ethical guidelines, protocols, and regulations outlined in the Declaration of Helsinki and the Measures of the Ethical Review of Life Science and Medical Research Involving Humans, the study ensured that informed consent was obtained from all participants. All nurses who participated in this study provided written informed consent and were informed of their right to withdraw at any point without penalty. All collected data were kept strictly confidential.

3. Results

3.1 Demographic characteristics and variable scores

A total of 458 oncology nurses were included in the study, with 190(41.5%) classified into the low presenteeism group and 268（58.5%）into the high presenteeism group based on a cutoff score of 17. The sample was predominantly female (88%), with a majority aged between 26 and 30 years（33% and possessing 1–5 years of nursing experience (43%). Most participants were married (59%), childless (52%), and employed on a contract basis (84%). Regarding hospital settings, 76% worked in general

hospitals, and 73% were from tertiary hospitals. Most nurses held a bachelor's degree (74%) and occupied positions of senior staff nurse (38%) or staff nurse (34%). Monthly income for the majority ranged between 6001–8000 RMB (40%). Nearly half of the nurses reported working overtime 1–2 times per week (41%) and rotating shifts 5–8 times per month (32%). In terms of job satisfaction, 38% reported being satisfied, while 12% expressed dissatisfaction. Furthermore, the mean presenteeism score among oncology nurses was 16.34 ± 4.18, with psychological capital at 137.96 ± 21.09, perceived social support at 61.68 ± 10.77, and challenge–hindrance stress at 33.55 ± 9.40. More information is presented in Table 1.

Table 1
Demographic Characteristics and Variable Scores

Variables	Total (n = 458)	Low presenteeism group (n = 190)	High presenteeism group (n = 268)
Age (years, %)			
≤ 25	134 (29)	53 (28)	81 (30)
26 ~ 30	151 (33)	54 (28)	97 (36)
31 ~ 35	107 (23)	45 (24)	62 (23)
36 ~ 40	30 (7)	16 (8)	14 (5)
>40	36 (8)	22 (12)	14 (5)
Nursing experience (years, %)			
1 ~ 5	198 (43)	72 (38)	126 (47)
6 ~ 10	129 (28)	48 (25)	81 (30)
11 ~ 15	82 (18)	38 (20)	44 (16)
16 ~ 20	21 (5)	17 (9)	4 (1)
>20	28 (6)	15 (8)	13 (5)
Gender (%)			
Male	57 (12)	32 (17)	25 (9)
Female	401 (88)	158 (83)	243 (91)
Marriage (%)			
Single	189 (41)	80 (42)	109 (40)
Marriage	269 (59)	110 (58)	159 (59)
Child (%)			
0	236 (52)	88 (46)	148 (55)
1	141 (31)	81 (43)	60 (22)
≥ 2	81 (18)	21 (11)	60 (22)
Hospital types (%)			
General hospital	347 (76)	111 (58)	236 (88)
Specialized hospital	111 (24)	79 (42)	32 (12)
Hospital level (%)			

Variables	Total (n = 458)	Low presenteeism group (n = 190)	High presenteeism group (n = 268)
Second-class hospitals	125 (27)	105 (55)	20 (7)
Tertiary hospitals	333 (73)	85 (45)	248 (93)
Professional title (%)			
Staff nurse	154 (34)	57 (30)	97 (36)
Senior staff nurse	174 (38)	74 (39)	100 (37)
Advanced practice nurse	130 (28)	59 (31)	71 (26)
Educational background (%)			
Junior college	100 (22)	43 (23)	57 (21)
Bachelor degree	337 (74)	141 (74)	196 (73)
Master's degree	21 (5)	6 (3)	15 (6)
Employment form (%)			
Contract-based employment	386 (84)	159 (84)	227 (85)
Permanent position	72 (16)	31 (16)	41 (15)
Frequency of overtime per week (%)			
0	118 (26)	82 (43)	36 (13)
1 ~ 2	188 (41)	68 (36)	120 (45)
3 ~ 4	79 (17)	26 (14)	53 (20)
>4	73 (16)	14 (7)	59 (22)
Shift frequency (month, %)			
0	98 (21)	41 (22)	57 (21)
1 ~ 4	116 (25)	54 (28)	62 (23)
5 ~ 8	148 (32)	68 (36)	80 (30)
>8	96 (21)	27 (14)	69 (26)
Monthly income (RMB, %)			
≤ 4000	62 (14)	31 (16)	31 (12)
4001 ~ 6000	114 (25)	51 (27)	63 (24)
6001 ~ 8000	182 (40)	60 (32)	122 (46)

