BMJ Open

Turnover intention and related factors among resident physicians in China under the standardised residency training programme: a cross-sectional survey

Xiaoting Sun ,[1,2,3] Mengmeng Zhang,[3] Zhanghong Lu,[4] Zhaoyu Zhang,[3] Jialin Charlie Zheng,[5] Liming Cheng,[6] Lianhua Zeng,[3] Yingli Qian,[3] Lei Huang[2]

To cite: Sun X, Zhang M, Lu Z, *et al*. Turnover intention and related factors among resident physicians in China under the standardised residency training programme: a cross-sectional survey. *BMJ Open* 2022;**12**:e061922. doi:10.1136/bmjopen-2022-061922

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (http://dx.doi.org/10.1136/bmjopen-2022-061922).

Received 11 February 2022
Accepted 01 March 2022

For numbered affiliations see end of article.

Correspondence to
Dr Lei Huang;
huanglei@tongji.edu.cn

ABSTRACT

Objectives This study aimed at examining the extent of turnover intention among the Chinese resident physicians who entered the newly established national standardised residency training programme (SRTP), and exploring factors associated with their turnover intention.

Design Cross-sectional survey.

Setting Ten institutions from five geographical areas in China.

Methods 1414 residents were surveyed using paper-based questionnaires and scales regarding their demographics, work situation, attitudes towards SRTP, job satisfaction, psychological resilience, burnout and turnover intention in 2017. The turnover intention was described and compared between categorical groups. Linear regressions were used to select the factors associated with turnover intention. The structural equation model was used to capture the potential mediating effects.

Results The mean turnover intention score was 12.45 (SD=4.47). Nearly half (47.87%) of the residents had a high and very high level of turnover intention. Psychological resilience (β=0.066), burnout (β=0.141) and job satisfaction (β=0.022) were positively associated with turnover intention, while specialty (β=−0.135), year of training (β=−0.687), career in medicine (β=−2.191), necessity of training (β=−0.695) and satisfaction with income (β=−1.215) had negative associations with turnover intention. Working hours and nightshift interval indirectly were associated with turnover intention through the mediating effects of burnout. Career in medicine, necessity of training, satisfaction with income, and psychological resilience showed direct effects and indirect effects on turnover intention through burnout and job satisfaction as mediators.

Conclusions The turnover intention among Chinese residents was prevalent and unignorable. Burnout was the major contributing factor, while year of training and positive attitudes towards training were protective factors. Burnout and job satisfaction also served as mediators. Interventions targeting these factors should be incorporated in the training programmes to keep a prosperous physician workforce.

Strengths and limitations of this study

- The study was the first to report the turnover intention among Chinese residents from all specialties under the newly established standardised residency training programmes in 10 institutions.
- Multiple methodologies including linear regressions and structural equation model were used to select the factors associated with turnover intention and capture potential mediating effects.
- Data were self-reported and might suffer from recall bias.
- Due to the cross-sectional study design, the effects only implied associations rather than causalities.
- It was unclear whether our sample differed from the national population, therefore the results should be interpreted and generalised with caution.

INTRODUCTION

China's standardised residency training programme (SRTP) was designed to reduce the inequity of services offered in different levels of practice through standardising post-graduate training. It was initiated in Shanghai in 2010 and compulsorily implemented in every province as a national policy in China since 2015. The training quality of young doctors has been greatly promoted because the programme established standardised evaluation details to ensure that residents who graduated from different programmes have achieved the same and measurable knowledge and abilities.[1 2] The training standards for each specialty included training objectives, rotation length requirements, training content and reference material. Trainees must complete annual evaluations and final examination for SRTP, and pass the national medical certificate examination to get the completion certification of the SRTP.[3]

Though standardisation improves the quality of training, SRTP residents are facing more challenges than what has been commonly reported, including overwhelming workload and pressure, intense doctor–patient relationships and diminished professional self-identity, which could all lead to turnover.[4] They need to overcome longer training time, higher requirements and evaluation standards, while they might receive insufficient income and suffer from job uncertainty.[5] Before the policy, medical graduates received residency training managed by their employed hospitals with varied lengths and requirements. Most of those residency programmes were permanent contract, meaning they were secured with jobs within their training hospitals. The SRTP sites are usually located in tertiary hospitals where the patient volume and workload are relatively heavy. SRTP residents in many provinces are under temporary contract and must seek new employment after training, often in other hospitals.[3] As a result of these new changes at the beginning of their professional career, burnout symptoms, job dissatisfaction, negative views towards training and turnover have been observed among SRTP residents,[5] hinting that their attrition might be severer than estimated. The reasons might be different from physicians who were official employees of the hospitals, due to the change of employment status and social identities that may cause diminish of career commitment and the intent to quit the programme. Therefore, it is essential to know the situation of turnover among these SRTP residents and find out the reasons and factors behind, before effective and timely interventions can be designed. Otherwise, China's healthcare system may suffer from the loss of young promising physicians due to the prolonged training time resulting from the implementation of SRTP.

Physicians' turnover happens when physicians voluntarily quit their jobs.[6] Researchers in western countries have been studying residents' attrition phenomenon for years due to the long existence of their residency training programmes.[7] The reported annual attrition rates varied by the residents of different specialties, from the lowest of 1.5% in emergency medicine to the highest of 7.9% in psychiatry in the USA.[8] Turnover intention, however, was considered to precede turnover behaviour in many models, such as March and Simon's participant determination model,[9] and Price and Mueller's loss motivation model.[10] It was confirmed as the principal cognitive precursor and predictor of turnover behaviour, and also affects job performance and productivity.[11] It could better reflect the real internal organisational management level compared with turnover behaviour, which was easily affected by other external factors (such as availability of the external job positions).[12] Hence, at the beginning stage of SRTP when there were not enough data on turnover, gauging the turnover intentions among SRTP residents, rather than observing the real turnover behaviours, could help in better estimating their propensity to leave.

There are many reasons causing turnover intention among medical professionals, and previous studies varied in the selection of factors. From the industrial viewpoint, the medical system, occupational environment, professional development, doctor–patient relationship and external job opportunities all contribute to turnover intention.[10 12–14] Individual factors that were often examined consist of demographics such as age, gender, marital status, work ability, and work-related factors such as working hours, salary, social security, job stress, job autonomy, job satisfaction, and burnout.[4 15 16] Burnout and job dissatisfaction were the most commonly cited work-related factors that were considered to affect turnover intention in most literature.[17–20] Burnout, a prolonged response to chronic emotional and interpersonal stressors, was reported to be positively related to turnover intentions among medical professionals.[17–19] Job satisfaction is another emotional status resulting from the appraisal of one's job experiences.[20] It was also reported to be negatively associated with burnout and turnover intention among nurse practitioners, physician assistants and workers in primary care institutions.[18 19] However, modelling the relationships among burnout, job satisfaction and turnover intention has been complex in previous literature, as many factors were found to be simultaneously associated with them. Job and role stress, duration of employment, working hours, work environment, self-efficacy and financial worries were proven to be associated with work satisfaction and burnout, which were also proven to be predicted factors for turnover intention.[20–23] Besides, some researchers have treated job satisfaction as the intermediary variable between burnout and turnover intention,[24] while some proved the mediating effect of burnout on turnover.[25 26] The turnover intention was also noted to be affected by age, education level, monthly income, hire form, and night shift directly or through the mediators of satisfaction and burnout.[24 27] Hence, potential mediating effects from satisfaction and burnout should be considered when examining their relationships with turnover intention.

