Compassion fatigue in Chinese internship nursing students in junior college: scale validation, prevalence, and psychological mechanisms

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DOCTORAL THESIS
2024

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DOCTORAL THESIS

Supervised by

Dr. **Maria F. Jiménez-Herrera**

UNIVERSITAT ROVIRA i VIRGILI

Nursing Department

Tarragona, 2024

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FAIG CONSTAR que aquest treball, titulat "***La fatiga per compassió en estudiants xinesos de pràctiques d'infermeria en centres de formació professional: validació de l'escala, prevalença i mecanismes psicològics***", que presenta ***Lijuan Yi*** per a l'obtenció del títol de Doctor, ha estat realitzat sota la meva direcció al Departament ***Departament d'Infermeria*** d'aquesta universitat.

HAGO CONSTAR que el presente trabajo, titulado "***La fatiga por compasión en estudiantes chinos de prácticas de enfermería en centros de formación profesional: validación de la escala, prevalencia y mecanismos psicológicos***", que presenta ***Lijuan Yi*** para la obtención del título de Doctor, ha sido realizado bajo mi dirección en el ***Departamento de Enfermería*** de esta universidad.

I STATE that the present study, entitled "***Compassion fatigue in Chinese internship nursing students in junior college: scale validation, prevalence, and psychological mechanisms***", presented by ***Lijuan Yi*** for the award of the degree of Doctor, has been carried out under my supervision at the ***Department of Nursing*** of this university.

Tarragona, 2024

La directora de la tesi doctoral
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Curriculum Vitae

Yi Lijuan was admitted to Guangdong Pharmaceutical University in 2009, commencing her higher education in nursing. She graduated with a Bachelor of Nursing degree in **2013**, having earned a National Scholarship in 2011 due to her excellent academic performance. Following her undergraduate studies, Yi pursued a Master's degree in Nursing at Tianjin University of Traditional Chinese Medicine from September **2013** to July **2016**.

Under the meticulous guidance of Professor Guomin Song, Director of Nursing at Tianjin University Tianjin Hospital, Yi focused her research on orthopedic nursing and evidence-based nursing practices, particularly excelling in systematic reviews and meta-analyses. She earned her Master's degree in Nursing in July **2016**. During her master's studies, Yi not only received another National Graduate Scholarship but also led and participated in multiple research projects, attending various research training workshops to enhance her scientific skills. Under the supervision of Professor Song, she published approximately 20 peer-reviewed articles in international academic journals.

In August **2017**, Yi Lijuan joined Hunan University of Chinese Medicine as a lecturer in basic nursing, securing four research grants. Her research interests included critical care nursing, oncological nutrition, and the

psychological care of cancer patients and nursing students. During this period, she published over 10 academic papers. At the end of **2021**, Yi was fortunate to join the research team led by Dr. Maria F. Jiménez-Herrera, former Dean of the Nursing Faculty at Universitat Rovira I Virgili and the current General Secretary, which significantly influenced her academic development.

Under the detailed supervision of Dr. Jiménez-Herrera, Yi's doctoral research focused on “Compassion fatigue in Chinese internship nursing students in junior college: scale validation, prevalence, and psychological mechanisms.” With encouragement and guidance from Dr. Jiménez-Herrera, Yi became an editor for the journal Frontiers in Psychology in **2023** and presented posters at several major academic conferences.

Looking forward, Yi Lijuan plans to continue her research in nursing education, psychological nursing, nursing ethics, and the synthesis and translation of evidence. She aims to collaborate with Dr. Jiménez-Herrera and other distinguished experts to promote international academic and clinical exchanges and development in the field of nursing.

Acknowledgement

When I started writing my doctoral thesis, I was filled with many thoughts. Although words are a powerful way to express ideas, they seem inadequate to fully express my deep gratitude to those who have supported me greatly during my PhD journey. Nevertheless, I will try my best to convey my endless thanks through words.

First and foremost, I must extend my deepest appreciation to my supervisor, Dr. Maria F. Jiménez-Herrera, for her meticulous and invaluable guidance, patience, and selfless dedication. Faced with the limitations on face-to-face interactions during the pandemic, she opted to use WeChat—a popular social chat app in China—to discuss my dissertation for my convenience, a gesture that deeply moved me. When I first arrived in Tarragona and shared this news, despite her busy schedule filled with many academic conferences and commitments, she promptly arranged our first offline meeting. Importantly, she taught me to find a balance between study and life and to savor every moment, which was a significant life lesson for me. Throughout my doctoral studies, she provided not only meticulous academic guidance but also substantial support in my personal life and emotional well-being, akin to a mother's care. Without her support, I could not imagine achieving the exciting outcomes evident in my dissertation. Thus, my gratitude towards Dr. Jiménez-Herrera is lifelong.

Second, I am very grateful to the experts who reviewed my thesis and

Acknowledgement

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Third, I want to thank all the staff at URV for their love, selfless help, and kindness. I also appreciate the support from the directors and teachers at the Nursing School of Hunan University of Chinese Medicine, Yueyang Vocational Technical College, and Yongzhou Vocational Technical College during my data collection and research.

Fourth, I'm especially grateful to Dr. Tian Xu, a fellow graduate student, who not only helped me get the chance to study with Dr. Jiménez-Herrera but also supported me and gave valuable advice on my dissertation during a tough time after my father passed away.

Fifth, I would like to extend my special thanks to the students from the 2022 and 2023 cohorts who participated in my research project. Despite their busy schedules with clinical internships, they generously dedicated their time and fully supported my scientific work. I am deeply grateful for their commitment and trust. I recognize the value of the data they have provided, and I am committed to transforming it into outcomes that are both meaningful and substantial, fulfilling the expectations placed upon us.

Sixth, I'm thankful to my English teachers, Marta and Giela, who helped improve my English so I could communicate better with my advisor and

make clear presentations at conferences. Their commitment was invaluable.

Lastly, leaving China to pursue a PhD in Spain was a difficult decision, especially being away from my four-year-old son and family. However, the unconditional support from my family when I decided to leave my job was deeply moving. My mother and husband financially supported my decision, and my mother-in-law promised to take good care of my son. I am sincerely grateful to my family for their dedication, generous support, and unconditional love.

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List of abbreviations

A	AGFI	Adjusted Goodness-of-fit Index
	AIID	α if Item Deleted
	ANOVA	Analysis of variance
	AVE	Average Variance Explained
B	BES-20	Basic Empathy Scale-20
	BO	Burnout
C	CFA	Confirmatory Factor Analysis
	CF	Compassion Fatigue
	CFI	Comparative Fit Index
	CFS	Compassion Fatigue Scale
	CFSS	Compassion Fatigue Short Scale
	CFST	Compassion Fatigue Self Test
	CI	Confidence interval
	CI-TC	Corrected Item-Total Correlations
	CNKI	China National Knowledge Infrastructure
	CR	Composite Reliability
	CS	compassion satisfaction
	CSF	Compassion Satisfaction and Fatigue Scale
D	*df*	Degrees of freedom
E	EFA	Exploratory Factor Analysis

List of abbreviations

G	GFI	Goodness-of-fit Index
	GRADE	Grading of Recommendations, Assessment, Development and Evaluation
I	ICC	Intraclass Correlation Coefficient
	IFI	Incremental Fit Index
	IQR	Interquartile Range
K	KMO	Kaiser-Meyer-Olkin
M	MeSH	Medical subject heading
	MD	Mean difference
N	NFI	Normed fit index
P	PPQ-22	22-item Psychological Capital Questionnaire
	PR	Psychological Resilience
	PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
	ProQOlS	Professional quality of life scale
	PSS-14	Perceived Stress Scale-14
	PTG	Post-Traumatic Growth
R	RMSEA	Root Mean Square Error of Approximation
S	SD	Standard Deviation
	SEM	Structural equation model
	SPSS	the Statistical Package for Social Sciences
	SRMR	Standard Root Mean-square Residual
	STS	Secondary traumatic stress

List of abbreviations

	STROBE	Strengthening the Reporting of Observational Studies in Epidemiology
T	TLI	Tucker-Lewis Index
	TV	Tolerance Value
V	VIF	Variance Inflation Factor
X	χ^2	Chi-square
	χ^2/df	chi-square/degrees of freedom

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List of publications

Related papers to the thesis

1. **Yi LJ**, Liu Y, Tang L, Cheng L, Wang GH, Hu SW, Liu XL, Tian X, Jiménez-Herrera MF. A Bibliometric Analysis of the Association Between Compassion Fatigue and Psychological Resilience From 2008 to 2021. *Front Psychol*. 2022, 13:890327. doi: 10.3389/fpsyg.2022.890327.

2. **Yi LJ**, Cai J, Ma L, Lin H, Yang J, Tian X, Jiménez-Herrera MF. Prevalence of Compassion Fatigue and Its Association with Professional Identity in Junior College Nursing Interns: A Cross-Sectional Study. *Int J Environ Res Public Health*. 2022 17;19 (22):15206. doi: 10.3390/ijerph192215206.

3. **Yi LJ**, Hua SW, Liao MQ, Cheng L, Tian X, Jiménez-Herrera MF. Prevalence and related factors of compassion fatigue among registered nurses and nursing students during the internship: a systematic review and meta-analysis. *BMC Nursing.* 2024. Peer review.

4. **Yi LJ**, Shuai T, Li Y, Wang GH, Long HY, Lin H, Tian X, Jiménez-Herrera MF. Validity and reliability of the Compassion Fatigue Short Scale among nursing interns. *Journal of Psychology in Africa.* 2024. In press.

5. **Yi LJ**, Tian, Lin H, Ma L, Shuai T, Jiménez-Herrera MF. Impact of internship nursing students' stress exposure on compassion fatigue: insights from the ABC-X Model. *BMC nursing.* 2024. Peer review.

Unrelated papers to the thesis

1. **Yi LJ**, Cai J, Shuai T, Jiménez-Herrera MF, Gu L, Tian X. Mediating effect of moral sensitivity and professional identity between moral courage and compassion fatigue among nursing interns: a cross-sectional study. BMC Nurs. 2024 Aug 13;23(1):551. doi: 10.1186/s12912-024-02173-8.

2. **Yi LJ**, Tian X, Jin YF, Luo MJ, Jiménez-Herrera MF. Effects of yoga on health-related quality, physical health and psychological health in women with breast cancer receiving chemotherapy: a systematic review and meta-analysis. *Ann Palliat Med*. 2021, 10(2):1961-1975. doi: 10.21037/apm-20-1484.

3. **Yi LJ**, Tian X, Chen M, Lei JM, Xiao N, Jiménez-Herrera MF. Comparative Efficacy and Safety of Four Different Spontaneous Breathing Trials for Weaning From Mechanical Ventilation: A Systematic Review and Network Meta-Analysis. *Front Med (Lausanne)*. 2021, 8:731196. doi: 10.3389/fmed.2021.731196.

4. Shuai T, **Yi LJ**, Maria F. Jiménez-Herrera MF, Tian X (2024). Moral distress and compassion fatigue among nursing interns: A cross-sectional study on the mediating roles of moral resilience and professional identity. BMC Nurs. Advance online publication. (**Shuai T *and Yi LJ contributed equally to this work.***)

5. Tian X, **Yi LJ**, Liang CS, Gu L, Peng C, Chen GH, Jiménez-Herrera MF. The Impact of Mindfulness-Based Stress Reduction (MBSR) on Psychological Outcomes and Quality of Life in Patients with Lung Cancer: A Meta-Analysis. *Front Psycho*l. 2022, 13:901247. doi: 10.3389/fpsyg.2022.901247. (***Tian X and Yi LJ contributed equally to this work.***)

Contents

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Abstract

Background: Compassion fatigue, encompassing secondary traumatic stress and occupational burnout, is prevalent among nursing professionals who are frequently exposed to patients' traumatic experiences. As a significant source of psychological distress, compassion fatigue impairs nurses' ability to deliver optimal care and affects their physical and mental health. During the Covid-19 pandemic, the issue of compassion fatigue in clinical nurses received widespread attention. While there is some research on compassion fatigue among internship nursing students, studies focusing specifically on those in junior colleges are notably absent, leaving their condition largely unexplored. Studies involving pre-licensure health profession students indicate that high levels of compassion fatigue or burnout may increase their intention to leave their educational programs, potentially predicting actual attrition. Consequently, the use of validated tools for the timely detection of early signs and symptoms of compassion fatigue is crucial. Unfortunately, no measurement tools specifically designed for assessing compassion fatigue in internship nursing students have yet been developed. Furthermore, the precise psychological mechanisms underlying compassion fatigue in these students are not well understood, resulting in a lack of effective interventions to alleviate this issue.

Objectives: The current thesis aims firstly to evaluate the psychometric properties of the Chinese Version of the Compassion Fatigue Short Scale among internship nursing students in junior colleges. Subsequently, it aims to investigate the prevalence of compassion fatigue within this group. Finally, the thesis seeks to explore the potential psychological mechanisms underlying compassion fatigue among internship nursing students.

Methods: The current thesis designs five separate studies, and various methods are used in different studies to achieve different objectives. Study 1 utilizes descriptive bibliometric analysis and science mapping to identify

and analyze existing literature on compassion fatigue and psychological resilience. Additionally, this study includes a specialized analysis to assess the impact of the COVID-19 pandemic on research trends, comparing these findings with overarching data. Study 2 is a systematic review and meta-analysis that includes literature published up to January 2024 from databases such as PubMed, EMBASE, the Cochrane Library, China National Knowledge Infrastructure (CNKI), and Wanfang. This study begins by assessing the risk of bias using the Cochrane risk of bias assessment tool, then combines prevalence rates and average scores of compassion fatigue and its sub-dimensions (burnout and secondary traumatic stress) among nurses and nursing students during the internship, and identifies their related factors. Subsequently, the Grading of Recommendations Assessment, Development and Evaluation (GRADE) system is used to evaluate the quality of evidence for these associated factors. Study 3 employs a cross-sectional design to validate the psychometric properties of the Chinese version of the Compassion Fatigue Short Scale among internship nursing students in China. The scale's structural integrity is assessed using both exploratory and confirmatory factor analyses. Criterion validity is established through correlation with the Professional Quality of Life Scale. Additionally, the study comprehensively evaluates internal consistency, test-retest reliability, and convergent validity. Study 4, also employing a cross-sectional design, utilizes the previously validated Chinese version of the Compassion Fatigue Short Scale to further investigate the prevalence of compassion fatigue among internship nursing students in junior colleges. Study 5 utilizes a cross-sectional design to collect data on stress exposure during internships, empathy, psychological capital, perceived stress, and compassion fatigue. Using correlation analysis and structural equation model, this study aims to determine the pathways and magnitude of influence between these various factors. Statistical analyses for the second, third, and fifth studies were conducted using the Statistical Package for the Social Sciences

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version 26.0. Additionally, the fifth study also utilized AMOS version 23.0 (Chicago, IL, United States). In contrast, the statisticalanalyses for the first study were performed using Citespace® 5.8.R1, while the analyses for the fourth study were conducted using STATA 17.0 (StataCorp, Texas, USA).

Results: In Study 1, a total of 388 publications were identified, displaying a generally increasing trend in annual publication numbers, albeit with slight fluctuations. Analysis of journals and keywords revealed that nurses and social workers are the primary research subjects, with their psychological issues being the main topics of study. Notably, the turnover intention of healthcare providers, especially during the COVID-19 pandemic, emerged as a focal research area.

Study 2 included 196 studies (with 73,034 nurses and 4,551 nursing students during the internship). For nurses, the pooled mean scores for burnout and secondary traumatic stress were 26.81 (95% CI 26.28 to 27.35) and 25.88 (95% CI 25.39 to 26.37), respectively. For nursing students during the internship, the pooled mean scores of burnout and secondary traumatic stress were 29.16 (95% CI 26.95 to 31.37) and 25.64 (95% CI 20.95 to 30.34), respectively. Subgroup analyses revealed that post-COVID-19 pandemic, nurses exhibit higher levels of compassion fatigue, especially those working in ICU or emergency departments. Syntheses of evidence from 93 studies suggested that nurses' burnout and secondary traumatic stress are both influenced by work environment, social support, job satisfaction, workload, and psychological capital (moderate to low-certainty evidence). For nursing students during the internship, evidence highlights the significant role of psychological capital in these strains (moderate to low-certainty evidence).

Study 3 demonstrated that exploratory factor analyses confirmed the validity of the Chinese Compassion Fatigue Short Scale, despite a partial misfit in the original two-factor model as indicated by confirmatory factor analyses. The scale also exhibited good criterion validity, excellent internal

consistency, and reliable test-retest performance.

Study 4 showed that the median score of compassion fatigue was 40 out of a total score of 130, and 19.5% of the participants scored above the compassion fatigue-Short Scale median scores for compassion fatigue among 2256 Chinese internship nursing students.

Study 5 revealed that internship nursing students' average compassion fatigue score was 50.2 (24.1). Both work-related stress and negative life events during internships influenced compassion fatigue through three mediating paths: (a) through psychological capital: $\beta = 0.038$ ($P = 0.005$), $\beta = 0.039$ ($P = 0.004$); effect sizes between small and medium; (b) through perceived stress: $\beta = 0.035$ ($P = 0.001$), $\beta = 0.056$ ($P = 0.001$); effect sizes between small and medium; (c) through psychological capital and perceived stress sequentially: $\beta = 0.010$ ($P = 0.003$), $\beta = 0.011$ ($P = 0.002$); small effect sizes. In contrast, empathy was not found to significantly mediate the relationship between work-related stress and negative life events during internships and compassion fatigue.

Conclusions: Based on the results of five separate studies, various conclusions are drawn, which are summarized below in the order of study.

i. Study 1 provides insights into the current state and recent developments within the fields of compassion fatigue and psychological resilience.

ii. Study 2 indicates that both registered nurses and internship nursing students experience moderate levels of compassion fatigue. Common factors associated with burnout and secondary traumatic stress in registered nurses include a poor work environment, a lower social support, a lower job satisfaction, a heavier workload stress, and a lower psychological capital. Besides, low psychological capital is a common factor associated with burnout and secondary traumatic stress in nursing students during the internship.

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However, due to the limited evidence, further research is necessary.

iii. Study 3 confirms the effectiveness of the Compassion Fatigue Short Scale for assessing compassion fatigue among internship nursing students, highlighting its importance as an assessment tool.

iv. Study 4 reveals that although the overall level of compassion fatigue among internship nursing students is low, approximately one in five nursing students is at risk of developing compassion fatigue. Therefore, more attention should be paid to these high-risk internship nursing students.

v. Study 5 finds that internship nursing students exhibit a moderate level of compassion fatigue. Work-related stress and negative life events during internships are significantly correlated with increased compassion fatigue. Psychological capital and perceived stress partially mediate the impact of these stressors on compassion fatigue. These findings provide valuable insights for designing targeted interventions aimed at preventing or mitigating compassion fatigue among internship nursing students.

Key words: compassion fatigue; internship nursing students; junior college; burnout, secondary traumatic stress; nurse; COVID-19; ABC-X model; physiological resilience; empathy; psychological capital; perceived stress; structural equation model; professional identity; influential factors; psychometric analysis; bibliometric analysis; meta-analysis; systematic review.

Resum

Antecedents: La fatiga per compassió, que inclou l'estrès traumàtic secundari i el desgast professional, és prevalent entre els professionals d'infermeria que estan freqüentment exposats a les experiències traumàtiques dels pacients. Com a font significativa d'angoixa psicològica, la fatiga per compassió impedeix als infermers oferir una atenció òptima i afecta la seva salut física i mental. Durant la pandèmia de la Covid-19, la qüestió de la fatiga per compassió en les infermeres clínics van rebre una atenció generalitzada. Tot i que hi ha algunes investigacions sobre la fatiga per compassió entre els estudiants d'infermeria en pràctiques, els estudis que se centren específicament en aquells que es troben en estudiants de formació professional són notablement absents, deixant la seva condició en gran part inexplorada. Els estudis que involucren estudiants de professions sanitàries abans de finalitzar el grau d'infermeria indiquen que nivells elevats de fatiga per compassió o desgast professional poden augmentar la seva intenció de deixar els seus programes educatius, cosa que potencialment prediu el desgast. En conseqüència, l'ús d'eines validades per a la detecció oportuna dels signes i símptomes primerencs de fatiga per compassió és crucial. Malauradament, encara no s'han desenvolupat eines de mesura específicament dissenyades per avaluar la fatiga per compassió en estudiants d'infermeria en pràctiques. A més, els mecanismes psicològics precisos que subjauen a la fatiga per compassió en aquests estudiants no es comprenen bé, resultant en una manca d'intervencions efectives per alleujar aquest problema.

Objectius: La present tesi té com a primer objectiu avaluar les propietats psicomètriques de la Versió Xinesa de l'Escala Breu de Fatiga per Compassió entre els estudiants d'infermeria en pràctiques en centres de formació professional. Posteriorment, pretén investigar la prevalença de la fatiga per compassió dins d'aquest grup. Finalment, la tesi busca explorar els possibles mecanismes psicològics que subjauen a la fatiga per compassió

entre els estudiants d'infermeria en pràctiques.

Mètodes: La present tesi dissenya cinc estudis separats, i s'utilitzen diversos mètodes en diferents estudis per assolir diferents objectius. L'estudi 1 utilitza anàlisi bibliomètrica descriptiva i mapatge científic per identificar i analitzar la literatura existent sobre la fatiga per compassió i la resiliència psicològica. A més, aquest estudi inclou una anàlisi especialitzada per avaluar l'impacte de la pandèmia de la COVID-19 en les tendències de recerca, comparant aquests resultats amb dades generals. L'estudi 2 és una revisió sistemàtica i meta-anàlisi que inclou literatura publicada fins a gener de 2024 de bases de dades com PubMed, EMBASE, la Cochrane Library, China National Knowledge Infrastructure (CNKI) i Wanfang. Aquest estudi comença avaluant el risc de biaix utilitzant l'eina d'avaluació del risc de biaix de Cochrane, després combina les taxes de prevalença i les puntuacions mitjanes de la fatiga per compassió i les seves subdimensions (esgotament i estrès traumàtic secundari) entre infermeres i estudiants d'infermeria durant les pràctiques, i identifica els seus factors relacionats. Posteriorment, s'utilitza el sistema Grading of Recommendations Assessment, Development and Evaluation (GRADE) per avaluar la qualitat de les evidències per a aquests factors associats. L'estudi 3 utilitza un disseny transversal per validar les propietats psicomètriques de la versió xinesa de l'Escala Breu de Fatiga per Compassió entre estudiants d'infermeria en pràctiques a la Xina. La integritat estructural de l'escala s'avalua utilitzant tant anàlisis factorials exploratòries com confirmatòries. La validesa de criteri s'estableix mitjançant la correlació amb l'Escala de Qualitat Professional de Vida. A més, l'estudi avalua de manera exhaustiva la consistència interna, la fiabilitat test-retest i la validesa convergent. L'estudi 4, també utilitzant un disseny transversal, utilitza la versió xinesa validada anteriorment de l'Escala Breu de Fatiga per Compassió per investigar més a fons la prevalença de la fatiga per compassió entre estudiants d'infermeria en pràctiques. L'estudi 5 utilitza un disseny transversal per

recollir dades sobre l'exposició a l'estrès durant les pràctiques, l'empatia, el capital psicològic, l'estrès percebut i la fatiga per compassió. Utilitzant l'anàlisi de correlació i el model d'equacions estructurals, aquest estudi té com a objectiu determinar els camins i la magnitud de la influència entre aquests diversos factors. Les anàlisis estadístiques per als estudis segon, tercer i cinquè es van dur a terme utilitzant el Statistical Package for the Social Sciences versió 26.0. A més, el cinquè estudi també va utilitzar AMOS versió 23.0 (Chicago, IL, Estats Units). En canvi, les anàlisis estadístiques per al primer estudi es van realitzar utilitzant Citespace® 5.8.R1, mentre que les anàlisis per al quart estudi es van dur a terme utilitzant STATA 17.0 (StataCorp, Texas, EUA).

Resultats: En l'estudi 1, es van identificar un total de 388 publicacions, mostrant una tendència generalment creixent en el nombre anual de publicacions, tot i que amb lleugeres fluctuacions. L'anàlisi de revistes i paraules clau va revelar que les infermeres i treballadores socials són els principals subjectes d'investigació, sent els seus problemes psicològics els principals temes d'estudi. Notablement, la intenció de rotació dels proveïdors de salut, especialment durant la pandèmia de COVID-19, va emergir com una àrea de recerca central.

L'estudi 2 va incloure 196 estudis (amb 73.034 infermeres i 4.551 estudiants d'infermeria durant la pràctica). Per a les infermeres, les puntuacions mitjanes combinades per a l'esgotament i l'estrès traumàtic secundari van ser de 26,81 (IC 95% 26,28 a 27,35) i 25,88 (IC 95% 25,39 a 26,37), respectivament. Per als estudiants d'infermeria durant la pràctica, les puntuacions mitjanes combinades per a l'esgotament i l'estrès traumàtic secundari van ser de 29,16 (IC 95% 26,95 a 31,37) i 25,64 (IC 95% 20,95 a 30,34), respectivament. Les anàlisis de subgrups van revelar que després de la pandèmia de COVID-19, les infermeres presenten nivells més alts de fatiga per compassió, especialment aquelles que treballen a la UCI o en departaments d'emergències. Les síntesis d'evidències de 93 estudis van suggerir que l'esgotament i l'estrès traumàtic secundari de les

infermeres estan influïts per l'entorn laboral, el suport social, la satisfacció laboral, la càrrega de treball i el capital psicològic (evidència de certesa moderada a baixa). Per als estudiants d'infermeria durant la pràctica, l'evidència destaca el paper significatiu del capital psicològic en aquestes tensions (evidència de certesa moderada a baixa).

L'estudi 3 va demostrar que les anàlisis factorials exploratòria van confirmar la validesa de l'Escala Breu de Fatiga per Compassió en Xinès, malgrat un ajust parcial en el model original de dos factors indicat per les anàlisis factorials confirmatòries. L'escala també va exhibir una bona validesa criterial, excel·lent consistència interna i un rendiment fiable en la prova-reprova.

L'estudi 4 va mostrar que la puntuació mitjana de fatiga per compassió va ser de 40 sobre un total de 130, i el 19,5% dels participants van obtenir puntuacions superiors a la mitjana de l'Escala Breu de Fatiga per Compassió entre 2.256 estudiants d'infermeria en pràctiques xineses.

L'estudi 5 va revelar que la puntuació mitjana de fatiga per compassió dels estudiants d'infermeria en pràctiques era de 50,2 (24,1). Tant l'estrès relacionat amb la feina com els esdeveniments negatius de la vida durant les pràctiques van influir en la fatiga per compassió a través de tres vies de mediació: (a) a través del capital psicològic: $\beta = 0,038$ ($P = 0,005$), $\beta = 0,039$ ($P = 0,004$); mides d'efecte entre petites i mitjanes; (b) a través de l'estrès percebut: $\beta = 0,035$ ($P = 0,001$), $\beta = 0,056$ ($P = 0,001$); mides d'efecte entre petites i mitjanes; (c) a través del capital psicològic i l'estrès percebut seqüencialment: $\beta = 0,010$ ($P = 0,003$), $\beta = 0,011$ ($P = 0,002$); mides d'efecte petites. En contrast, no es va trobar que l'empatia mediés significativament la relació entre l'estrès relacionat amb la feina i els esdeveniments negatius de la vida durant les pràctiques i la fatiga per compassió.