Variables	Total (n = 458)	Low presenteeism group (n = 190)	High presenteeism group (n = 268)
8001 ~ 10000	79 (17)	36 (19)	43 (16)
>10000	21 (5)	12 (6)	9 (3)
Job satisfaction (%)			
Very satisfied	74 (16)	54 (28)	20 (7)
Satisfied	173 (38)	88 (46)	85 (32)
General satisfaction	141 (31)	39 (21)	102 (38)
Dissatisfied	54 (12)	8 (4)	46 (17)
Very dissatisfied	16 (3)	1 (1)	15 (6)
Health status (%)			
Suboptimal health status with comorbid chronic diseases	58 (13)	23 (12)	35 (13)
Suboptimal health status	276 (60)	114 (60)	162 (60)
Health	124 (27)	53 (28)	71 (26)
Presenteeism (M ± SD)	16.34 ± 4.18	12.39 ± 3.26	19.15 ± 1.85
Psychological capital(M ± SD)	137.96 ± 21.09	149.58 ± 20.73	129.72 ± 17.11
Hope(M ± SD)	31.77 ± 5.20	34.23 ± 5.14	30.04 ± 4.50
Cooperative communication(M ± SD)	28.32 ± 4.48	30.28 ± 4.58	26.94 ± 3.85
Emotional intelligence(M ± SD)	23.50 ± 3.71	25.38 ± 3.71	22.17 ± 3.10
Responsibility(M ± SD)	18.34 ± 3.18	20.05 ± 3.02	17.13 ± 2.71
Resilience(M ± SD)	18.25 ± 3.18	19.81 ± 3.08	17.14 ± 2.76
Confidence (M ± SD)	17.76 ± 3.62	19.82 ± 3.13	16.30 ± 3.21
Perceived social support(M ± SD)	61.68 ± 10.77	67.13 ± 10.93	57.81 ± 8.83
Family support(M ± SD)	21.39 ± 4.03	23.17 ± 4.14	20.13 ± 3.44

Variables	Total (n = 458)	Low presenteeism group (n = 190)	High presenteeism group (n = 268)
Friend support(M ± SD)	20.85 ± 3.74	22.40 ± 3.80	19.75 ± 3.28
Other important support(M ± SD)	19.56 ± 4.66	21.99 ± 3.94	17.83 ± 4.35
Challenge-Hindrance stress(M ± SD)	33.55 ± 9.40	29.13 ± 9.75	36.68 ± 7.75
Challenge stressors(M ± SD)	19.17 ± 5.56	16.56 ± 5.88	21.01 ± 4.49
Hindrance stressors(M ± SD)	14.38 ± 4.68	12.56 ± 4.59	15.66 ± 4.31

3.2 The LASSO regression analysis of the potential predictive factors associated

with presenteeism

To identify potential predictive factors associated with presenteeism among oncology nurses, a LASSO logistic regression analysis was conducted using 18 candidate variables. Figure 1. **(A)** displays the coefficient trajectories of all variables as a function of log(λ). As the penalty increased, irrelevant variables were progressively shrunk to zero, effectively performing variable selection. Figure 1. **(B)** shows the results of 10-fold cross-validation, which identified the optimal lambda value at log(λ) = -5.253. At this value, the model retained eight variables with non-zero coefficients. The final predictors associated with presenteeism included: nursing experience (β = -0.022), hospital level (β = 1.479), number of overtime hours per week (β = 0.196), monthly income (β = 0.172), job satisfaction (β = 0.207), psychological capital (PCQ) (β = -1.470), perceived social support (PSS) (β = -1.221) and challenge-Hindrance stress (Stress) (β = 1.167). Among these, psychological capital and perceived social support emerged as strong protective factors, whereas challenge-hindrance stress, hospital level, and job satisfaction were prominent risk factors.

3.3 Binary logistic regression analysis of predictors associated with presenteeism among oncology nurses

Based on the variables selected by LASSO regression, a binary logistic regression was conducted to identify the key predictors associated with presenteeism among oncology nurses. As shown in Table 2, the nursing experience (16 ~ 20 years) (OR, 0.183, 95% CI: 0.044–0.646; *P*<0.05), higher hospital level (tertiary hospitals) was significantly associated with increased odds of presenteeism (OR = 5.55, 95% CI: 2.889–11.012, *P* < 0.001), monthly income (4001 ~ 6000,6001 ~ 8000, 8001 ~ 10000, >10000) (OR, 2.589, 95% CI: 1.16–5.875, *P*<0.05; OR, 5.32, 95% CI: 2.404–12.069, *P*<0.001; OR, 5.936, 95% CI: 2.191–

16.698, *P*<0.05; OR, 7.273, 95% CI: 1.772–31.469, *P*<0.01), challenge-hindrance stress(OR, 1.053, 95% CI: 1.018–1.091, *P*<0.01).

