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Predictive factors of turnover intention of newly graduated nurses in their first year of employment: a longitudinal study

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Abstract

Background The turnover of newly graduated nurses is a severe challenge for healthcare systems, and so it is essential to identify its predictive factors. This study investigates whether professional commitment, career adaptability, career self-efficacy, anxiety, and depression levels before and after internship can predict the turnover intention of newly graduated nurses after one year of employment.

Methods In a longitudinal study, 271 undergraduate nursing students recruited by convenience sampling were surveyed before internship (T1), after internship (T2), and after one year of employment (T3), with all surveys conducted on the Wenjuanxing survey platform (www.wjx.cn). Generalized linear models and restricted cubic spline models were used to explore possible linear and nonlinear relationships between turnover intention and the variables of interest.

Results Professional commitment both pre-internship ($\beta = -0.060$, $p = 0.007$, 95% CI [−0.104, −0.016]) and post-internship ($\beta = -0.053$, $p = 0.015$, 95% CI [−0.096, −0.010]) can negatively predict turnover intention. There is also a negative linear relationship between post-internship career self-efficacy and turnover intention ($\beta = -0.308$, $p < 0.001$, 95% CI [−0.436, −0.180]). In addition, professional commitment both pre-internship (adjusted $R^2 = 0.046$, $p = 0.004$) and post-internship (adjusted $R^2 = 0.068$, $p < 0.001$), career self-efficacy both pre-internship (adjusted $R^2 = 0.039$, $p = 0.008$) and post-internship (adjusted $R^2 = 0.116$, $p < 0.001$), career adaptability both pre-internship (adjusted $R^2 = 0.057$, $p < 0.001$) and post-internship (adjusted $R^2 = 0.039$, $p = 0.008$), anxiety both pre-internship (adjusted $R^2 = 0.035$, $p = 0.014$) and post-internship (adjusted $R^2 = 0.048$, $p = 0.003$), and depression levels both pre-internship (adjusted $R^2 = 0.031$, P nonlinear = 0.021) and post-internship (adjusted $R^2 = 0.053$, $p = 0.002$) are nonlinearly associated with turnover intention.

Conclusions Nursing educators and clinical care administrators must take action to enhance the professional commitment and career self-efficacy of nursing students during their internship. It is also important to pay attention

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to their career adaptability, as well as to any anxiety or depression that they may experience during clinical practice. This can help to reduce the turnover intention during the first year of their nursing career.

Keywords Newly graduated nurses, Turnover intention, Professional commitment, Career adaptability, Career self-efficacy, Anxiety, Depression

Introduction

The shortage of nurses is a prominent global issue, and the World Health Organization estimates that an additional nine million nurses and midwives will be required globally by 2030 [1]. In 2022, China had 3.7 registered nurses per 1000 people [2], far lower than the average for developed countries. Nurse turnover is widely recognized as the primary cause of the nursing shortage [3], and in China there have been reports of high annual turnover rates of hospital nursing care staff, ranging from 20 to 45% [4]. Nurse turnover is a serious topic in health systems, affecting the quality of nursing services and patient safety and further exacerbating the shortage of nurses and the human resources crisis in nursing [5].

Turnover intention (TI) is an individual's tendency to leave their current job, and it is considered to be a vital and effective predictor of actual turnover behavior [6]. A study of 63,947 Chinese nurses found that 63.4% of them intended to leave their jobs [5]. Furthermore, newly graduated nurses are more likely to quit their jobs than experienced nurses [7], with Zhang et al. [8] showing that the TI of newly graduated nurses was as high as 71.8% after one year of employment. Newly graduated nurses are often transitioning from student to registered nurse, involving career preparation and identity change. Despite having completed at least 10 months of full-time clinical internship in hospitals, they are assigned to challenging tasks and are expected to take on independent responsibilities without adequate training and systematic preparation [8]. The numerous unpredictable challenges in the new work environment—e.g., inadequate clinical experience [9], complex interpersonal relationships [10], adapting to new roles [11], overcoming differences between theory and practice [11]—make them prone to burnout and even the intention to quit their jobs. The turnover of newly graduated nurses increases the workload for existing nursing staff, leading to increased stress and burnout [12], lower job satisfaction, and a negative impact on the standard of care [13, 14]. In addition, hospitals have to pay more for hiring and training new employees [15]. Therefore, it is necessary to pay attention to TI and its influencing factors among newly graduated nurses in their early stage of employment, so as to provide a reference for implementing targeted measures to reduce TI and strengthen the stability of the nursing workforce.

Clinical practice is a critical period of a nurse's career preparation because it shapes professional attitudes, emotions, and identity [16]. Nursing students' professional commitment and career adaptability have been demonstrated to influence their future career development, decision-making, and stability [17, 18]. Professional commitment is an individual's identity and loyalty to their career [19]; it has a substantial influence on nurses' career decisions, and there is a close correlation between increased professional commitment and decreased TI [20]. In addition, the predictive effect of career adaptability on nurses' TI has also been widely confirmed [21, 22]. Career adaptability is the capacity of an individual to adjust to and deal with unforeseen occurrences in their career [23], which can assist individuals in overcoming obstacles in the workplace and maintaining a positive outlook on their future professional development [24]; those who lack career adaptability may have lower job satisfaction in high-pressure work environments and tend to quit their jobs [25].