Conclusions: Basant-se en els resultats de cinc estudis separats, es treuen diverses conclusions, que es resumeixen a continuació segons l'ordre de l'estudi.

i. L'estudi 1 proporciona informació sobre l'estat actual i els desenvolupaments recents en els camps de la fatiga per compassió i la resiliència psicològica.

ii. L'estudi 2 indica que tant les infermeres registrades com els estudiants en pràctiques d'infermeria experimenten nivells moderats de fatiga per compassió. Els factors comuns associats amb el burnout i l'estrès traumàtic secundari en les infermeres registrades inclouen un entorn de treball deficient, un menor suport social, una menor satisfacció laboral, un estrès de càrrega de treball més gran i un menor capital psicològic. A més, el baix capital psicològic és un factor comú associat amb el burnout i l'estrès traumàtic secundari en els estudiants d'infermeria durant les seves pràctiques. No obstant això, a causa de l'evidència limitada, es necessita més investigació.

iii. L'estudi 3 confirma l'efectivitat de l'Escala Breu de Fatiga per Compassió per avaluar la fatiga per compassió entre els estudiants en pràctiques d'infermeria, destacant la seva importància com a eina d'avaluació.

iv. L'estudi 4 revela que, tot i que el nivell general de fatiga per compassió entre els estudiants en pràctiques d'infermeria és baix, aproximadament un de cada cinc estudiants d'infermeria està en risc de desenvolupar fatiga per compassió. Per tant, cal prestar més atenció a aquests estudiants en pràctiques d'alt risc.

v. L'estudi 5 demostra que els estudiants en pràctiques d'infermeria presenten un nivell moderat de fatiga per compassió. L'estrès relacionat amb la feina i els esdeveniments negatius de la vida durant les pràctiques estan significativament correlacionats amb l'augment de la fatiga per compassió. El capital psicològic i l'estrès percebut mediatitzen parcialment l'impacte d'aquests estressors sobre la fatiga per compassió. Aquests resultats proporcionen

informació valuosa per dissenyar intervencions específiques dirigides a prevenir o mitigar la fatiga per compassió entre els estudiants en pràctiques d'infermeria.

Paraules clau: fatiga per compassió; estudiants en pràctiques d'infermeria; centres de formació professional; burnout; estrès traumàtic secundari; infermera; COVID-19; model ABC-X; resiliència psicològica; empatia; capital psicològic; estrès percebut; model d'equacions estructurals; identitat professional; factors influents; anàlisi psicomètrica; anàlisi bibliomètrica; metanàlisi; revisió sistemática

Resumen

Antecedentes: La fatiga por compasión, que abarca el estrés traumático secundario y el agotamiento profesional, es prevalente entre los profesionales de la enfermería que están frecuentemente expuestos a las experiencias traumáticas de los pacientes. Como una fuente significativa de angustia psicológica, la fatiga por compasión deteriora la capacidad de las enfermeras para brindar una atención óptima y afecta su salud física y mental. Durante la pandemia de Covid-19, la problemática de la fatiga por compasión en las enfermeras clínicas recibió una amplia atención. Aunque hay algunas investigaciones sobre la fatiga por compasión entre los estudiantes de enfermería en prácticas, los estudios que se centran específicamente en ellos son notablemente escasos, dejando su condición en gran medida inexplorada. Los estudios que involucran a estudiantes de profesiones de la salud antes de obtener su graduación indican que los altos niveles de fatiga por compasión o agotamiento pueden aumentar su intención de abandonar sus programas educativos, lo que potencialmente predice la deserción real. En consecuencia, el uso de herramientas validadas para la detección oportuna de los primeros signos y síntomas de la fatiga por compasión es crucial. Desafortunadamente, aún no se han desarrollado herramientas de medición específicamente diseñadas para evaluar la fatiga por compasión en los estudiantes de enfermería en prácticas. Además, los mecanismos psicológicos precisos que subyacen a la fatiga por compasión en estos estudiantes no están bien comprendidos, lo que resulta en una falta de intervenciones efectivas para aliviar este problema.

Objetivos: La presente tesis tiene como objetivo, en primer lugar, evaluar las propiedades psicométricas de la Versión China de la Escala Breve de Fatiga por Compasión entre los estudiantes de enfermería en prácticas de colegios universitarios. Posteriormente, tiene como objetivo investigar la prevalencia de la fatiga por compasión dentro de este grupo. Finalmente, la tesis busca explorar los posibles mecanismos psicológicos subyacentes

a la fatiga por compasión entre los estudiantes de enfermería en prácticas.

Métodos: La presente tesis diseña cinco estudios separados, y se utilizan diversos métodos en diferentes estudios para lograr distintos objetivos. El estudio 1 utiliza el análisis bibliométrico descriptivo y el mapeo científico para identificar y analizar la literatura existente sobre la fatiga por compasión y la resiliencia psicológica. Además, este estudio incluye un análisis especializado para evaluar el impacto de la pandemia de COVID-19 en las tendencias de investigación, comparando estos hallazgos con datos generales. El estudio 2 es una revisión sistemática y un meta-análisis que incluye literatura publicada hasta enero de 2024 de bases de datos como PubMed, EMBASE, la Biblioteca Cochrane, la Infraestructura Nacional de Conocimiento de China (CNKI) y Wanfang. Este estudio comienza evaluando el riesgo de sesgo utilizando la herramienta de evaluación del riesgo de sesgo de Cochrane, luego combina las tasas de prevalencia y los puntajes promedio de fatiga por compasión y sus subdimensiones (burnout y estrés traumático secundario) entre enfermeras y estudiantes de enfermería durante el internado, e identifica sus factores relacionados. Posteriormente, se utiliza el sistema de Evaluación, Desarrollo y Evaluación de Recomendaciones (GRADE) para evaluar la calidad de la evidencia de estos factores asociados. El estudio 3 emplea un diseño transversal para validar las propiedades psicométricas de la versión china de la Escala Corta de Fatiga por Compasión entre estudiantes de enfermería en internado en China. La integridad estructural de la escala se evalúa utilizando tanto análisis factorial exploratorio como confirmatorio. La validez de criterio se establece mediante la correlación con la Escala de Calidad de Vida Profesional. Además, el estudio evalúa exhaustivamente la consistencia interna, la fiabilidad test-retest y la validez convergente. El estudio 4, también utilizando un diseño transversal, emplea la versión china previamente validada de la Escala Corta de Fatiga por Compasión para investigar aún más la prevalencia de la fatiga por

Resumen

compasión entre los estudiantes de enfermería en internado en centros de formación profesional. El estudio 5 utiliza un diseño transversal para recopilar datos sobre la exposición al estrés durante los internados, la empatía, el capital psicológico, el estrés percibido y la fatiga por compasión. Mediante el análisis de correlación y el modelado de ecuaciones estructurales, este estudio tiene como objetivo determinar las vías y la magnitud de la influencia entre estos diversos factores. Los análisis estadísticos para los estudios segundo, tercero y quinto se realizaron utilizando el Paquete Estadístico para las Ciencias Sociales versión 26.0. Además, el quinto estudio también utilizó AMOS versión 23.0 (Chicago, IL, Estados Unidos). En contraste, los análisis estadísticos para el primer estudio se realizaron utilizando Citespace® 5.8.R1, mientras que los análisis para el cuarto estudio se realizaron utilizando STATA 17.0 (StataCorp, Texas, EE.UU.).

Resultados: En el estudio 1, se identificaron un total de 388 publicaciones, mostrando una tendencia generalmente creciente en el número anual de publicaciones, aunque con ligeras fluctuaciones. El análisis de revistas y palabras clave reveló que los enfermeros y trabajadores sociales son los principales sujetos de investigación, siendo sus problemas psicológicos los temas principales de estudio. Notablemente, la intención de rotación de los proveedores de atención médica, especialmente durante la pandemia de COVID-19, emergió como un área de investigación focal.

El estudio 2 incluyó 196 estudios (con 73,034 enfermeros y 4,551 estudiantes de enfermería durante su pasantía). Para los enfermeros, las puntuaciones medias combinadas para el agotamiento y el estrés traumático secundario fueron 26.81 (IC 95% 26.28 a 27.35) y 25.88 (IC 95% 25.39 a 26.37), respectivamente. Para los estudiantes de enfermería durante las pasantías, las puntuaciones medias combinadas para el agotamiento y el estrés traumático secundario fueron 29.16 (IC 95% 26.95 a 31.37) y 25.64 (IC 95% 20.95 a 30.34), respectivamente. Los análisis de subgrupos revelaron que, después de la pandemia de COVID-19, las enfermeras exhiben niveles más altos de fatiga por compasión, especialmente aquellos que

trabajan en las unidades de cuidados intensivos o en los departamentos de emergencia. La síntesis de evidencia de 93 estudios sugirió que tanto el agotamiento como el estrés traumático secundario de los enfermeros están influenciados por el entorno laboral, el apoyo social, la satisfacción laboral, la carga de trabajo y el capital psicológico (evidencia de certeza moderada a baja). Para los estudiantes de enfermería durante las pasantías, la evidencia resalta el papel significativo del capital psicológico en estas tensiones (evidencia de certeza moderada a baja).

El estudio 3 demostró que los análisis factoriales exploratorios confirmaron la validez de la Versión China de la Escala Breve de Fatiga por Compasión, a pesar de un desajuste parcial en el modelo original de dos factores, como lo indicaron los análisis factoriales confirmatorios. La escala también mostró una buena validez de criterio, excelente consistencia interna y un rendimiento fiable en las pruebas de repetición.

El estudio 4 mostró que la puntuación mediana de fatiga por compasión fue de 40 sobre una puntuación total de 130, y el 19.5% de los participantes obtuvieron puntuaciones por encima de la mediana de la Escala Breve de Fatiga por Compasión entre 2,256 estudiantes chinos de enfermería en pasantía.

El estudio 5 reveló que la puntuación promedio de fatiga por compasión de los estudiantes de enfermería en pasantía fue de 50.2 (24.1). Tanto el estrés relacionado con el trabajo como los eventos negativos de la vida durante las prácticas influyeron en la fatiga por compasión a través de tres caminos de mediación: (a) a través del capital psicológico: $\beta = 0.038$ ($P = 0.005$), $\beta = 0.039$ ($P = 0.004$); tamaños del efecto entre pequeños y medianos; (b) a través del estrés percibido: $\beta = 0.035$ ($P = 0.001$), $\beta = 0.056$ ($P = 0.001$); tamaños del efecto entre pequeños y medianos; (c) a través del capital psicológico y el estrés percibido secuencialmente: $\beta = 0.010$ ($P = 0.003$), $\beta = 0.011$ ($P = 0.002$); tamaños del efecto pequeños. En contraste, no se encontró que la empatía mediara significativamente la relación entre

el estrés relacionado con el trabajo y los eventos negativos de la vida durante las prácticas y la fatiga por compasión.

Conclusiones: Basado en los resultados de cinco estudios independientes, se extraen diversas conclusiones, que se resumen a continuación en el orden de los estudios.

i. El estudio 1 proporciona información sobre el estado actual y los avances recientes en los campos de la fatiga por compasión y la resiliencia psicológica.

ii. El estudio 2 indica que tanto las enfermeras registradas como los estudiantes de enfermería en prácticas experimentan niveles moderados de fatiga por compasión. Los factores comunes asociados con el agotamiento y el estrés traumático secundario en las enfermeras registradas incluyen un entorno laboral deficiente, un menor apoyo social, una menor satisfacción laboral, un estrés laboral más intenso y un menor capital psicológico. Además, el bajo capital psicológico es un factor común asociado con el agotamiento y el estrés traumático secundario en los estudiantes de enfermería durante sus prácticas. Sin embargo, debido a la evidencia limitada, se necesita más investigación.

iii. El estudio 3 confirma la efectividad de la Escala Breve de Fatiga por Compasión para evaluar la fatiga por compasión entre los estudiantes de enfermería en prácticas, destacando su importancia como herramienta de evaluación.

iv. El estudio 4 confirma la efectividad de la Escala Breve de Fatiga por Compasión para evaluar la fatiga por compasión entre los estudiantes de enfermería en prácticas, destacando su importancia como herramienta de evaluación.

v. El estudio 5 demuestra que los estudiantes de enfermería en prácticas exhiben un nivel moderado de fatiga por compasión. El estrés

relacionado con el trabajo y los eventos negativos de la vida durante las prácticas están significativamente correlacionados con un aumento en la fatiga por compasión. El capital psicológico y el estrés percibido median parcialmente el impacto de estos factores estresantes en la fatiga por compasión. Estos hallazgos proporcionan información valiosa para diseñar intervenciones dirigidas a prevenir o mitigar la fatiga por compasión entre los estudiantes de enfermería en prácticas.

Palabras clave: fatiga por compasión; estudiantes de enfermería en prácticas; centros de formación profesional; burnout; estrés traumático secundario; enfermera; COVID-19; modelo ABC-X; resiliencia psicológica; empatía; capital psicológico; estrés percibido; modelo de ecuaciones estructurales; identidad profesional; factores influyentes; análisis psicométrico; análisis bibliométrico; meta-análisis; revisión sistemática

1. INTRODUCTION

1.Introduction

Nursing is a highly stressful, but compassionate profession. People choosing to be a nurse are empathetic in providing professional help and support according to patients' needs[1]. However, overexposure to patients' traumatic experiences during long-term professional engagements could be a source of psychological distress for nursing practitioners, which could erode their ability to take care of patients at an optimum level, as well as their own physical and psychological health[2,3]. This phenomenon was termed as compassion fatigue by Joinson in 1992, which refers to the formal caregiver's reduced capacity or interest in being empathic and is considered as the natural consequence of constantly witnessing the traumatizing events suffered by other people[4].

In recent years, compassion fatigue among clinical nurses has received widespread attention, particularly during the COVID-19 pandemic, which has exacerbated the issue[5,6]. However, there has been limited research on internship nursing students, especially those in associate degree programs. These students must adapt to high-stress work environments similar to those faced by professional nurses while managing personal learning and emotional issues, making them more susceptible to compassion fatigue[7-9]. Studies have shown that high levels of compassion fatigue or burnout are associated with an increased risk of leaving educational programs[10-15]. Therefore, it is crucial to use appropriate measurement tools to determine the prevalence of compassion fatigue in this population.

Currently, survey questionnaires are the primary method for assessing compassion fatigue. These include indirect measurement tools (e.g., Impact of Event Scale, Trauma and Attachment Belief Scale, World Assumptions Scale) and direct measurement tools (e.g., Compassion Fatigue Self-Test, Compassion Satisfaction and Fatigue Scale, Compassion Fatigue Scale, Compassion Fatigue Short Scale, Professional Quality of Life Scale) [10-15]. However, the reliability and validity of indirect tools, which are primarily based on studies of individuals with direct trauma, have not been fully

established[10]. Some early versions of direct measurement tools for compassion fatigue also lack extensive validation studies and robust psychometric properties[11,12,16].

The Professional Quality of Life Scale and the Compassion Fatigue Short Scale are commonly used tools for measuring compassion fatigue[17-22]. Although the Professional Quality of Life Scale is extensively utilized, its comprehensive item set (30 items) may lead to rapid, superficial responses from participants, potentially hindering accurate assessments[23]. Additionally, although the Professional Quality of Life Scale uses burnout and secondary traumatic stress subscales to measure compassion fatigue, there is overlap between these subscales, making it inadvisable to simply combine their scores[14,15]. These factors collectively complicate the effective monitoring of compassion fatigue using the Professional Quality of Life Scale. In contrast, the Compassion Fatigue Short Scale offers a more concise and comprehensible format, addressing some of the challenges associated with the Professional Quality of Life Scale. It has been used and validated in various cultures and countries, demonstrating reliability and validity among social workers, firefighters, and healthcare workers[13,24-26]. However, the psychometric properties of the Chinese version of the Compassion Fatigue Short Scale have not been adequately evaluated among nursing interns29.

Nursing students face unique stressors due to their dual roles as students and novice caregivers, which differ from those in other nursing professions[25]. This may lead to variations in their experiences and manifestations of compassion fatigue. Therefore, it is essential to further evaluate the reliability and validity of the Compassion Fatigue Short Scale in the context of associate degree nursing students.

Given that early exposure to compassion fatigue can significantly impact internship nursing students' career trajectories and retention rates, elucidating its development and progression mechanisms is crucial[10-15]. Several

systematic reviews[3,27-32] have found that compassion fatigue is influenced by various stressors and psychosocial factors. However, the relationship between these factors and internship nursing students, especially those in junior college programs, has not been fully elucidated. Additionally, due to the limited support from family and school during internships, individual psychological factors become particularly important. Therefore, it is essential to investigate the pathways and extent to which stressors and psychological factors affect compassion fatigue, in order to elucidate the potential mechanisms in junior college internship nursing students.

Following these open questions mentioned above, the current thesis designed the following five parts to generate additional knowledge to bridge these gaps between research findings and clinical practice:

Part I, study 1, is designed as a bibliometric analysis aimed at mapping the current landscape and identifying emerging trends in the research fields of compassion fatigue and psychological resilience.

Part II, study 2, is designed as a systematic review and meta-analysis to synthesize and evaluate the existing evidence on the prevalence of compassion fatigue and its influential factors among nurses and nursing interns. It aims to elucidate the disparities in compassion fatigue levels between these two cohorts and to identify the principal factors that contribute to compassion fatigue among both nurses and nursing interns.

Part III, study 3, is designed to assess the validity and reliability of the Chinese Version of the Compassion Fatigue Short Scale among internship nursing students in junior colleges in China.

Part IV, study 4, is a cross-sectional survey designed to assess the prevalence of compassion fatigue among internship nursing students in junior colleges in China. It also aims to determine whether significant variations in CF levels correlate with the diverse sociodemographic characteristics of these students.

Part V, study 5, is a multi-center, cross-sectional study, with the aims of applying the ABC-X stress model to explore how internship stressors, such as work pressures and negative life events, influence compassion fatigue in nursing students. We examine the mediating roles of psychological capital, empathy (cognitive/affective), and perceived stress in this process.

2. OBJECTIVES

2.Objectives

Based on the gaps identified between research findings and clinical practice through a literature review, the current thesis is designed to achieve the following two major goals: (i) to identify an appropriate tool for the timely and accurate assessment of compassion fatigue among Chinese internship nursing students, and (ii) to elucidate potential psychosocial mechanisms underlying compassion fatigue. Additionally, this thesis has established the following five specific objectives to more precisely accomplish the two main goals outlined above:

1. To identify the current status and trends in the compassion fatigue and psychological resilience field from 2008 to 2021 and during COVID-19 pandemic.

2. To synthesize evidence on the levels of compassion fatigue and its two dimensions (burnout and secondary traumatic stress) among nurses and internship nursing students, and then to identify factors influencing the development of compassion fatigue.

3. To evaluate the validity and reliability of the Chinese Version of CFSS among Chinese internship nursing students in junior colleges.

4. To examine the prevalence of compassion fatigue among internship nursing students in junior colleges in China and to determine whether there are significant differences in CF levels based on the diverse sociodemographic characteristics of these students.

5. Utilizing the ABC-X model of stress, this study aims to explore the relationship between internship stressors, such as work pressures and negative life events, and compassion fatigue among nursing students. Additionally, to examine the mediating roles of psychological capital, empathy (cognitive/affective), and perceived stress in this relationship.

3. BACKGROUND

3.Background

3.1 Conceptualization of compassion fatigue

Compassion fatigue (CF) was first defined by Joinson in 1992, referring to a state of physical, psychological, and social dysfunction resulting from prolonged exposure to patient suffering or continuous confrontation with individual trauma[4,33]. However, many scholars frequently confuse and misuse this term with related concepts such as burnout (BO)[34], secondary traumatic stress (STS)[10], vicarious traumatization[35], and traumatic countertransference[36]. To clarify these concepts and maintain consistency, this paper focuses exclusively on CF.

According to Stamm[14], although BO and STS are related to CF, they are distinct outcomes of exposure. BO typically arises from work-related stressors and manifests as dissatisfaction with the work environment, feelings of detachment, and indifference[10,14,37,38]. In contrast, STS is a reaction to fear and work-related trauma, often triggering intense negative emotional experiences[33,39]. If left unaddressed, STS and BO can ultimately lead to CF. Therefore, in this study, we adopt Stamm's perspective, which posits that CF primarily comprises two elements: BO and STS.

3.2 Introduction to nursing education programs in Chinese junior colleges

In China, nursing education programs in junior colleges aim to cultivate high-quality, application-oriented nursing professionals capable of working in primary healthcare institutions[40]. These programs serve as a primary channel to address the shortage of clinical nursing staff [41]. The programs are offered in two formats: a three-year program for graduates of secondary vocational schools or regular high schools, and a five-year program for graduates of regular junior high schools. The five-year program

integrates both secondary and junior college education to achieve the goal of training associate degree-level nursing professionals. Those programs predominantly enroll students who are typically 18-19 years old. The curriculum includes general foundational courses, basic medical courses, nursing humanities and social sciences courses, specialized nursing courses, and comprehensive practical training courses. The programs emphasize the combination of theoretical knowledge and practical skills. After completing the theoretical studies on campus, students undertake at least eight months of clinical internship during their final year to gain hands-on work experience.

3.3 Prevalence and adverse consequences of compassion fatigue

3.3.1 Prevalence and adverse consequences of compassion fatigue among nurses

Clinical nurses' CF has garnered widespread attention and become a focal point of research[5]. Evidence indicates that the prevalence of moderate-to-severe CF can be as high as 57.7%, especially among clinical nurses working in intensive care units, emergency departments, oncology, psychiatry, and pediatrics[42]. A recent systematic review involving 28,509 clinical nurses revealed that CF levels have increased over time, particularly among clinical nurses in Asian regions who suffer from severe CF symptoms[32]. During the COVID-19 pandemic, clinical nurses are more likely to encounter traumatic and life-altering events, exacerbating the CF issue[6]. Under various pressures such as enormous nursing workloads, the highest risk of contagion, and the inability to fulfill family responsibilities, clinical nurses need to provide more complex care and psychological support for COVID-19 patients[43].

The progression of CF can weaken clinical nurses' ability to feel sympathy

and empathy at work, thereby hindering the provision of safe, competent, and ethical care[44,45]. Previous studies have shown that a large number of nurses suffer from various negative physiological and psychological symptoms related to CF, such as headaches, insomnia, musculoskeletal disorders, depression, and professional helplessness[46-49]. Moreover, clinical nurses suffering from CF not only exhibit low job satisfaction and engagement but also demonstrate poor job performance and increased medical errors[50-53]. Therefore, all these adverse effects of CF result in higher absenteeism and turnover rates among nursing staff, which are escalating issues faced by healthcare systems[54,55].

3.3.2 Prevalence and adverse consequences of compassion fatigue among internship nursing students

Nursing interns face unique and complex pressures and challenges during their clinical placements. They must adapt to high-stress work environments similar to those faced by professional nurses while managing personal learning and emotional issues, which can readily precipitate CF[7-9]. A survey of 972 Chinese nursing students found that the prevalence rates of moderate BO and STS were 97.8% and 55.3%, respectively[56]. Additionally, a study by Han et al. involving 201 late-stage undergraduate nursing interns found that these students exhibited moderate levels of BO and STS, with mean scores of 52.66 and 47.34, respectively[57].

Among pre-licensure health professions students, including nursing students, high levels of CF or BO have been associated with an increased intention to discontinue their educational programs, which predicts actual attrition rates[58-62]. Moreover, BO developed during educational programs may persist post-graduation, affecting the well-being and retention rates of new nurses[63]. A longitudinal study demonstrated that BO during the internship period was associated with lower self-rated clinical performance and higher turnover intentions one year post-graduation[59]. Clearly, CF or

BO negatively impacts the career development of nursing students. Therefore, understanding how to mitigate CF is of paramount importance.

3.3.3 The necessity of evaluating the status of compassion fatigue among internship nursing interns in junior college

In China, nursing students at the junior college level constitute a critical reserve force of professional nursing personnel. According to the "China Health and Wellness Statistical Yearbook (2022)", by the end of 2021, approximately 48.7% of the total 5.02 million registered nurses held an associate degree, marking a slight increase from 47.8% in 2020[64]. This data highlights the significant proportion of junior college nursing students within the national nursing workforce. The "National Nursing Development Plan (2021-2025)" specifies that during the "Fourteenth Five-Year Plan" period, a focus will be placed on the role of junior college education in the construction of nursing disciplines, with the aim of cultivating professional nursing personnel capable of meeting the extensive health care needs of society and families[65].

Although existing studies[56,66-69] have investigated the prevalence of CF among nursing interns, the majority of these studies have focused on undergraduates or a mixed group of undergraduate and junior college students, with a marked lack of detailed analysis specifically targeting junior college nursing students. Research indicates that nurses with associate degrees are more susceptible to higher levels of CF compared to those with bachelor's degrees[70,71]. This disparity may stem from a lower level of education, resulting in insufficient knowledge and skills reserves. Within the hospital environment, these nurses may exhibit weaker professional capabilities in providing supportive care and managing traumatic events, which not only reduces their job satisfaction but also increases their risk of experiencing CF[72,73]. Therefore, a thorough assessment of CF among junior

college nursing interns is crucial for comprehensively understanding their condition and developing effective intervention strategies.

3.3.4 Measurement tools for compassion fatigue

Due to classification challenges, conceptual ambiguity, and the association of CF with occupational stress, measuring CF is significantly challenging[74]. Consequently, CF assessments are not used as diagnostic tests but rather as screening tools designed to detect CF and provide decision-making guidance for organizations and individuals seeking to mitigate workplace factors contributing to CF[14]. Currently, questionnaire surveys, encompassing both direct and indirect measurement tools, are the primary methods for assessing CF[15]. For example, questionnaires initially developed to assess direct trauma responses—such as the Impact of Event Scale, Trauma and Attachment Belief Scale, and World Assumptions Scale—are now employed in CF research[10]. However, the reliability and validity of these tools, primarily based on studies involving directly traumatized individuals, have not been fully validated for CF measurement, thus introducing uncertainties[10].

To enhance the accuracy of CF assessments, researchers including Figley and Stamm have developed a series of specialized tools, such as the Compassion Fatigue Self Test (CFST)[10], Compassion Satisfaction and Fatigue scale (CSF)[11], the Compassion Fatigue Scale (CFS)[12], Compassion Fatigue Short Scale (CFSS)[13] and the Professional Quality of Life Scale (ProQOLS)[14]. The interrelationships among these tools are depicted in Figure 1. Although these scales are critical for assessing CF, some earlier versions[11,12,16], still lack comprehensive validation studies and adequate psychometric property data[75]. Nonetheless, particularly the ProQOLS and CFSS have been widely applied in practice and have demonstrated their practicality and effectiveness in real-world settings.

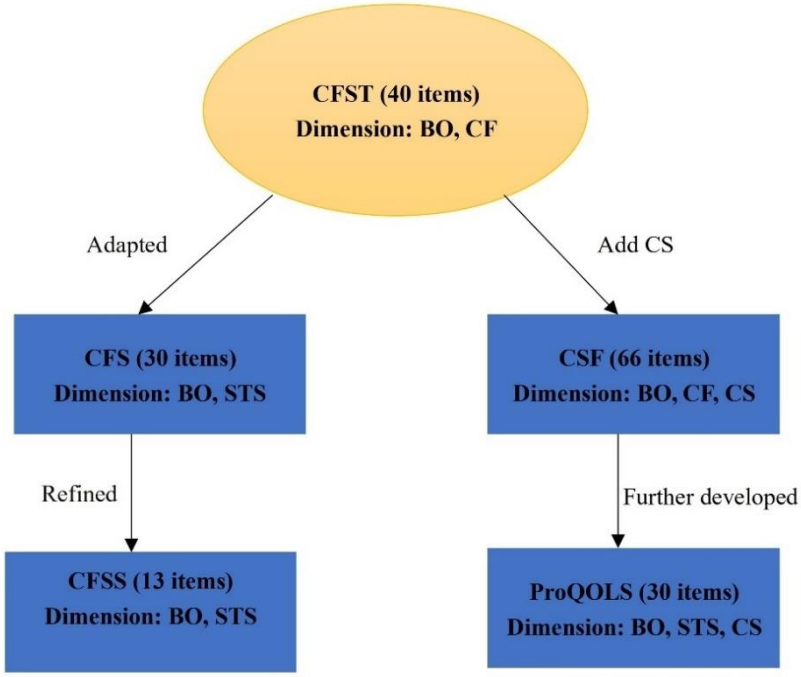

Figure 1. Evolutionary Diagram of Direct Compassion Fatigue Measurement Tool

Note: CFST: Compassion Fatigue Self Test; CSF: Compassion Satisfaction and Fatigue Test; CFS: Compassion Fatigue Scale; CFSS: Compassion Fatigue Short Scale; ProQOLS: Professional Quality of Life Scale

3.3.5 Professional Quality of Life Scale

The Professional Quality of Life Scale (ProQOLS) (https://proqol.org/proqol-measure) , especially its latest version, is currently the most widely used and validated instrument for assessing both the negative and positive work-related outcomes of individuals caring for traumatized patients[17-22]. The latest version of the scale comprises 30 items, systematically divided into three distinct subscales: compassion satisfaction (CS), BO, and STS.