Table 2
Binary Logistic regression analysis for presenteeism risk among oncology nurses

Predictors	***B***	***SE***	**Wald**	**OR_with_CI**	***P*_value**
(Intercept)	-0.385	1.559	0.061	0.68 (0.032, 14.513)	0.8049
Nursing experience					
1 ~ 5	Ref (–)				
6 ~ 10	0.117	0.328	0.128	1.125 (0.592, 2.152)	0.7206
11 ~ 15	-0.187	0.413	0.205	0.829 (0.369, 1.873)	0.6506
16 ~ 20	-1.698	0.674	6.34	0.183 (0.044, 0.646)	**0.0118**
>20	-0.461	0.526	0.769	0.631 (0.224, 1.78)	0.3806
Hospital level					
Second-class hospitals	Ref (–)				
Tertiary hospitals	1.714	0.34	25.4	5.55 (2.889, 11.012)	**<0.001**
Frequency of overtime per week					
0	Ref (–)				
1 ~ 2	0.476	0.329	2.099	1.61 (0.844, 3.073)	0.1474
3 ~ 4	0.544	0.41	1.76	1.723 (0.773, 3.873)	0.1846
>4	0.861	0.475	3.289	2.365 (0.947, 6.146)	0.0698
Monthly income					
≤ 4000	Ref (–)				
4001 ~ 6000	0.951	0.413	5.314	2.589 (1.16, 5.875)	**0.0212**
6001 ~ 8000	1.672	0.41	16.605	5.32 (2.404, 12.069)	**<0.001**
8001 ~ 10000	1.781	0.517	11.884	5.936 (2.191, 16.698)	**0.0006**
>10000	1.984	0.73	7.385	7.273 (1.772, 31.469)	**0.0066**
Job satisfaction (%)					
Very satisfied	Ref (–)				
Satisfied	0.041	0.421	0.009	1.041 (0.454, 2.381)	0.9232
General satisfaction	0.558	0.465	1.438	1.747 (0.697, 4.348)	0.2305
Dissatisfied	0.942	0.621	2.305	2.566 (0.775, 8.969)	0.1289
Very dissatisfied	1.464	1.164	1.58	4.322 (0.617, 89.907)	0.2088

Predictors	*B*	*SE*	Wald	OR_with_CI	*P*_value
Psychological capital	-0.016	0.01	2.518	0.984 (0.964, 1.004)	0.1126
Perceived social support	-0.031	0.017	3.099	0.97 (0.937, 1.003)	0.0783
Challenge-Hindrance stress	0.052	0.018	8.585	1.053 (1.018, 1.091)	**0.0034**

3.4 Construction and validation of the nomogram for presenteeism risk among oncology nurses

To address the limited number of significant predictors in traditional logistic regression and to enhance model robustness and clinical utility, we constructed the nomogram using eight key predictors selected by LASSO regression. These variables were: nursing experience, hospital level, number of overtime hours per week, monthly income, job satisfaction, psychological capital, perceived social support and challenge-hindrance stress. A nomogram was developed to predict the risk of presenteeism using the training cohort (70% of the total sample), and its performance was subsequently validated in the internal validation cohort (30% of the total sample). The prediction results were shown in Fig. 2. This nomogram translates each variable's value into a specific point score. The cumulative score corresponds vertically to the predicted probability of elevated presenteeism risk among oncology nurses. A higher total score indicates an increased likelihood of experiencing high levels of presenteeism. The optimal cut-off for predicting high presenteeism risk in the nomogram is 431 points, corresponding to a 77.2% (sensitivity: 82.5%, specificity: 71.9%) probability of high presenteeism risk according to the nomogram model.

The nomogram showed strong discriminatory performance in both the training and validation sets for distinguishing oncology nurses with high versus low presenteeism risk, yielding AUCs of 0.864 (95% CI: 0.824–0.904 and 0.879 (95% CI: 0.823–0.934), respectively **(**Fig. 3**).** The calibration curve demonstrated satisfactory consistency between the predicted probabilities of the nomogram and the actual probabilities, with Hosmer–Lemeshow test *P*-values of 0.915 and 0.243 in the training and validation cohorts, respectively **(**Fig. 4A, B**)**. Furthermore, DCA curves were drawn for the training and validation cohorts to assess the clinical utility of the predictive model. DCA indicated that the nomogram conferred high clinical net benefit (Fig. 5).

4. Discussion

This study represents the first effort to construct and validate a nomogram for predicting presenteeism risk among oncology nurses, offering an individualized tool with strong discriminatory power and reliable calibration. In this study, the predicted prevalence of presenteeism among oncology nurses was 77.2%, indicating a high burden within this clinical subgroup. This rate substantially exceeds the levels reported in previous research. For instance, a recent meta-analysis involving 28 studies across 14 countries estimated a pooled presenteeism rate of 49.2% among nurses worldwide [8]. Likewise, a large-scale multicenter study in China reported a rate of 65.5% among general clinical nurses [25]. The elevated prevalence observed in our study may be attributed to the unique stressors inherent in oncology settings,

such as prolonged exposure to terminal illness, complex care coordination, and sustained emotional engagement with patients and families. This high rate of presenteeism is concerning, as it not only compromises nurses' physical and psychological well-being but may also adversely affect the quality and safety of patient care[26]. Persistent presenteeism has been linked to reduced work performance, impaired clinical decision-making, and increased risk of adverse events[27, 28]. Furthermore, it may reflect systemic challenges such as inadequate staffing, limited organizational support, and a workplace culture that implicitly discourages sick leave[29]. These findings underscore the urgency of implementing tailored interventions within oncology units, focusing on workload management, psychological resilience training, and supportive institutional policies to mitigate presenteeism and its potential consequences.