Career self-efficacy is an individual's belief in their ability to complete occupational work [26], which encourages them to set career goals and make career decisions [27]. Some researchers have explored the association between self-efficacy and TI and discovered that low self-efficacy may increase nurses' desire to leave [28]. Although previous studies have demonstrated that self-efficacy is closely related to TI [29], empirical studies are lacking regarding whether career self-efficacy before and after internship can predict TI after entering work. In addition, the impact of nurses' mental health status on TI is also a topic of concern, especially after the outbreak of COVID-19, and some studies have found that mental health status (i.e., anxiety and depression) is an important predictor of TI [30, 31].

According to person-environment fit theory, TI can be attributed to a failure to match nurses with the professional environment, this being because the degree of matching between individual characteristics such as attitude, belief, and ability and the environment is a critical factor in producing positive or negative outcomes [32]. Therefore, professional commitment, career adaptability, career self-efficacy, and mental health status as individual psychosocial structures may provide a physical, psychological, and emotional connection to career decision-making [33–35] and thus become important predictors of TI. Although several cross-sectional studies have explored the relationships between TI and the above factors, it remains unclear whether these factors before and after internship can predict the TI of newly graduated nurses in their employment, presenting the first research

question of this study. Moreover, the second research question pertains to the types of relationships that exist between TI and these variables of interest. Addressing these two questions will provide valuable insights for nursing educators, clinical nursing managers, and policymakers, thereby enabling them to develop effective strategies for retaining newly graduated nurses.

Therefore, this study uses a longitudinal design to investigate whether professional commitment, career adaptability, career self-efficacy, anxiety, and depression before and after internship can predict the TI of newly graduated nurses after one year of employment. To answer the second research question, this study uses generalized linear models to examine the connections between TI and the variables of interest; these are an extension of traditional regression models with broader applicability and powerful modeling capabilities. Also, the study uses restricted cubic spline (RCS) models, which allow for the continuous presentation of the dose-response relationship of the correlation intensity, making it more practical. The combination of these two data analysis approaches to facilitate the exploration of possible linear and nonlinear associations between variables has also been used widely in previous studies [36, 37]. The present study provides a basis for enriching the knowledge of educators and clinical nursing managers, and it can help in alleviating the loss of nursing talent.

Methods

Sample and research design

Convenience sampling was used to recruit undergraduate students from a medical university in China, and the inclusion criteria were (i) being enrolled in a full-time four-year undergraduate nursing program, (ii) finishing all required courses in the first three years, and (iii) starting internship in the summer of 2021 and finishing it in the spring of 2022. Participants with less than 10 months of internship were excluded. According to Zhang et al., the sample size for regression analysis should be 10–20 times the number of independent variables [8]. The present study involved 18 variables and hence an estimated minimum sample size of 180, and so accounting for the 20% attrition that is typical of longitudinal studies [38], a minimum of 216 samples were required. A total of 271 undergraduate nursing students completed the three rounds of surveys, which were performed before internship (T1), after internship (T2), and after one year of employment (T3). All surveys were conducted on Wenjuanxing (www.wjx.cn), a popular online survey platform in China. Participants were given the option to participate voluntarily, with assurance that their responses would be private and accessible by only the researchers.

Measures

General demographic questionnaire

The general demographic questionnaire collected information including gender, age, parent's educational level, whether the nursing profession was chosen voluntarily, and enjoyment of the profession.

Career self-efficacy scale

The Career Self-efficacy Scale revised by Jiang and Guo [39] was used to measure the level of nursing students' career self-efficacy before and after internship. The scale consists of two subscales: completing educational requirements and fulfilling job responsibilities. Participants were asked to answer yes or no; a "no" answer was scored as zero, and for a "yes" answer, the associated confidence level was assessed on a scale from 1 to 10. The Career Self-efficacy Scale has good reliability and validity [39], and in the present study, its value of Cronbach's α was 0.916.

Career adaptability scale

The Career Adaptability Scale developed by Wu [40] was used to measure the level of nursing students' career adaptability before and after internship. It consists of 21 items, each scored on a five-point Likert scale (1=strongly disagree; 5=strongly agree), with a total score ranging from 21 to 105; a higher total score indicates a greater level of career adaptability. Numerous studies of Chinese university students have confirmed that the Career Adaptability Scale has good reliability and validity [41], and in the present study, its value of Cronbach's α was 0.935.

Undergraduates' professional commitment scale

The 27-item Undergraduates' Professional Commitment Scale developed by Lian and Wu [42] was used to assess the level of nursing students' professional commitment before and after internship. Each item was scored on a five-point Likert scale (1=strongly disagree; 5=strongly agree), with a total score ranging from 27 to 135; a higher total score indicates greater professional commitment. The Undergraduates' Professional Commitment Scale has good reliability [43], and in the present study, its value of Cronbach's α was 0.959.