Psychological resilience is an inherent personal trait that helps individuals to adapt and overcome adversity and stress, which can be improved through external cultivation and training.[28 29] Studies have shown that people with higher psychological resilience or emotional intelligence were more willing to get engaged in work, hold positive attitudes towards stressful events and experience less burnout.[30 31] Organisation commitment was another commonly considered factor that contributes to turnover intention.[32] However, most standardised trained residents were not permanently contracted with the hospitals they were trained in. Therefore, rather than measuring their commitment to the organisation, we suspected that their attitudes towards the career and the newly established training programme might be more likely to contribute to their intention to leave, thus variables regarding their attitudes were intentionally constructed in our self-administrated survey.

There have been limited studies on turnover intention conducted among Chinese standardised trained residents,

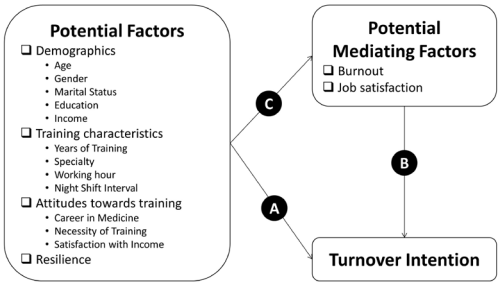


Figure 1 Conceptual framework of potential factors for turnover intention in standardised trained residents in China.

while most literature focused on physicians with high risks of leaving their jobs, such as general practitioners[24 26] or physicians in tertiary hospitals.[33] A nationwide online survey found out 18.7% of the psychiatry residents had an intention to quit residency.[34] Another study conducted in a single tertiary hospital in central China reported their standardised residents to have a high rate of burnout, and 37.8% of them reported having the turnover intention.[35] However, these two studies did not examine the reasons and related factors for the turnover intention.

To address the above-mentioned research gaps, this study aimed at examining factors related to turnover intention among Chinese standardised trained residents of all specialties by conducting a cross-sectional survey enrolling a large sample of representative residents from SRTPs in 10 institutions located in five different geographical areas in China. We hypothesised that turnover intention was higher among Chinese SRTP residents compared with other physician populations. Due to the complex review of potential factors associated with turnover intention among physicians, we classified those factors according to the conceptual framework drawn in figure 1. Applying different methodologies and models, we aimed to figure out influential factors without and with considering the existence of potential mediating effects from burnout and job satisfaction. We hypothesised that:

H1: Positive attitudes towards the training were negatively associated with turnover.

H2: Burnout was positively associated with turnover intention.

H3: Resilience and job satisfaction were negatively associated with turnover.

H4: Burnout and job satisfaction played mediating roles in contributing to turnover intention.

METHODS

Design, samples and settings

This study employed a cross-sectional survey design. To ensure that all survey questions were culturally and linguistically appropriate and easily understandable, the survey was conducted through a pilot study with 20 residents from one institution, and all self-designed items and validated scales were modified accordingly. Residents from 10 collaborating training institutions located at east, west, south, north and central of China (online supplemental appendix 1) were randomly sampled to complete the paper-based survey from March to May 2017. The survey was distributed through the programme assistants. The random sampling was based on a computerised sampling programme using residents' badge numbers. We aimed to include about 30% of the entire resident population at each of the 10 institutions (total population roughly 5810 across all institutions), accounting for survey drop-outs of about 20%. A stratified sampling strategy was employed to ensure balanced representation across the institutions (ie, about 30% of the resident population at each institution).

Patient and public involvement

The patient and the public were not involved in the conduct of the study.

Survey instruments

Participants' demographic characteristics (including gender, age, marital status, educational background and annual income level) and training characteristics (including years of being trained at the time of the survey, specialty, working hours and night shift interval) were collected in the self-designed module. Three questions regarding residents' attitude towards the training were also asked, including their 'satisfaction with income' (dissatisfied, neutral, satisfied), whether they originally chose 'career in medicine' (yes/no) and their thoughts on the 'necessity of training' (unnecessary/neutral/necessary).

The turnover intention was measured by the validated Turnover Intention Scale.[12 36] All six items used a 5-point Likert-type scale ranging from 0 (never) to 4 (always), measuring three dimensions, including the possibility of quitting from the current job, the motivation of finding other jobs and the possibility of getting new jobs. The total scores were calculated, which ranged from 0 to 24 with a higher score indicating higher turnover intention. Participants were also categorised into four groups according to the degree of turnover intention, including low (0–6), moderate (7–12), high (13–18) and very high (19–24) according to a previous study,[32] to show the distribution of the scores by degree. Residents were also asked to choose the frequency (never, sometimes or often) of thinking about turnover, and choose the major reason for quitting their jobs from five provided reasons or fill in their personalised answers.

Job satisfaction was measured using the short version of Minnesota Satisfaction Questionnaire, validated in the Chinese population.[37 38] This questionnaire also used 5-point Likert-type items, ranging from 1 (very dissatisfied) to 5 (very satisfied), measuring intrinsic (12 items) and extrinsic satisfaction (6 items) and general satisfaction (2 items). The total scores ranged from 20 to 100 with a higher score indicating higher job satisfaction.

Psychological resilience was measured using the Chinese version of Connor-Davidson Resilience Scale, validated among the Chinese population.[28] A total of 25 positive-toned items ranging from 1 (not at all) to 5 (almost always like that), measured three dimensions: optimism, tenacity and strength. The total scores ranged from 25 to 125 with a higher score indicating higher resilience.

Burnout was measured using the Chinese version of the Maslach Burnout Inventory-Human Services Survey,[39] which has been validated among Chinese health professionals.[40 41] This survey includes 22 items of 7-point Likert-type scales ranging from 0 (never) to 6 (every day) and measuring three dimensions: emotional exhaustion, depersonalisation and personal accomplishment.[15] Except for personal accomplishment items, the others were negatively toned. The personal accomplishment score was reversely calculated into reduced personal accomplishment so that the scores of the three dimensions remain the same direction. The total score was calculated by adding three subscale scores, ranging from 0 to 132 points, with a higher score indicating a higher degree of burnout. The reliability of the measures was tested via Cronbach's alpha coefficient. The score distributions and Cronbach's alpha coefficients of all the scales were acceptable (α>0.80) and reported in online supplemental appendix 2.

Statistical analyses

Descriptive analyses were performed to describe the demographics, training characteristics and attitudes towards the training of all the participants. The mean turnover intention score was calculated and categorically described by its degree, frequency and major reason. The differences in turnover intention across categorical groups were analysed using independent samples t-test, or one-way analysis of variance (ANOVA). If more than two groups were present, independent samples t-tests were used when one-way ANOVA detected significant results. Pearson's correlation tests were performed between turnover intention and continuous variables. Univariate linear regression between turnover intention score and each potential factor was conducted individually. Multiple linear regressions were conducted by first including the significant factors only (model 1), and including all the factors (model 2), using turnover intention score as a continuous dependent variable. Multicollinearity was assessed using the variance inflation factor (VIF) test after each multiple linear regression. In sensitivity analyses, logistic regressions were used, after transforming the continuous outcome variable into a binary variable with '1' indicating the participant has a high turnover intention (score is higher than its median), and '0' indicating low turnover intention. Similarly, univariate logistic regressions and two multiple logistic regressions with partial (model 3) and full factors (model 4) were conducted. Finally, the structural equation model (SEM) was used to examine the relationships among the potential factors and turnover intention considering the existence of mediating effects from burnout and job satisfaction. The model was initially fitted assuming no mediating effects among all factors (original model), then gradually added potential paths, or delete insignificant paths according to the modification indexes. The final model was accepted and considered having a good fit when all path coefficients were significant at the level of 0.05; $X^2/df<5$; the root mean square error of approximation and the standardised root mean square residual were both below 0.08; the root mean square residual was below 0.10; and the Comparative Fit Index and the Tucker-Lewis Index were above 0.90. All statistical analyses were performed using STATA software (STATA/SE V.14.2; StataCorp, College Station, Texas, USA).