Several key predictors were identified, including hospital level, monthly income, job satisfaction, psychological capital, perceived social support, and challenge-hindrance stress, all of which played important roles in shaping presenteeism behaviors. Among these, psychological capital and perceived social support emerged as notable protective factors in the LASSO regression model, emphasizing their potential relevance in mitigating presenteeism. This finding aligns with existing literature indicating that individuals with high psychological capital, encompassing optimism, resilience, hope, and self-efficacy, are better equipped to manage workplace demands and maintain performance under stress[15, 30, 31]. Similarly, greater levels of perceived social support are known to buffer work-related stressors by enhancing emotional regulation and offering both emotional and practical resources[32, 33]. However, these variables did not retain statistical significance in the subsequent binary logistic regression analysis or in the final nomogram. This inconsistency may be due to methodological differences. LASSO regression is optimized for variable selection by penalizing less informative predictors, thereby retaining variables that may exert subtle, combined effects[34]. In contrast, traditional logistic regression isolates independent predictors, and in the presence of stronger correlated variables, such as challenge-hindrance stress or job satisfaction, the effects of psychological capital and social support may have been attenuated. Additionally, limitations in statistical power due to sample size and the number of outcome events may have further influenced this discrepancy. Nevertheless, from a practical standpoint, interventions aimed at fostering psychological strengths and supportive work environments remain valuable strategies for reducing presenteeism.

Challenge-hindrance stress, particularly when perceived as obstructive, was significantly associated with increased presenteeism risk. Oncology nurses often work under intense emotional pressure, manage high-acuity patients, and coordinate complex care, all of which contribute to high stress levels[3, 35]. When such stress is appraised as hindering rather than motivating, it may compel nurses to work while unwell, driven by fear of burdening colleagues or disrupting care continuity.

Structural and socioeconomic factors also influenced presenteeism. Nurses employed in tertiary hospitals showed higher presenteeism rates, possibly due to heavier workloads, stricter institutional demands, or more complex clinical responsibilities [17, 36]. Interestingly, nurses with higher monthly incomes also demonstrated greater presenteeism, potentially reflecting stronger financial commitments

or a heightened sense of professional responsibility. Counterintuitively, job satisfaction was positively associated with presenteeism. One plausible explanation is that highly satisfied nurses may feel a stronger commitment to their roles or institutions, prompting them to remain at work despite suboptimal health. Alternatively, satisfaction may coexist with internalized performance pressure, especially in the high-stakes oncology care context.

Regarding model performance, the nomogram exhibited excellent discriminatory ability, with AUC values of 0.864 in the training cohort and 0.879 in the validation cohort. Both are greater than 0.7, indicating robust predictive capability[37]. The selected predictors collectively contributed to a stable and effective stratification of presenteeism risk. In terms of calibration, the model performed well. Non-significant p-values in the Hosmer-Lemeshow goodness-of-fit tests ($P = 0.915$ and $P = 0.243$) and well-aligned calibration plots confirmed that the predicted probabilities closely approximated observed outcomes, underscoring the model's reliability in estimating absolute risk. Moreover, decision curve analysis (DCA) supported the clinical utility of the nomogram. The net benefit curves demonstrated favorable outcomes across a wide range of threshold probabilities in both cohorts, indicating that the nomogram could guide decision-making, reduce misclassification, and optimize the allocation of intervention resources. Altogether, the nomogram provides a clinically meaningful, statistically sound, and user-friendly tool for early identification of oncology nurses at elevated risk for presenteeism. It may serve as a valuable resource for nursing administrators and occupational health professionals to implement timely and targeted interventions.

4.1 Limitations

Several limitations should be considered when interpreting the results of this study. First, its cross-sectional design prevents causal inferences between predictors and presenteeism; future longitudinal studies are needed to clarify temporal relationships. Second, all data were obtained through self-administered questionnaires, which may introduce response biases such as recall bias or social desirability bias. Third, the sample was limited to oncology nurses in China, potentially reducing the generalizability of the findings to other specialties or geographic contexts. Fourth, while internal validation was conducted, external validation in independent samples is necessary to confirm the model's applicability in diverse settings. Lastly, potential influencing factors such as organizational climate, leadership style, or physical health conditions were not included due to data constraints, which may have limited the model's comprehensiveness.