Hospital anxiety and depression scale

The Hospital Anxiety and Depression Scale developed by Zigmond and Snaith [44] is composed of an Anxiety subscale (HADS-A) and a Depression subscale (HADS-D). Each subscale contains seven items scored on a four-point Likert scale from 0 to 3, with a total score ranging from 0 to 21; a higher total score indicates more severe symptoms. The Hospital Anxiety and Depression Scale

has good psychometric properties [45], and in this study, its value of Cronbach's α was 0.863.

Turnover intention questionnaire

The Chinese version of the Turnover Intention Questionnaire revised by Li and Li [46] was used to measure the degree of participants' TI after one year of employment. The questionnaire consists of six items, each scored on a four-point Likert scale (1=never; 2=rarely; 3=occasionally; 4=often), with a total score ranging from 6 to 24; a higher total score indicates stronger TI. The Turnover Intention Questionnaire has good reliability as validated in previous studies with nurses [47], and in the present study its value of Cronbach's α was 0.799.

Data analyses

Descriptive statistics (i.e., mean and standard deviation) were used to describe the sample characteristics. Correlation analysis was performed on the correlation variables. Generalized linear and RCS models were used to examine the possible linear and nonlinear relationships among career self-efficacy, career adaptability, professional commitment, anxiety, depression, and TI. Changes in career self-efficacy, career adaptability, professional commitment, anxiety, and depression before and after internship were assessed using calculation difference scores (Δ=post-internship minus pre-internship). Possible nonlinear associations were examined using RCSs with four knots. The rms package in R (version 4.1.2) was used to build the RCS models, while SPSS (version 23.0) was used for all other statistical analyses. All statistical tests were two-sided, with the significance level set at $p<0.05$.

Results

Descriptive and correlation analyses

Of the 271 participants, 90.4% of them were female, their mean age was 21.20 years (SD=0.73), and 86.7% of them chose the nursing profession voluntarily. Table 1 lists the correlations among TI and the variables of interest. As can be seen, TI is negatively correlated with whether the nursing profession was chosen voluntarily ($r=-0.162$, $p<0.01$) and enjoyment of the profession ($r=-0.196$, $p<0.01$). Therefore, the two variables were controlled for in the subsequent analyses.

Generalized linear models of associations between turnover intention and variables of interest

The outcomes of the generalized linear models are presented in Tables 2, 3 and 4. As can be seen, the nursing students with higher professional commitment both pre-internship ($\beta = -0.060$, $p=0.007$, 95% CI [−0.104, −0.016]) and post-internship ($\beta = -0.053$, $p=0.015$, 95% CI [−0.096, −0.010]) were more likely to have lower TI. Also, their post-internship career self-efficacy ($\beta = -0.308$, $p<0.001$, 95% CI [−0.436, −0.180]) negatively predicted their TI. Furthermore, there was a significant negative linear relationship between TI and change in career self-efficacy before and after internship ($\beta = -0.235$, $p < 0.001$, 95% CI [−0.347, −0.124]). Surprisingly, career adaptability, anxiety, and depression levels both pre- and post-internship were not significantly related to TI.

Restricted cubic spline models of associations between turnover intention and variables of interest

Figures 1, 2 and 3 show the nonlinear relationships between TI and the variables of interest. As shown in Fig. 1, with increasing pre-internship career adaptability (adjusted $R^2=0.057$, $F=4.256$, P nonlinear<0.001) and career self-efficacy (adjusted $R^2=0.039$, $F=3.202$, P nonlinear=0.008), the nursing students' TI decreased and then increased before decreasing again. The nonlinear relationship between TI and pre-internship depression (adjusted $R^2=0.031$, $F=2.712$, P nonlinear=0.021) showed an overall increasing trend. With increasing pre-internship professional commitment (adjusted $R^2=0.046$, $F=3.615$, P nonlinear=0.004), the TI decreased overall. With increasing pre-internship anxiety (adjusted $R^2=0.035$, $F=2.929$, P nonlinear=0.014), the TI increased and then slowly decreased.

As shown in Fig. 2, with increasing post-internship career adaptability (adjusted $R^2=0.039$, $F=3.182$, P nonlinear=0.008) and depression (adjusted $R^2=0.053$, $F=4.034$, P nonlinear=0.002), the nursing students' TI showed a similar trend to that in the pre-internship period. With increasing post-internship professional commitment (adjusted $R^2=0.068$, $F=4.938$, P nonlinear<0.001), the TI increased until around 85 and then decreased continually. The nonlinear relationship between TI and post-internship anxiety (adjusted $R^2=0.048$, $F=3.703$, P nonlinear=0.003) showed an increasing trend followed by a continuous decline. With increasing post-internship career self-efficacy (adjusted $R^2=0.116$, $F=8.115$, P nonlinear<0.001), the TI showed an overall downward trend.