RESULTS

Demographics, training characteristics and attitudes towards the training among participants

A total of 1743 residents were contacted and distributed the questionnaire, and 1427 returned the survey (response rate: 81.9%). Among the 1427 sampled residents, 1414 completed all questions and were enrolled in our analyses (questionnaire-reclaiming efficiency: 99.08%). The demographic characteristics of the participated residents and the turnover intention score according to demographic groups were shown in table 1. Most of the participants were 24–28 years old (67.26%), female (59.48%), single/divorced (84.79%), holding a bachelor's degree (67.40%) and having less than 50 000 RMB annual income (75.60%). Around half of them were in the third year of training (48.16%), having a night-shift interval longer than 7 days (56.08%) and working 45~54 hours per week (50.50%). Participants were from 16 different specialties, but they were regrouped into five categories, with internal medicine residents consisting of the largest portion (29.21%), followed by surgery residents (20.30%). Only 36.99% of them originally planned a career in medicine. Most of them (50.14%) thought the training was necessary, but a great number of them were dissatisfied with the income (74.26%).

Prevalence of the turnover intention among participants

The mean total score of the turnover intention of all the participants was 12.45 (SD=4.47) (table 2). When categorising turnover intention score by its degree, nearly half (47.87%) of the residents had a high (39.60%) and very high (8.27%) level of turnover intention. When asked about the frequency of thinking about turnover, 51.63% of the residents reported 'sometimes', and 11.46% of the residents reported 'often'. The most selected major reason for turnover was 'low income' (46.11%), followed by 'heavy work stress' (21.15%) (table 3). Turnover intention score was found significantly lower for residents from 50 000 to 100 000 income group when compared with those from <50 000 RMB income group (p=0.003), lower for residents at the third year of training when compared with those at the first year of training (p=0.01), lower for

Table 1 Demographics, training characteristics and attitudes towards the training of sample residents, and comparing turnover intention score across categorical groups (n=1414)

Turnover intention score	N	%	Mean (SD)	F	P value	t	P value
Age group				1.78	0.16		
<24	282	19.94	12.00 (4.73)				
24–28	951	67.26	12.53 (4.40)				
>28	181	12.80	12.63 (4.20)				
Gender							
Male	573	40.52	12.38 (4.57)			−0.4	0.668
Female	841	59.48	12.48 (4.37)				
Marital status						−0.7	0.47
Single/divorced	1199	84.79	12.40 (4.48)				
Married	215	15.21	12.64 (4.28)				
Education				2.15	0.11		
Bachelor	953	67.40	12.30 (4.47)				
Master	388	27.44	12.62 (4.34)				
Doctor	73	5.16	13.30 (4.60)				
Annual income level				6.15	<0.001		
<50 000 RMB	1069	75.60	12.60 (4.51)			Ref	
50–100 000 RMB	319	22.56	11.76 (4.12)			3.01	0.003
>100 000 RMB	26	1.84	14.00 (5.05)			−1.6	0.12
Year of training				9.72	<0.001		
1	145	10.25	12.85 (4.03)			Ref	
2	588	41.58	12.96 (4.41)			−0.3	0.78
3	681	48.16	11.90 (4.51)			2.34	0.01
Specialty				3.28	0.01		
Internal medicine	413	29.21	12.87 (4.59)			Ref	
Surgery	287	20.30	12.32 (4.59)			1.56	0.12
Gynaecology & obstetrics, general medicine and paediatrics	244	17.26	11.72 (3.75)			3.31	0.001
Neurology, psychiatry, emergency and anaesthesiology	203	14.36	12.87 (4.66)			−0.01	0.99
Others	267	18.88	12.22 (4.41)			1.83	0.07
Nightshift interval							0.02
<7 days	621	43.92	12.74 (4.64)				
≥7 days	793	56.08	12.20 (4.28)				
Working hours				7.26	<0.001		
<45 hours/week	499	35.29	11.90 (4.33)			Ref	
45~54 hours/week	714	50.50	12.60 (4.45)			−2.7	0.007
>54 hours/week	201	14.21	13.22 (4.61)			−3.6	<0.001
Career in medicine						9.43	<0.001
No	891	63.01	13.27 (4.29)				
Yes	523	36.99	11.02 (4.37)				
Necessity of training				14.8	<0.001		
Unnecessary	257	18.18	13.41 (4.37)			Ref	
Neutral	448	31.68	12.84 (4.32)			1.67	0.1
Necessary	709	50.14	11.83 (4.47)			4.87	<0.001
Satisfaction with income				24.6	<0.001		

Continued

Table 1 Continued

Turnover intention score	N	%	Mean (SD)	F	P value	t	P value
Dissatisfied	1050	74.26	12.88 (4.39)			Ref	
Neutral	302	21.36	11.46 (4.25)			4.97	<0.001
Satisfied	62	4.38	9.74 (4.79)			5.44	<0.001

F, statistic of one-way analysis of variance test; t, statistic of independent samples t-test.

residents from gynaecology and obstetrics, general medicine and paediatrics when compared with internal medicine residents as reference (p=0.001), lower for residents with longer (≥7 days) nightshift interval (p=0.02), lower for residents who planned a career in medicine (p<0.001), lower for residents who thought the training was necessary when comparing with those who hold a negative view (p<0.001), and lower for residents who felt neutral or satisfied with their income when comparing with those dissatisfied residents (both p<0.001). Compared with residents who worked for <45 hours per week, those who worked for 45~54 hours per week (p=0.007) and >54 hours per week (p<0.001) had a significant higher turnover intention (table 1).

Factors associated with turnover intention

Psychological resilience and burnout were positively associated with turnover intention (table 2) in Pearson's correlation tests. Univariate and multiple linear regression results were shown in table 4. Annual income level, nightshift interval and working hours were significant in univariate analyses but were insignificant in both multiple linear models. The year of training, specialty, career in medicine, necessity of training, satisfaction with income, resilience and burnout were selected as significant factors for turnover intention (table 4). The VIF values for multiple linear regressions were all below 5 (online supplemental appendix 2), indicating no severe collinearity issue existed. In sensitivity analyses using logistic regressions, similar factors were selected, except for necessity of training (online supplemental appendix 3).

SEM testified the existence of mediating effects from burnout and job satisfaction that were not allowed in linear regression models (figure 1, pathway C). Using the SEM method, the original model which assumed no mediating effects among potential factors did not achieve fitness according to the model fit statistics (online supplemental appendix 4). By considering the mediating effects of burnout and job satisfaction, significant paths on pathway C were gradually added according to modification indexes. The final model was fitted and standardised path coefficients were displayed in figure 2, and the total effect of each factor on turnover intention was calculated in table 5. Working hours (β=0.284), psychological resilience (β=0.066), burnout (β=0.141) and job satisfaction (β=0.022) showed positive effects on turnover intention, while nightshift interval (β=−0.330), specialty (β=−0.135), year of training (β=−0.687), career in medicine (β=−2.191), necessity of training (β=−0.695) and satisfaction with income (β=−1.215) had negative effects on turnover intention. Among these factors, the effects from working hours and nightshift interval were indirect through the mediating effects of burnout. Career in medicine, necessity of training, satisfaction with income, and psychological resilience showed direct effects and indirect effects on turnover intention through burnout and job satisfaction as mediators. The current SEM explained 70.5% of the total variance of turnover intention (coefficient of determination: 0.705), which was higher than the linear regression (R^2 value: 36.0%).