5. Conclusions

This study developed and internally validated a novel nomogram for predicting presenteeism risk among oncology nurses, integrating eight key predictors selected through LASSO regression. The model demonstrated excellent performance in terms of discrimination, calibration, and clinical utility. Although some variables, such as psychological capital and perceived social support, did not achieve statistical significance in traditional regression models, their inclusion in the nomogram highlights their potential

value in a multifactorial risk framework. These findings underscore the importance of addressing psychological resources, workplace stressors, and organizational factors in interventions aimed at mitigating presenteeism. Future research should focus on external validation and the exploration of dynamic, longitudinal factors that influence presenteeism behaviors over time.

6. Implications

The developed nomogram provides nursing managers with a feasible and evidence-based tool to screen oncology nurses at high risk of presenteeism. By incorporating demographic, occupational, and psychosocial predictors, managers can better understand risk profiles and tailor interventions accordingly. Proactive measures, such as optimizing staffing allocation, promoting job satisfaction, strengthening psychological capital, and improving perceived social support, may help mitigate presenteeism. Furthermore, applying this tool in routine management could not only improve the well-being and retention of oncology nurses but also enhance patient safety and the overall efficiency of healthcare organizations.

Declarations

Clinical trial number

not applicable.

Consent for publication:

Not applicable.

Ethics approval and consent to participate:

Approval was obtained from Medical Ethics Committee, Sichuan Nursing Vocational College (Number: 2024011, Date: September 15, 2024). Adhering to the ethical guidelines, protocols, and regulations outlined in the Declaration of Helsinki and the Measures of the Ethical Review of Life Science and Medical Research Involving Humans, the study ensured that informed consent was obtained from all participants. All nurses who participated in this study provided written informed consent and were informed of their right to withdraw at any point without penalty. All collected data were kept strictly confidential.

Declaration of competing interest

The authors declare no conflict of interest.

Funding:

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Author Contribution

ZQ.Y: Conceptualization; Methodology; Formal analysis; Writing – original draft; Project administration; Visualization. JL.W: Supervision; Writing – review & editing; Validation.WY.N: Investigation; Data curation; Project administration. L.T: Investigation; Resources; Writing – review & editing. L.Z:Software; Validation; Writing – review & editing. FX.Y: Methodology; Visualization; Writing – review & editing. All authors have read and approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

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Data Availability

The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Consent for publication

This study informed consent was obtained from all subjects and/or their legal guardian(s).