Figure 3 shows that with increasing changes in anxiety (adjusted $R^2=0.075$, $F=5.376$, P nonlinear<0.001) and depression (adjusted $R^2=0.058$, $F=4.347$, P nonlinear<0.001), the TI showed an overall increasing trend. With increasing change in career adaptability (adjusted $R^2=0.032$, $F=2.776$, P nonlinear=0.018), the TI showed a similar trend to that in the pre- and post-internship periods. With increasing change in professional commitment (adjusted $R^2=0.037$, $F=3.072$, P nonlinear=0.010), the TI showed a rapidly decreasing trend followed by a slow continuous rise. Finally, with increasing change in career self-efficacy (adjusted $R^2=0.125$, $F=8.702$, P

Table 1 Correlations among turnover intention (TI) and variables of interest ($N = 271$)

Variables	M ± SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Turnover intention after one year of employment	15.83 ± 3.40	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2. Enjoyment of the profession	3.40 ± 0.82	−0.196**	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3. Age	21.20 ± 0.73	−0.012	0.025	1	-	-	-	-	-	-	-	-	-	-	-	-	-
4. Pre-internship career self-efficacy	15.62 ± 3.06	−0.055	0.463**	0.009	1	-	-	-	-	-	-	-	-	-	-	-	-
5. Pre-internship career adaptability	73.74 ± 9.63	−0.128*	0.298**	−0.034	0.425**	1	-	-	-	-	-	-	-	-	-	-	-
6. Pre-internship professional commitment	94.24 ± 13.06	−0.196**	0.447**	0.031	0.492**	0.690**	1	-	-	-	-	-	-	-	-	-	-
7. Pre-internship anxiety	11.58 ± 2.77	0.034	−0.248**	0.042	−0.363**	−0.377**	−0.326**	1	-	-	-	-	-	-	-	-	-
8. Pre-internship depression	10.59 ± 2.61	0.021	−0.269**	0.089	−0.446**	−0.431**	−0.395**	0.692**	1	-	-	-	-	-	-	-	-
9. Post-internship career self-efficacy	14.13 ± 3.35	−0.323**	0.224**	−0.053	0.368**	0.408**	0.303**	−0.199**	−0.255**	1	-	-	-	-	-	-	-
10. Post-internship career adaptability	74.45 ± 10.39	−0.134*	0.199**	−0.074	0.370**	0.456**	0.359**	−0.271**	−0.378**	0.450**	1	-	-	-	-	-	-
11. Post-internship professional commitment	94.19 ± 13.63	−0.223**	0.221**	−0.098	0.358**	0.397**	0.401**	−0.165**	−0.257**	0.429**	0.747**	1	-	-	-	-	-
12. Post-internship anxiety	11.05 ± 3.01	0.133*	−0.093	0.035	−0.254**	−0.324**	−0.251**	0.401**	0.352**	−0.269**	−0.458**	−0.425**	1	-	-	-	-
13. Post-internship depression	10.64 ± 3.28	0.109	−0.103	0.068	−0.279**	−0.361**	−0.317**	0.305**	0.432**	−0.319**	−0.554**	−0.503**	0.807**	1	-	-	-
14. Gender	-	0.043	< 0.001	−0.014	−0.028	0.076	0.106	0.11	−0.03	0.075	0.073	0.109	−0.051	−0.108	1	-	-
15. whether the nursing profession was chosen voluntarily	-	−0.162**	0.271**	−0.113	0.254**	0.112	0.219**	−0.093	−0.088	0.085	0.160**	0.217**	−0.015	0.003	−0.091	1	-
16. Father's educational level	-	−0.081	0.256**	0.001	0.108	0.113	0.133*	−0.123*	−0.111	0.141*	0.049	0.148*	−0.062	−0.048	−0.063	0.074	1
17. Mother's educational level	-	0.084	0.07	0.009	0.058	0.106	0.144*	−0.057	−0.106	−0.023	−0.057	< 0.001	−0.007	0.015	−0.043	−0.053	0.480**

Notes: *$p < 0.05$, **$p < 0.01$

Table 2 Generalized linear models of associations between TI and variables of interest before internship ($N=271$)

Variables	β	SE	95% CI	Wald X^2	*P*
	21.739	2.627	(16.591, 26.888)	68.486	< 0.001
Pre-internship career self- efficacy	0.042	0.080	(−0.116, 0.199)	0.271	0.603
Pre-internship career adaptability	−0.003	0.030	(−0.061, 0.056)	0.008	0.929
Pre-internship professional commitment	−0.060	0.022	(−0.104, −0.016)	7.163	0.007
Pre-internship anxiety	0.021	0.102	(−0.178, 0.221)	0.044	0.834
Pre-internship depression	−0.090	0.114	(−0.313, 0.133)	0.624	0.430

Table 3 Generalized linear models of associations between TI and variables of interest after internship ($N=271$)

Variables	β	SE	95% CI	Wald X^2	*P*
	20.974	2.348	(16.372, 25.576)	79.798	< 0.001
Post-internship career self-efficacy	−0.308	0.065	(−0.436, −0.180)	22.179	< 0.001
Post-internship career adaptability	0.052	0.030	(−0.006, 0.111)	3.045	0.081
Post-internship professional commitment	−0.053	0.022	(−0.096, −0.010)	5.933	0.015
Post-internship anxiety	0.126	0.108	(−0.086, 0.338)	1.350	0.245
Post-internship depression	−0.100	0.107	(−0.309, 0.109)	0.874	0.350

Table 4 Generalized linear models of associations between TI and changes in variables of interest ($N=271$)

Variables	β	SE	95% CI	Wald X^2	*P*
	15.510	0.223	(15.074, 15.946)	4859.349	< 0.001
Δ Career self-efficacy	−0.235	0.057	(−0.347, −0.124)	17.053	< 0.001
Δ Career adaptability	−0.001	0.024	(−0.048, 0.046)	0.001	0.973
Δ Professional commitment	0.01	0.018	(−0.025, 0.045)	0.328	0.567
Δ Anxiety	0.063	0.093	(−0.120, 0.246)	0.457	0.499
Δ Depression	0.021	0.093	(−0.162, 0.204)	0.051	0.821

nonlinear < 0.001), the TI showed a rapidly decreasing trend followed by a slow continuous decline.