Within the ProQOLS framework, CF is conceptualized as reflecting the "negative aspects of helping others," predominantly assessed through the

BO and STS subscales. Although BO and STS share some overlap, the authors emphasize the unique psychometric properties of each subscale and advise against simply combining the scores of these subscales into a total score[14,15]. This characteristic, coupled with the large number of items on the scale, may lead to rapid and potentially superficial responses from participants, who may not fully comprehend the scale's content[23]. These factors collectively increase the complexity of effectively monitoring CF through ProQOLS.

3.3.6 Compassion Fatigue Short Scale

The CFSS is a revised and simplified version of the Compassion Satisfaction and Fatigue Test scale (CSF)[4,12,33,76]. This instrument has been translated and applied across various countries and cultural contexts, including the United States[13] Turkish[26] and China[25]. Its two-factor structure has been validated among social workers, firefighters, and medical workers, affirming its applicability[13,24-26]. While the reliability and validity of the Chinese version of the CFSS have been confirmed among medical workers and firefighters, demonstrating excellent construct validity and strong internal consistency, other psychometric properties such as convergent validity and test-retest reliability have not undergone rigorous evaluation[25]. Nevertheless, by offering a more concise (13-item) and comprehensible format, the CFSS is expected to address some challenges associated with the ProQOLS. It emerges as an ideal tool for measuring CF among nursing interns, facilitating a more accurate assessment and understanding of occupational stress within this group[13].

3.3.7 The necessity of the psychometric properties of the Chinese Version of CFSS among internship nursing students in junior colleges

To accurately measure the levels of CF among internship nursing students

in junior colleges, it is crucial to validate the psychometric properties of the Chinese Version of the CFSS. Considering the unique dual pressures faced by nursing students, which differ from those encountered in other nursing professions, there is a potential for variations in their experiences and manifestations of CF[25]. Hence, a targeted validation of the scale is necessary. Although several large-scale surveys[56,66,77,78] have utilized the CFSS in the past three years to examine levels of CF and preliminarily explore its underlying mechanisms, the applicability and effectiveness of the scale among internship nursing students in China have not been sufficiently validated[77,78].

Therefore, further assessment of the CFSS in this specific cohort is particularly critical. Accumulating evidence from studies across various populations can enhance our confidence in the psychometric robustness and applicability of the scale[79]. In summary, a systematic evaluation of the CFSS in different application environments is essential to ensure its scientific and effective use among internship nursing students in junior colleges.

3.4 The influential factors of compassion fatigue

3.4.1 The influential factors of compassion fatigue among nurses

Numerous studies have investigated the influential factors of CF among clinical nurses or healthcare personnel[3,27-32]. Zhang et al. l[28] conducted a correlative meta-analysis among nurses and found that factors related to stress and negative emotions (such as traumatic stress, perceived stress, insomnia, workload, financial stress, anxiety, alcohol use, and emotional dysregulation) were moderately positively correlated with CF in nurses. In contrast, factors related to positive emotions, social life, demographic characteristics, and professional aspects (such as resilience, job satisfaction, positive emotions, social support, exercise, age, marital status,

education level, years of work experience, and hours per shift) were not significantly associated with CF. This finding is consistent with another systematic review[80], which found that nurses with bachelor's or master's degrees, or those with registered nurse or licensed practical nurse status, had a lower prevalence of CF. However, no other demographic or professional variables were found to be significantly associated with CF in nurses.

Nevertheless, some studies do not fully support or only partially support these findings. A systematic review focusing on oncology nurses[29] found that the development of CF may be influenced by demographic factors (such as age, marital status, education background, health condition, and gender), professional factors (such as job satisfaction, income satisfaction, years of work experience, professional title, position, and work environment), and psychosocial factors (such as social support, coping strategies, self-compassion, professional cognition, and psychological training). Additionally, a review conducted by Bayuo and Agbenorku[30] revealed that certain professional factors, such as staffing levels, remuneration, work environment, and years of work experience, were associated with the development of CF, particularly among burn care nurses. These contradictory findings mainly exist among nurses in different departments, indicating that the work environment may have a significant impact on CF. Furthermore, the association between psychosocial factors and CF has only been investigated in a few studies, indicating a need for further research to validate these associations.

3.4.2 The influential factors of compassion fatigue among internship nursing students

Currently, data on CF among internship nursing students remain limited. Previous studies have primarily explored the impact of demographic and professional factors on CF, including gender, place of origin, whether they are only children, education level, hospital grade, current internship

department, satisfaction with the current schedule, number of night shifts, work recognition, and enjoyment of the nursing profession[56,57,66,78]. Additionally, only a few studies have focused on the role of psychosocial factors such as empathy, social support, resilience, and coping style in relation to CF[66,77]. To our knowledge, there are currently no studies specifically addressing CF among nursing interns in vocational colleges, indicating a lack of comprehensive understanding of the factors related to CF in this group.

3.5 The mechanisms of compassion fatigue

3.5.1 Conceptualized Framework

The ABC-X stress theory model, developed by Reuben Hill, was initially applied to the study of family stress[81-83] and later expanded to individual and occupational stress contexts [84-86]. The model comprises four core components: Factor A represents the stressor event or situation; Factor B represents the resources available to cope with the stress, which can be found at personal, family, or community levels and affect the experience and management of stress; Factor C represents the individual's cognitive appraisal, reflecting the significance and evaluation of the stressor; Factor X represents the outcome, indicating the impact and degree of the stress event on the individual[87,88]. Factors B and C are conceptualized as mediators or moderators of the relationship between Factor A and Factor X, indicating that the stress response outcome (Factor X) results from the interaction between the stress event (Factor A), individual cognition, and available resources.

Compared to previous classic stress theories, such as Lazarus and Folkman's transactional model of stress and coping, and Hobfoll's conservation of resources theory[89,90], the ABC-X model demonstrates unique characteristics. It not only integrates the evaluation of stressors and resources but also incorporates cognitive appraisal to systematically explain the relationship between stressors and outcomes. Nursing students face dual roles

as learners and novice caregivers during their internships, which brings unique stress and challenges. By adopting an ecological "person-in-environment" perspective, the ABC-X model provides a more comprehensive stress response framework, offering a solid theoretical foundation for understanding and addressing these issues[91].

3.5.2 Stressor Events (A)---Stress exposures during internship

Stress responses are physiological and psychological reactions to threats or challenges[92]. The intensity of these responses depends on the frequency and duration of exposure to stressors, thereby impairing an individual's physical and mental well-being. For professional nurses and nursing interns, occupational demands often necessitate repeated exposure to others' sufferings in high-stress environments, elevating the risk of CF[15,93]. A study involving 400 undergraduate nursing interns identified poor working conditions, lack of mentor support, and long working hours as key factors increasing the risk of CF[56]. Additionally, research by Yan et al. highlighted that excessive workloads are a critical cause of STS and BO in palliative care nurses[94]. Studies have also shown that CF is also heavily influenced by personal experiences, particularly negative life events and traumatic experiences, which substantially increase the risk of CF[75,92,95]. A study of 967 oncology and palliative care nurses found that nurses who had recently experienced personal health crises or family tragedies were more susceptible to CF[96]. Similarly, a survey by Yu et al. revealed that emergency nurses with poorer health conditions exhibited higher levels of CF[97]. The psychological Stress System proposed by Jiang posits that stressors, such as work-related issues, educational challenges, economic difficulties, and interpersonal problems, do not exist in isolation. Their interplay can intensify an individual's stress response, potentially worsening mental health outcomes[98].

3.5.3 Perception of the Event (Factor C)---Perceived stress

Perceived stress is the subjective assessment of one's stress levels and coping capacity when faced with stressors[99,100]. Internship nursing students often experience moderate-to-high stress levels due to academic demands, patient care responsibilities, interpersonal interactions, and personal life challenges[101-103]. Elevated perceived stress has been linked to increased CF[102,104-107]. According to Chachula KM[58], there is a significant positive correlation between the perceived stress levels of nursing and psychiatric nursing students and the BO dimension of CF.

3.5.4 Coping Resources (Factor B)--- empathy, psychological capital

Empathy as a mediator

Empathy, encompassing cognitive and emotional domains, is crucial for effective caregiving[108-111]. However, studies indicate declining empathy levels among nursing interns[112,113]. Factors contributing to this decline include academic and clinical workload, lack of positive role models, and patients' negative emotions[114-117]. Family dynamics also play a crucial role, with feelings of loneliness negatively impacting empathy[118,119]. These professional and familial stressors collectively affect nursing students' abilities in both affective and cognitive empathy.

In stressful environments, individuals' attention often focuses on salient elements, particularly potential threats[120]. This shift in attention, facilitated by vicarious experiences or cognitive inferences, not only enhances their ability to manage others' negative emotions, but also deepens their emotional resonance with others, thereby strengthening affective empathy[121]. However, when the pressure exceeds their coping capacities, their focus may become more self-centered. This shift towards self-regulation reduces their ability to recognize and share others' emotional states,

significantly weakening their ability to understand others' perspectives, thereby challenging their cognitive empathy[121].

In Figley's Model of Empathic Stress and Fatigue, empathy is described as a key motivating force in the helping process, encouraging individuals to engage in helping behaviors, while also exposing them to a certain degree of caregiver stress[122]. This dual role positions empathy as both a valuable asset for caregivers and a potential source of CF[4,123]. Several empirical studies have demonstrated that cognitive empathy acts as a protective factor against CF among nursing interns and professional nurses, whereas emotional empathy is a risk factor[53,124-127]. Indeed, a high level of cognitive empathy facilitates an understanding of others' emotions rather than directly feeling them, helping caregivers maintain the necessary emotional distance to effectively alleviate the stress caused by emotional resonance[128]. Conversely, emotional empathy may lead to over-identification with patients, thereby exposing caregivers to high levels of negative emotions[128].

Psychological capital as a mediator

Psychological capital represents positive psychological states fostering personal growth and performance[129]. In the workplace, individuals with high psychological capital are more effective in addressing challenges, maintaining an optimistic attitude towards negative situations, anticipating positive outcomes, and quickly recovering from setbacks[130-133]. Although the precise definition of its sub-domains remains a topic of debate, it is commonly agreed that psychological capital comprises four core psychological abilities: self-efficacy, optimism, hope, and resilience[134]. As a protective resource, psychological capital can assist nursing students in timely identifying and effectively regulating the perceived stress levels in their internship work and daily life, facilitating enhanced adaptability to environments and professional identity[135-139]. Research indicates that nursing interns with higher psychological capital experience less stress

when facing depressive clinical environments and interpersonal conflicts, reducing their disidentification with the nursing profession [140-142]. Additionally, Wang Rui et al.[140] found through a survey of 657 vocational nursing students that enhancing psychological capital can effectively alleviate the stress reactions caused by negative life events, thereby aiding students in better adapting to the school environment. Furthermore, research indicates that psychological capital not only enhances nurses' cognitive empathy abilities but also effectively alleviates emotional exhaustion caused by affective empathy, and reduces the negative impacts of CF [143,144]. A survey of 1,064 nurses revealed that those with higher levels of psychological capital scored higher on dimensions reflecting cognitive empathy, while scoring lower on dimensions related to the personal distress associated with affective empathy[145,146]. Additionally, a study involving 453 emergency nurses from 18 tertiary hospitals demonstrated that psychological capital could both directly and indirectly alleviate the issues of CF triggered by various work-related stressors[147].

3.5.5 The necessity of elucidating psychological mechanisms of compassion fatigue among internship nursing students in junior colleges

During their internships, nursing students in junior colleges often face numerous challenges, such as demanding internship and academic tasks, harsh working conditions, and traumatic personal experiences[56-58,78,148], which may lead to CF[4,33]. Studies have reported that internship nursing students commonly experience moderate levels of CF[56,66]. Given that they are an important reserve force for professional nursing, especially in primary care settings, it is crucial to understand how specific stressors encountered during internships contribute to and exacerbate CF to develop effective prevention and support strategies.

At this critical stage of internships, the support from family and school may

diminish, highlighting the importance of individual psychological factors. Therefore, it is essential to investigate the psychological mechanisms underlying CF in nursing interns. By understanding these mechanisms, we can implement more effective interventions to help nursing students cope with the challenges of their internships, thereby improving their internship experience and career prospects.

4. HYPOTHESIS

4.Hypothesis

In the present study, we have the following hypotheses:

1. We expected that the Chinese version of Compassion Fatigue Short Scale (CFSS) has a good psychometric property to assess the compassion fatigue among internship nursing students in junior colleges.

2. We expected that there would be positive correlations between exposure to work-related stress and negative life events during internships with both perceived stress **(H1)** and compassion fatigue **(H2)**. Furthermore, stress exposure during internships was anticipated to be positively correlated with the perception of stress **(H3)**, and perceived stress was expected to be positively correlated with compassion fatigue **(H4**). In terms of empathy, it was anticipated that stress exposure would negatively correlate with cognitive empathy **(H5)** and positively with affective empathy **(H6)**. Cognitive empathy was expected to be negatively correlated with compassion fatigue **(H7)**, while affective empathy was hypothesized to show a positive correlation **(H8)**. A negative correlation was also expected between cognitive and emotional empathy **(H9)**. Regarding psychological capital, negative correlations were predicted both with stress exposure **(H10)** and perceived stress **(H11)**, and a positive correlation with cognitive empathy **(H12)**, but a negative correlation with affective empathy **(H13)**. Lastly, psychological capital was anticipated to be negatively correlated with compassion fatigue **(H14)** (see Figure 2).

Hypothesis

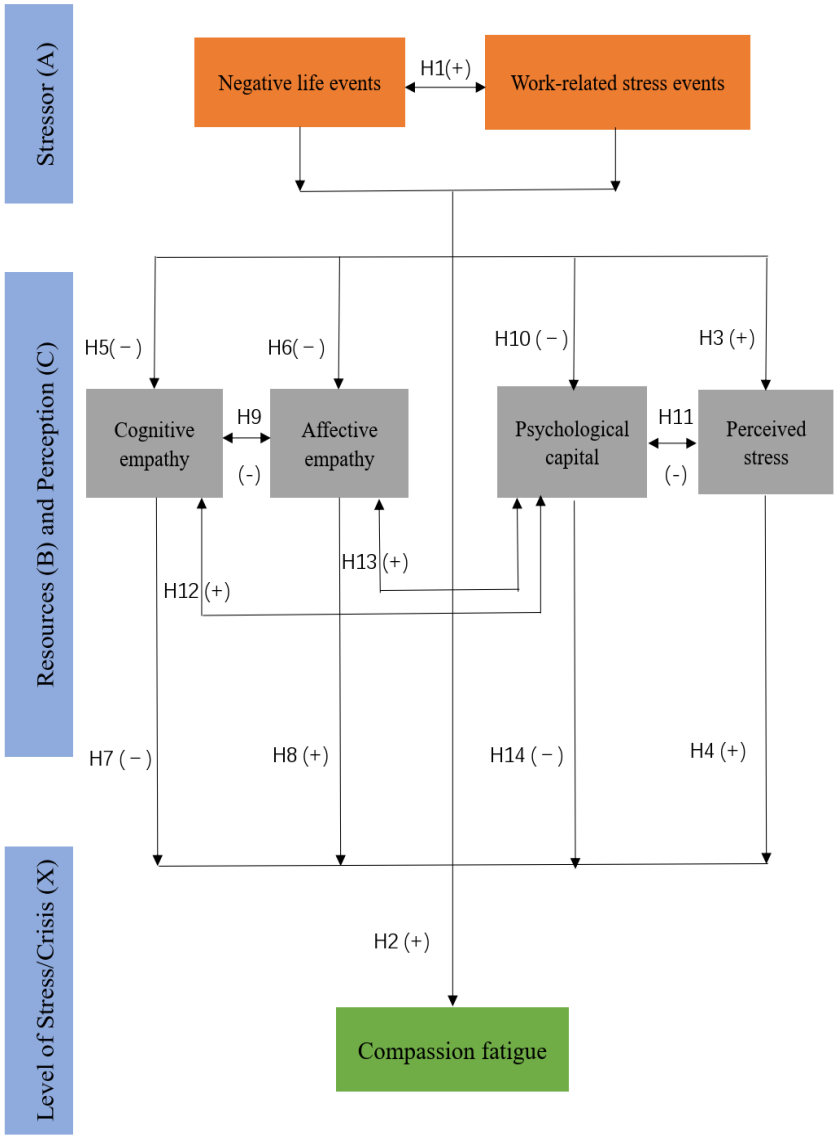

Figure 2. Mapping of hypotheses through path analysis to the ABC-X model of stress and adaption.

5. METHODS

5.Methods

The main goals of the current thesis are to evaluate the validity and reliability of the Compassion Fatigue Scale (CFSS) among Chinese internship nursing students, and to assess their levels of CF. Furthermore, this thesis aims to explore potential psychosocial mechanisms underlying CF in this target population. To achieve these anticipated goals, the thesis includes five independent studies utilizing a range of research designs: bibliometric analysis, cross-sectional survey studies, systematic reviews, and meta-analyses. The flowchart of the whole thesis is shown in Figure 3.

5.1 Study 1: A bibliometric analysis of the association between compassion fatigue and psychological resilience from 2008 to 2021

5.1.1 Design

This was a descriptive bibliometric analysis and science mappings, which was performed to identify and analyze literature on CF and PR. Meanwhile, we performed a separate analysis to determine the impact of COVID-19 pandemic on research trend. Certainly, we also made a comparison between the overall findings and the COVID-19 pandemic.

5.1.2 Sample

We retrieved targeted literature from Web of Science because it's the largest academic publication database in conducting bibliometric analyses.

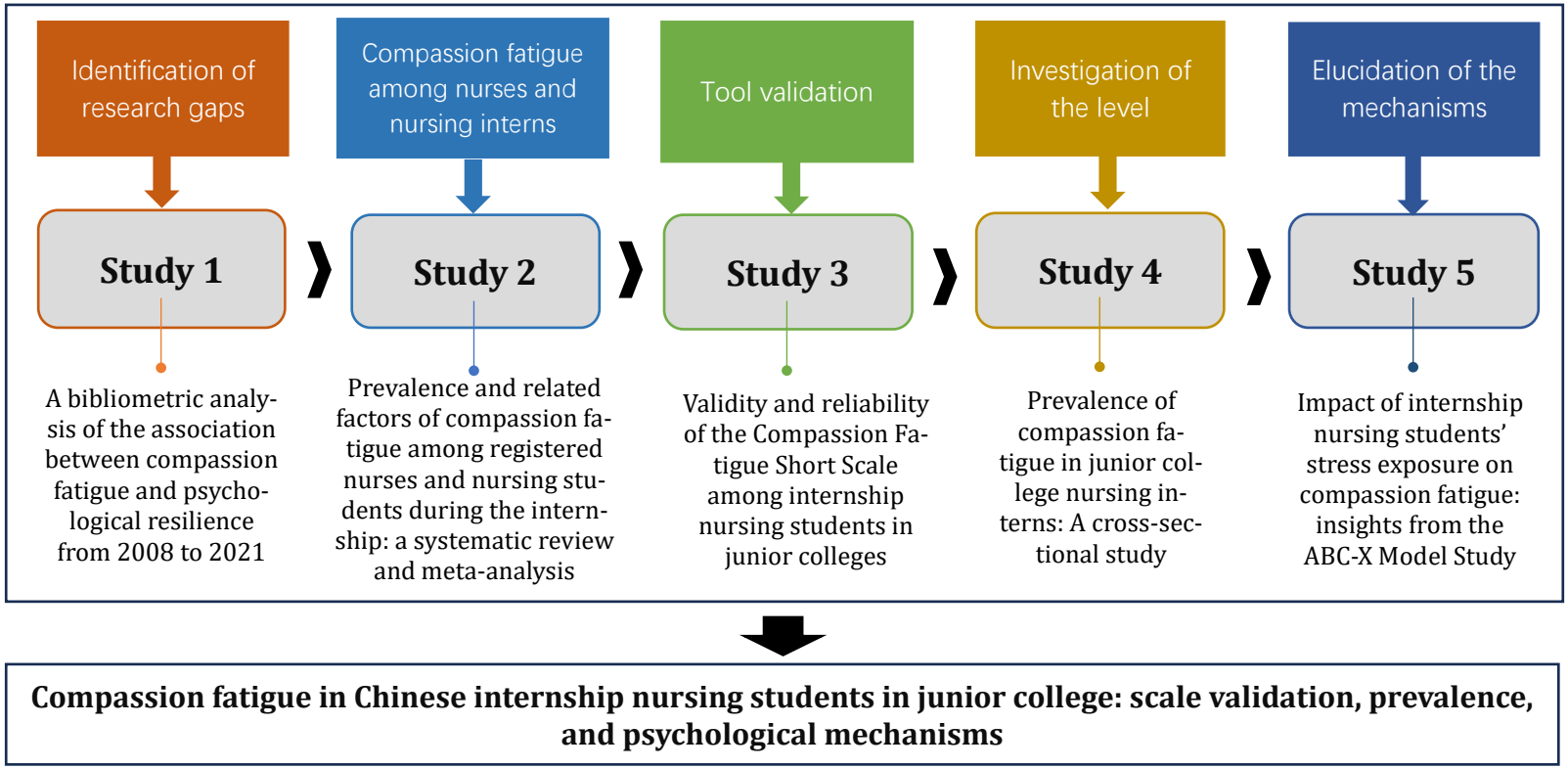

Figure 3. Flow chart of the current thesis

5.1.3 Data collection

We performed a systematic search in Web of Science Core Collection®, which includes Science Citation Index expanded, Social Science Citation Index, Arts & Humanities Citation Index, Conference Proceedings Citation Index-Social Sciences & Humanities, and Emerging Science Citation Index, to identify relevant literature labeled as article or review. Search was limited from the inception until to 30 September, 2021.The following search terms was used to construct search strategy, including "compassion fatigue" and "psychological resilience". We did not impose any restrictions for our literature search, such as countries, categories and language. We show the search strategy in Supplementary File 1.

5.1.4 Ethical consideration

No institutional ethical approval and patient's informed consent was necessary because the present study didn't recruit animal or human subjects.

5.1.5 Data analysis

Data analysis was performed by using CiteSpace 5.8.R1 and Microsoft® Excel 2013[149]. Specifically speaking, Microsoft® Excel 2013 was used to visually describe the trend of publications as the time. However, CiteSpace was applied for visually show the distribution of research fields, constructing country, institution and author co-occurrence map, generating clusters of co-citing reference publications and exploring the intellectual landscape of studies about CF and PR by time. Additionally, co-occurring keywords were also analyzed by Citespace to detect research trends and frontiers. We defined the following parameters for CiteSpace: time slicing was from January 2008 to October 2021 and from December, 2019 to October 2021, respectively, with years per slice (slice length=1). All options in the term source were selected, a node type was selected at a time according to

specific conditions, “top 50 levels” as a threshold that are cited or most frequent in the corresponding time slice. For a visualization knowledge figure, node and link were the essential elements. A node represented an element, such as author, keyword, or institution, and the size of a node was proportional to the frequency of appearance or citation, and the color of node indicated the year. Besides, each node is described with a series of tree-rings across the series of time slices. The size of the concentric circles represents the number of publications. And the circles of different colors signified the year of 2008 to 2021 or of 2019 to 2021 from the inside to the outside of the nodes. Link between two nodes represented cooperation or co-occurrence or co-citation relationship. The purple ring represented the betweenness centrality of literature. If knowledge map appeared nodes with high betweenness centrality value, these nodes were believed to bridge different stages of the development of a scientific field[150].Red circles indicate the time slices in which citation bursts or abrupt increases of citations are detected[151].

5.2 Study 2: Prevalence and related factors of compassion fatigue among registered nurses and nursing students during the internship: a systematic review and meta-analysis

5.2.1 Design

We conducted this systematic review utilizing standard Cochrane methods and report it in accordance with the Meta-analysis of Observational Studies in Epidemiology checklist[152]. The review protocol was registered with the PROSPERO (CRD42023444173).

5.2.2 Literature searches

We conducted searches in electronic databases including the Cochrane

Library, PubMed, EMBASE, CNKI, and WanFang, covering the period from their inception up to November 30, 2022. We only updated the literature search for nursing students during the internship up to January 17, 2024. This was an arbitrary but pragmatic decision. Our considerations were that (1) there has been well known evidence on registered nurses in this area but evidence is limited for nursing students during the internship; and (2) nurses-related evidence had been well representative but updated evidence for nursing students during the internship is much more required in this area. Our search strategies utilized a combination of Medical subject heading (MeSH) terms and free-text words. Initially, a search strategy was developed for PubMed and was subsequently adapted for use in the other databases (see Supplementary Table 7). In addition, we screened the reference lists of relevant articles and reviews to identify any potentially eligible studies.

5.2.3 Eligibility criteria

We included studies published in English or Chinese that reported data on the prevalence and related factors of compassion fatigue (CF) or its two dimensions (burnout (BO) and secondary traumatic stress (STS)) among registered nurses or third-year nursing students during their clinical internship in various care settings. We excluded studies that included health professionals other than nurses such as midwives, social workers. We focused on including studies that utilized validated tools for measuring CF and/or its two dimensions (BO and STS). We selected studies that employed the Compassion Fatigue Short Scale (CFSS) and the Professional Quality of Life Scale - Version 5 (ProQOL-5) to measure CF. The CFSS was chosen because it directly measures the level of CF. The ProQOL-5 measures CF at the two aspects of BO and STS, which is in line with the view of Stamm[14], considering BO and STS as the two components of CF. Both of the two scales demonstrate high reliability and validity, ensuring their scientific rigor in evaluating CF[11,12,16]. However, studies using only

one or two subscales (BO and STS) of the ProQOL-5 for measurement were excluded, as our aim was to identify research providing a comprehensive assessment of these constructs.

We included cross-sectional studies that could report data on point, period or lifetime prevalence of CF and its two dimensions (BO and STS)[153]. To be included in the synthesis of factors-related evidence, eligible studies were required to use multivariate analysis methods such as multiple regression, logistic regression, and structural equation model to adjust for multiple variables simultaneously. We excluded qualitative studies, case reports, editorials, conference abstracts, letters, notes, protocols, reviews, as well as studies that focused on examining interventions or mitigation strategies.

To guarantee the validity of the data included, we excluded studies of low quality as assessed by the criteria detailed below. Besides, we excluded studies with insufficient information, particularly those from which additional data could not be obtained from the authors to calculate mean or median scores, or the prevalence of CF and its two dimensions (BO and STS).

5.2.4 Study selection and data extraction

We managed search results using EndNote X7 (Thomas Reuters, New York, USA). Duplicates were removed, and two review authors (YLJ and HSW) independently screened titles and abstracts to identify potentially relevant studies. Full texts of potential studies were retrieved and examined by both authors. Disagreements were resolved by consulting a third reviewer (TX). One author (YLJ) utilized a predetermined data extraction form to extract data from the included studies. Two independent reviewers (HSW and LMQ) verified all extracted data. In assessing the relevant factors for nurses and nursing students during the internship, we extracted the following data items: first author, publication year, country, sampling methods, whether the study was single-center or multi-center, sample sizes, the

number of male and female participants, average age, tools used for measuring CF and its two dimensions (BO and STS), reported data on CF and its two dimensions (BO and STS), and reported related factors. Meanwhile, for the nurse group, we extracted information related to the department they worked in; for the nurse intern group, we further extracted information about their educational level and the duration of their internship. For studies with multiple publications, the most comprehensive publication was used.