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Figures

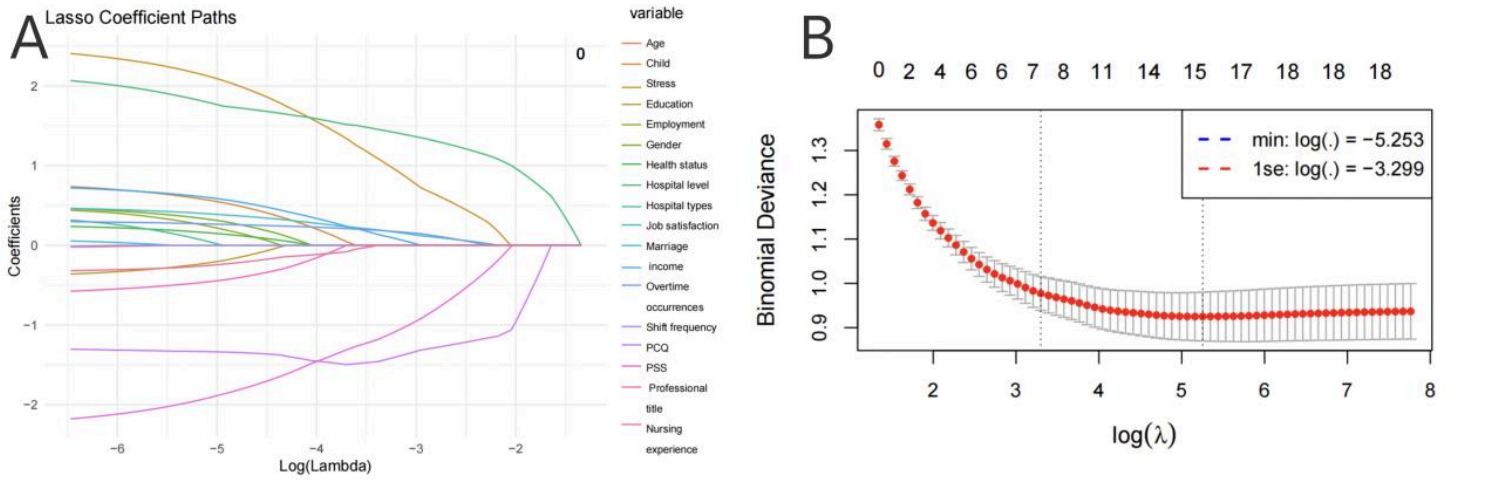


Figure 1

the results of LASSO regression analysis and 10-fold cross-validation

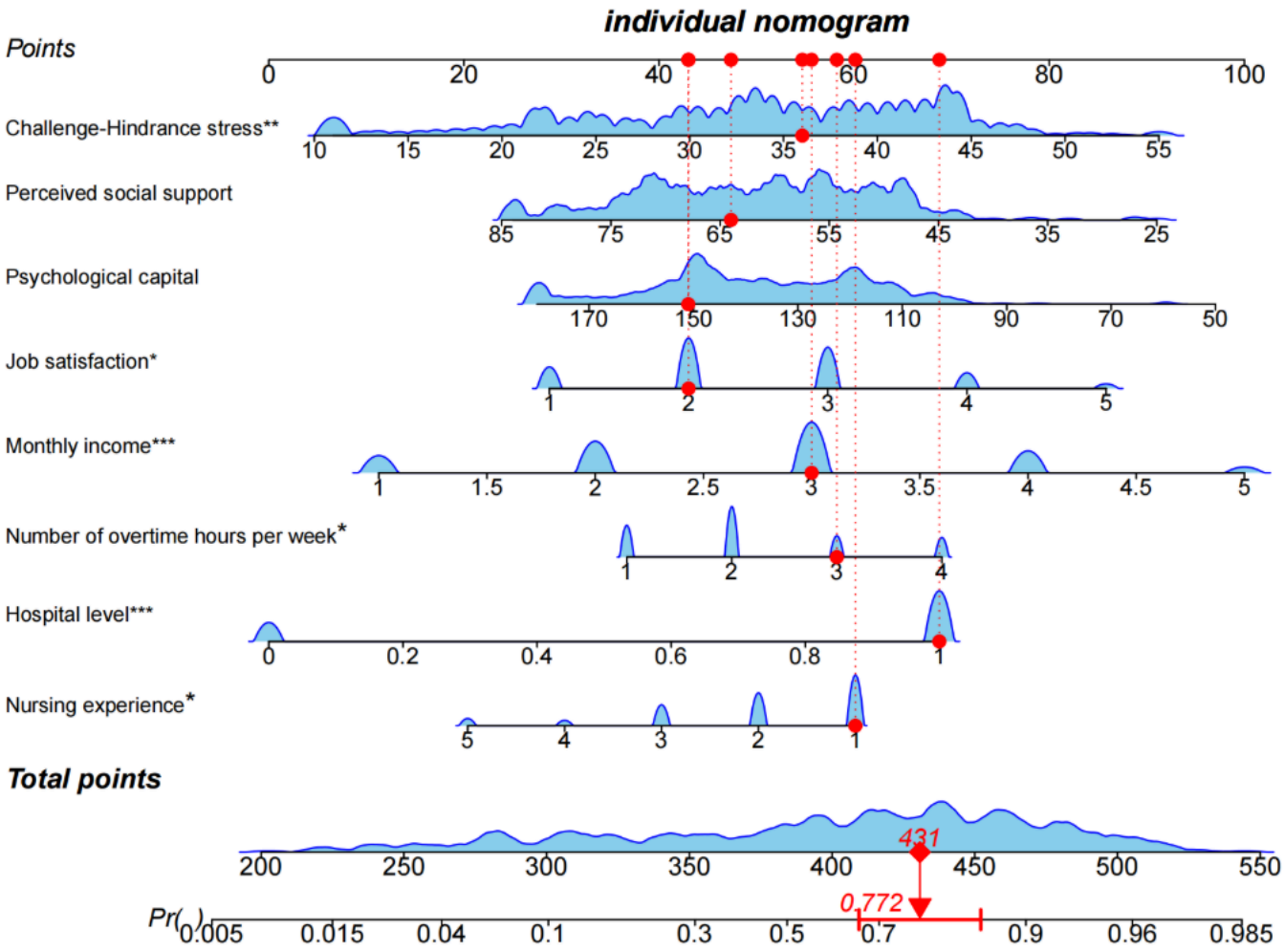


Figure 2