Discussion

The present study reveals that professional commitment both pre-internship and post-internship can significantly predict the TI of newly graduated nurses after one year of employment, which supports previous studies [20, 48]. Nursing students with higher professional commitment strongly believe in following their professional objectives and beliefs [49] and can maintain their enthusiasm for the work even when it is difficult and varied [20]. Therefore, such sufficient professional commitment can help newly graduated nurses better perform their nursing duties and reduce TI. Interestingly, the nonlinear relationship between pre- and post-internship professional commitment and TI reveals that when post-internship professional commitment has not increased to a sufficiently high level, the TI shows a slow increase trend. This may be because nursing students' exposure to the realities of the clinical environment affects their opinions about their careers [50]. Stronger levels of professional commitment developed in nursing education programs may imply higher expectations and demands for personal career development and a sense of self-worth [51, 52]. Thus, the inconsistency between a real clinical environment involving high workload, occupational stress, risk, and intensity [53] and their idealistic career perceptions may shake their professional beliefs and produce motivation to leave. Only when professional commitment reaches a sufficiently high level will they be able to understand the value of their profession, cope with professional challenges, and resolve to remain in their positions [49, 54, 55]. Our findings indicate the importance of implementing supportive interventions to help nursing students maintain an adequate, stable, and sustainable commitment to their careers, which can ultimately reduce their TI. Possible measures that could be considered include rationalizing the university curriculum, enhancing the satisfaction of nursing students during internships [56], strengthening nurse-physician collaboration [57], improving career interests, and consolidating human capital [20].

The present study reveals a significant negative linear relationship between TI and post-internship career self-efficacy, meaning that nurses with lower career self-efficacy are more likely to quit their jobs [58]. Career self-efficacy is crucial for motivating nursing students to engage in adaptive career behaviors during clinical practice [59]. According to social cognitive career theory, the self-efficacy that individuals exhibit in their careers can positively influence outcome expectations and goal setting and ultimately contribute to career decision-making and stability [60]. Concurrently, our results further