5.2.5 Critical appraisal of included studies

Two review authors (YLJ and CL) independently assessed the quality of the included studies using the Agency for Healthcare Research and Quality tool [154]. This assessment tool comprises a total of 11 items related to data sources, research design, participants, variables, data, bias, sample size, quantitative variables, statistical analysis, measurements, follow-up. Each item was scored with 0 for 'No' or 'Unclear' and 1 for 'Yes.' A summed score of ≥ 8 was considered to indicate 'high' quality of study, scores ranging from 4–7 as 'medium,' and <4 as 'low.' Any disagreements were resolved through discussion with a third review author (MFJH).

5.2.6 Data analysis

We described the characteristics of the included studies narratively and report their summaries using descriptive statistics such as frequencies and percentages, median and range. When data pooling was appropriate, we undertook meta-analyses of data on CF and its two dimensions (BO and STS), where we pooled their prevalence rates and mean scores separately.

In the meta-analysis, we used the random-effects model, which allows for heterogeneity. We assessed heterogeneity between the included studies using Cochrane's Q test and the I^2, considering an $I^2 > 75\%$ as indicative of substantial heterogeneity. We noted that meta-analysis of prevalence

study data likely exhibits substantial heterogeneity. We performed subgroup analyses for three pre-specified factors to explore the sources of heterogeneity: recruiting from multiple hospital wards, publication year, and hospital ward types.

We performed all analyses using STATA 17 and presented pooled results with 95% CI and p values. Where relevant, we narratively synthesized evidence on the factors relating to CF or its two dimensions (BO and STS).

5.2.7 The certainty of evidence assessment

We present the summarized evidence of the review and assessed the evidence certainty using GRADE principles. In the assessment, we began with evidence at a high level of certainty, and where applicable, we downgraded the certainty of evidence to be moderate, low, or very low based on considerations of factors: study limitation, inconsistency, imprecision, indirectness, and publication bias.

5.3 Study 3: Validity and reliability of the Compassion Fatigue Short Scale among internship nursing students in junior colleges

5.3.1 Design

This cross–sectional study adhered to the Strengthening the Reporting of Observational studies in Epidemiology (STROBE) checklist[155] and conformed to the Consensus-based Standards for the selection of health status Measurement Instruments guidelines[156].

5.3.2 Settings and Participants

From January 7, 2023 to January 13, 2023, eligible participants were conveniently sampled from eight junior colleges in Hunan Province, China. A

subset of 33 students was selected for two CF measurements at intervals of 3-4 weeks[17], designated as the test-retest reliability subgroup. During the exploratory factor analysis (EFA) of the CFSS, no adjustments or eliminations were made to the number or content of items. To further substantiate this finding, a confirmatory factor analysis (CFA) was performed on a specific subset (491 valid questionnaires) derived from a previous survey on CF prevalence among junior college nursing interns[78]. In line with Wei-Hao Zhang's recommendation[157], a sample size between 200 to 500 was chosen to ensure sufficient statistical power and stability. Through simple random sampling using the Statistical Package for the Social Sciences (SPSS) software, about 22% of the population, equating to 491 participants, was randomly selected from a total of 2256 nursing interns. These 491 valid questionnaires were subsequently used for the CFA subgroups analysis. As the comprehensive details of this survey have been reported in a previous publication[78], here we present only a concise overview of the demographic characteristics for this specific subgroup (refer to Table 5).

Eligibility criteria for participants in the study included: (a) were enrolled in a three-year associate nursing program; (b) were undergoing a nursing practicum of at least eight months in secondary hospitals or higher; (c) agreed to participate in this survey study and provided valid informed consent. Students who were not directly involved in patient care during their internship were excluded.

5.3.3 Sample Size Calculation

The sample size to item ratio should be at least 10:1, and the CFSS is a two-dimensional instrument with 13 items. Thus, the minimum required number of participants was established at 130. Accounting for an anticipated invalid response rate of 20% to ensure a sufficient sample size, the theoretical final number of subjects needed was determined to be 156. For the test-retest reliability subgroup, a second questionnaire was distributed to 15-20% of those who validly completed the first. For the CFA subgroup, a

minimum of ten cases per item is recommended as a reasonable sample size[158,159].

5.3.4 Data Collection

Several student counsellors were engaged as research assistants to support the survey administration. In China, these counsellors play a crucial role in overseeing the daily life and safety of students[160]. An online questionnaire was developed using Sojump, a widely-utilized web platform for surveys. Following standardized training, these counsellors informed all potential participants about the objectives and methodology of the study and disseminated the survey links through WeChat and Ding Talk, two extensively used social media platforms in China. To optimize the response rate, several strategies were employed: (1) setting all questions as compulsory to ensure data completeness; (2) restricting each software account to only one submission to avoid repeated entries; (3) providing a monetary incentive to students for completing the questionnaire. Responses with a completion time of ≤ 4 minutes, or those with repetitive, identical, or logically inconsistent answers were classified as invalid and excluded. Of the 435 questionnaires initially collected from nursing interns, 229 met the validity criteria after meticulous examination, yielding a valid response rate of 52.6% (229/435).

5.3.5 Instruments

Sociodemographic Characteristics

A custom-developed demographic information form was utilized to gather personal and clinical details from survey participants. This included variables such as gender, age, major orientation, level of the internship hospital, and career intention. These variables were selected based on their relevance as indicated in multiple foundational studies focusing on CF among nursing interns[56,66,78,137].

CFSS

The CFSS was developed by Adams et al. (2006)[13]. This instrument comprises 13 items, divided into two sub-scales: BO (CFSS - BO; 8 items) and STS (CFSS - STS; 5 items). The score range of the CFSS is from 13 to 130, with higher scores indicating increased levels of CF. Given that the native language of the survey respondents was Chinese, the CFSS was administered in its Chinese version for this study. Sun and colleagues[25] validated the psychometric properties of this version among medical workers and firefighters. EFA demonstrated a strong correlation between STS and BO with CF. CFA confirmed that all fit indices of the two-factor model were satisfactory. Moreover, the Cronbach's alpha coefficient for the total scale ranged from 0.87 to 0.95, suggesting excellent reliability. Details of both the original and the Chinese version are provided in Supplementary File 6.

Professional Quality of Life Scale

Given the lack of a definitive gold standard for assessing CF symptoms, the ProQOLS serves as a practical alternative[31]. This scale, developed by Stamm et al.[14], comprises 30 items categorized into three domains: BO (ProQOLS-BO; 10 items), STS (ProQOLS-STS; 10 items), and CS (ProQOLS-CS; 10 items), with the latter two intimately associated with CF. Each subscale has an independent scoring ranging from 10 to 50, where scores below 22 denote low levels, scores from 23 to 41 represent average levels, and those above 42 reflect high levels[14]. For our study, the term 'helper' in the Chinese version of ProQOLS, obtained with permission from the official website, was modified to 'nursing intern' to better resonate with our participants. Zheng Xing and colleagues[161] conducted a cultural adaptation and validation of the Chinese version among clinical nurses. The results of the EFA uncovered a three-factor structure, with subscale Cronbach's alpha (α) values ranging between 0.73 and 0.82, showcasing solid structural validity and internal consistency[161]. Our study's application of the Chinese ProQOLS yielded acceptable internal reliability, as evidenced by CS scoring

0.926, BO 0.836, and STS 0.787.

5.3.6 Statistical Analysis

For data analysis, IBM SPSS statistics version 25.0 was employed, except for CFA which utilized IBM SPSS AMOS Version 26.0. Measurement ranges were based on scale score percentages at both extremes – the highest (upper effect = percentage at 130 [always]) and the lowest score (lower effect = percentage at 13 [never]). Acceptable measurement standards were considered for surveys with minimal floor or ceiling effects (1%–15%)[162]. In this study, no significant ceiling or floor effects were observed in both CFSS and ProQOLS. Considering the sample size, normality of data was examined using the Kolmogorov-Smirnov test, revealing abnormal distribution in CFSS-T, CFSS-BO, CFSS-STS, and all 13 items ($p < 0.05$) similar to the ProQOLS subscales. Descriptive statistics for demographic and work-related variables, and item scores included median, interquartile range (IQR) for quantitative data, and frequency and percentage for qualitative data. Statistical significance was set at a two-sided p-value of < 0.05.

Construct Validity

We employed CFA to assess the structural validity of the scales. This approach utilized 491 valid questionnaires from a previous survey to validate the underlying structure of the instrument as identified in the original CFSS study. Model fit was evaluated using various indices, including the minimum chi-square/degrees of freedom ($\chi 2/df$) value, GFI, AGFI, incremental fit index (IFI), Tucker-Lewis index (TLI), comparative fit index (CFI), Standard root mean-square residual (SRMR) and root mean square error of approximation (RMSEA). The following threshold values were recommended as criteria for an acceptable model: $\chi 2/df < 3.00$, GFI > 0.80, AGFI > 0.80, IFI > 0.90, TLI > 0.90, CFI > 0.90, SRMR < 0.5 and RMSEA < 0.08[163,164].

If the CFA results indicate suboptimal fit in certain aspects, we proceeded

to use EFA with the current survey data to extract the factor structure and underlying components measured by the CFSS in the nursing interns. The Kaiser-Meyer-Olkin (KMO) measure and Bartlett's test of sphericity were applied to assess the sample adequacy and appropriateness for EFA with KMO expected to be over 0.60 and Bartlett's test p-value to be less than 0.05[165]. Principal component analysis with varimax rotation was conducted for factor extraction[166], without limiting the number of factors and retaining those with eigenvalues of 1.0 or higher. Items with a factor loading under 0.30 were removed as per standard guidelines[167].

Convergent Validity

Convergent validity of the scale was confirmed through a three-pronged approach. Post-CFA, item loadings on their respective subscales were first evaluated[168]. Secondly, the average variance explained (AVE) for each factor was calculated, to assess whether the proportion of variance explained by each factor exceeded 0.5[169]. Thirdly, composite reliability (CR) was computed, with values above 0.7 signifying a strong association between item and the dimension[169,170].

Criterion Validity

To examine the criterion validity, we conducted Spearman's correlation analysis to assess the relationships between CFSS-T, CFSS-BO, CFSS-STS, and various dimensions of ProQOLS[171,172]. Reference standards for interpreting the correlations were set as follows: values less than 0.3 indicate weak correlation, values greater than 0.3 but less than 0.5 suggest moderate correlation, values between 0.5 and 0.7 denote adequate correlation, and value exceeding 0.7 represent high correlation[173,174].

Reliability

For assessing internal consistency, we utilized several metrics with their established reference values: (1) Cronbach's α, where values greater than 0.8 indicate strong consistency[175]; (2) Corrected item-total correlations

(CI–TC), with a threshold above 0.2 suggesting satisfactory item correlation[176]; (3) the α if item deleted (AIID), ensuring that excluding any item does not significantly inflate the αs of the sub-scales or the total scale[177]; and (4) Split-half reliability, requiring a correlation above 0.7 between two arbitrarily divided halves of the item set for acceptable reliability[178,179].

External reliability was evaluated through test-retest reliability. A subgroup of 14.4% of participants from the initial survey was reselected to complete the CFSS again after 3-4 weeks. To determine the test-retest reliability of the CFSS over two different time points, the intraclass correlation coefficient (ICC) was calculated using a two-way random model and an absolute agreement[180]. An ICC value was above 0.7 denotes good test-retest reliability for the scale[181].

Factors Influencing CF

We evaluated the possible effect of several socio-demographic and work-related variables (age, gender, major orientation, level of internship hospital, and career intentions) on CFSS-T by a multivariate linear regression analysis ('enter' method). The F-statistic was utilized to assess the significance of the regression equations, while the goodness of fit was evaluated using the adjusted R-squared. To examine the potential for multicollinearity, we scrutinized both the tolerance value (TV) and the variance inflation factor (VIF). The absence of multicollinearity is indicated when TV consistently exceed 0.10 and VIF remain below 10, ensuring the reliability of the regression model.

5.3.7 Ethical Approval

Ethical approval for this study protocol was granted by the Ethics Committee of Hunan College of Traditional Chinese Medicine (approval number: YX20220718). Eligible participants provided electronic informed consent, being fully briefed about the study's nature. The voluntary and anonymous nature of participation, and confidentiality of the data were emphasized.

5.4 Study 4: Prevalence of compassion fatigue in junior college nursing interns: A cross-sectional study

5.4.1 Design

We conducted a cross-sectional survey to assess the current status of CF among junior college nursing interns in China and explore the association between CF and professional identity.

5.4.2 Participants

A convenience sampling method was used to select eligible participants from 10 public junior colleges in Hunan Province, China from December 2021 to June 2022. Eligible participants were nursing interns who had completed at least 2 years of nursing-related courses (including nursing students who specialize in general nursing and midwifery), had a clinical internship in a second-level or above hospital, had a clinical internship for no less than 8 months and gave informed consent and voluntary participation in this study. The exclusion criteria were nursing interns whose clinical practice positions were clerical management or administration and not directly in contact with patients.

5.4.3 Sample Size

The sample size was calculated using the formula: $n = \frac{z_a^2 * \sigma^2}{\delta^2}$. There is no study using the CF Short Scale (CFSS) to measure CF among nursing interns. Therefore, the sample size in our study was calculated based on a study reporting the CF among nursing staff in China (standard deviation (SD) = 22.88)[182]. Based on the expected error of estimation of 1 and a 5% margin of error, theoretically, a minimal sample size of 2011 was required. A total of 2405 nursing interns were recruited.

5.4.4 Data Collection

The data collection process was carried out through an online survey. The teaching counsellors from each college were invited to perform the recruitment. All invited teaching counsellors were informed of the research purpose and detailed survey procedures based on standardized trainings to ensure participants meeting eligible criteria and to avoid bias in the data collection process. Sojump (also named as "Wenjuan Star") software was used to perform the online survey, and the link was sent to participants through WeChat (the most popular and practical instant communication software in China). The average time of the entire answer process is about 15 to 20 min. Completion of the previous question is a mandatory criterion for entering into the next question to ensure the completeness of the questionnaire responses. The purpose and method of this study were explained to the nursing interns who met the inclusion criteria by trained teaching counsellors. Each participant read and signed an electronic written informed consent form before filling out the questionnaires. Moreover, they could quit at any time. Questionnaires with identical answers or regular answers were excluded. After removing 149 invalid responses, we were left with a final count of 2256 (an effective response rate is 93.8%).

5.4.5 Measures

Demographic Characteristics

The demographic characteristics questionnaire was designed by the research team to collect participants' gender, age, specialty, duration of an associate program, whether being from an only child family, frequency of night shifts, home location (rural or urban), monthly living expenses and employment intentions.

Compassion Fatigue Short Scale

Nursing interns' CF was measured by the CFSS. The original CFSS was

developed and tested by Adams et al. (2006)[13], consisting of 13 items in 2 dimensions including STS (five items) and BO (eight items). The Cronbach's alpha coefficient of the total scale, STS subscale and BO subscale was 0.90, 0.80 and 0.90, respectively. Each item is scored at a 10-point Likert scale, ranging from 1(never) to 10 (always), with a total score of 13–130. The higher the score indicated the more severe CF. The present study used the Chinese version of the CFSS, which was translated and validated by Sun (2015)[25], to measure CF. In this study, the Cronbach's α of the total scale, STS subscale and BO subscale was 0.917, 0.857 and 0.888, respectively.

Professional Identity Scale

Professional identity was measured using the Professional Identity Scale which was developed by Brown et al.[183]. The Professional Identity Scale is a unidimensional scale and consists of 10 items. Of these 10 items, five are positive and the other five items are negative. Items are rated on a 5-point rating scale from 1 (never) to 5 (always), with a total score of 10–50. The higher score indicated the stronger professional identity. The Cronbach's coefficient of the original scale is 0.71. This study used the Chinese version of this scale, which has been translated and validated by Lu et al. with a Cronbach's coefficient of 0.82, to measure professional identity[184]. The Cronbach's of the scale in this study was 0.803.

5.4.6 Data Analysis

Data analysis was conducted using SPSS (version 25.0) software (IBM Corp., Armonk, New York). A two-tailed *p*-value less than 0.05 was deemed statistically significant. First, participants' baseline characteristics were summarized as frequency, percentage, mean and SD. We further classified the score of CFSS into dichotomous variables by using the median of the total score as the cut-off value[185]. Specifically, if participants who reported a total score of CFSS ≥ 65, BO subscale ≥ 40 or secondary trauma subscale

≥ 25, they were considered to be at high risk for CF, BO and STS. Secondly, we used the Kolmogorov–Smirnov test to evaluate the distribution of the total score of the CFSS and Professional Identity Scale, suggesting abnormal distributions of the two scores (CF: D = 0.092, $p < 0.001$; professional identity: D = 0.079, $p < 0.001$). However, according to the following two reasons, we selected the parametric test to compare the difference of CF between participants with different categories: (1) when the data sample size is big enough, the normality test result is unstable and not always reliable[186] and (2) the central limit theorem also confirmed that the sampling distribution tends to be normal in large samples, despite the shape of the data[187,188]. Therefore, independent *t*-test and one-way Analysis of variance (ANOVA) was used to assess the difference of CF level between participants from different groups. The significant factors were then included in the linear regression to further test which baseline factors could contribute to the development of CF. The enter strategy was used when conducting the multivariate linear regression analysis. Pearson correlation was used to explore the association between CF and professional identity. Cohen's rule of thumb has become a de factor standard for this effect size[186,] suggesting that r = 0.10 was "small", r = 0.30 was "medium" and r = 0.50 was "large". However, we also performed the non-parametric analysis to examine robustness of the findings.

5.5 Study 5: Impact of internship nursing students' stress exposure on compassion fatigue: insights from the ABC-X Model

5.5.1 Design

The study employed a cross-sectional survey design.

5.5.2 Study setting and sampling

Participants were purposefully selected from eight junior colleges, including one private and seven public institutions, located in Hunan Province, China. A pilot study assessed feasibility and determined the time required to complete the survey. The formal survey ran from January 7 to 13, 2023. Participants independently completed the questionnaires. Inclusion criteria were: (a) enrollment in a three-year associate degree nursing program, (b) active participation in clinical internships at secondary or tertiary hospitals for at least eight months, and (c) willingness to participate and provide informed consent. Students not engaged in direct patient care during clinical practicums were excluded.

5.5.3 Sample size calculation

We employed structural equation model (SEM) with maximum likelihood estimation to analyze the interactions between variables. The N:q rule (10:1) was applied to determine the minimum required sample size, where N represents the required number of cases and q denotes the number of parameters to be estimated[189]. By using this rule, we calculated a minimum sample size of 220 for 22 estimated parameters. Accounting for a 20% rate of invalid questionnaires, the sample size was adjusted to 264. To ensure generalizability of the results and minimize sampling bias, 640 nursing interns from eight public junior colleges in Hunan Province were surveyed.

5.5.4 Data collection

Questionnaires were distributed via WeChat and DingTalk, popular social media platforms in China. Participants accessed the survey through a Quick Response code. We emphasized voluntary participation, confidentiality, and the right to withdraw. Only after clicking the "Agree to Participate Voluntarily" button could participants proceed with the survey. The study

received approval from the Ethics Committee of Hunan University of Chinese Medicine (Approval Number: YX20220718).

To maximize the response rate, we (1) required responses to all questions; (2) restricted submissions to one per account, device, and IP address; and (3) offered financial incentive. Questionnaires exhibiting “straight-lining” (identical answers across questions), “gibberish” (logically inconsistent answers), or excessive speed (completion time under four minutes) were considered invalid and excluded from analysis. Of 671 surveys, 640 met the criteria, yielding an effective response rate of 95.4%.

5.5.5 Instruments

Personal information sheet

We developed a self-designed general information sheet in two steps. First, we conducted a literature review on nurses and nursing interns to identify socio-demographic and occupational variables potentially influencing CF. Second, through three rounds of expert panel discussions, we selected eight factors suitable for the student population: gender, age, specialty, degree of major satisfaction, level of intern hospital, average hours of sleep per night, health status, career aspirations.

Stress exposures during the internship

We assessed stress events using two variables: personal and work-related dimensions. Participants reported on thirteen personal stress events from the past year, such as academic pressure or disappointment in evaluations, based on the "Adolescent Self-Rating Life Events Checklist" by Professor Liu Xianchen[190]. Fourteen work-related stress events, including frequent night shifts and high workloads, were assessed using the "Nursing Work Stressor Scale" by Li Xiaomei for this assessment[191]. Participants reported all relevant events providing a comprehensive view of their experiences.

Compassion Fatigue Short Scale

The Compassion Fatigue Short Scale-13 (CFSS-13) comprises 13 items, categorized into BO (CFSS-BO; 8 items) and STS (CFSS-STS; 5 items)[13]. Scores range from 13 to 130 (CFSS-T), with higher scores indicating greater CF. The psychometric properties of the Chinese version of this scale were validated by Sun et al[25].

The Basic Empathy Scale

The Basic Empathy Scale-20 (BES-20), developed by Darrick Jolliffe and Farrington in 2006, was employed to assess empathy among young individuals[192]. The Chinese version, translated by Li et al., has satisfactory psychometric properties[193,194]. This 20-item scale measures emotional and cognitive empathy on a 5-point Likert scale. In this study, the Cronbach's α coefficient of the Chinese version was 0.710.

The Perceived Stress Scale

The Perceived Stress Scale-14 (PSS-14) was originally developed by Cohen et al.[195] and subsequently translated and adapted into a Chinese version by Yang et al.[196]. This scale primarily assesses an individual's perceived stress levels in the past month, particularly focusing on unpredictable, uncontrollable, or overloaded lifestyle stressors. The PSS-14 comprises 14 items, categorized into two dimensions: perceived stress and loss of control. Employing a Likert 5-point scoring system, it ranges from 0 (never) to 4 (always), yielding a total score range of 0 to 56. Higher scores reflect increased perceived stress, with 0 to 28 indicating normal stress levels, 29 to 42 signifying moderate stress levels, and 43 to 56 denoting high stress levels. Demonstrating robust reliability and validity, it boasts a Cronbach's α coefficient of 0.78[197]. In this study, the scale achieved a Cronbach α coefficient of 0.80.

Psychological capital

Psychological capital was assessed using the Chinese version of the 22-item Psychological Capital Questionnaire (PPQ-22), originally developed

by Wu et al.[198]. This questionnaire extends upon the classic four dimensions of psychological capital defined by Luthans—self-efficacy, optimism, hope, and resilience—by adding two interpersonal dimensions: forgiveness and prosocial behavior. This addition not only emphasizes the positive and proactive aspects of psychological capital in interpersonal interactions among college students but also enhances the stability and specificity of the measurement[199]. The PPQ comprises six subscales: self-efficacy (5 items), optimism (4 items), hope (4 items), resilience (3 items), forgiveness (3 items), and prosocial (3 items). Reverse scoring was applied to Questions 15 and 18. All items were rated on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The scale has been widely used in Chinese research, demonstrating strong reliability and validity[200,201]. In the original version, Cronbach's α and Split-half reliability were reported as 0.896 and 0.807, respectively[198]. In the present study, the Cronbach's α for the scale was calculated as 0.917.

5.5.6 Statistical analysis

Data were analyzed using SPSS 26.0 (IBM, Armonk, NY, USA) and AMOS 23.0 (SPSS, Inc., Chicago, IL, United States). Descriptive statistics were used to summarize the general characteristics of the subjects and the average scores for each research variable. We applied the Kolmogorov-Smirnov test to assess the distribution of total scores across the CFSS-13, PPQ-22, and PSS-14 scales, except for the BES-20, which presented dimension scores. The results indicated that the data did not meet the normality assumption. However, we opted for parametric tests (independent t-tests and one-way ANOVA) to compare CF differences among participants in different categories for two main reasons: (1) the instability and unreliability of normality test results with large sample sizes[202], and (2) the central limit theorem, which asserts that sampling distributions of large samples tend to approximate normality, regardless of the data's shape[188,203]. Concurrently, Pearson's correlation analyses were employed to examine the

relationships between CF, BO, STS, psychological capital, cognitive empathy, affective empathy, perceived stress, and the number of negative life events and work-related stress events.

We evaluated the overall model using established fit index criteria. According to Schreiber's statistical guidelines[204], a model is considered well-fitted if the Chi-square ($\chi 2$) test does not reach statistical significance ($P > 0.05$), the $\chi 2$/degrees of freedom (df) ratio is between 1 and 3, the root-mean-square error of approximation (RMSEA) is below 0.08, and indices such as the goodness of fit index (GFI), adjusted GFI (AGFI), CFI, IFI, and normed fit index (NFI) exceed 0.900. A two-tailed P-value of 0.05 was set as the significance threshold. To determine effect size of standardized direct effects, cutoffs from Cohen (1988) were used: 0.1 = small, 0.3 = medium, and 0.5 = large[205].

Additionally, we conducted tests for indirect effects using a bootstrap approach, calculating 2,000 resamples with replacement to generate 95% bias-corrected confidence intervals. This method was employed to explore the potential mediating roles of psychological capital, cognitive empathy, affective empathy, and perceived stress in the relationship between CF and stress exposure during the internship. The significance of the mediating effect is indicated by a confidence interval that excludes zero. To determine effect size of standardized indirect effects, cutoffs from Kenny (2011) were used: 0.01 = small, 0.09 = medium, and 0.25 = large[206].

6. RESULTS

6.Results

Based on different methods, we sorted and analyzed the data of the three studies, and obtained the results of the three studies as follow

6.1 Study 1: A bibliometric analysis of the association between compassion fatigue and psychological resilience from 2008 to 2021

6.1.1 Annual trends in publications and citations

Overall, 391 records published between 2008 and 2021 were analyzed. As shown in Figure 4, research on compassion fatigue (CF) and psychological resilience (PR) can be roughly separated into two periods. In the first stage from 2008 to 2012, the first article on target research dates to 2008, and we saw fluctuations in the volume of publications at a level <10. In the second stage from2013 to 2021, the number of publications increased rapidly, despite two downwards trends were detected in 2014 and 2019. Besides, to the search date, papers analyzed in this study were cited 5170 times totally, and the average number of citations was 13.22.

During the COVID-19 pandemic, the number of publications increased rapidly in the field of CF and PR, accounting for 45.01% of 391 publications in Set #4 (see Supplementary File 1). Among them, 22 documents are reviews and 154 documents are original articles.

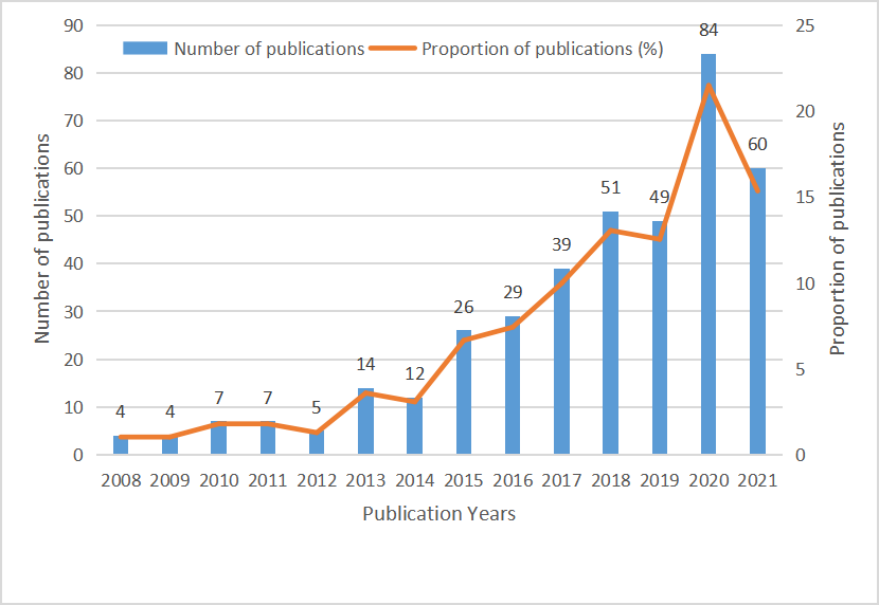

Figure 4. The distribution of the bibliographic records per year.