DISCUSSIONS

Turnover intention among Chinese residents of SRTP

This was the first multi-institutional study that investigated the turnover intention of the standardised trained residents from all specialties that entered the national SRTP. The mean turnover intention score was 12.45 (SD=4.47) among sampled Chinese residents. Nearly half (47.87%) of them were classified into 'high' and 'very high' turnover intention level, and 11.46% of them 'often' thought

Table 2 Reliabilities, descriptive of four continuous measurement variables (scales) and their correlations

Variable	Cronbach's α	Mean (SD)	Min	Max	Correlation coefficient			
					Turnover intention	Job satisfaction	Psychological resilience	Burnout
Turnover intention	0.820	12.45 (4.47)	0	24	1			
Job satisfaction	0.927	51.12 (15.50)	20	100	0.050	1		
Psychological resilience	0.910	67.87 (16.91)	25	125	0.153*	0.744*	1	
Burnout	0.862	51.38 (16.12)	5	117	0.430*	−0.397*	−0.382*	1

*p<0.05

Table 3 Prevalence of turnover intention by its degree, frequency and major reason (n=1414)

Turnover intention	N	%
Degree		
Low (0–5)	144	10.18
Moderate (6–12)	593	41.94
High (13–18)	560	39.60
Very high (19–24)	117	8.27
Frequency		
Never	522	36.92
Sometimes	730	51.63
Often	162	11.46
Major reason		
Low income	652	46.11
Heavy work stress	299	21.15
Low personal accomplishment	120	8.49
Disrespect	112	7.92
Tense doctor–patient relationship	168	11.88
Others	63	4.46

about quitting. The prevalence of high turnover intention among SRTP trainees (47.87%) was higher in our sample than that among residents in one teaching hospital in central China (37.8%),[35] and higher than that among psychiatry residents from a national sample (18.7%).[42] Compared with other Chinese physician populations, the average turnover intention score was lower than it was reported for general practitioners in Hubei (15.40, SD=3.43).[14] The percentage of physicians with high turnover intention was similar to that for village doctors in Shandong (46.9%),[43] but higher than that for physicians in tertiary hospitals (20.5%),[44] and for rural health workers from 11 western provinces in China (29.1%).[45] When comparing internationally, the percentage was higher than that among general surgery residents in Canada (32.0%)[46] and in the USA (20.0%),[47] and general internal medicine residents in Switzerland (21.0%).[48] Though the percentage-wise prevalence seemed to be higher for our sample than other physician populations, these studies differed in methodology and study period, which could compromise the direct comparability. 'Low income' was the most selected (46.11%) major reason chosen for turnover, which was unsurprising given that 75.60% of residents reported annual income level less than 50 000 RMB. Though Chinese residents usually do not have a huge financial burden coming from the student loan,[47] their annual income was uncompetitive with other entry-level professions. Moreover, SRTP residents were paid with a relatively lower level of salary and bonus than the residents with permanent contract before the implementation of SRTP, which may be the greatest obstacle for medical graduates to enter and stay through the programme. Our study showed half of the residents (50.50%) worked 45~54 hours per week, 14.21% worked more than 54 hours per week and 43.92% of them had a nightshift interval less than 7 days. 'Heavy work stress' was the second most selected reason, which revealed the fact that some trainees felt overwhelmed by the tasks and workload allocated to them. As longer working hours and shorter nightshift intervals showed an indirect effect on turnover intention through burnout, adjusting residents' workload to prevent burnout may indirectly lower turnover intention.

Factors for turnover intention

Multiple methodologies repeatedly identified the similar factors associated with the turnover intentions among the sampled residents. Variables such as age, gender, marital status, education and annual income level were not associated with turnover intention in any of the models, though they were controlled in the multiple linear regression (table 4, model 2) and sensitivity analysis using multiple logistic regression (online supplemental appendix 3, model 4). Though being residents of surgery, gynaecology and obstetrics, general medicine, paediatrics and other specialties was associated with lower turnover intention, this could only suggest that specialty was confounding the turnover intention, as different grouping strategies could lead to different results. A previous study for physicians in tertiary hospitals in China also found the intention to leave was different among different specialties.[44] It could be explained by the fact that the training intensity and requirements, the working environment and the doctor–patient relationship were different in different specialties, which inspired further thorough investigation.

Protective factors identified in our study included the year of training, career in medicine, necessity of training and satisfaction with income. Our results indicated that being at the third year of training was associated with lower turnover intention, and the year of training had direct negative effects on turnover intention. These results were consistent with a study conducted in the USA that found residents were less likely to experience attrition later in residency.[49] It could be possibly explained by sunk cost effect, that trainees at their later year of training were near the end of the programme so that turnover would cost them more than finishing the programme. The three attitude variables toned positive were significantly associated with lower turnover intention, which was consistent with our hypothesis (H1). Unsurprisingly, the residents would have lower turnover intention scores if they were originally planned a career in medicine, believed the residency to be necessary and with higher satisfaction towards income. It is worth noting that it was the satisfaction of income, instead of the income level, that was proven to be related to turnover intention. Plus, these three factors were also proven to be indirectly associated with turnover intention through the mediating effects of negative effects on burnout and positive effects on job satisfaction, which was consistent with our

Table 4 Modelling turnover intention using linear regressions (n=1414)

Turnover intention score	Univariate linear regression	Multiple linear regression (model 1)	Multiple linear regression (model 2)
	Coefficient (SE)	Coefficient (SE)	Coefficient (SE)
Age group			
<24	Ref		Ref
24–28	0.227 (0.257)		0.338 (0.261)
>28	0.62 (0.402)		0.539 (0.41)
Gender			
Male	Ref		Ref
Female	0.103 (0.241)		0.349 (0.215)
Marital status			
Single/divorced	Ref		Ref
Married	0.333 (0.328)		0.078 (0.295)
Education			
Bachelor	Ref		Ref
Master	0.316 (0.268)		0.395 (0.237)
Doctor	1.001 (0.54)		0.431 (0.518)
Annual income level			
<50 000 RMB	Ref	Ref	Ref
50–100 000 RMB	−0.849 (0.283)**	0.133 (0.245)	−0.075 (0.267)
>100 000 RMB	1.396 (0.88)	1.466 (0.751)	1.005 (0.794)
Year of training			
1	Ref	Ref	Ref
2	0.111 (0.41)	−0.278 (0.336)	−0.252 (0.338)
3	−0.947 (0.404)*	−1.154 (0.333)**	−1.045 (0.348)**
Specialty			
Internal medicine	Ref	Ref	Ref
Surgery	−0.551 (0.341)	−0.744 (0.285)**	−0.604 (0.299)*
Gynaecology & obstetrics, general medicine and paediatrics	−1.150 (0.358)**	−0.693 (0.297)*	−0.649 (0.299)*
Neurology, psychiatry, emergency and anaesthesiology	0.001 (0.38)	−0.338 (0.313)	−0.279 (0.315)
Others	−0.651 (0.348)	−0.737 (0.285)*	−0.689 (0.285)*
Nightshift interval			
<7 days	Ref	Ref	Ref
≥7 days	−0.533 (0.238)*	−0.218 (0.196)	−0.234 (0.197)
Working hours			
<45 hours/week	Ref	Ref	Ref
45~54 hours/week	1.134 (0.480)*	0.462 (0.215)	0.454 (0.215)
>54 hours/week	2.018 (0.585)**	0.479 (0.310)	0.452 (0.310)
Career in medicine			
No	Ref	Ref	Ref
Yes	−2.243 (0.238)***	−1.295 (0.212)***	−1.307 (0.212)***
Necessity of training			
Unnecessary	Ref	Ref	Ref
Neutral	−1.415 (0.286)***	−0.796 (0.260)**	−0.774 (0.260)**
Necessary	−3.136 (0.572)***	−1.728 (0.518)**	−1.738 (0.519)**