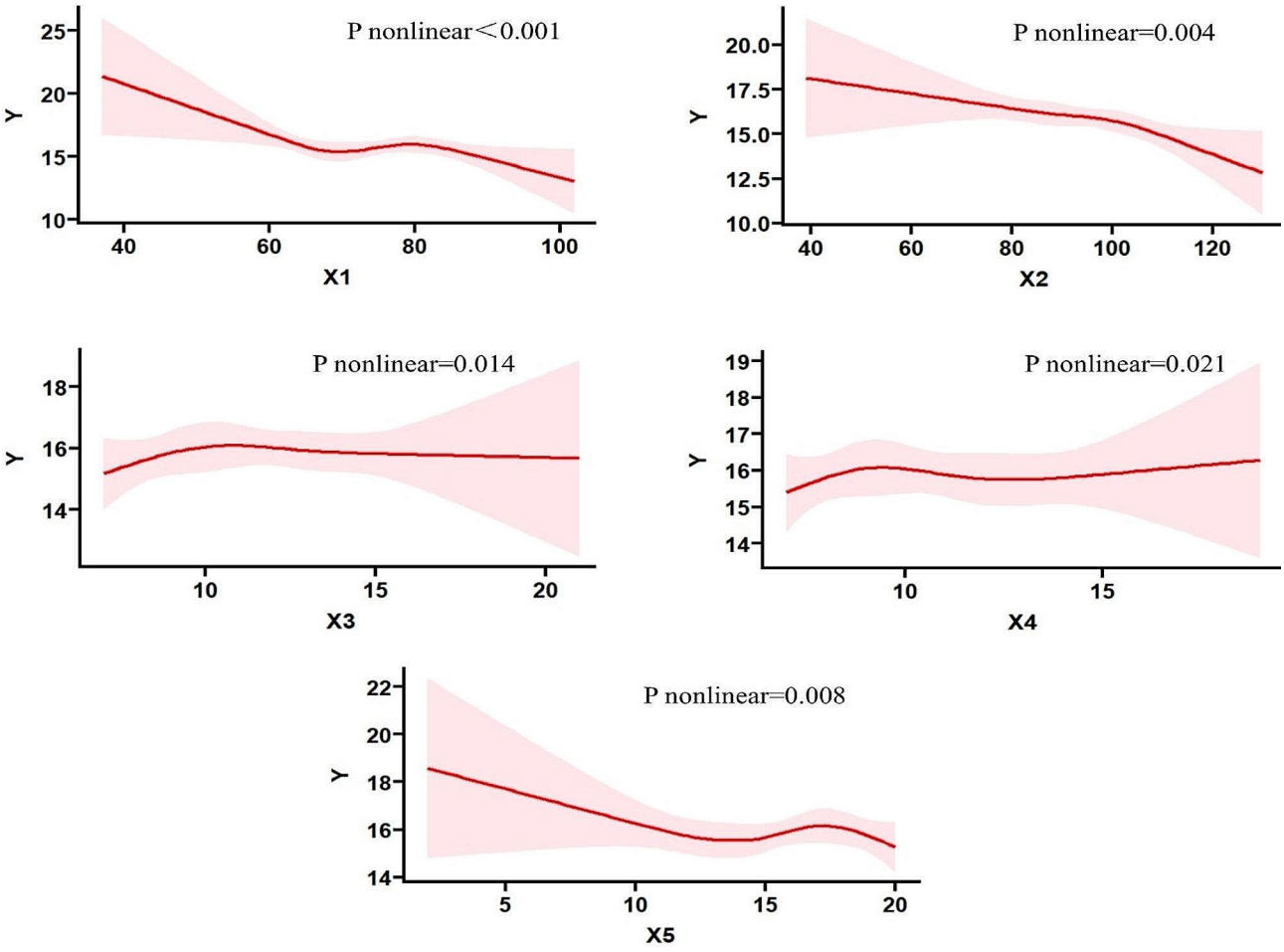

Fig. 1 Restricted cubic spline (RCS) models of associations between TI and independent variables before internship (*N* = 271)
Notes: X1 = Pre-internship career adaptability
X2 = Pre-internship professional commitment
X3 = Pre-internship anxiety
X4 = Pre-internship depression
X5 = Pre-internship career self-efficacy

demonstrate that the more significant the increase in nursing students' career self-efficacy from before to after internship, the lower their TI after one year of employment. This important discovery serves as a reminder for nursing educators and administrators to pay attention to nursing students without strong career self-efficacy before their internships and deliver timely and effective interventions during their internships to enhance their career self-efficacy and ultimately reduce their TI. In addition, the RCS modeling revealed nonlinear associations between TI and career self-efficacy before and after internship. It is important to note that when pre-internship career self-efficacy increases to a certain level, it may lead to a transient increase in the TI of newly graduated nurses. Further mechanistic studies are needed to clarify why career self-efficacy is associated with a temporary increase in TI. Given the strong connection between career self-efficacy and TI, nursing educators and hospital administrators need to assist nursing students in identifying, developing, and capitalizing on their strengths [61], increasing their confidence and engagement in their work, and creating a better person-job fit [29] to reduce turnover and ensure the delivery of high-quality care.

Additionally, our research also identified a significant nonlinear association between TI and career adaptability before and after internship. As nursing students' career adaptability increased before and after internship, their TI showed an overall decreasing trend. Many previous studies have confirmed that career adaptability is an important determinant in reducing nurses' TI [22, 62]. Furthermore, it should be noted that when nursing students' career adaptability increases to a certain level, there is a temporary increase in TI. Lee et al. [62] also found that career adaptability is a double-edged sword and has a positive correlation with TI. A high degree of