6.1.2 Category analysis

The top 10 frequencies and centrality of subject categories related to CF and PR indexed by Web of Science® were visualized using CiteSpace (see Figure 5 (a) and Supplementary Table 1 (a)). As shown in Figure 5 (a), 85 nodes and 240 links constituted the network of these subject categories. Among them, the most common category is psychology (93 articles), followed by nursing (77 articles), psychiatry (58 articles), social work (48 articles), and clinical psychology (45 articles). The highest centrality was public, environmental & occupational health (0.36). Additionally, a dual-map overlay analysis of 391 articles was conducted. The results showed that the citing journals (on the left side of the base map) are associated with topics including medicine, psychology, health, education, clinical, and immunology. The major clusters of the cited journals (on the right side of the base map) were directed towards disciplinary areas such as medicine, psychology, health, education, nursing, and social sciences (see Figure 6).

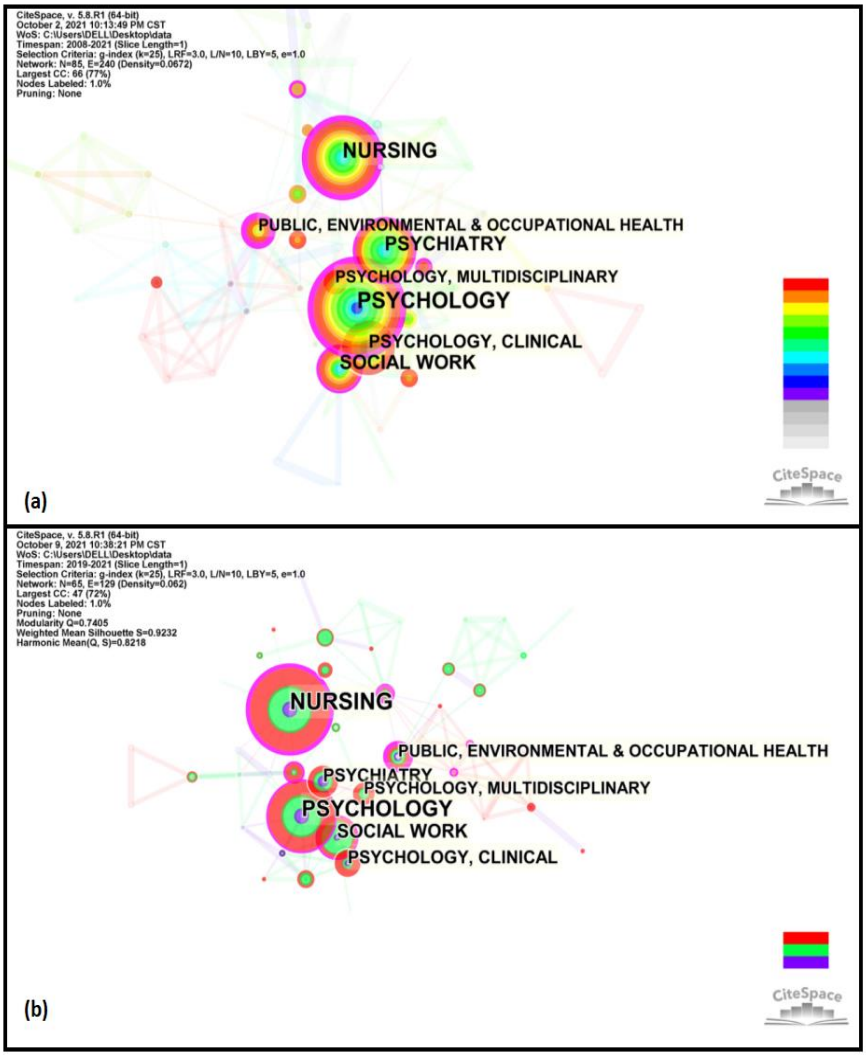

Figure 5. The co-occurrence network of subject categories in the field of compassion fatigue and psychological resilience during 2008–2021 (A) and the COVID-19 pandemic (B).

Note: A circle indicates a subject category. The various colors of nodes indicate the different years, and the size of a circle was weighted by the amount of literature on the category. The link between two nodes represents the interdisciplinary interaction of the literature, and the thickness of the lines was weighted by the relevance between different areas of research. The purple rims of circles indicate high betweenness centralities.

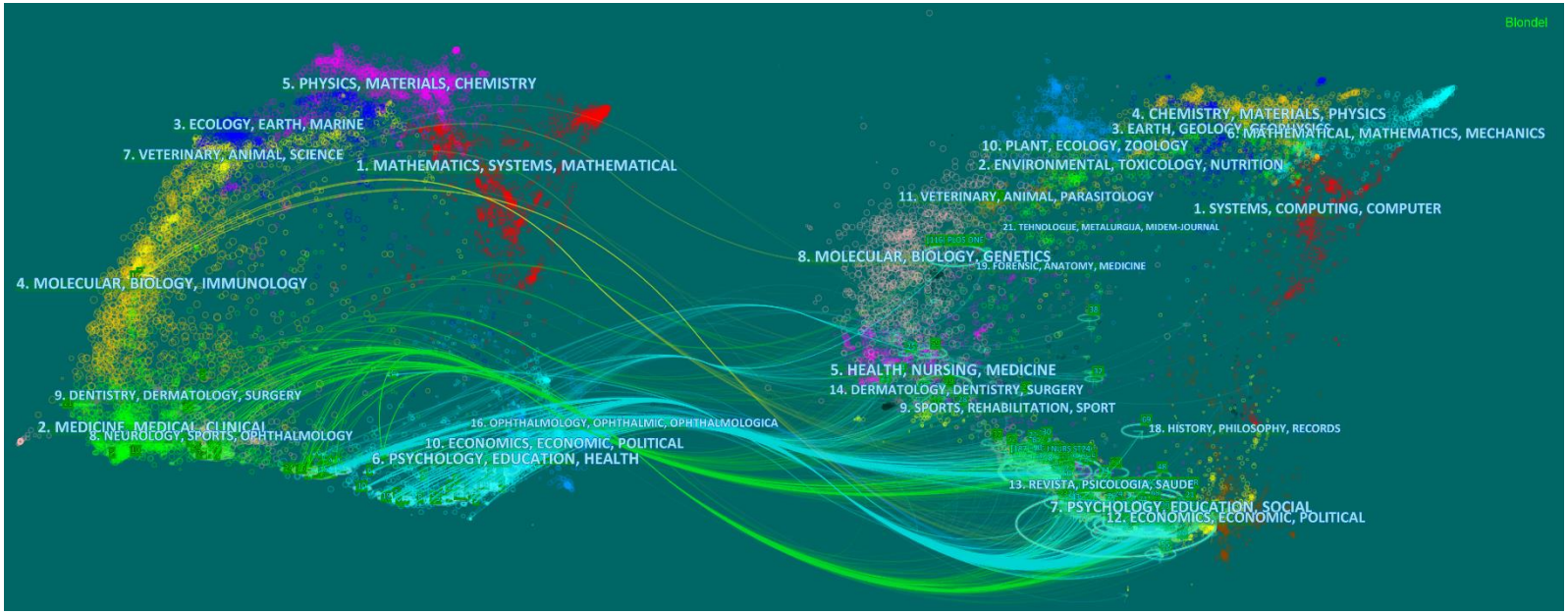

Figure 6. The dual-map overlay of journals

Note: Citing journals are on the left and cited journals are on the right, and the colored paths between them suggested the cited relationships.

During the COVID-19 pandemic, the top 10 subject categories with the greatest number of publications remained essentially the same (see Figure 5 (b) and Supplementary Table 1 (b)). Notably, education and educational research (11 publications) entered the top 10. In this special area, a total of five studies focused on self-care practice and resilience-based interventions. The centrality of the top 5 research areas remained unchanged (see Figure 5 (b) and Supplementary Table 1 (b)).

6.1.3 Overview of the research co-operation

Visualized knowledge mapping provides information on influential research teams and potential collaborators and helps researchers establishing collaborative relationships[212].

Distribution of countries and institutions

An analysis of the country distribution of these publications revealed that the top four countries for centrality were the USA (0.41), Canada (0.36), England (0.22), and Australia (0.17), which also ranked as the top four countries in terms of the number of articles published (see Supplementary Table 2 (a)). Supplementary Table 3 (a) lists the top ten institutions by the number of articles published. Most of the academic institutions active in the CF and PR field are located in these top four countries. Additionally, three institutions in Israel also ranked in the top ten. The distribution map of countries and institutions consists of 317 nodes and 624 links (see Figure 7 (a)), showing relatively few links between these nodes.

During the COVID-19 pandemic, the USA (71 articles), Canada (19 articles), and England (19 articles) remained the leading countries in this field (see Supplementary Table 2 (b)). Most of the most productive institutions were also located in these developed countries (see Supplementary Table 3 (b)). Notably, Sichuan University, a Chinese institution, entered the top ten. Four studies from Sichuan University[51,66,213,214] confirmed the relationships among variables related to CF and PR and supported strategies to reduce

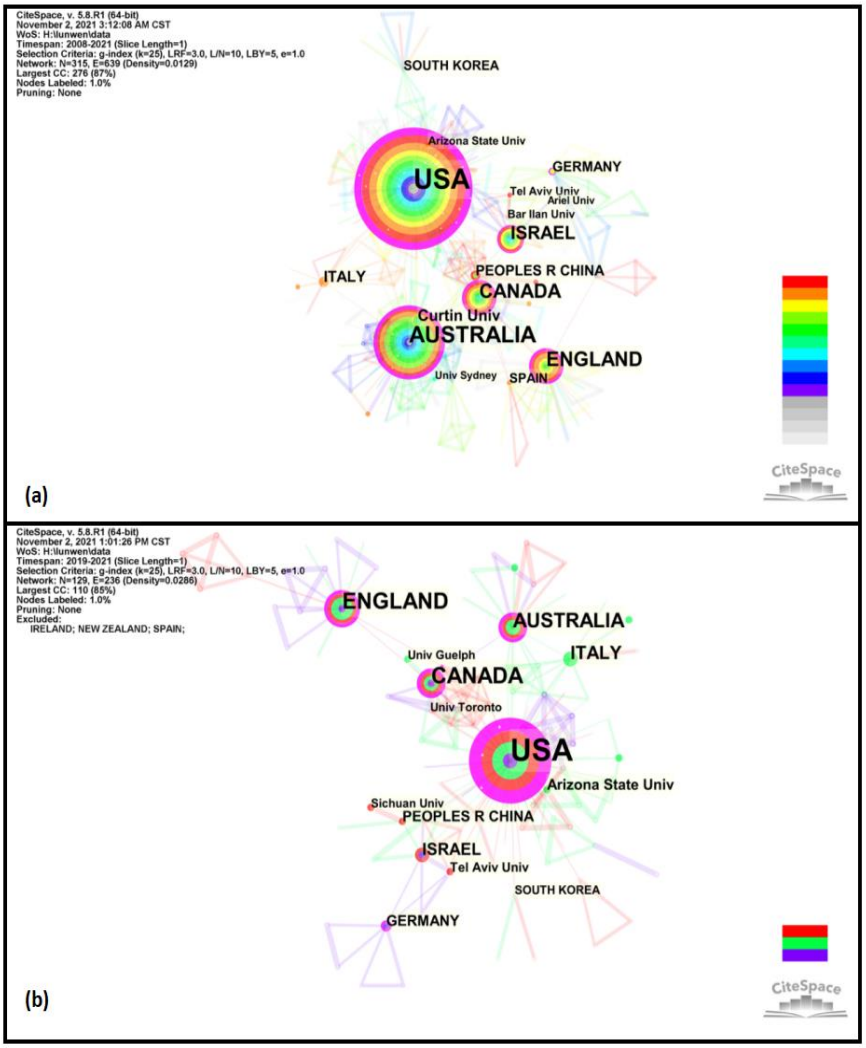

Figure 7. Institutions-countries hybrid network of publications in the field of compassion fatigue and psychological during 2008–2021 (A) and the COVID-19 pandemic (B).

Note: The individual circle indicates one country or institution, and the size of the circle was weighted by the number of articles published by countries or institutions. The link between two nodes represents partnership, and its thickness was weighted by the frequency of collaborations. The purple rims of circles indicate high betweenness centralities.

CF among nurses or nursing students, enhance professional quality of life, and mitigate organizational turnover intentions. All centrality scores were zero, reflecting the issue of limited collaboration among authors, as shown in the distribution map of countries and institutions (see Figure 7 (b)).

Author analysis

The map of authors reveals the most prolific authors and co-authors, visually demonstrating the closeness of collaboration among authors. This information provides insights into influential research groups and potential collaborators, aiding researchers in establishing cooperative relationships. Supplementary Table 4 (a) shows that Craigie M (5 articles) published the most studies, followed by Hegney D (5 articles), Perret JL (4 articles), Rees C (4 articles), and Khosa DK (4 articles). Three of these authors are from Curtin University in Australia, and the others are from the University of Guelph in Canada. Additionally, Figure 8 (a) shows 339 nodes and 325 links, with a network density of only 0.0057, indicating that collaboration among authors in this field is not close, as reflected by the zero centrality scores.

During the COVID-19 period, the map of authors included 101 nodes and 64 links (see Figure 8 (b) and Supplementary Table 4 (b)). The number of nodes is about twice that of the links, indicating reduced collaboration. Supplementary Table 4 (b) shows that only four authors entered the top ten. The top five authors were Khosa DK (4 articles), Perret JL (4 articles), Jones-Bitton A (4 articles), Cao XY (4 articles), and Best CO (4 articles). Except for Cao XY, all other authors are from Canada.

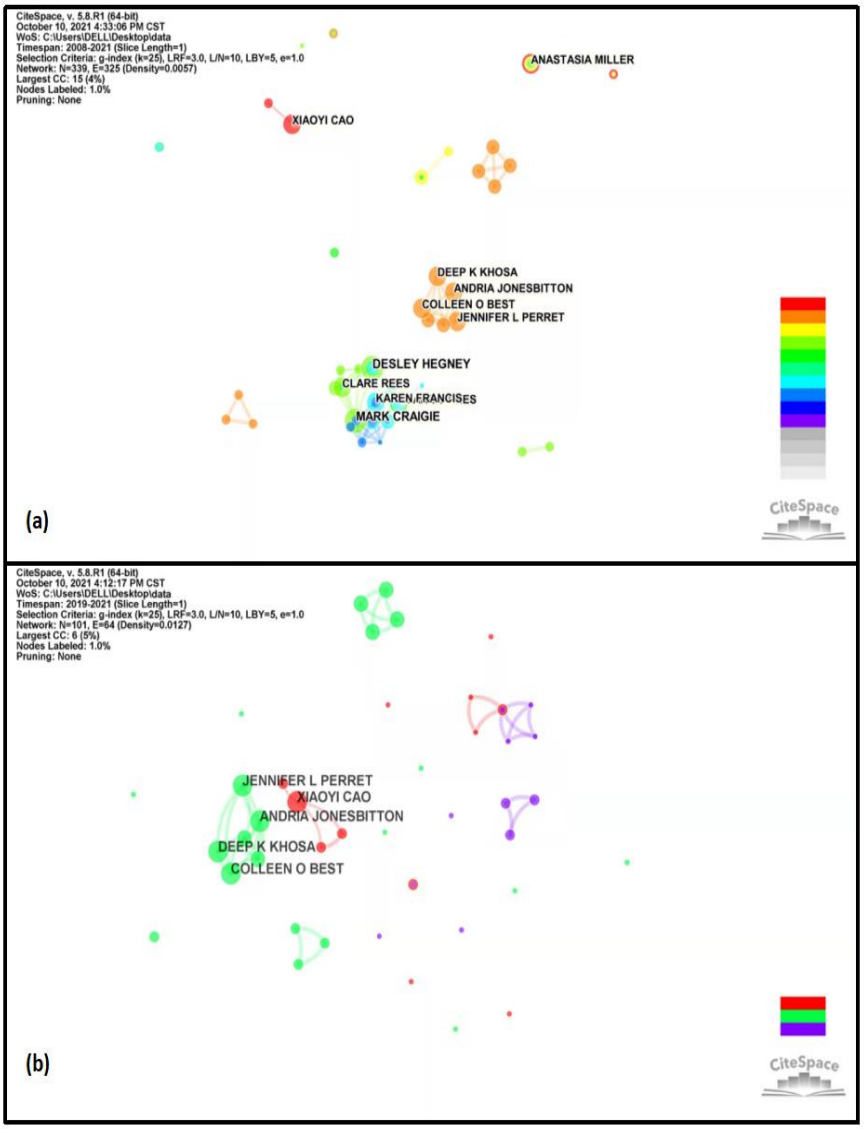

Figure 8. The network of co-authorship in the field of compassion fatigue and psychological during 2008–2021 (A) and the COVID-19 pandemic (B).

Note: The individual circle indicates one author, and the size of the circle was weighted by the number of articles published by authors. The individual link between two circles indicates collaboration between two authors on the same article, and its thickness was weighted by the frequency of collaborations. The purple rims of circles indicate high betweenness centralities.

Analysis of journals

The analysis of journals helps to understand the direction of specific research topics[215]. The Web of Science® Core Collection shows that the 391 documents from the past 14 years are spread across 260 different journals. We analyzed the top 15 active journals that published the most articles (see Supplementary Table 5), accounting for 17.9% of the 391 publications. The average impact factor (IF) of these top 15 journals in 2020 was 2.978. Frontiers in Psychology was the most productive journal (8 articles, 2020 IF = 2.990), followed by the British Journal of Social Work (7 articles, 2020 IF = 1.884) and the International Journal of Environmental Research and Public Health (6 articles, 2020 IF = 3.390). Among these journals, 8 out of the top 15 specialize in social work and psychology, and 4 are nursing journals.

The map of cited journals consists of 458 nodes and 3448 links, including a total of 10,585 references (see Figure 9 (a) and Supplementary Table 6 (a)). In terms of frequency and centrality, J Trauma Stress and Anxiety Stress Coping ranked first.

During the COVID-19 period, the cited journal map generated by CiteSpace included 271 nodes and 1348 links (see Figure 9 (b) and Supplementary Table 6 (b)). J Trauma Stress and Int J Nurs Stud ranked first in terms of frequency and centrality.

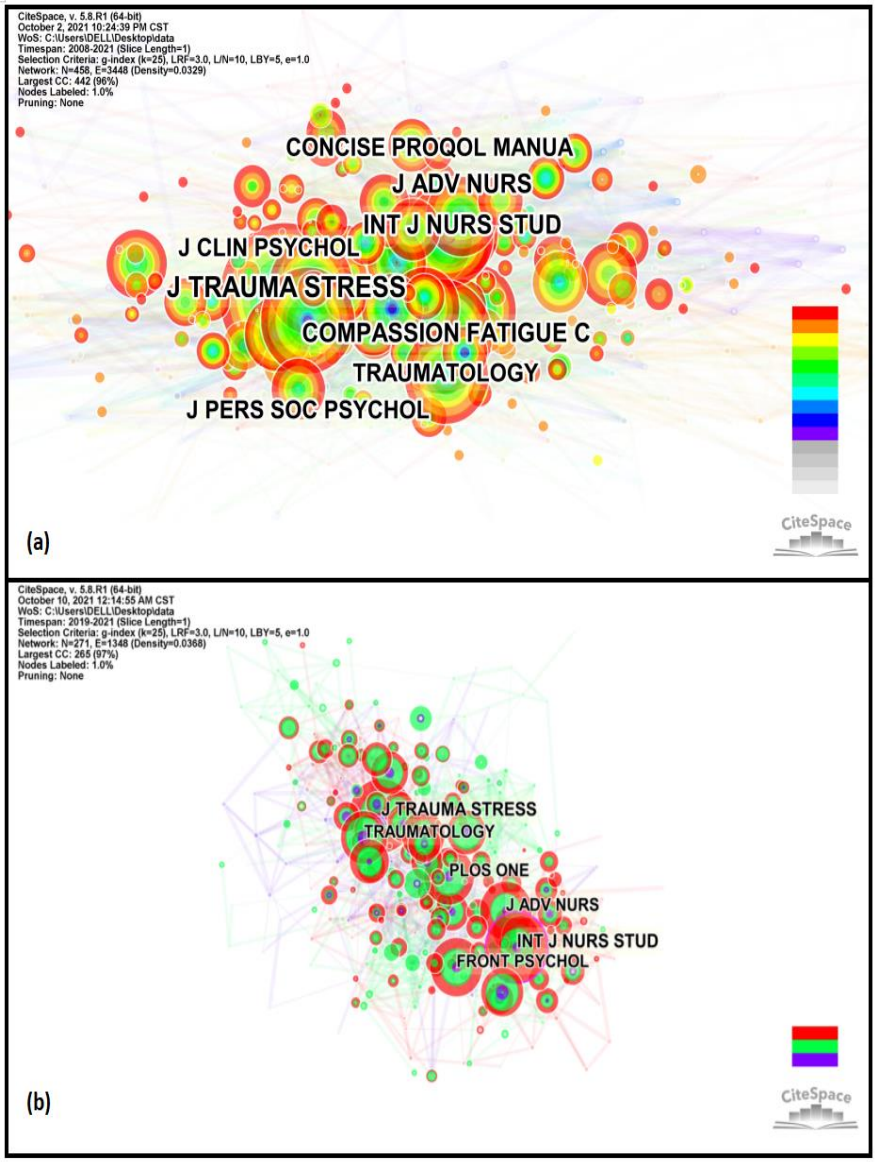

Figure 9. The network visualization map of journal co-citation analysis during 2008–2021 (A) and the COVID-19 pandemic (B).

Note: The individual circle indicates a journal, and its size was weighted by the number of cited journals. The individual link between two circles meant co-citation relationships, and its thickness was weighted by the frequency of collaborations. The purple rims of circles indicate high betweenness centralities.

6.1.4 The knowledge base of a research field

Reference co-citation analyses

The knowledge base is composed of co-cited documents. By constructing a synthesized network of cited references and co-citation clusters, we revealed the intellectual base and corresponding trends in the research area[221]. Table 1 (a) documents 12 major clusters of reference co-citations (each cluster containing over 15 members), labeled by noun phrases from the keywords of their citers[222]. The size of a cluster is proportional to the number of members it contains, with more members indicating higher representativeness. Thus, clusters #0 to #6 are particularly important due to their larger sizes. The silhouette values, which measure the homogeneity of a cluster, ranged from 0.739 to 0.995, indicating high homogeneity[222].

A timeline visualization shows the 12 major clusters along horizontal timelines, helping us understand the evolution of the CF and PR field over the years (see Figure 10 (a)). Clusters are numbered starting from 0, with Cluster #0 being the largest (nursing) and Cluster #10 the smallest (anxiety). The map of cited reference clusters indicates that most clusters were concentrated from 2003 to 2020. Early research focused on clusters #7 ("child protection workers") and #6 ("caregivers"), with most publications around 2006. This was followed by clusters #4 ("post-traumatic growth"), #1 ("anxiety"), and #9 ("well-being"), with most publications around 2000. Researchers then shifted their attention to clusters #0 ("nursing") and #3 ("secondary traumatization"), with most publications around 2015. Recent research has focused on clusters #10 ("police officers"), #8 ("COVID-19"), #5 ("health care"), and #2 ("turnover intention"), with most publications around 2017. Cluster #2 has a high concentration of nodes with citation bursts, consistent with it being the most recently formed cluster. Additionally, clusters #5 and #8 show recent citation bursts. The sustainability of specialties varies; for example, Cluster

Table 1. Main clusters (>15 members) of reference co-citation analysis in the field of compassion fatigue and psychological resilience.

Table 1 a. Main clusters (>15 members) of reference co-citation analysis in the field of CF and PR (from 2008 to 2021)

rank	cluster ID	size	silhouette	mean(year)	theme
1	0	66	0.739	2014	nursing
2	1	38	0.909	2011	anxiety
3	2	37	0.905	2017	turnover intention
4	3	32	0.957	2015	secondary traumatization
5	4	31	0.923	2011	posttraumatic growth
6	5	31	0.894	2017	health care provider
7	6	26	0.977	2007	caregivers
8	7	25	0.99	2005	child protection workers
9	8	21	0.995	2017	COVID-19
10	9	18	0.97	2013	well-being
11	10	17	0.95	2016	police officers

Table 1 b. Main clusters (>15 members) of reference co-citation analysis in the field of CF and PR (during the COVID-19 pandemic)

rank	cluster ID	size	silhouette	mean (year)	theme
1	0	31	0.835	2018	health care provider
2	1	21	0.995	2017	hardiness
3	2	21	0.983	2015	resilience factors
4	3	20	0.875	2016	physicians
5	4	20	0.956	2018	turnover intention

Note: Abbreviations: WOS = Web of science; CF = compassion fatigue; PR = psychological resilience.

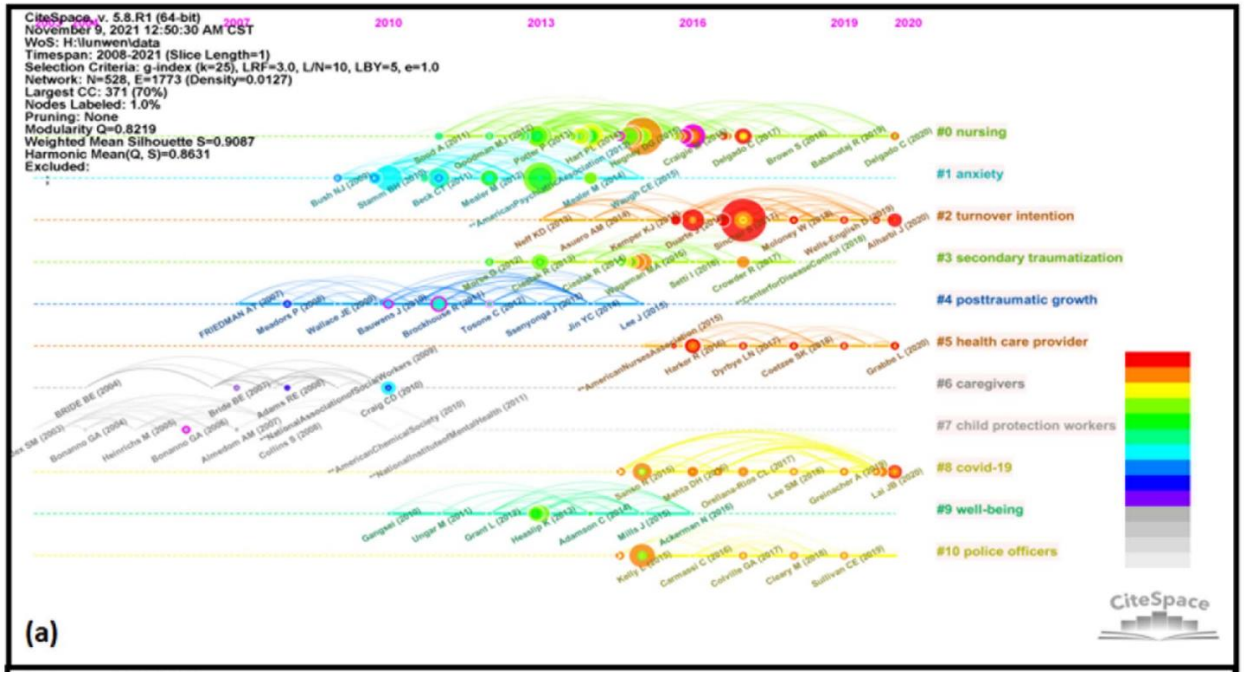

Figure 10 a. The timeline view of research focused on compassion fatigue and psychological during 2008–2021.

Note: In the timeline view plot, keywords on the same horizontal line belong to the right cluster. The colors of lines and keywords are corresponding to the colors of the time slice at the top.