Continued

Table 4 Continued

Turnover intention score	Univariate linear regression	Multiple linear regression (model 1)	Multiple linear regression (model 2)
	Coefficient (SE)	Coefficient (SE)	Coefficient (SE)
Satisfaction with income			
Dissatisfied	Ref	Ref	Ref
Neutral	−0.567 (0.345)	−0.266 (0.292)	−0.225 (0.295)
Satisfied	−1.576 (0.321)***	−0.739 (0.284)**	−0.682 (0.286)*
Psychological resilience	0.040 (0.007)***	0.092 (0.009)***	0.093 (0.009)***
Job satisfaction	0.014 (0.008)	0.019 (0.01)	0.018 (0.01)
Burnout	0.118 (0.007)***	0.135 (0.007)***	0.136 (0.007)***
R^2	/	0.355	0.360
F	/	40.386***	31.169***

*0.01<p<0.05, **0.001<p<0.01, ***p<0.001.

hypothesis (H4). These demonstrated that individual affective commitment towards the career and the training would possibly affect the quality of relationships between the trainees and the programmes distinctively. This was also proven in US surgeons that those who were unhappy with career choice had reduced job satisfaction,[50] as well as in Italian nurse population that those with high levels of individual affective commitment had low levels of turnover intention.[51]

In accordance with earlier studies among other physician populations[19 52 53] and our hypothesis (H2), burnout was considered as a risk factor because it was positively associated with turnover intention among Chinese SRTP residents in all models. Burnout was quite common in medical residents all over the world, as residency training can be a very stressful time for them to carry responsibilities on providing care while learning and gaining new skills. According to a recent meta-analysis using studies from 47 countries, the prevalence of burnout among residents varied widely by region, with a pooled prevalence of 47.3%.[54] As a matter of fact, a high rate of burnout among standardised trained residents was reported in a single tertiary hospital in central China (71.5%),[35] and in our previous research among residents from four sites of SRTP in Shanghai (71.4%).[3] Our study demonstrated that burnout had a directly positive effect on turnover intention while serving as a mediator. Therefore, interventions designed to alleviate burnout would be effective in reducing the turnover intention. Actions such as reducing workload, cultivating positive attitudes towards training, and enhancing psychological resilience would have opportunities to, directly and indirectly, decrease the turnover intention through reducing burnout.[22]

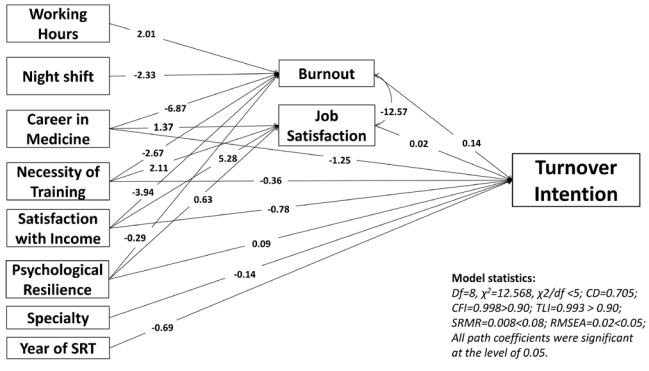


Figure 2 Path coefficients for the final structural equation model in the current study sample. CD, coefficient of determination; CFI, Comparative Fit Index; RMSEA, root mean square error of approximation; SRMR, standardised root mean square residual; SRT, standardised residency training; TLI, Tucker-Lewis Index

With regard to our hypothesis (H3), psychological resilience and job satisfaction, which were conventional protective factors in previous studies, showed opposite results in our sample. Psychological resilience was positively associated with turnover intention in linear regressions while job satisfaction was insignificant. SEM demonstrated that they both had positive total effects on turnover intention, though the effects were relatively limited (total effect β=0.066 and β=0.022, respectively). The possible reason for this discrepancy was that those who rated their resilience higher might also have more confidence in finding new jobs, leading to a higher turnover intention score. Besides, the psychological resilience had a positive effect on job satisfaction (β=0.629) and a negative effect on burnout (β=−0.293), which were consistent with previous research,[12 18 19 29 45] indicating that SRTP residents with better resilience experienced less burnout and higher job satisfaction. Though resilience and job satisfaction were not proven to be protective factors of turnover intention in our sample, they are still essential in helping physicians to achieve less burnout. Chinese students received little or no training on enhancing psychological resilience during medical school. Therefore, enhancing psychological resilience during residency could lead to better

Table 5 Total, direct and indirect effects of model paths using structural equation model (n=1414)

Model paths	Total effect	95% CI	Direct effect	95% CI	Indirect effect	95% CI
Turnover intention ←						
Working hours	0.284***	0.071 to 0.497	/	/	0.284**	0.071 to 0.497
Nightshift interval	−0.330**	−0.538 to 0.121	/	/	−0.330**	−0.538 to 0.121
Specialty	−0.135*	−0.263 to 0.008	−0.135	−0.263 to 0.008	/	/
Year of training	−0.687***	−0.972 to 0.402	−0.687	−0.972 to 0.402	/	/
Career in medicine	−2.191***	−2.652 to 1.730	−1.252*	−1.668 to 0.835	−0.939***	−1.179 to 0.700
Necessity of training	−0.695***	−0.988 to 0.401	−0.364**	−0.627 to 0.100	−0.331***	−0.480 to 0.182
Satisfaction with income	−1.215***	−1.622 to 0.808	−0.777***	−1.152 to 0.401	−0.438***	−0.662 to 0.215
Psychological resilience	0.066***	0.053 to 0.079	0.094***	0.077 to 0.111	−0.027***	−0.041 to 0.013
Burnout	0.141***	0.127 to 0.154	0.141***	0.127 to 0.154	/	/
Job satisfaction	0.022*	(0.003 to 0.042)	0.022*	0.003 to 0.042	/	/
Burnout ←						
Working hours	2.014**	0.513 to 3.514	2.014**	0.513 to 3.514	/	/
Nightshift interval	−2.340**	−3.802 to 0.878	−2.340**	−3.802 to 0.878	/	/
Career in medicine	−6.879***	−8.445 to 5.313	−0.293***	−8.445 to 5.313	/	/
Necessity of training	−2.679***	−3.674 to 1.683	−6.879***	−3.674 to 1.683	/	/
Satisfaction with income	−3.936***	−5.314 to 2.558	−2.679***	−5.314 to 2.558		
Psychological resilience	−0.293***	−0.338 to 0.248	−3.936***	−0.338 to 0.248	/	/
Job satisfaction ←						
Career in medicine	1.373*	0.286 to 2.459	0.629*	0.286 to 2.459	/	/
Necessity of training	2.114***	1.422 to 2.805	1.373***	1.422 to 2.805	/	/
Satisfaction with income	5.290***	4.333 to 6.247	2.114***	4.333 to 6.247		
Psychological resilience	0.629***	0.598 to 0.660	5.290***	0.598 to 0.660	/	/

*0.01<p<0.05, **0.001<p<0.01, ***p<0.001.

training results and strengthen their work engagement and career commitment.[43]

Educational implications

This study revealed a high prevalence of turnover intention among SRTP residents. Evidence on factors and mediators for turnover intention inspired us to make suggestions on incorporating interventions into the training programmes. First, alleviating work burnout would be imperative and effective to prevent attrition among Chinese residents, as burnout could happen at the very early stage of career and contribute to turnover intention. Hence, programme directors of the SRTP should monitor the extent and the causes of burnout among their residents through active communication and feedback, and design interventions accordingly, such as assigning mentors or senior residents to junior residents, adjusting workload and responsibilities, holding Balint sessions or forming assistant groups to help those who have experienced burnout during their training.[55–59] Second, cultivating individual affective commitment would be effective in preventing turnover. Our results suggested that residents' determination of becoming a doctor and positive attitudes towards the new training programme were crucial in supporting them to go through this tough training stage. Unlike in many western countries where only students with the strongest determination are selected into medical school, some Chinese students are reassigned into clinical medicine majors. Without original career commitment and positive perspectives as internal motivation, residents would be susceptible to quitting the programme for other jobs. Therefore, besides enhancing the medical school admission criteria, medical educators could reinforce their positive attitudes towards the medical training by facilitating the formation of a stronger career plan and offering fruitful and meaningful learning experiences. Last but not the least, increasing the income of residents to a satisfactory level is also desperately needed. Though it was regulated that those who quit the training programmes will pay fines, it was not the fundamental way to prevent turnover considering that Chinese residents are relatively underpaid compared with other entry-level professions.[60] There should be a national or municipal financial investment and policy to improve and guarantee the income of these young doctors in their earlier careers so that they do not have to be discouraged by not being able to support their families.