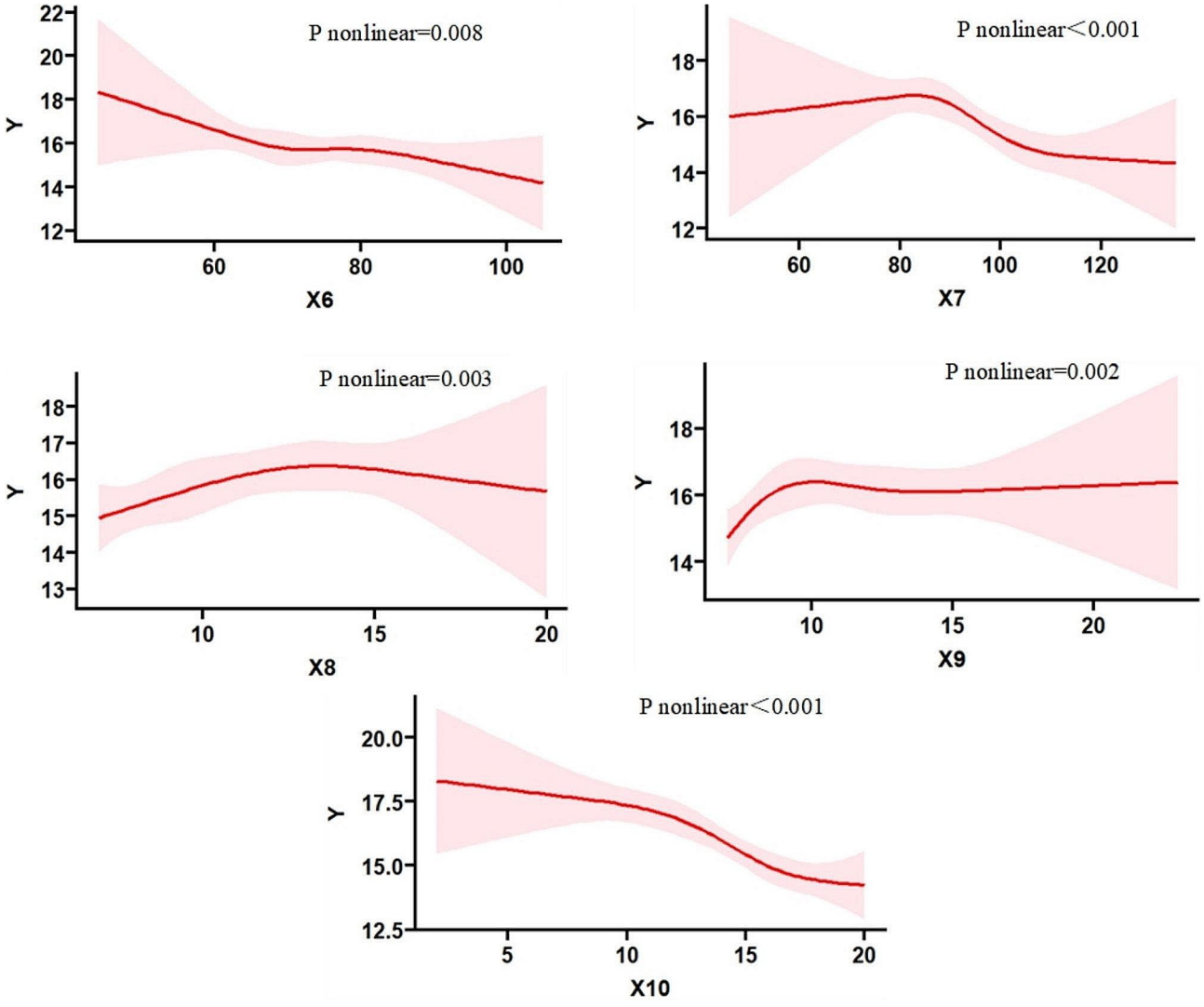

Fig. 2 RCS models of associations between TI and independent variables after internship ($N = 271$)
Notes:
X6 = Post-internship career adaptability
X7 = Post-internship professional commitment
X8 = Post-internship anxiety
X9 = Post-internship depression
X10 = Post-internship career self-efficacy

career adaptability means that such individuals are less reliant on the organization and more likely to seek other career opportunities if they lack adequate work and social support [62]. Therefore, nursing educators and administrators should assist nursing students in developing career adaptability resources while also improving work and social support to enhance their organizational belonging and manage their careers more effectively.

A nonlinear relationship between TI and nursing students' anxiety and depression before and after internship was also found in this study. There was an overall rise in TI when nursing students' depression levels increased before and after internships. Previous research has similarly reported an association between depression levels and TI [30]. Surprisingly, we found that as nursing students' anxiety levels increased before and after internship, their TI showed a trend of first increasing and then decreasing. This may be because anxiety serves as an alarm mechanism that helps people assess threats from the external environment and respond in an appropriate self-protective manner [63]. When nursing students feel higher levels of anxiety, they may be inclined to cope with professional challenges by improving their professional knowledge and skills and seeking support from superiors and peers. Such self-protective and adaptive behaviors help them reduce the possibility of resignation. The