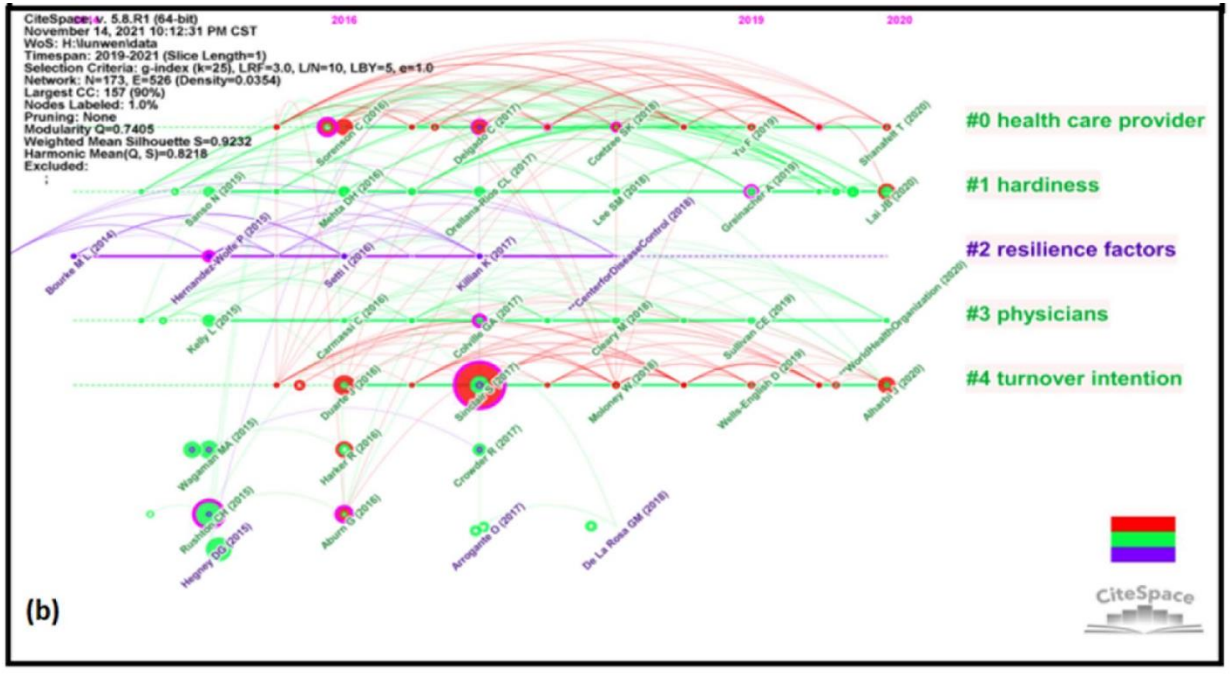

Figure 10 b. The timeline view of research focused on compassion fatigue and psychological during the COVID-19 pandemic.

Note: In the timeline view plot, keywords on the same horizontal line belong to the right cluster. The colors of lines and keywords are corresponding to the colors of the time slice at the top.

#0 has been active for 11 years. Additionally, we also summarized the five largest clusters during the COVID-19 pandemic (see Table 1 (b)). The silhouette values ranged from 0.835 to 0.995, indicating high homogeneity for each cluster[222]. As shown in the timeline overview (see Figure 10 (b)), early research focused on clusters #2 ("resilience factors") and #3 ("physicians"), followed by clusters #0 ("health care provider"), #1 ("hardiness"), and #4 ("turnover intention"). Except for clusters #2 and #5, the others remain active.

Most cited articles analysis

The most cited references are usually considered landmark studies due to their foundational contributions to their respective fields. By analyzing these references, the key knowledge base of each research area can be identified[255]. We conducted this analysis for all included references and found that among the top 10 most frequently cited references, there are two books, two reviews, and six clinical studies (see Table 2 (a)). Most of these references[15,72,256-260] were published in nursing journals, indicating their significance and influence in this field. Sinclair S (2017) is the most cited article, reflecting its substantial impact on CF research among healthcare providers[15]. Additionally, two descriptive studies[256,259] first examined the therapeutic effects of CF resilience programs designed for oncology and emergency nurses, respectively, and recommended that nurses develop resilience skills to effectively manage CF.

We also specifically analyzed the most cited references published during the COVID-19 period and found that three of the top 10 landmark articles were the same as before (see Table 2 (b)) [15,260,261]. Most studies focused on the relationship between variables involved in PR and/or CF[127,260-265]. Additionally, Ludick et al. [266] explored the mechanisms of secondary trauma induction and reduction, proposing a CF resilience model, which offers important guidance for future trauma management and secondary stress management.

Table 2. Main clusters (>15 members) of reference co-citation analysis in the field of compassion fatigue and psychological resilience

Table 2 a. Top 10 highest cited articles in the field of CF and PR (during 2008-2021)

rank	author and publication year	frequency	title	journal	IF (2020)	quartile (2020)	category
1	Sinclair S, 2017	16	Compassion fatigue: A meta-narrative review of the healthcare literature	International Journal of Nursing Studies	5.837	Q1	Nursing
2	Rushton CH, 2015	15	Burnout and Resilience Among Nurses Practicing in High-Intensity Settings	American Journal of Critical Care	2.228	Q4	Nursing
3	Hegney DG, 2015	14	The contribution of individual psychological resilience in determining the professional quality of life of Australian nurses	Frontiers in Psychology	2.988	Q2	Psychology
4	American Psychiatric Association, 2013	13	Diagnostic and statistical manual of mental disorders	NA	NA	NA	NA
5	Hart PL, 2014	10	Resilience in nurses: an integrative review	Journal of Nursing Management	3.325	Q1	Nursing
6	Stamm BH, 2010	10	The Concise ProQOL Manual: The concise manual for the Professional Quality of Life Scale	NA	NA	NA	NA

Table 2 a. Top 10 highest cited articles in the field of CF and PR (during 2008-2021)

rank	author and publication year	frequency	title	journal	IF (2020)	quartile (2020)	category
7	Potter P, 2013	9	Evaluation of a Compassion Fatigue Resiliency Program for Oncology Nurses	Oncology Nursing Forum	2.172	Q4	Nursing
8	Hunsaker S, 2015	9	Factors That Influence the Development of Compassion Fatigue, Burnout, and Compassion Satisfaction in Emergency Department Nurses	Journal of Nursing Scholarship	3.176	Q1	Nursing
9	Kelly L, 2015	9	Predictors of Compassion Fatigue and Compassion Satisfaction in Acute Care Nurses	Journal of Nursing Scholarship	3.176	Q1	Nursing
10	Flarity K, 2013	8	The Effectiveness of an Educational Program on Preventing and Treating Compassion Fatigue in Emergency Nurses	Advanced Emergency Nursing Journal		Q4	Nursing

Table 2 b. Top 10 highest cited articles in the field of CF and PR (during the COVID-19 pandemic)

rank	author and publication year	frequency	title	journal	IF (2020)	quartile (2020)	category
1	Sinclair S, 2017	16	Compassion fatigue: A meta-narrative review of the healthcare literature	International Journal of Nursing Studies	5.837	Q1	Nursing
2	Rushton CH, 2015	9	Burnout and Resilience Among Nurses Practicing in High-Intensity Settings	American Journal of Critical Care	2.228	Q4	Nursing
3	Hegney DG, 2015	9	The contribution of individual psychological resilience in determining the professional quality of life of Australian nurses	Frontiers in Psychology	2.988	Q2	Psychology
4	Duarte J, 2016	8	Relationships between nurses' empathy, self-compassion and dimensions of professional quality of life: a cross-sectional study	International Journal of Nursing Studies	5.837	Q1	Nursing
5	Wagaman MA	7	The Role of Empathy in Burnout, Compassion Satisfaction, and Secondary Traumatic Stress among Social Workers	Social Work	2.29	Q2	Social work
6	Kapoulitsas M	6	Compassion fatigue and resilience: A qualitative analysis of	Qualitative Social Work	1.171	Q1	Social work

Table 2 b. Top 10 highest cited articles in the field of CF and PR (during the COVID-19 pandemic)

rank	author and publication year	frequency	title	journal	IF (2020)	quartile (2020)	category
			social work practice				
7	Alharbi J, 2020	6	Personal characteristics, coping strategies, and resilience impact on compassion fatigue in critical care nurses: A cross-sectional study	Nursing and Health Sciences	1.857	Q3	Nursing
8	Harker R, 2016	6	Exploring resilience and mindfulness as preventative factors for psychological distress burnout and secondary traumatic stress among human service professionals	Work-a Journal of Prevention Assessment and Rehabilitation	1.505	Q4	Public, Environmental and Occupational Health
9	Lai JB, 2020	6	Factors Associated with Mental Health Outcomes Among Health Care Workers Exposed to Coronavirus Disease 2019	JAMA Network Open	8.485	Q1	Medicine, General and Internal
10	Ludick M, 2017	6	Toward a Mechanism for Secondary Trauma Induction and Reduction: Reimagining a Theory of Secondary Traumatic Stress	Traumatology	NA	NA	NA

6.1.5 Emerging trends and research frontiers of caregivers

Keyword co-occurrence analysis

In the keyword co-occurrence analysis of dataset #4, there were 348 co-occurrence keywords (see Supplementary File 1). To make the statistics clearer and more standardized, we filtered out two conventional keywords, "compassion fatigue" and "resilience," and manually merged several synonyms. Keywords with low co-occurrence frequency were not related to trending research topics; therefore, we set the co-occurrence frequency threshold to 20 for better analysis. Figure 11 (a) shows the co-occurrence when the threshold is set to 20, including 26 keywords. The figure indicates that nurses and social workers are the main target populations. Mental health issues (burnout (BO), posttraumatic stress disorder, depression) and the personal or organizational effects of CF (job satisfaction and quality of life) have become research hotspots. Currently, surveys are a common method to estimate the prevalence of CF and explore CF-related risk factors. The practice of self-care is an essential individual approach to build PR and increase mindfulness, thereby diminishing CF and promoting personal growth[267-270].

During the COVID-19 pandemic (Figure 8 (b)), the distribution of co-occurrence keywords showed little change. This phenomenon implies that the research focus has not changed in the context of the epidemic.

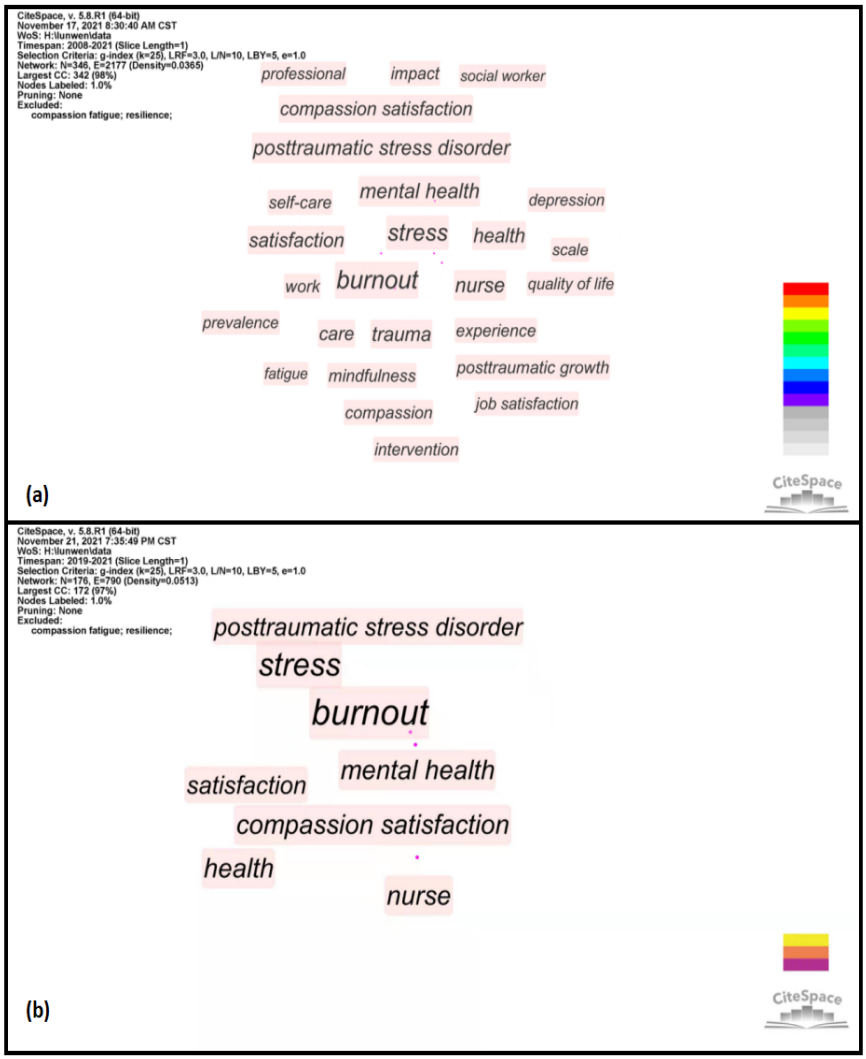

Figure 11. The co-occurrence network of keywords during 2008–2021 (A) and the COVID-19 pandemic (B).

6.2 Study 2: Prevalence and related factors of compassion fatigue among registered nurses and nursing students during the internship: a systematic review and meta-analysis

6.2.1 Search results

We identified 3469 articles through searching electronic databases and an

additional 5 articles by searching the reference lists of relevant studies. In this review, we included 197 studies that were all published between 2010 and 2023 (see Figure 12).

6.2.2 Characteristics of the included studies

In this review, the 196 included studies involved 73,034 clinical nurses and 4,551 nursing students during the internship (see Table 3 and Supplementary Table 8). The median sample sizes were 307 for clinical nurses and 254 for nursing students during the internship. Among these studies, 151 were conducted in China. A total of 188 studies (95.9%) focused on clinical nurses, while 8 studies (4.1%) centered on nursing students during the internship (see Table 3). Convenience sampling methods were employed in 161 studies, including 153 studies involving clinical nurses and 8 studies concerning nursing students during the internship. The research on clinical nurses spanned various hospital wards and clinical areas, with 78 studies involving nurses from multiple ward types. The studies on nursing students during the internship predominantly included participants with Associate degrees, undertaking internships ranging from 3 to 12 months. For measuring BO and STS, 176 studies utilized the ProQOL-5 scale, while 20 studies employed the CFSS scale.

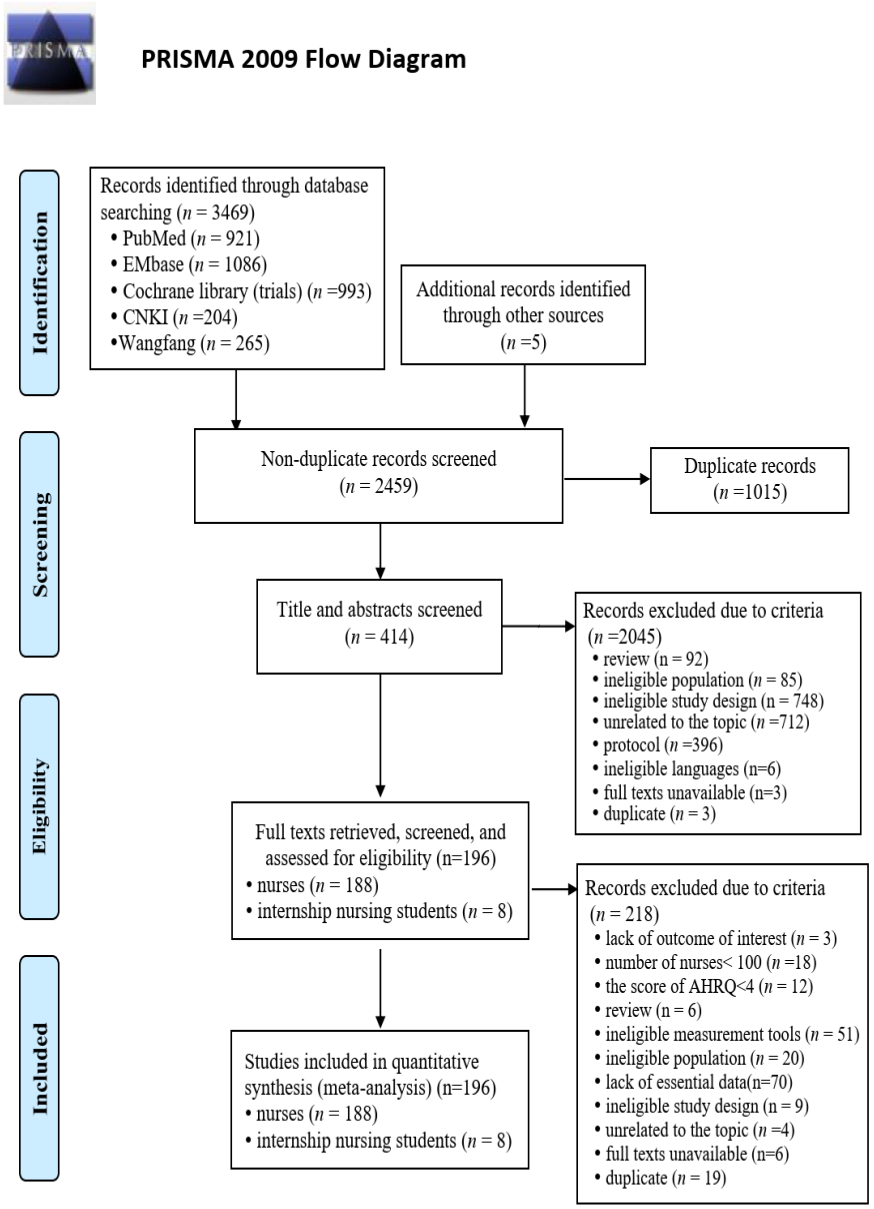

Figure 12. PRISMA flow diagram of retrieval and selection of studies

Table 3. Summary characteristics of the included studies

items	summary results of studies in nurses (188 studies)	summary results of studies in nurse interns (8 studies)
publication year		
before the COVID-19 pandemic	83 studies	3 studies
after the COVID-19 pandemic	105 studies	5 studies
sample sizes	Median 307 (range 100 to 4913)	Median 254 (range 96 to 2256)
average age (years)	Median 31.24 years, range 22.45 to 44 years among 91 studies	Median 21.52 years, range 21.17 to 22.00 years among 3 studies
numbers of male/ female	7319/ 59043(162 studies)	385/ 3952 (6 studies)
use of convenience sampling methods	153/188 studies (81.48%)	8/8 studies (100%)
numbers of studies by countries		
China	144 (76.72%)	7 (87.5%)
United States	11 (6.88%)	1 (12.5%)
Iran	8 (4.23%)	NA
Saudi Arabia	7 (3.70%)	NA
Korea	6 (3.17%)	NA
other countries including Portugal, Australia, Jordan, Spain, Japan, Turkey, Uganda	12 (5.82%)	NA
hospital ward types (188 studies**)**		
various wards	78 (41.26%)	NA
ICU and/or emergency	42 (22.70%)	NA
oncology	21(11.11%)	NA
psychiatry	11 (5.81%)	NA

items	summary results of studies in nurses (188 studies)	summary results of studies in nurse interns (8 studies)
pediatrics	11 (5.81%)	NA
operating room	7 (3.70%)	NA
others	18 (9.52%)	NA
measurement tools used	ProQOL-5 (170 studies) • mean scores of BO, STS and CS/fatigue by ProQOL-5: 156 studies (82.99%) • prevalence rates defined using raw scores: 35 studies (18.61%) • prevalence rates defined using standardized scores: 32 studies (17.02%) CFSS • mean scores: 18 (9.57%)	ProQOL-5 (6 studies) • mean scores of BO, STS and CS/fatigue: 4 studies (50%) • prevalence rates defined using raw scores: 2 studies (25%) • prevalence rates defined using standardized scores: 2 studies (25%) CFSS • mean scores: 2 (25%)
numbers of studies involving multi centers	151/188 (80.32%)	3/8 (37.5%)
interns with Associate/ Bachelor degree	Not relevant	2933/1522
duration of internship	Not relevant	Range 3 to 12 months

6.2.3 Critical appraisal results

The overall quality of the included studies showed variation, with a majority of them (108 studies, 55.1%) presenting high-quality data, while the remainder (88 studies, 44.8%) were characterized by moderate-quality data. As Figure 13 indicates, most studies well defined or addressed issues including: the source of information (100%); the description of inclusion and exclusion criteria (95.4%); the time period used for patient identification (88.3%); inclusion of consecutive participants (88.8%); blinding of outcome assessors (72.0%); quality assurance assessments (86.2%); dealing with confounding (62.8%); and patient response rates and data completeness (91.3%). However, only 54.6% of the included studies clarified the handling of missing data in the analysis; and a mere 13.8% justified patient exclusions from the analysis. Besides, none of the studies reported details about participant follow-up. More information is available in Supplementary Table 9.

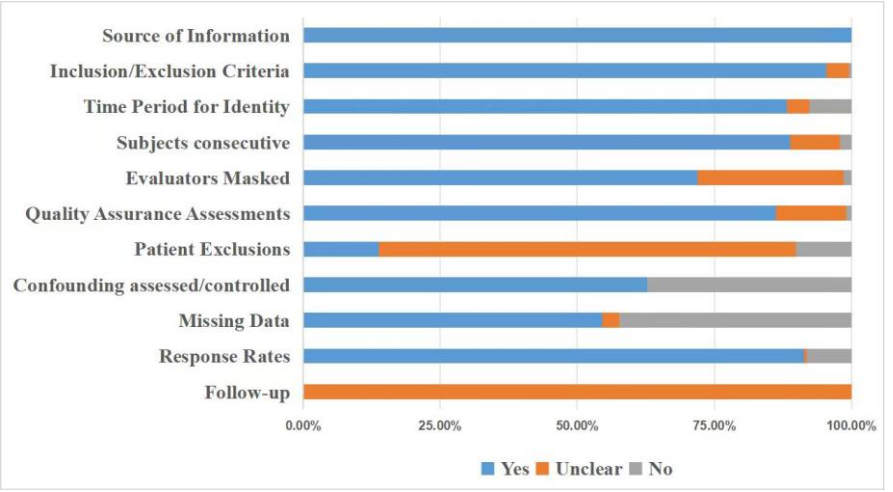

Figure 13. Summary results of critical appraisal using the Agency for Healthcare Research and Quality tool

6.2.4 Levels of compassion fatigue, burnout and secondary traumatic stress

Registered nurses. A total of 156 studies (involving 63,254 nurse staff) reported mean scores measured using the ProQOL-5 for BO and STS (see Supplementary Table 10). The pooled mean score was 26.81 (95% CI 26.28 to 27.35, $I^2 = 99.5\%$, $p < 0.001$) for BO (Fig. S1), and 25.88 (95% CI 25.39 to 26.37, $I^2 = 99.4\%$, $p < 0.001$) for STS (Fig. S2), indicating moderate levels of CF in registered nurses. Furthermore, 18 studies (5007 participants) reported CFSS scores for CF among nurse staffs, with a pooled mean score of 53.78 (95% CI 47.07 to 60.49, $I^2 = 99.5\%$, $p < 0.001$) (see Fig. S11 and Supplementary Table 13).

A total of 37 studies classified scores of BO and STS into low, moderate, and high levels using ProQOL-5 raw scores (see Supplementary Table 11). Our pooling suggested that 71% (95% CI 66.2% to 75.5%, $I^2 = 97.73\%$, $p < 0.001$) of nurse staffs were at a moderate level of BO (see Fig. S3), while 3.2% (95% CI 1.6% to 5.3%, $I^2 = 97.81\%$, $p < 0.001$) were at a high level (see Fig. S4). For STS, 63.5% (95% CI 58.8% to 68.1%, $I^2 = 97.45\%$, $p < 0.001$) were at a moderate level (see Fig. S5), while 4.3% (95% CI 2.2% to 7%, $I^2 = 98.29\%$, $p < 0.001$) were at a high level (see Fig. S6). Additionally, 32 studies used ProQOL-5 standardized scores to classify BO and STS, with results showing some variations (see Figs. S7 to S10 and Supplementary Table 12).

Nursing students during the internship. Four studies reported mean scores of BO, and STS in nursing students during the internship (n = 1691) using ProQOL-5 (see Supplementary Table 10). Pooled mean scores were 29.16 (95% CI 26.95 to 31.37, $I^2 = 98.8\%$, $p < 0.0001$) for BO, and 25.64 (95% CI 20.95 to 30.34, $I^2 = 99.6\%$, $p < 0.0001$) for STS, respectively (see Figs. S1 to 2). Two studies (with 2563 interns) reported CFSS scores that were at 52.74 (95% CI 37.44 to 68.05, $I^2 = 99.1\%$, $p < 0.001$) (see Fig. S11 and Supplementary Table 13).

Two studies reported data by low, moderate, and high levels for BO and STS in nursing students during the internship using ProQOL-5 raw scores (see Supplementary Table 11). Our pooling suggested that more than 90% of nursing students during the internship reported moderate BO (see Fig. S3), and only 0.7% reported high BO (see Fig. S4). We found that 59.4% of nursing students during the internship reported a moderate level of STS (see Fig. S5), and 1.5% was at the high level of STS (see Fig. S6). Additionally, 2 studies used ProQOL-5 standardized scores to classify BO and STS, with results showing some variations (see Figs. S7 to S10 and Supplementary Table 12).

Subgroup analysis. Our analyses showed that nurse staff had a higher CF in studies published after the COVID-19 pandemic. Nurses from the ICU, emergency, and psychiatry departments showed lower levels of BO and STS than those in other departments. The results of subgroup analyses are presented in Supplementary Table 14.

In the above analyses, we did not perform the Egger's test pre-planned for exploring publication bias.

6.2.5 Factors related to compassion fatigue and its dimensions

In this study, a total of 107 studies were identified that evaluated a range of factors related to CF and its two dimensions (BO and STS) (see Table 4 and Supplementary Tables 15 and 16). Among these, 102 studies focused on nurses (93 on BO and STS, and 8 on CF), while 5 studies focused on nursing students during the internship (3 on BO and STS, and 2 on CF).