Study limitations

Due to the cross-sectional design, this study has several limitations. First, it only captured participants' perceptions on the factors measured at the time of the survey, and data were self-reported and might be influenced by

recall bias. Though the SEM incorporated the complex mediating effects and calculated the total effect of each factor on turnover intention, it only implied association but no causal relationship. Second, we used the Chinese version of standardised instruments, which might suffer from biases caused by cultural and linguistic differences. We selected scales that have been validated in the Chinese population and conducted a pilot study to minimise such biases. Third, the generalisation of the study results should be taken with caution, because it was unclear how our sampled residents differ from the national residents' population. To increase the representation, we sampled residents from 10 training institutions located in populous cities from five geographical areas in China. Further studies are required to enrol more institutions so that the results could be confidently generalised to all residents. Fourth, though the study was conducted and data were collected 4 years ago, it still has implication values as the training policy has not been changed much in recent years. As more trainees have graduated from the training programmes, collecting the up-to-date data on the actual turnover behaviours would also be constructive on the improvements of the training programmes. Lastly, we did not construct organisational factors that could also be influential to residents' intention to leave, such as hospital size, leadership, environment, patient-mix, etc. These factors should be involved in future research to generate more ideas on preventing resident turnover.

CONCLUSIONS

The turnover intention was prevalent among standardised trained Chinese residents. Burnout was the major contributing factor, while the year of training and positive attitudes towards training were important protective factors of turnover intention. Burnout and job satisfaction also served as mediators of turnover intention. These findings call for targeted interventions to be incorporated in the training programmes from educators and policymakers to create a prosperous educational experience and better career development environment for SRTP residents and to eventually prevent turnover. Future research is needed to incorporate more organisational factors, and test if those interventions can diminish the turnover intention.

Author affiliations
[1]Postdoctoral station, Shanghai Tenth People's Hospital Affiliated to Tongji University, Shanghai, China
[2]Department of Psychiatry, Tongji Hospital, Tongji University School of Medicine, Shanghai, China
[3]Tongji University School of Medicine, Shanghai, China
[4]Teaching office, Renmin Hospital of Wuhan University, Wuhan, Hubei, China
[5]Dean's Office, Tongji University School of Medicine, Shanghai, China
[6]Department of Orthopedics, Tongji Hospital, Tongji University School of Medicine, Shanghai, China

Acknowledgements The authors would like to thank all the programme directors and assistants from collaborating institutions in helping us organise and collect data.

Contributors XS, ZZ and LH drafted the original manuscript. XS and LH analysed the data. MZ, LZ, YQ and LH collected data. JCZ, LC and LH supervised the entire research project. XS, ZL and LH revised the manuscript. All authors participated in manuscript drafting, results interpretation and discussion, and all reviewed and approved the final version of the manuscript. LH served as the guarantor of this work.

Funding This work was supported by grants from key projects of the Ministry of Education in 2019 under the '13th Five-year Plan' for national educational science (no. DIA190409 to LH); Shanghai Pujiang Program (no. 2020PJC097 to LH); Tongji University Postgraduate Educational Research and Reform Cultivation Project in 2021 (no. 2021PY09 to LMC); and National Natural Science Foundation of China (no. 72104182 to XS).

Map disclaimer The inclusion of any map (including the depiction of any boundaries therein), or of any geographic or locational reference, does not imply the expression of any opinion whatsoever on the part of BMJ concerning the legal status of any country, territory, jurisdiction or area or of its authorities. Any such expression remains solely that of the relevant source and is not endorsed by BMJ. Maps are provided without any warranty of any kind, either express or implied.

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not required.

Ethics approval This study involves human participants and was approved by the Ethics Committee of Shanghai Tongji Hospital (#KYSB-2016-100). Participants signed consent forms and filled in the survey anonymously to protect their privacy.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request.

ORCID iD
Xiaoting Sun http://orcid.org/0000-0003-0086-0900

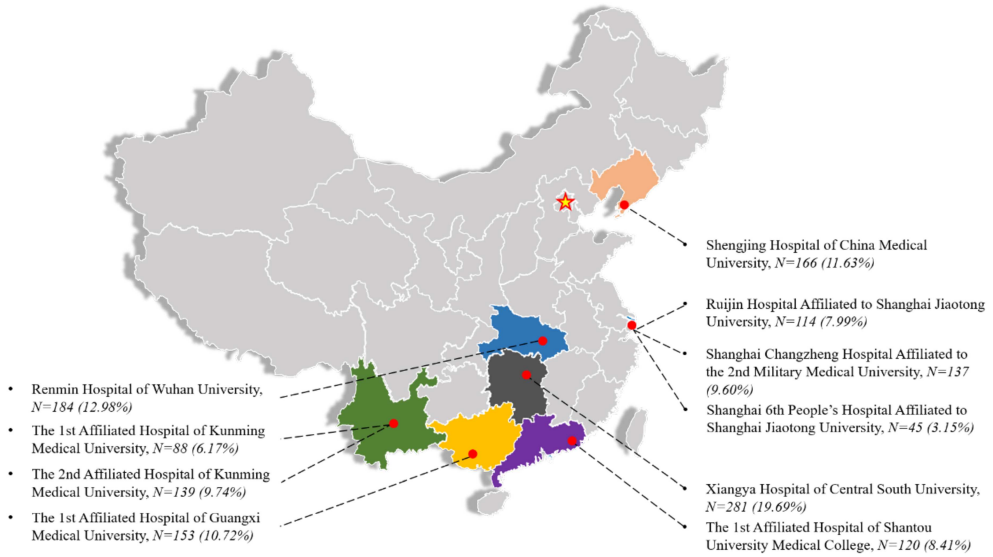
REFERENCES

1 Lio J, Dong H, Ye Y, *et al*. Standardized residency programs in China: perspectives on training quality. *Int J Med Educ* 2016;7:220–1.
2 Zhu J, Li W, Chen L. Doctors in China: improving quality through modernisation of residency education. *Lancet* 2016;388:1922–9.
3 Huang L, Caspari JH, Sun X, *et al*. Risk and protective factors for burnout among physicians from standardized residency training programs in Shanghai: a cross-sectional study. *BMC Health Serv Res* 2020;20:1–12.
4 Lu Y, Hu X-M, Huang X-L, *et al*. The relationship between job satisfaction, work stress, work-family conflict, and turnover intention among physicians in Guangdong, China: a cross-sectional study. *BMJ Open* 2017;7:e014894.
5 Xiao Y-T, Wang Y-T. Standardised residency training: students' concerns. *Lancet* 2017;389:905.
6 Hayes LJ, O'Brien-Pallas L, Duffield C, *et al*. Nurse turnover: a literature review. *Int J Nurs Stud* 2006;43:237–63.
7 Khoushhal Z, Hussain MA, Greco E, *et al*. Prevalence and causes of attrition among surgical residents: a systematic review and meta-analysis. *JAMA Surg* 2017;152:265–72.