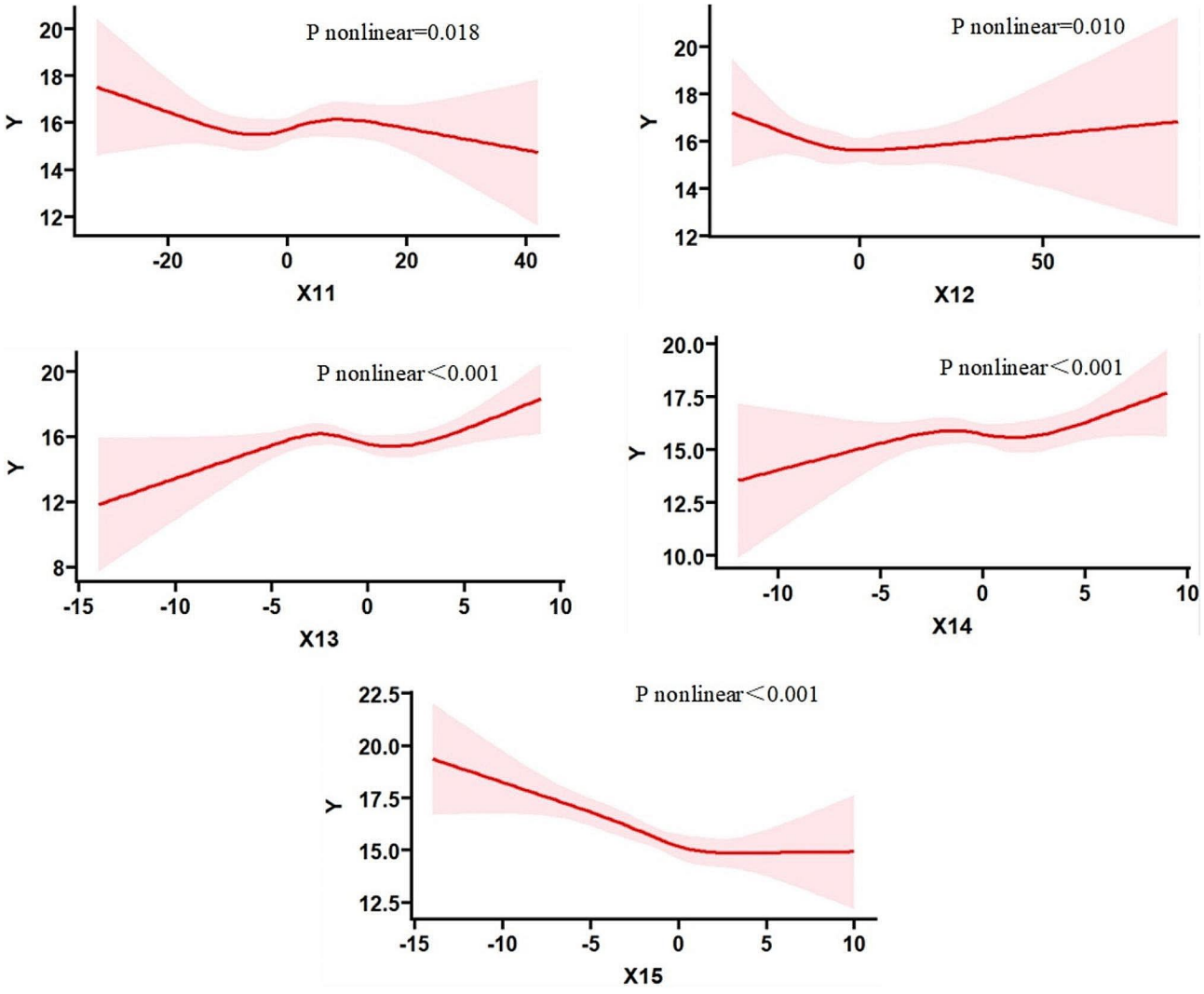

Fig. 3 RCS models of associations between TI and changes in independent variables (*N* = 271)
Notes:
X11 = Δ Career adaptability
X12 = Δ Professional commitment
X13 = Δ Anxiety
X14 = Δ Depression
X15 = Δ Career self-efficacy

above findings emphasize the importance of focusing on nursing students' mental health and developing coping resources in clinical practice programs to reduce TI.

Limitations and future research directions

Although this study has provided meaningful findings, several limitations must be noted. First, convenience sampling was used, with the sample drawn from students at only one eastern Chinese university, most of whom are employed in eastern coastal cities. Therefore, the representativeness of our sample is compromised given the differences in economic and healthcare levels between the eastern and western regions of China. To generalize the findings of this study, future research should consider using random sampling and expanding the sample to include a more diverse and representative group of newly graduated nurses from different geographic regions. Second, while this study met the required minimum sample size, we should proceed with caution when interpreting our findings because of the relatively small sample size. It would be beneficial for future studies to validate our preliminary findings in a larger sample. Third, this study included confounding factors mentioned in previous studies that may affect TI [64, 65], while also controlling for variables that showed significant correlation in the correlation analysis to avoid the impact of confounding

factors. However, there may be additional confounding factors that have not yet been noticed. Subsequent research could delve into the confounding variables that may affect TI and incorporate them into the analysis to enhance the reliability of the findings. Finally, the first year of employment is a critical period for nursing students as they transition into nurses and adapt to their roles, and it is also the peak period for newly graduated nurses to develop TI [8]. However, the TI of newly graduated nurses may be recurrent and fluctuate [66]. Research has shown that the TI among newly graduated nurses increased from 27% in their first year to 43% after three years of employment [67]. According to Zhang et al., the TI of newly graduated nurses must be monitored for 3–5 years [8]. Extending the follow-up period and understanding how TI changes over time can help clinical administrators to identify critical time points for intervention and develop effective strategies to retain newly graduated nurses. Our study offers valuable insights into the factors predicting the TI of newly graduated nurses in their first year of employment. However, it is unclear whether these predictors continue to influence TI over a longer period. Subsequent studies should include longer and well-designed follow-up waves to determine whether these predictor variables—both before and after internship—have a lasting impact on TI, which would be valuable for guiding nursing education and clinical practice management.

Conclusion

This study found that professional commitment both pre-internship and post-internship, as well as post-internship career self-efficacy, can negatively predict the turnover intention of newly graduated nurses after one year of employment. Furthermore, the RCS results indicate that professional commitment, career self-efficacy, career adaptability, anxiety, and depression both pre-internship and post-internship are nonlinearly associated with turnover intention. This research offers valuable strategies for nursing educators and clinical care administrators to retain newly graduated nurses. It suggests that they need to take action to enhance nursing students' professional commitment and career self-efficacy. Meanwhile, nursing students' career adaptability, anxiety, and depression levels during their internship are also important factors to consider.

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Author contributions
All authors contributed to the study design. JZ, LX, and YW performed the data analysis and completed the manuscript draft. TY and YW collected and examined data. CD and EZ contributed to the revisions of the manuscript. All authors contributed to the article and approved the submitted manuscript.

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Data availability
The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
Informed consent was obtained from all participants for this study. This study received approval from the Ethics Committee of Wenzhou Medical University (code: 2022 – 028). All methods were carried out in accordance with relevant guidelines and regulations.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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