Nomogram of probability to develop presenteeism risk among oncology nurses

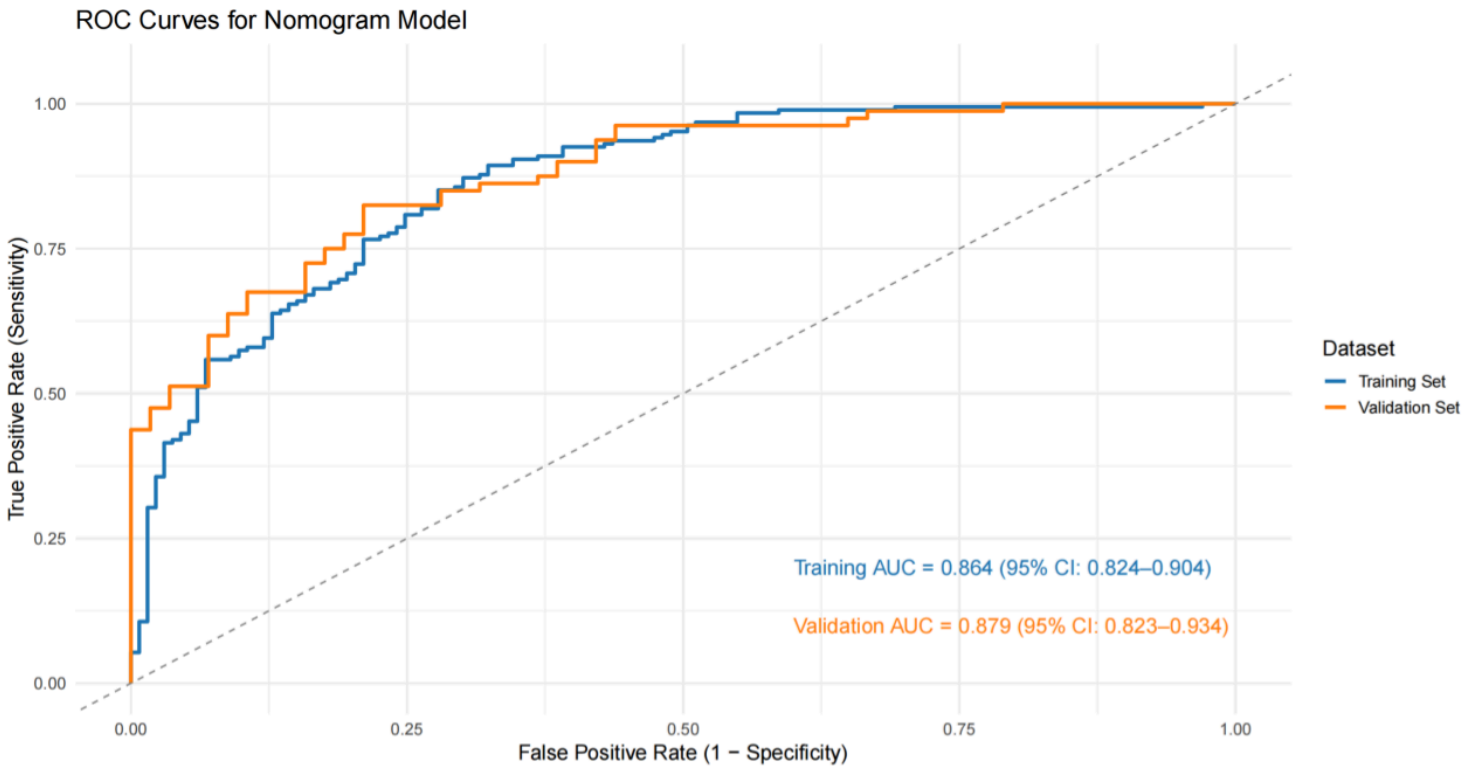


Figure 3

Receiver operating characteristic (ROC) curves for the nomogram model in the training and validation cohorts.