For nurses, the evidence indicates that psychosocial factors and a few work-related factors may influence the development and progression of BO and STS. Specifically, a poor work environment, a lower social support,

Table 4. The evidence of factors influencing compassion fatigue and its dimensions

items	related factors in registered nurses	related factors in internship nursing students
Burnout	Moderate or low-certainty evidence suggests that: • a poor work environment is likely to contribute to increased levels of burnout. • the higher frequency of workplace violence likely resulted in increased levels of burnout. • higher social support may result in a lower burnout score. • the lower the job satisfaction, the higher the burnout. • nurses with a higher psychological resilience may have lower burnout levels. • the heavier workload stress, the higher burnout scores. • the higher psychological capital, the lower burnout scores. Moderate or low-certainty evidence suggests no relationship between burnout and the following factors: • age as reported in 73.8% (48/65) studies with data available for this factor; • education levels as reported in 80% (52/65) of the studies with data available for this factor;	Moderate or low-certainty evidence suggests that: • the more night shifts, the higher burnout scores • the higher psychological resilience, the lower burnout scores • the more enjoyment of the nursing profession, the lower burnout Moderate or low-certainty evidence suggests no relationship between burnout and the following factors: • gender • being the only child of a family • age • current internship department • hospital types • social support

items	related factors in registered nurses	related factors in internship nursing students
Burnout	• marital status as reported in 77.2% (44/57) of the studies with data available for this factor; • gender as reported in 88.7% (47/53) studies with data available for this factor; • income as reported in 81.5% (22/27) studies with data available for this factor; • the situation of nurses' children as reported in 94.7% (18/19) studies with data available for this factor; • religion as reported in 81.8% (9/11) studies with data available for this factor; • years of working experience as reported in 87.1% (54/62) studies with data available for this factor; • professional title as reported in 84.5% (38/45) of the studies with data available for this factor; • type of employment as reported in 82.1% (32/39) of the studies with data available for this factor; • department types as reported in 75% (27/36) studies with data available for this factor; • official position in terms of leadership roles as reported in 80% (20/25) studies with data available for this factor; • night shift frequencies as reported in 70.6% (12/17) studies with data available for this factor; • daily or weekly working hours as reported in 94.4% (17/18) studies with data available for this factor;	

items	related factors in registered nurses	related factors in internship nursing students
burnout	• shift work/ shift predominantly as reported in 100% (10/10) studies with data available for this factor; • income satisfaction as reported in 62.5% (5/8) studies with data available for this factor. Uncertain evidence on the relationship between burnout and the following factors: • health status • hospital type such as tertiary hospitals • the willingness to re-choose the nursing career • personality traits	
secondary traumatic stress	Moderate or low-certainty evidence suggests that: • worse health status could lead to higher levels of secondary traumatic stress. • a poor work environment is related to increased levels of secondary traumatic stress. • higher social support may result in a lower secondary traumatic stress score. • the lower the willingness to re-choose the nursing career, the lower secondary traumatic stress scores.	Moderate or low-certainty evidence suggests that: • the higher psychological resilience, the lower secondary traumatic stress scores Moderate or low-certainty evidence suggests no relationship between burnout and the following factors: • gender • age • current internship department

items	related factors in registered nurses	related factors in internship nursing students
secondary traumatic stress	• the lower the job satisfaction, the higher the secondary traumatic stress scores. • the heavier workload stress, the higher secondary traumatic stress scores. • the higher psychological capital, the lower secondary traumatic stress scores. Moderate or low-certainty evidence suggests no relationship between secondary traumatic stress with the following factors: • age as reported in 82.8% (53/64) studies with data available for this factor; • education levels as reported in 81.5% (53/65) of the studies with data available for this factor; • marital status as reported in 91.4% (53/58) of the studies with data available for this factor; • gender as reported in 92.7% (51/55) studies with data available for this factor; • income as reported in 76% (22/29) studies with data available for this factor; • the situation of nurses' children as reported in 94.4% (17/18) studies with data available for this factor; • religion as reported in 81.8% (9/11) studies with data available for this factor;	• night shift frequencies • hospital types • social support • enjoyment of the nursing profession Uncertain evidence on the following factors: being the only child of a family

items	related factors in registered nurses	related factors in internship nursing students
secondary traumatic stress	• years of working experience as reported in 88.1% (52/59) studies with data available for this factor; • professional title as reported in 87.0% (40/46) of the studies with data available for this factor; • type of employment as reported in 91.9% (34/37) of the studies with data available for this factor; • department types as reported in 65% (24/37) studies with data available for this factor; • official position in terms of leadership roles as reported in 88% (22/25) studies with data available for this factor; • night shift frequencies as reported in 76.5% (14/17) studies with data available for this factor; • daily or weekly working hours as reported in 77.8% (14/18) studies with data available for this factor; • shift work/ shift predominantly as reported in 90% (9/10) studies with data available for this factor; • income satisfaction as reported in 100% (7/7) studies with data available for this factor. Uncertain evidence on the following factors: • hospital type such as tertiary hospitals • workplace violence • psychological resilience • personality traits	

items	related factors in registered nurses	related factors in internship nursing students
compassion fatigue	Moderate or low-certainty evidence suggests no relationship between burnout and the following factors: • age as reported in 75% (6/8) studies with data available for this factor; • marital status as reported in 100% (7/7) studies with data available for this factor; • gender as reported in 100% (5/5) studies with data available for this factor; • years of working experience as reported in 100% (8/8) studies with data available for this factor; • professional title as reported in 100% (6/6) studies with data available for this factor; • type of employment as reported in 100% (6/6) studies with data available for this factor;	Moderate or low-certainty evidence suggests that: • Internship nursing students who worked more night shifts had higher compassion fatigue scores • internship nursing students in secondary hospitals exhibited higher levels of compassion fatigue compared to those in tertiary hospitals. • internship nursing students intending to leave the profession had significantly higher compassion fatigue levels compared to those who wished to stay. • The higher social support, the lower levels of compassion fatigue. • The higher psychological resilience, the lower compassion fatigue or higher compassion satisfaction. Moderate or low-certainty evidence suggests no relationship between compassion fatigue and the following factors: • gender • being the only child of a family

a lower job satisfaction, a heavier workload stress, and a lower psychological capital are associated with higher scores of BO and STS (moderate or low-certainty evidence; see Table 4). However, this study did not find significant effects of demographic characteristics and some work-related factors on CF, BO and STS. For nursing students during the internship, the evidence is sparse. Moderate or low-certainty evidence suggests that more night shifts, lower psychological capital, or less enjoyment of the nursing profession may lead to higher BO. Students with higher psychological capital may have lower STS scores (moderate or low-certainty evidence; see Table 4). Additionally, students with lower social support, lower psychological capital, or less enjoyment of the nursing profession may experience higher levels of CF (moderate or low-certainty evidence; see Table 4).

6.3 Study 3: Validity and reliability of the Compassion Fatigue Short Scale among internship nursing students in junior colleges

6.3.1 The logic sequence of the study

The process flowchart in Figure 14 illustrates the enrolment steps and the statistical methods for assessing the psychometric properties of the CFSS. Of the 277 participants who completed the online questionnaire, 48 were excluded due to either incomplete responses or not meeting the response criteria. Consequently, the final sample consist-ed of 229 participants, predominantly female (88.2%), with an average age of 20.34 (SD = 0.968), and the majority interning at tertiary hospitals (87.8%, Table 5). Additionally, the distribution of baseline characteristics among nursing interns in the test-retest reliability and CFA subgroup is detailed in Table 5

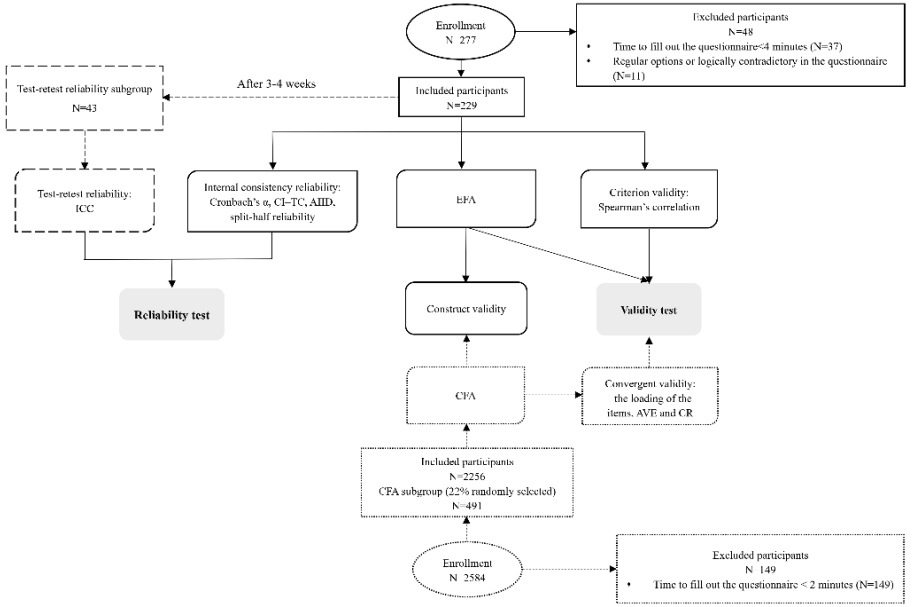

Figure 14. The logic sequence of the study

Note: The three line styles represent different survey times, the solid line represents the period of the first survey, namely, 2022.01.7 to 2022.01.13; the dashed line represents the period of the second survey, namely, 2022.02.8- 2022.02.18; the dotted line represents the period of a survey conducted among nursing interns in 10 junior colleges in Hunan Province, namely, 2021.12 to 2022.01. Abbreviations: α: alpha; CI–TC: the corrected item-total correlations; AIID: the α if item deleted; EFA: exploratory factor analysis; CFA: confirmatory factor analysis; AUC: area under the receiver operating characteristic curve; AVE: the average variance explained; CR: the composite reliability.

Table 5. Participants' descriptive characteristics (N =229)

variable	categories	nursing interns	test-retest reliability subgroup	CFA subgroup
		n=229	n=43	n=491
		n (%) / M±SD	n (%) / M±SD	n (%) / M±SD
Age, years		20.34±0.968	20.36±0.962	n.a.
Gender	Female	202 (88.2%)	29(87.9%)	461(93.9%)
	Male	27 (11.8%)	4(12.1%)	30(6.1%)
Major orientation	nursing	225 (98.3%)	30(90.9%)	425(86.6%)
	midwifery	4 (1.7%)	3(9.1%)	64(13.0%)
Level of internship hospital	Secondary hospital	28 (12.2%)	2(6.1%)	50(10.2%)
	Tertiary hospital	201 (87.8%)	31(93.9%)	441(89.8%)
Intention to be a nurse or midwifery	Yes	196 (85.6)	29(87.9%)	434(88.4%)
	No	33 (14.4%)	4(12.1%)	57(11.6%)

Note: Abbreviations: M: mean; SD: standard deviation; CFA: confirmatory factor analysis; n.a.: Not available

6.3.2 The Status of CF

For CFSS, we found that 16.2%, 21.0%, and 9.6% of respondents were above the median on the CFSS, BO subscale, and STS subscale. For ProQOLS, the majority of the respondents reported average levels of CS (84.8%), BO (72.1%) and STS (79.5%). All descriptive statistics for two scales were presented in Table 6.

6.3.3 Construct Validity

A CFA was performed to test the original two-factor model of the CFSS scale. The structural path models were depicted in Figure 15. The results of the model fit indices are below: $\chi 2/df$ =6.431, GFI = 0.881, AGFI = 0.831, IFI = 0.927, TLI = 0.911, CFI = 0.927, SRMR = 0.052 and RMSEA = 0.105. Although the majority of the parameters met the criteria, two fit indices exceeded the standard thresholds in the sample of nursing interns, indicating the two-factor model did not fit the data as well as expected.

Subsequently, we conducted EFA on the CFSS scores from the sample. The KMO measure of sampling adequacy yielded an index of 0.907, suggesting a high suitability for factor analysis. Bartlett's test of sphericity confirmed this suitability with a significant result ($\chi 2$=1651.29, $p < 0.001$). These findings supported the feasibility of conducting an EFA of the CFSS. The EFA extracted two factors corresponding to the subscales of the CFSS Chinese version—BO and STS —explaining 65.53% of the total variance. The factor loadings ranged from 0.50 to 0.836, with no evidence of cross-loading among items. Consequently, despite the CFA results suggesting some limitations of the two-factor model, the two-factor structure of the CFSS was appropriately applied to the nursing intern population without necessitating the removal of any items. Detailed factor loadings for all items are presented in Table 7.

Table 6. Distribution of Compassion Fatigue Short Scale and Professional

Quality of Life Scale scores, range and median score among nursing interns (N =229)

variable		range	Medium (IQR)	Frequency (percentage)
CFSS[a]	**CFSS-T**	13-90	37(27)	
	low			192 (83.8%)
	high			37 (16.2%)
	CFSS-BO	8-66	27(20.5)	
	low			181 (79%)
	high			48 (21.0%)
	CFSS-STS	5-36	10(11)	
	low			207 (90.4%)
	high			22 (9.6%)
ProQOL[b]	**ProQOLS-BO**	10-40	26(7.5)	
	low			64 (27.9%)
	average			165 (72.1%)
	high			0
	ProQOLS-STS	13-41	27(7)	
	low			47 (20.5%)
	average			182 (79.5%)
	high			0
	ProQOLS-CS	20-50	35(10)	
	low			0
	average			194 (84.8%)
	high			35(15.2%)

Note: Abbreviations: IQR: interquartile range; CFSS–BO/STS/T: Compassion Fatigue short Scale–burnout/secondary traumatic stress/total; ProQOLS–BO/STS/CS: Professional Quality of Life Scale–burnout/secondary traumatic stress/compassion satisfaction. a: In CFSS and its subscales, a median value (65) is the cut-off. Scores ≥65 for CFSS total, ≥40 for BO, and ≥25 for STS indicate high risk. b: In ProQOLS, scores ≤22 indicate low, 23–41 average, and ≥42 high for BO, STS, and CS.

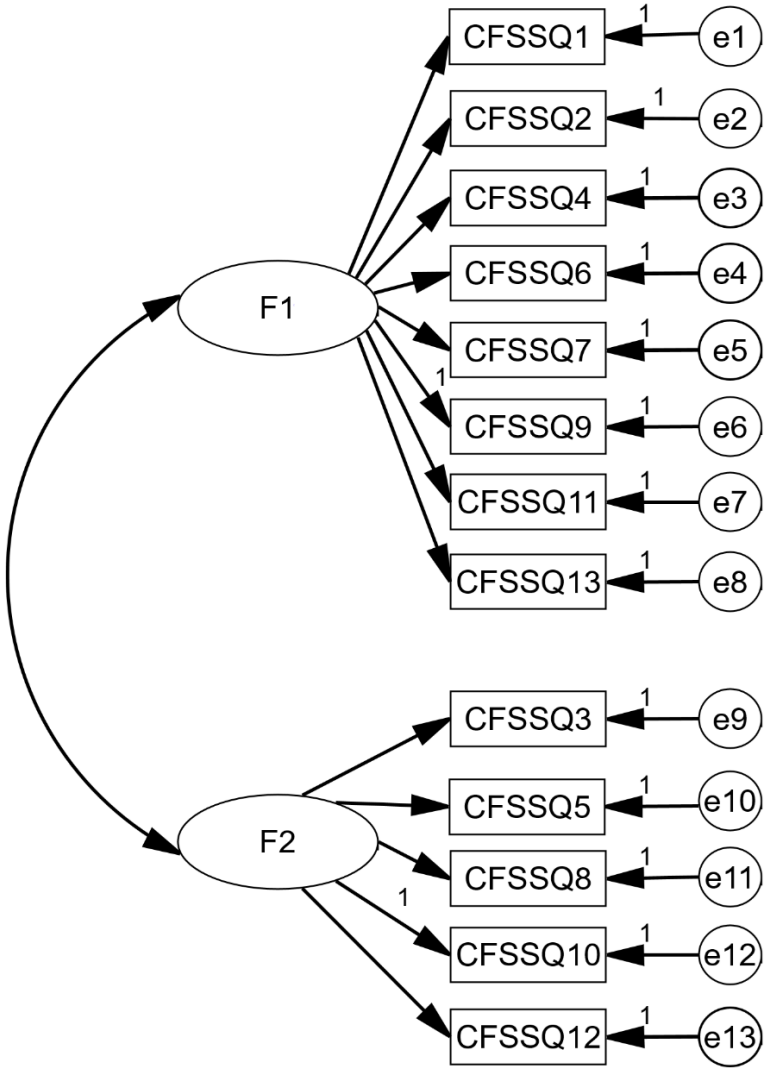

Figure 15. Structural equation model about confirmatory factor analysis of the Compassion Fatigue Short Scale Chinese nursing intern's version.
Note: Abbreviations: CFA, confirmatory factor analysis; CFSS, Compassion Fatigue Short Scale.

Table 7. Final Rotated Component Matrix for Factor Analysis of 13 Items in four versions of Compassion Fatigue Short Scale (N = 229)

item	Chinese nursing-intern version of CFSS		English social-work version of CFSS [a]		Chinese medical-worker version of CFSS [b]		Turkey's healthcare-professional version of CFSS [c]		Turkey nurse version of CFSS [d]	
	component		component		component		component		component	
	1	2	1	2	1	2	1	2	1	2
Q 9	0.793		0.788		0.800		0.75		0.694	
Q 7	0.772		0.616		0.546		0.74		0.626	
Q 1	0.754		0.766		0.686		0.79		0.744	
Q 6	0.726		0.701		0.638		0.67		0.565	
Q 13	0.718		0.872		0.774		0.65		0.693	
Q 2	0.674		0.747		0.581		0.85		0.688	
Q 4	0.549		0.765		0.620		0.78		0.577	
Q 11	0.500		0.731		0.674		0.72		0.539	
Q 5		0.836		0.615		0.754		0.63		0.493
Q 10		0.826		0.846		0.730		0.61		0.828
Q 8		0.726		0.718		0.587		0.73		0.676
Q 12		0.710		0.630		0.728		0.65		0.686
Q 3		0.568		0.781		0.717		0.76		0.623

Note: Abbreviations: Q=Question, [a] Adams, R.E., J.A. Boscarino, and C.R. Figley, Compassion fatigue and psychological distress among social workers: a validation study. Am J Orthopsychiatry, 2006. 76(1): 103-8. [b]Sun, B., et al., Validation of the Compassion Fatigue Short Scale among Chinese medical workers and firefighters: a cross-sectional study. BMJ Open, 2016. 6(6): e011279. In this study, we only extracted data related to medical workers. [c]Yıldırım, S. and F. Cavcav, The Compassion Fatigue-Short Scale for healthcare professionals: A Turkish study of validity and reliability. Perspect Psychiatr Care, 2021. 57(3): p. 1459-1465. [d] DİNÇ, S. and M. Ekinci, Turkish adaptation, validity and reliability of Compassion Fatigue Short Scale. Curr Approaches Psychiatr, 2019. 11(Suppl 1): p. S192-S202.

6.3.4 Convergent Validity

Table 8 illustrated that the standardized factor loadings for all 13 items in the Chinese nursing-intern version of the CFSS ranged from 0.5 to 0.95, confirming the validity of each item. Furthermore. both dimensions of the scale satisfied the criteria of AVE >0.50 and CR > 0.70, thereby substantiating the scale's robust convergent validity.

Table 8. The analysis result of convergent validity

subscale	item	standardized factor loading	measure error	CR	AVE
CFSS-BO	Q1	0.742	0.449	0.925	0.609
	Q2	0.620	0.616		
	Q4	0.780	0.392		
	Q6	0.840	0.294		
	Q7	0.754	0.431		
	Q9	0.887	0.213		
	Q11	0.711	0.494		
	Q13	0.875	0.234		
CFSS-STS	Q3	0.659	0.566	0.908	0.666
	Q5	0.830	0.311		
	Q8	0.809	0.346		
	Q10	0.924	0.146		
	Q12	0.837	0.299		

6.3.5 Criterion Validity

To assess criterion validity, Spearman's rank correlations coefficients were calculated to examine the relationship between the total scale and two subscales of the CFSS, and the three subscales of the ProQOLS. As indicated in Table 9, the majority of these correlations exhibited adequate to high effect sizes, all with statistical significance ($p < 0.001$), thereby supporting the considerable criterion validity of the CFSS.

Table 9. Spearman's correlations between the Chinese version of Compassion Fatigue Short Scale and Professional Quality of Life Scale scores (N=229)

	ProQOLS-CS	ProQOLS-BO	ProQOLS-STS
CFSS-BO	-0.663	0.715	0.452
CFSS-STS	-0.395	0.476	0.566
CFSS-T	-0.621	0.685	0.532

Note: All p-values are less than 0.001 and are based on Spearman's product-moment correlations (ρ). Referenced ρ values: '< 0.3' indicates weak, '0.3 to 0.5' moderate, '0.5 to 0.7' adequate, and '> 0.7' high correlation. Abbreviations: CFSS–BO/STS/T: Compassion Fatigue Simple Scale–burnout/ secondary traumatic stress/total, respectively; ProQOLS–BO/STS/CS: Professional quality of life Scale-burnout/secondary traumatic stress/compassion satisfaction, respectively.

6.3.6 Reliability

The internal consistency of the Chinese version of CFSS is detailed in Table 10. The Cronbach's α coefficients for the CFSS-BO, CFSS-STS, and the CFSS-T ranged from 0.841 to 0.910. The CI–TC of the 13 items showed acceptable values (>0.2), verifying that each item was correlated with the overall scale. Furthermore, the omission of any item, except for Q2, did not significantly affect the overall Cronbach's α of CFSS-T, CFSS-BO, and CFSS-STS. The split-half reliability for CFSS–T, CFSS–BO, and CFSS–STS was 0.886, 0.886, and 0.830 respectively, indicating a consistent measurement of CF across different sections of the test (refer to Table 10, row 16). Additionally, the test-retest reliability was good, with an ICC of 0.717 (95% CI 0.50-0.849) for the scale.

Table 10. Internal reliability variables of Chinese nursing-intern versions of Compassion Fatigue Short Scale (N=229)

subscale	item	medium (IQR)	*AIID*			*CT-TC*		
			CFSS-T	*CFSS-BO*	*CFSS-STS*	*CFSS-T*	*CFSS-BO*	*CFSS-STS*
CFSS-BO	Q1	5.00 (3)	.903	.869		.646	.674	
	Q2	5.00 (5)	.913	.890		.468	.501	
	Q4	2.00 (3)	.904	.877		.623	.594	
	Q6	2.00 (3)	.900	.864		.725	.742	
	Q7	4.00 (4)	.903	.869		.661	.688	
	Q9	3.00 (3)	.897	.857		.770	.793	
	Q11	2.00 (3)	.905	.880		.600	.566	
	Q13	2.00 (3)	.898	.862		.755	.755	
CFSS-STS	Q3	2.00 (4)	.903		.834	.651		.589
	Q5	1.00 (2)	.907		.796	.536		.701
	Q8	2.00 (2)	.903		.803	.650		.675
	Q10	2.00 (2)	.902		.783	.680		.752
	Q12	2.00 (2)	.908		.832	.527		.562
Cronbach's α			0.910	0.886	0.841			
The split-half reliability			0.886	0.886	0.830			

Note: Abbreviations: IQR: interquartile range; α: Alphas; CFSS–BO/STS/T: Compassion Fatigue Simple Scale–burnout/ secondary traumatic stress/total, respectively; AIID: Cronbach's α if item deleted; CT-TC: corrected item-total correlations.

6.4 Study 4: Prevalence of compassion fatigue in junior college nursing interns: A cross-sectional study

6.4.1 Participants' Socio-Demographic Characteristics

Participants' characteristics are presented in Table 11. The majority of participants who returned the validated questionnaires were female (n = 2077, 92.1%) and from the nursing specialized field (n = 1660, 73.6%). Most of the participants have undertaken a three-year nursing course (n = 1736, 77%) and have their internship in the tertiary hospital (n = 1708, 75.7%). The majority were from the urban areas (n = 1784, 79.1%), not the only child in their family (n = 1962, 87%) and had monthly expenses between 1000 to 2000 yuan (69.8%). About half of the participants have the experience of being student leaders (n = 1172, 52%) and 86.1% of nursing interns intend to be a nurse or midwifery.

Significant differences were found among five factors from the results of the independent *t*-test or one-way ANOVA test (Table 11). Specifically, participants who specialized in midwifery were female, had internships at secondary hospitals and intended to be a nurse or midwife after graduation reported significantly higher CF levels than those who specialized in general nursing (mean difference [MD]: −2.89, 95% confidence interval [CI] −4.91 to −0.83), were male (MD: −4.93, 95% CI: −8.37 to −1.48), had an internship at a tertiary hospital (MD: −4.26, 95% CI: −6.48 to −2.04) and did not intend to become a nurse and midwifery after graduation (MD: −15.55, 95%CI −18.51 to −12.59). Additionally, participants who experienced more night shifts reported higher levels of CF than those who experienced relatively fewer night shifts.

Table 11. The score of compassion fatigue according to various characteristics.

variable	categories	n (%)	average score of CF		
			Mean ± SD	t/F	*p*-Value
Specialty	Nursing	1660 (73.6%)	44.23 ± 22.97	−2.671*	0.008
	Midwifery	596 (26.4%)	47.11 ± 21.35		
Degree	Three years course	1736 (77.0%)	44.9 ± 22.65	−0.374*	0.709
	Five years course	520 (23.0%)	45.32 ± 22.39		
Gender	Male	179 (7.9%)	40.46 ± 22.45	−2.804*	0.005
	Female	2077 (92.1%)	45.38 ± 22.56		
The place of birth	Urban area	472 (20.9%)	44.02 ± 21.91	−1.051*	0.293
	Rural area	1784 (79.1%)	45.25 ± 22.76		
Only child	Yes	294 (13.0%)	43.68 ± 22.85	−1.066*	0.287
	No	1962 (87.0%)	45.19 ± 22.54		
Monthly expense	<1000 yuan	420 (18.6%)	44.50 ± 21.39	0.248#	0.780
	1000–2000 yuan	1574 (69.8%)	45.00 ± 22.94		
	>2000 yuan	262 (11.6%)	45.76 ± 22.32		
Experience of being student leaders	Yes	1172 (52.0%)	45.15 ± 22.92	0.352*	0.725
	No	1084 (48.0%)	44.82 ± 22.22		
Level of intern hospital	Tertiary hospital	1708 (75.7%)	43.96 ± 22.24	−3.858*	<0.01
	Secondary hospital	548 (24.3%)	48.22 ± 23.34		
No. of night shifts (monthly)	0–2/month	803 (35.6%)	43.67 ± 21.56	5.471#	0.001
	2–4/month	1037 (46.0%)	44.59 ± 22.49		
	4–6/month	278 (12.3%)	47.27 ± 22.84		
	>6/month	138 (6.1%)	51.19 ± 27.10		
Intent to be a nurse or midwifery	Yes	1943 (86.1%)	42.83 ± 21.36	−11.642*	<0.01
	No	313 (13.9%)	58.39 ± 25.24		

Note: CF: compassion fatigue; SD: standard deviation; IQR: interquartile range; *: *t*-test statistic; #: one-way ANOVA statistic (F statistic).

6.4.2 The Status of CF

The mean and SD of the score of total CF was 44.99 ± 22.58, with 29.26 ± 15.04 for BO and 15.73 ± 9.41 for STS (Table 12), all of which were considered a positive indication of weak CF among nursing interns. Median values were used as a threshold to divide the total score of CFSS and the two CFSS subscales into two levels. There were 440 (19.5%) participants reporting an overall CF score above 65 and were regarded as having high levels of CF. In addition, 24.2% of the respondents had BO and 17.2% showed symptoms of STS.

Table 12. Distribution of responses to Compassion Fatigue Short Scale and its subscales, and median score among internship nursing students (n = 2256).

variables	mean ± SD	distribution of responses (%) [a]	
		low (N, %)	high (N, %)
CF	44.99 ± 22.58	1816 (80.5%)	440 (19.5%)
BO	29.26 ± 15.04	1711 (75.8%)	545 (24.2%)
STS	15.73 ± 9.41	1867 (82.8%)	389 (17.2%)

Note: CF: compassion fatigue; burnout: BO; STS: secondary traumatic stress; CFSS: the CF Short Scale; IQR: interquartile range; SD: standard deviation; a: preset median value as a cut point to classify the total score of CFSS and two subscales into two levels, respectively. If participants with a total score of CFSS greater than or equal to 65, they were considered to be at high risk for CF. If participants had a total score of BO subscale greater than or equal to 40, they were considered to be at high risk for BO, and if participants had a total score of STS subscale greater than or equal to 25, they were considered to be at high risk for STS subscale.

6.4.3 Multiple Linear Regression Analysis of Influencing Factors

Table 13. Multivariate linear regression analysis of compassion fatigue among internship nursing students (n = 2256)

variable	categories	*B*	SE	*Beta*	*t*	*p*-Value
Specialty	Nursing*					
	Midwifery	2.573	1.063	0.05	2.421	0.016
Gender	Male*					
	Female	2.394	1.735	0.029	1.379	0.168
Level of hospitals	Tertiary hospital*					
	Secondary hospital	3.902	1.076	0.074	3.628	<0.01
No. of night shifts per month	2–4/ month*					
	0–2/month	−0.628	1.027	−0.013	−0.612	0.54
	4–6/month	1.393	1.478	0.02	0.943	0.346
	>6/month	1.510	0.549	0.056	2.753	0.006
Intent to be a nurse or midwifery	Yes*					
	No	15.047	1.335	0.230	11.270	<0.01
Constant term		12.304	3.863		3.185	0.001
Adjusted R^2 = 0.068; F = 33.794; *p*-value < 0.000						

Note: *: this variable is viewed as the reference; B: the regression coefficient; Beta: the standardized regression coefficient; SE: standard error

Table 13 displays the results from the multiple linear regression analysis. Five factors (specialty, gender, level of hospital, the number of night shift per month and employment intention) with a p-value of <0.05, showing a statistically significant association with a t-test or ANOVA, were placed in the multiple linear regression model. The tolerance values ranged from 0.958 to 0.989, indicating no multi-collinearity. The results of linear

regression demonstrated a positive association among four personal factors (midwifery, secondary hospital, six night-shifts per month and no intent to be a nurse or midwife) and CF. However, these four variables only explained 6.8% of the total variance CF ($p < 0.001$). It indicates that there are other factors besides demographic and sociological factors and at the level of the inter hospital, there are other factors that should be considered which could explain the CF level of nurse interns.