8 Kennedy KA, Brennan MC, Rayburn WF, *et al*. Attrition rates between residents in obstetrics and gynecology and other clinical specialties, 2000-2009. *J Grad Med Educ* 2013;5:267–71.
9 March JG. *Simon HA: organizations*. New York: Wiley, 1958.
10 Price JL: the development of a causal model of voluntary turnover. *Ames: Iowa State University Press* 2000.
11 Griffeth RW, Hom PW, Gaertner S. A meta-analysis of antecedents and correlates of employee turnover: update, Moderator tests, and research implications for the next millennium. *J Manage* 2000;26:463–88.
12 Hann M, Reeves D, Sibbald B. Relationships between job satisfaction, intentions to leave family practice and actually leaving among family physicians in England. *Eur J Public Health* 2011;21:499–503.
13 Fang P, Liu X, Huang L, *et al*. Factors that influence the turnover intention of Chinese village doctors based on the investigation results of Xiangyang City in Hubei Province. *Int J Equity Health* 2014;13:84.
14 Gan Y, Gong Y, Chen Y, *et al*. Turnover intention and related factors among general practitioners in Hubei, China: a cross-sectional study. *BMC Fam Pract* 2018;19:74.
15 Miao Y, Li L, Bian Y. Gender differences in job quality and job satisfaction among doctors in rural Western China. *BMC Health Serv Res* 2017;17:848.
16 Choi JS, Kim KM. Job embeddedness factors as a predictor of turnover intention among infection control nurses in Korea. *Am J Infect Control* 2015;43:1213–7.
17 Bria M, Băban A, Andreica S, *et al*. Burnout and Turnover Intentions Among Romanian Ambulance Personnel. In: Uzunboylu H, Demirok M, eds. *3Rd world conference on psychology, counseling and guidance, Wcpcg-2012*. Amsterdam: Elsevier Science Bv, 2013: 84. 801–5.
18 Hoff T, Carabetta S, Collinson GE. Satisfaction, burnout, and turnover among nurse practitioners and physician assistants: a review of the empirical literature. *Med Care Res Rev* 2019;76:3–31.
19 Chen X, Ran L, Zhang Y, *et al*. Moderating role of job satisfaction on turnover intention and burnout among workers in primary care institutions: a cross-sectional study. *BMC Public Health* 2019;19:1526.
20 Shader K, Broome ME, Broome CD, *et al*. Factors influencing satisfaction and anticipated turnover for nurses in an academic medical center. *J Nurs Adm* 2001;31:210–6.
21 Han SS, Sohn IS, Kim NE. [New nurse turnover intention and influencing factors]. *J Korean Acad Nurs* 2009;39:878.
22 Zhou AY, Panagioti M, Esmail A, *et al*. Factors associated with burnout and stress in trainee physicians: a systematic review and meta-analysis. *JAMA Netw Open* 2020;3:e2013761.
23 Zangaro GA, Soeken KL. A meta-analysis of studies of nurses' job satisfaction. *Res Nurs Health* 2007;30:445–58.
24 Ran L, Chen X, Peng S, *et al*. Job burnout and turnover intention among Chinese primary healthcare staff: the mediating effect of satisfaction. *BMJ Open* 2020;10:e036702–9.
25 Leiter MP, Maslach C. Nurse turnover: the mediating role of burnout. *J Nurs Manag* 2009;17:331–9.
26 Zhang T, Feng J, Jiang H, *et al*. Association of professional identity, job satisfaction and burnout with turnover intention among general practitioners in China: evidence from a national survey. *BMC Health Serv Res* 2021;21:1–11.
27 Deng W, Feng Z, Yao X, *et al*. Occupational identity, job satisfaction and their effects on turnover intention among Chinese paediatricians: a cross-sectional study. *BMC Health Serv Res* 2021;21:1–12.
28 Yu X, Zhang J. Factor analysis and psychometric evaluation of the CONNOR-DAVIDSON resilience scale (CD-RISC) with Chinese people. *Soc Behav Pers* 2007;35:19–30.
29 Ríos-Risquez Mª Isabel, García-Izquierdo M, Sabuco-Tebar Emiliana de Los Ángeles, *et al*. Connections between academic burnout, resilience, and psychological well-being in nursing students: a longitudinal study. *J Adv Nurs* 2018;74:2777–84.
30 Guo Y-F, Luo Y-H, Lam L, *et al*. Burnout and its association with resilience in nurses: a cross-sectional study. *J Clin Nurs* 2018;27:441–9.
31 Rushton CH, Batcheller J, Schroeder K, *et al*. Burnout and resilience among nurses practicing in high-intensity settings. *Am J Crit Care* 2015;24:412–20.
32 Al-qolaq A, Abu-jarad I. Antecedents of employee turnover intention : A proposed theoretical framework. *Conf Bus Manag Res* 2013;20132013:474–87.
33 Zhang C, Hu L, Ma J. Factors determining intention to leave among physicians in tertiary hospitals in China: a national cross-sectional study. *BMJ Open* 2019;9:1–10.
34 Jiang F, Zhou H, Hu L, *et al*. Psychiatry residents in China: socio-demographic characteristics, career satisfaction, and related factors. *Front Psychiatry* 2019;10:1–8. APR.
35 Geng H, Tan F, Deng Y, *et al*. High rate of burnout among residents under standardized residency training in a tertiary teaching hospital of middle China: results from a cross-sectional survey. *Medicine* 2020;99:e20901.
36 Zhao X, Sun T, Cao Q, *et al*. The impact of quality of work life on job embeddedness and affective commitment and their co-effect on turnover intention of nurses. *J Clin Nurs* 2013;22:780–8.
37 Ge C, Fu J, Chang Y, *et al*. Factors associated with job satisfaction among Chinese community health workers: a cross-sectional study. *BMC Public Health* 2011;11:884.
38 Fu J, Sun W, Wang Y, *et al*. Improving job satisfaction of Chinese doctors: the positive effects of perceived organizational support and psychological capital. *Public Health* 2013;127:946–51.
39 Montiel-Company JM, Subirats-Roig C, Flores-Martí P, *et al*. Validation of the Maslach burnout Inventory-Human services survey for estimating burnout in dental students. *J Dent Educ* 2016;80:1368–75.
40 Lee H-F, Chien T-W, Yen M. Examining factor structure of Maslach burnout inventory among nurses in Taiwan. *J Nurs Manag* 2013;21:648–56.
41 Choy HB, Wong MC. Occupational stress and burnout among Hong Kong dentists. *Hong Kong Med J* 2017;23:480–8.
42 Jiang F, Zhou H, Hu L, *et al*. Psychiatry residents in China: socio-demographic characteristics, career satisfaction, and related factors. *Front Psychiatry* 2019;10:1–8.
43 Zhang X, Bian L, Bai X, *et al*. The influence of job satisfaction, resilience and work engagement on turnover intention among village doctors in China: a cross-sectional study. *BMC Health Serv Res* 2020;20:283.
44 Zhang C, Hu L, Ma J, *et al*. Factors determining intention to leave among physicians in tertiary hospitals in China: a national cross-sectional study. *BMJ Open* 2019;9:e023756.
45 Liu J, Zhu B, Wu J, *et al*. Job satisfaction, work stress, and turnover intentions among rural health workers: a cross-sectional study in 11 Western provinces of China. *BMC Fam Pract* 2019;20:9.
46 Ginther DN, Dattani S, Miller S, *et al*. Thoughts of quitting general surgery residency: factors in Canada. *J Surg Educ* 2016;73:513–7.
47 Dolan PT, Symer MM, Mao JI, *et al*. National prospective cohort study describing how financial stresses are associated with attrition from surgical residency. *Am J Surg* 2020;220:519–23.
48 Zumbrunn B, Stalder O, Limacher A, *et al*. The well-being of Swiss general internal medicine residents. *Swiss Med Wkly* 2020;150:w20255.
49 Yeo HL, Abelson JS, Symer MM, *et al*. Association of time to attrition in surgical residency with individual resident and programmatic factors. *JAMA Surg* 2018;153:511–7.
50 Jackson TN, Pearcy CP, Khorgami Z, *et al*. The physician attrition crisis: a cross-sectional survey of the risk factors for reduced job satisfaction among US surgeons. *World J Surg* 2018;42:1285–92.
51 Galletta M, Portoghese I, Battistelli A, *et al*. The roles of unit leadership and nurse-physician collaboration on nursing turnover intention. *J Adv Nurs* 2013;69:1771–84.
52 Hamidi MS, Bohman B, Sandborg C, *et al*. Estimating institutional physician turnover attributable to self-reported burnout and associated financial burden: a case study. *BMC Health Serv Res* 2018;18:851.
53 Lo D, Wu F, Chan M, *et al*. A systematic review of burnout among doctors in China: a cultural perspective. *Asia Pac Fam Med* 2018;17:3.
54 Naji L, Singh B, Shah A, *et al*. Global prevalence of burnout among postgraduate medical trainees: a systematic review and meta-regression. *CMAJ Open* 2021;9:E189–200.
55 West CP, Dyrbye LN, Shanafelt TD. Physician burnout: contributors, consequences and solutions. *J Intern Med* 2018;283:516–29.
56 Aggarwal R, Deutsch JK, Medina J, *et al*. Resident wellness: an intervention to decrease burnout and increase Resiliency and happiness. *MedEdPORTAL* 2017;13:10651.
57 Rothenberger DA, Burnout P. Physician burnout and well-being: a systematic review and framework for action. *Dis Colon Rectum* 2017;60:567–76.
58 Huang L, Harsh J, Cui H, *et al*. A randomized controlled trial of Balint groups to prevent burnout among residents in China. *Front Psychiatry* 2019;10:957.
59 Bingmer K, Wojnarski CM, Brady JT, *et al*. A model for a formal mentorship program in surgical residency. *J Surg Res* 2019;243:64–70.
60 Yang Y, Li J, Wu X, *et al*. Factors influencing subspecialty choice among medical students: a systematic review and meta-analysis. *BMJ Open* 2019;9:e022097.