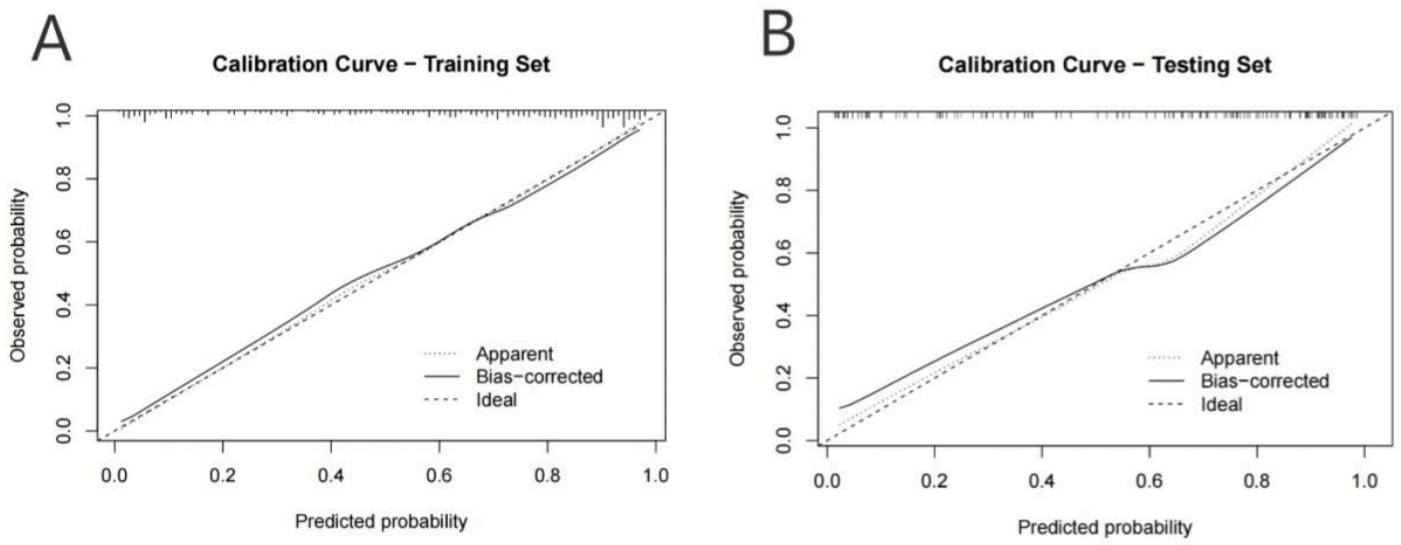


Figure 4

Calibration curves of the nomogram model in the training and validation cohorts.

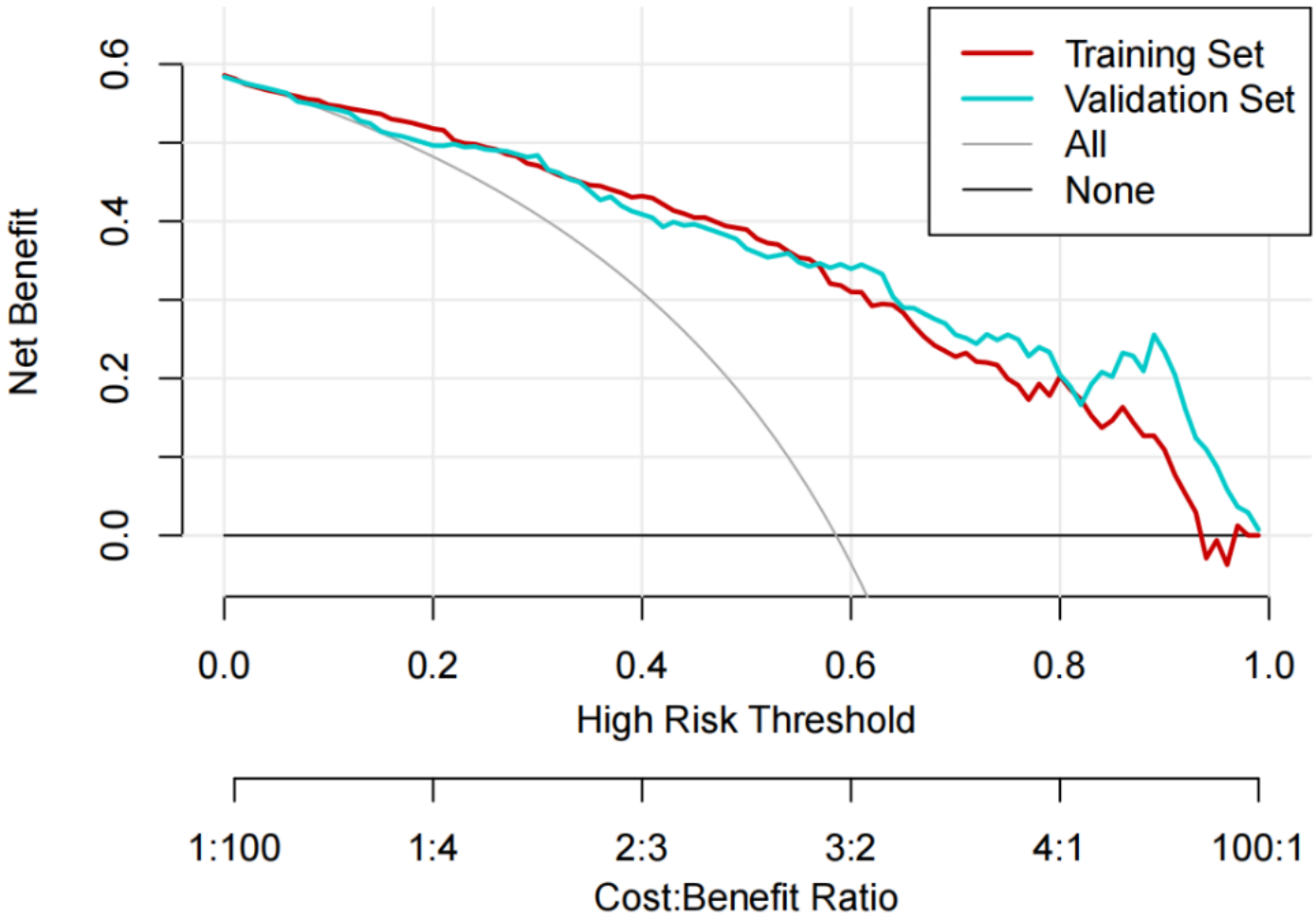


Figure 5

Decision curve analysis (DCA) for evaluating the clinical utility of the nomogram model in the training and validation cohorts.