Appendix

Appendix 1 The number of sampled residents by the institution of standardized residency training programs (n=1,414).



Appendix 2. VIF tests after multiple linear regressions in Table 3

Variable	VIF (Model 1)	VIF (Model 2)
Age Group		
24-28		1.65
>28		2.05
Gender (Female)		1.22
Marital Status (Married)		1.24
Annual Income Level		
50-100,000 RMB	1.14	1.36
>100,000 RMB	1.11	1.25
Education		
Master		1.22
Doctor		1.44
Year of training		
2	3.00	3.05
3	3.03	3.31
Specialty		
Surgery	1.43	1.59
Gynecology & Obstetrics, General Medicine and Pediatrics	1.38	1.40
Neurology, Psychiatry, Emergency, and Anesthesiology	1.32	1.33
Others	1.36	1.37
Nightshift interval (≥7 days)	1.04	1.05
Working hours		
45~54 hours/week	1.26	1.27
>54 hours/week	1.28	1.28
Career in Medicine	1.15	1.15
Necessity of Training		
Neutral	2.02	2.06
Necessary	2.20	2.24
Satisfaction with Income		
Neutral	1.24	1.25
Satisfied	1.23	1.24
Job Satisfaction	2.67	2.70
Resilience	2.42	2.44
Burnout	1.39	1.41
Mean VIF	**1.71**	**1.66**

Note: VIF, variance inflation factor.

Appendix 3. Modeling High Turnover intention using logistic regressions (n=1,414)

High Turnover Intention	Univariate Logistic Regression Odds Ratio (SE)	Multiple Logistic Regression (Model 3) Odds Ratio (SE)	Multiple Logistic Regression (Model 4) Odds Ratio (SE)
Age Group			
<24	Ref	Ref	Ref
24-28	1.218 (0.166)	1.163 (0.197)	1.173 (0.201)
>28	1.514 (0.290)**	1.621 (0.407)	1.521 (0.401)
Gender			
Male	Ref		Ref
Female	1.052 (0.114)		1.185 (0.164)
Marital Status			
Single/Divorced	Ref		Ref
Married	1.316 (0.194)		1.262 (0.239)
Education			
Bachelor	Ref	Ref	Ref
Master	0.998 (0.12)	0.998 (0.146)	0.935 (0.142)
Doctor	1.696 (0.42)*	1.578 (0.5)	1.41 (0.469)
Annual Income Level			
<50,000 RMB	Ref		Ref
50-100,000 RMB	0.796 (0.102)		1.105 (0.187)
>100,000 RMB	1.67 (0.681)		1.553 (0.844)
Year of training			
1	Ref	Ref	Ref
2	0.925 (0.172)	0.839 (0.175)	0.869 (0.184)
3	0.616 (0.113)**	0.511 (0.109)**	0.538 (0.117)**
Specialty			
Internal Medicine	Ref	Ref	Ref
Surgery	0.695 (0.107)*	0.557 (0.102)**	0.595 (0.116)**
Gynecology & Obstetrics, General Medicine and Pediatrics	0.555 (0.091)***	0.589 (0.112)**	0.579 (0.111)**
Neurology, Psychiatry, Emergency, and Anesthesiology	0.869 (0.149)	0.702 (0.142)	0.712 (0.145)
Others	0.655 (0.104)**	0.54 (0.099)**	0.54 (0.099)**
Nightshift interval			
<7 days	Ref		Ref
⩾7 days	0.854 (0.092)		0.913 (0.115)
Working hours			
<45 hours/week	Ref	Ref	Ref
45~54 hours/week	1.154 (0.135)	1.06 (0.147)	1.064 (0.148)
>54 hours/week	1.57 (0.264)**	1.153 (0.227)	1.161 (0.229)
Career in Medicine			
Yes	Ref	Ref	Ref
No	0.411 (0.047)***	0.477 (0.065)***	0.474 (0.065)***
Necessity of Training			
Unnecessary	Ref	Ref	Ref
Neutral	0.89 (0.14)	1.05 (0.193)	1.043 (0.193)
Necessary	0.635 (0.093)**	0.835 (0.149)	0.844 (0.152)
Satisfaction with Income			
Dissatisfied	Ref	Ref	Ref
Neutral	0.578 (0.077)***	0.694 (0.114)*	0.67 (0.114)*
Satisfied	0.322 (0.096)***	0.512 (0.177)	0.453 (0.165)*
Psychological Resilience	1.017 (0.003)***	1.058 (0.006)***	1.058 (0.006)***
Job Satisfaction	1.003 (0.003)	0.996 (0.006)	0.995 (0.007)
Burnout	1.045 (0.004)***	1.063 (0.006)***	1.063 (0.006)***
Pseudo r-squared		0.193	0.196
Chi-square		378.532***	383.036***

Turnover Intention Score was transformed into binary variable: High turnover intention=1 if score >12.

**0.01<p<0.05, **0.001<p<0.01, ***p<0.001*

Appendix 4. Model fitness index for the original SEM model and the final model

Fit statistic	χ^2 (P)	df	χ^2/df	CFI	TLI	RMSEA	SRMR	CD	Diagnosis
Recommended value	P>0.05	/	<5.0	≥0.90	≥0.91	<0.05	<0.08	Δ	
Original SEM Model (Without mediators)	424.128 (<0.001)	9	47.13	0.592	0.139	0.181	0.101	0.211	Not fit
Final SEM Model (Figure. 2)	12.568 (0.128)	8	1.57	0.998	0.993	0.02	0.008	0.705	Fit

Notes: RMSEA, Root mean squared error of approximation; CFI, Comparative fit index; TLI, Tucker-Lewis index; SRMR, Standardized root mean squared residual; CD, Coefficient of determination.
Δ, CD is like R-squared for the whole model, the higher value indicate higher percentage of data can be explained by the model.