6.5 Study 5: Impact of internship nursing students' stress exposure on compassion fatigue: insights from the ABC-X Model

6.5.1 Demographic characteristics

Table 14 outlines the baseline characteristics of the 640 nursing interns enrolled in this study. The majority of participants were female (593 students, 93.6%). The predominant age group was 20 to 21 years (529 students, 82.7%), with most interns majoring in nursing (565 students, 88.3%). Additionally, 88.1% of the participants (564 students) were completing their internship at a tertiary hospital. Concerning their major preference, 62.8% (402 students) reported a preference for their nursing major, while 37.2% (238 students) were either neutral or expressed dislike toward their major. The majority of respondents (496 students, 77.5%) aspired to careers as nurses or midwives. Moreover, 39.7% of the interns (254 students) reported experiencing shorter nightly sleep durations. During the month of the survey, 49.2% (315 students) described their health status as fair, and 22.2% (142 students) as poor.

Table 14. Compassion fatigue among internship nursing students with different personal characteristics (N=640).

variable	categories	n (%)	mean ±standard deviation	Z or χ^2	*p*
Gender	Male	47(6.4%)	54.91±28.7	1.391	0.165
	Female	593(93.6%)	49.83±23.7		
Age	≤19	77(12%)	53.71±24.93	1.663	0.174
	20	369(57.7%)	50.72±25.13		
	21	160(25.0%)	48.74±22.27		
	≥22	34(5.3%)	43.56±17.51		
Specialty	Nursing	565(88.3%)	49.69±24.07	-1.497	0.135
	Midwifery	75(11.7%)	54.12±24.25		
Level of intern hospital	Secondary hospital	76(11.9%)	49.97±26.03	-0.090	0.928
	Tertiary hospital	564(88.1%)	50.24±23.87		
Preference for the major	like very much	39(6.1%)	35.03±22.87	25.424	**<0.001**
	like moderately	363(56.7%)	45.48±22.02		
	moderate	185(28.9%)	56.42±22.75		
	dislike moderately	42(6.6%)	69.17±25.04		

variable	categories	n (%)	mean ±standard deviation	Z or χ^2	*p*
	dislike very much	11(1.7%)	83.18±19.68		
Intent to be a nurse or mid-wifery	Yes	496(77.5%)	47.32±23.06	24.066	**<0.001**
	No	72(11.3%)	67.49±26.74		
	Pursue one's stud-ies	72(11.3%)	52.79±21.01		
Average hours of sleep per night	<7 hours	254(39.7%)	57.65±23.37	6.537	**<0.001**
	≥7 hours	386(60.3%)	45.31±23.36		
State of health	good	183(28.6%)	39.76±21.55	41.848	**<0.001**
	fair	315(49.2%)	50.52±23.23		
	poor	142(22.2%)	62.97±22.96		

6.5.2 Correlation analysis

In the survey of 640 nursing students, the majority of participants reported experiencing multiple negative life events (Mean = 2.3) and work-related stress events (Mean = 4.0) during their internships. Among these, academic or career pressures and concerns about making mistakes or accidents at work were the most frequently reported negative life events and work-related stressors, respectively (see Table 15). Mean scores for CF, psychological capital, perceived stress, affective empathy and cognitive empathy were 50.2, 73.1, 42.4, 35.1 and 31.4, respectively. Table 16 displays the results of Spearman's correlation analyses among these variables. The correlations among all variables were as anticipated. All these correlation results were statistically significant at the $p < 0.05$ level.

6.5.3 Estimated results of the mediated effects model

Based on the results of the correlation matrix, we first established the relationship structure among all variables. Subsequent model fit analysis revealed that four direct paths were not statistically significant: stress exposures during the internship to cognitive empathy (H5), cognitive empathy to CF (H7), affective empathy to CF (H8), and affective empathy to psychological capital (H13). To improve model fit, these non-significant paths were removed. The revised model a strong fit between the structural model and the dataset ($\chi2 = 26.531$, $\chi2/df = 2.211$, AGFI = 0.970, IFI = 0.988, TLI = 0.973, CFI = 0.988, NFI = 0.979, RMSEA = 0.044). As demonstrated in Table 17 and Figure 16, work-related stress events were associated with nursing interns' psychological capital ($\beta = 0.121$, P = 0.001; between small and medium effect size), affective empathy ($\beta = 0.113$, P = 0.007; effect size between small and medium), perceived stress ($\beta = 0.143$, $P < 0.001$; between small and medium effect size), and CF ($\beta = 0.093$, P = 0.002; very small effect size). Similarly, negative life events were also

Table 15. Overview of work-related stress and negative life events among nursing students during their internship period (N = 640).

negative life events	frequency (%)	mean (SD)	work-related stress events	frequency (%)	mean (SD)
Academic or employment pressure	453 (70.8%)	0.71±0.46	frequent night shifts (≥4 per month) (note: Night shifts refer to shifts starting after 10:00 PM)	317(49.5%)	0.5±0.5
Unmet expectations in evaluations (e.g., scholarships)	57 (8.9%)	0.09±0.29	Excessive workload (>40 hours /week)	210(32.8%)	0.33±0.47
Misunderstandings or wrongful accusations	158 (24.75)	0.25±0.43	Excessive non-nursing tasks	255(39.8%)	0.4±0.49
Discrimination or mistreatment	65 (10.2%)	0.1±0.3	Poor working environment (e.g., overcrowded wards, insufficient equipment)	59(9.2%)	0.09±0.29
Disputes with classmates or friends	53 (8.3%)	0.08±0.28	Concerns about making errors or accidents at work	379(59.2%)	0.59±0.49
Difficulty in romantic relationships or experiencing a romantic breakup	32 (5.0%)	0.05±0.22	Lack of recognition for nursing work from patients or their families	181(28.3%)	0.28±0.45
Personal severe illness or unexpected accidents	10 (1.6%)	0.02±0.12	Taking care of severely ill patients	63(9.8%)	0.1±0.3

negative life events	frequency (%)	mean (SD)	work-related stress events	frequency (%)	mean (SD)
Severe illness, accidents, or loss of close relatives or friends	43 (6.7%)	0.07±0.25	Impolite or uncooperative patients or their families	321(50.2%)	0.5±0.5
Financial difficulties within the family	163 (25.5%)	0.25±0.44	Unreasonable or excessive demands from patients	103(16.1%)	0.16±0.37
Family conflicts	63 (9.8%)	0.1±0.3	Experiencing physical assault, emotional abuse, threats, intimidation, or harassment	55(8.6%)	0.09±0.28
Prolonged separation from family members	142 (22.2%)	0.22±0.42	Inability to meet the psychological needs of patients and their families with acquired knowledge	189(29.5%)	0.3±0.46
Family imposing academic or work-related pressures	133 (20.8%)	0.21±0.41	Concerns about nursing procedures causing patient discomfort or pain	214(33.4%)	0.33±0.47
Other events	92 (14.4%)	0.14±0.35	Sudden patient deaths during care.	88(13.8%)	0.14±0.34
			Lack of understanding and support from nursing management and/or other staff members	143(22.3%)	0.22±0.42
no events	72 (11.3%)		no events	34 (5.3%)	
The total number of events		4.03±2.35	The total number of events		2.29±1.7

Table 16. Pearson correlation coefficient of the total score of each study variable (*N*=640).

variables	mean (SD)	1	2	3	4	5	6	7	8	9
1.compassion fatigue	50.2 (24.1)	1								
2.Burnout	34.4 (16.3)	0.955**	1							
3. secondary traumatic stress	15.8 (9.9)	0.871**	0.686**	1						
4.Psychological capital	73.1 (11)	-0.443**	-0.506**	-0.249**	1					
5.Perceived stress	42.4 (3.5)	0.455**	0.498**	0.292**	-0.421**	1				
6. Affective empathy	35.1 (2.8)	0.138**	0.115**	0.149**	-0.127**	0.143**	1			
7. Cognitive empathy	31.4 (2.7)	-0.201**	-0.245**	-0.088*	0.463**	-0.169**	-0.100*	1		
8. Negative life events	2.3 (1.7)	0.310**	0.329**	0.216**	-0.213**	0.351**	0.144**	-0.099*	1	
9. Work-related stress events	4.0 (2.3)	0.280**	0.304**	0.183**	-0.207**	0.298**	0.151**	-0.090*	0.380**	1

Note: *Statistical significance at the level of 0.05 (two-tailed), **Statistical significance at the level of 0.01 (two-tailed).

Table 17. Decomposition of standardized effects from the path model (N=640).

no.	hypothesized pathway	standard error	critical ratio	standardized direct effects	standardized indirect effects	standardized total effects	*p*
1	H1: Negative life events ⇋ Work-related stress events	0.169	8.973	0.380	n.a.	0.380	<0.001
2	H2: Compassion fatigue ← Work-related stress events	0.231	3.097	0.093	0.086	0.179	0.002
3	H2: Compassion fatigue ← Negative life events	0.325	3.186	0.098	0.108	0.206	<0.001
4	H3: Perceived stress ← Work-related stress events	0.055	3.846	0.143	0.043	0.186	<0.001
5	H3: Perceived stress ← Negative life events	0.075	6.048	0.225	0.045	0.270	<0.001
6	H4: Compassion fatigue ← Perceived stress	0.167	7.776	0.248	n.a.	0.248	<0.001
7	H6: Affective empathy ← Work-related stress events	0.050	2.681	0.113	n.a.	0.113	0.007

no.	hypothesized pathway	standard error	critical ratio	standardized direct effects	standardized indirect effects	standardized total effects	*p*
8	H6: Affective empathy ← Negative life events	0.069	2.415	0.102	n.a.	0.102	0.016
9	H9: Cognitive empathy ← Affective empathy	0.038	-2.536	-0.100	n.a.	-0.100	0.011
10	H10: Psychological capital ← Negative life events	0.239	-3.356	-0.125	-0.005	-0.130	<0.001
11	H10: Psychological capital ← Work-related stress events	0.173	-3.240	0.121	-0.005	-0.126	0.001
12	H11: Perceived stress ← Psychological capital	0.011	9.804	-0.342	n.a.	-0.342	<0.001
13	H12: Psychological capital ← Cognitive empathy	0.141	12.814	0.444	n.a.	0.444	<0.001
14	H14: Compassion fatigue ← Psychological capital	0.050	-10.491	-0.315	-0.085	-0.400	<0.001

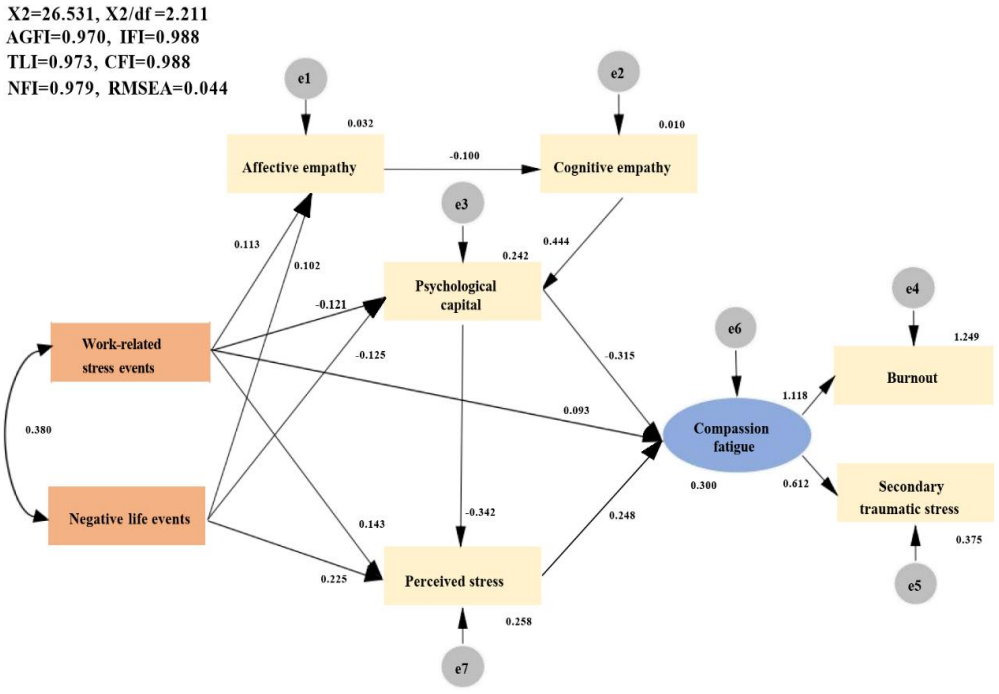

Figure 16. A path diagram of direct and indirect influences of psychological capital, empathy, perceived stress and stress exposures during the internship on compassion fatigue among Chinese internship nursing students (n = 640).

Note: The structural model has adequate fit to the data. All the coefficients in this figure are standardized and significant at level 0.05

related to psychological capital (β = -0.125, P < 0.001; between small and medium effect size), affective empathy (β = 0.102, P = 0.016; effect size between small and medium), perceived stress (β = 0.225, P < 0.001; between small and medium effect size), and CF (β = 0.098, P < 0.001; very small effect size). Moreover, psychological capital was found to have a significant negative direct association with perceived stress (β = -0.342, P < 0.001; between medium and large effect size) and CF (β = -0.315, P < 0.001; between medium and large effect size). Additionally, the pathways from negative life events to work-related stress events (β = 0.380, P < 0.001; between medium and large effect size), from affective empathy to cognitive empathy (β = -0.100, P = 0.011; small effect size), from cognitive empathy to psychological capital (β = 0.444, P < 0.001; between medium and large effect size), and from perceived stress to CF (β = 0.248, P < 0.001; between small and medium effect size) were all found to be statistically significant.

Further analysis utilizing the bias-corrected bootstrap method has revealed indirect pathways from work-related stress events and negative life events to CF. Specifically, work-related stress events indirectly impact CF through the independent mediating effects of psychological capital (β = 0.038, P = 0.005; between small and medium effect size) and perceived stress (β = 0.035, P = 0.001; between small and medium effect size), as well as through their combined mediation (β = 0.010, P = 0.003; small effect size). Similarly, negative life events also indirectly affect CF through the independent mediating roles of psychological capital (β = 0.039, P = 0.004; between small and medium effect size) and perceived stress (β = 0.056, P = 0.001; between small and medium effect size), as well as through their combined mediation (β = 0.011, P = 0.002; small effect size). Notably, our study found that when psychological capital, cognitive empathy, and affective empathy are considered together as mediating variables, they do not exhibit any mediating effects in the pathway from work-related stress events (β = 0.002, P = 0.070) and negative life events (β = 0.001, P = 0.076) to CF. The detailed results of these indirect pathways are presented in Table 18.

Table 18. Bias-corrected bootstrap test for all indirect pathways from stress exposure during the internship to compassion fatigue

no.	pathway	estimate (Bootstrap confidence)	*P*
1	Compassion fatigue ← Psychological capital ← Cognitive empathy ← Affective empathy ← Work-related stress events	0.002 (0.000, 0.006)	0.070
2	Compassion fatigue ← Psychological capital ← Work-related stress events	0.038 (0.012, 0.069)	0.005
3	Compassion fatigue ← Perceived stress ← Work-related stress events	0.035 (0.015, 0.061)	0.001
4	Compassion fatigue ← Perceived stress ← Psychological capital ← Work-related stress events	0.010 (0.004, 0.021)	0.003
5	Compassion fatigue ← Psychological capital ← Cognitive empathy ← Affective empathy ← Negative life events	0.001 (0.000, 0.006)	0.076
6	Compassion fatigue ← Psychological capital ← Negative life events	0.039 (0.011, 0.069)	0.004
7	Compassion fatigue ← Perceived stress ← Negative life events	0.056 (0.034, 0.083)	0.001
8.	Compassion fatigue ← Perceived stress ← Psychological capital ← Negative life events	0.011(0.004, 0.020)	0.002

Note: The value in the 95% confidence interval is obtained by bias-corrected percentile method. Abbreviation: **P<0.01; *P<0.05; CI, confidence interval; n.a., not available.

7. DISCUSSION

7. Discussion

The discussion of these five studies' results is presented below:

7.1 Study 1: A bibliometric analysis of the association between compassion fatigue and psychological resilience from 2008 to 2021

7.1.1 Annual trends in publications and citations

During the entire study period (2008 to 2021), especially after 2013, the number of publications on CF and PR increased significantly, indicating that these topics are becoming popular research areas. During the COVID-19 pandemic, the number of publications surged, further highlighting the importance of CF and PR research. The average number of citations per paper is 13.22, reflecting the significant academic impact of this field.

7.1.2 Category analysis

Psychology, nursing, psychiatry, social work, and clinical psychology are the most common subject categories in CF and PR research, indicating these topics are becoming prominent research areas. Public, environmental & occupational health ranked highest in centrality, highlighting its importance in this research field. The analysis of citing and cited journals' subject areas reveals the interdisciplinary influence of these categories in CF and PR research.

During the COVID-19 pandemic, education and educational research entered the top 10, underscoring the emphasis on self-care and resilience-based interventions. Self-care is the practice of behaviors that promote well-being, counteract work-related stress, and enhance resilience[207-211]. This shift reflects the significant impact of the pandemic on global mental health and the urgent need for CF and PR research. The unchanged

centrality of the top 5 research areas further underscores the importance of these categories in establishing collaborative relationships within the CF and PR field. Future research should focus on optimizing methods to foster resilience and exploring effective self-care strategies and interventions.

7.1.3 Overview of the research co-operation

Visualized knowledge mapping provides information on influential research teams and potential collaborators and helps researchers establishing collaborative relationships[212].

Distribution of countries and institutions

The USA, Canada, England, and Australia have made significant contributions to the CF and PR field. The USA is not only the most prolific country (153 articles) but also the highest in centrality, demonstrating its quantitative and qualitative strengths in CF and PR research. These countries were among the first to call for attention to CF and PR. Israel's contributions are also noteworthy. However, there is relatively limited interaction and cooperation between countries and institutions, as indicated by zero centrality scores, reflecting a lack of collaboration among authors. It is noteworthy that Sichuan University is the only Chinese institution to rank in the top ten. The initial outbreak of COVID-19 in Wuhan, China, may have spurred greater interest among Chinese scholars in this field.

Author analysis

The map of authors indicates that authors who publish more articles tend to collaborate more closely with others, which contrasts with the results of the country and institution analysis. Craigie M, as a representative figure, led his team to study the effects of anxiety, stress, and depression on compassion satisfaction (CS) and CF, and evaluated the effectiveness of psychosocial interventions designed to promote resilience among various

occupational groups, such as nurses and rural general practitioners. However, the low network density and centrality scores indicate insufficient collaboration among authors. Encouraging broader collaboration will help improve research quality.

During the COVID-19 period, author collaboration further decreased, with the number of nodes in co-authorship being about twice that of the links, reflecting reduced cooperation. Despite this, four of the top ten authors remained active, and except for Cao XY, all are from Canada, highlighting the significant contributions of Canadian researchers in this field. Sichuan University, as the only Chinese institution in the top ten, indicates that the outbreak of COVID-19 may have spurred greater interest among Chinese scholars in this field.

Analysis of journals

The analysis of journals shows that research in the CF and PR fields mainly focuses on nurses and social workers and their psychological issues, which is also validated in the category analysis. Nurses are typically exposed to various stressful work environments, such as patient deaths, violence, acute conditions, and patient suffering, which often overwhelm them[216,217]. For frontline clinical social workers, they face severe human service crises: clients with mental health problems exacerbated by COVID-19-related stress and individuals experiencing symptoms due to social isolation, quarantine, and drastic changes in daily life. Therefore, they experience higher levels of CF symptoms than other service practitioners[31,218]. Among the 167 records citing J Trauma Stress, a literature review by Dekel received a high number of citations[219],. This review described the intergenerational transmission of PTSD from fathers to sons in war veteran families and identified fathers' PTSD as a risk factor for increased emotional and behavioral problems among children. This underscores the importance of understanding and addressing PTSD.

During the COVID-19 period, the cited journal map shows that J Trauma

Stress and Int J Nurs Stud ranked first in terms of frequency and centrality, indicating increased attention to PTSD and nursing research during the pandemic. Among the 61 records citing J Trauma Stress, one review received a high number of citations[220]. This article summarized the risk and resilience factors for posttraumatic stress disorder and posttraumatic stress symptoms in healthcare workers, aiming to continually improve the effectiveness of intervention strategies.

7.1.4 The knowledge base of a research field

Reference co-citation analyses

Reference co-citation analysis reveals that health service practitioners such as nurses, physicians, therapists, child protection workers, police officers, and first responders often deal with potentially traumatic events and are required to help traumatized individuals (clusters #0, #5, #6, #7, and #10) [223-232]. However, exposure to traumatized populations can severely impact their mental and physical health, leading to compassion fatigue (CF) and compromising their well-being (cluster #9)[10,220,236,237].

Since the outbreak of COVID-19, attention to CF has significantly increased, as reflected in the rapid rise in annual publications in the CF and PR field (cluster #8) [15,32,229,238-241]. CF consists of secondary traumatic stress (STS) and burnout (BO) (cluster #3)[14]. Persistent CF can lead to decreased quality of care, strained relationships with colleagues, and severe mental health issues such as post-traumatic stress disorder (PTSD), anxiety, or depression (cluster #1)[242,243]. Additionally, several studies have shown that CF is significantly and positively correlated with turnover intention (cluster #2)[54,213,244-246]. A study conducted in China indicated that over 60% of nursing practitioners exhibited high or significantly high levels of turnover intention during the COVID-19 crisis. Therefore, high turnover and poor retention due to CF have become critical concerns, especially for healthcare providers. It is noteworthy that recent studies have found

individuals may exhibit positive changes following traumatic events, such as greater appreciation for life, enhanced close relationships, recognition and utilization of personal strengths, discovery of new possibilities, and spiritual development[233-235]. This phenomenon is referred to as post-traumatic growth (PTG).

The reference co-citation analysis during COVID-19 also found that coping with emergencies can bring significant psychological stress to healthcare providers, potentially accelerating the development of secondary trauma (clusters #0 and #3)[231]. Psychological resilience (PR) serves as a protective factor against secondary traumatization symptoms for frontline healthcare professionals (cluster #2)[229,247-249]. PR can mitigate the negative impact of CF on job satisfaction and turnover intention among healthcare workers (cluster #4)[250-252]. Furthermore, as a core component of PR, hardiness reframes negative experiences as opportunities and challenges, prompting individuals to take action to solve problems. This personality trait helps buffer against extreme stress, so strategies to enhance hardiness may promote PTG and well-being (cluster #1)[253,254].

Most cited articles analysis

The analysis of the most cited references reveals the central role of nursing in CF and PR research. Notably, the widely cited article by Sinclair S (2017) highlights its significant contribution to advancing CF research among healthcare providers[15]. The fact that most high-cited references are published in nursing journals further underscores the importance of the nursing field in CF and PR research.

The analysis of literature during the COVID-19 period shows a shift in research focus towards the relationship between variables related to PR and CF[127,260-265]. This shift reflects increased attention to these issues during the pandemic. The study by Ludick et al.[266] proposes a CF resilience model, providing new insights into the mechanisms of secondary trauma and theoretical basis for future trauma and secondary stress management. These

results indicate the critical importance of resilience skills in managing CF.

7.1.5 Emerging trends and research frontiers of caregivers

Keyword co-occurrence analysis

Keyword co-occurrence analysis reveals the core focus areas in CF and PR research. Nurses and social workers are the primary subjects of study, with research hotspots centering on mental health issues and the personal or organizational effects of CF. Self-care practices, as an important individual approach, are widely applied to build resilience and increase mindfulness, thereby reducing CF and promoting personal growth[267-270].

During the COVID-19 pandemic, the distribution of co-occurrence keywords remained largely unchanged, indicating that research priorities remained stable during the pandemic. This suggests that despite the global health crisis, researchers continued to focus on the same core issues, particularly on how to manage CF and improve the quality of life and job satisfaction of nurses and social workers through building resilience and self-care.

7.2 Study 2: Prevalence and related factors of compassion fatigue among registered nurses and nursing students during the internship: a systematic review and meta-analysis

In this review including 196 international, good-quality studies, we found that both registered nurses and nursing students during the internship had a moderate level of BO and secondary traumatic stress (STS) when these types of empathy-based strain constructs at work were measured using the ProQOL-5 scale. Both groups exhibited similar rates of moderate and high levels of STS using the ProQOL-5 scale. Using data from the CFSS, we found that both registered nurses and interns showed the moderate

level of CF. The included studies explored the relationship between CF, its two dimensions (BO and STS), and various factors. Five factors were identified as being associated with BO and STS in nurses: a poor work environment, lower social support, lower job satisfaction, heavier workload stress, and lower psychological capital, with the evidence being of moderate or low certainty. However, most reported factors did not show statistically significant relationships. Evidence for internship nursing students is sparse. But where available, lower psychological capital was also found to be related to BO and STS (moderate or low-certainty evidence). Less enjoyment of the nursing profession is related to a higher BO and a higher CF. The Conservation of Resources theory posits that stress arises from actual resource loss, the threat of resource loss, or the lack of resource gain, and that protecting and optimizing resources can help individuals more effectively manage stress[89]. Therefore, policymakers should establish and enforce strict standards to ensure that healthcare facilities provide safe and comfortable working environments with adequate resources and equipment. Hospital management should implement these standards by fostering a supportive and cooperative work atmosphere. Furthermore, nursing educators should emphasize the role of psychological capital in their curricula to help students maintain a positive mental state throughout their careers. Hospitals should also offer psychological counseling services to help nurses and nursing students maintain a positive mental state when facing work-related stress. Social Support Theory suggests that social support can provide emotional, informational, and practical assistance, reducing individual stress and enhancing coping abilities[271]. Consequently, policymakers should promote the establishment of effective support networks, including psychological counseling services and peer support programs. Hospital management should establish both formal and informal support networks, such as mentorship programs and peer support groups, to provide nurses with emotional support and professional guidance. The Job Demand-Control Model posits that work stress arises from the imbalance between job demands and personal control[272]. High-demand and low-

control work environments increase stress, but reasonable workload distribution and adequate support can effectively mitigate this stress[272]. Thus, policymakers should set reasonable workload standards to ensure that nurses' work burdens remain manageable. Hospital management should allocate workloads fairly and provide fair compensation and ongoing professional development opportunities to improve nurses' job satisfaction. Through these comprehensive measures, it is possible to effectively enhance the work environment, social support, job satisfaction, workload distribution, and psychological capital, thereby alleviating CF among nurses.

To our best knowledge, existing reviews have primarily focused on CF, BO, and STS among registered nurses, with a notable lack of evidence targeting at nursing students during the internship. The present review filled this gap by including data on nursing students during the internship, revealing that CF at work is prevalent (and at a moderate level) among them. In terms of the nurse-related data, this review is generally consistent with previous systematic reviews[29,32,273], all suggesting prevalent CF at work among registered nurses. Our review indicates that key factors relating to BO and STS in registered nurses are associated with work and psychosocial domains. Previously published systematic reviews only included studies with analyzable data for pooling to explore the factors related to CF at work [28,29,71,80,273-277]. In this present review, we found that it is challenging to perform a quantitative synthesis as factor variables were measured differently in the included studies, and the results were not always completely presented in included studies[28,29,71,80,273-278]. To generate better evidence, we followed Cochrane review approaches, incorporating study quality into evidence synthesis by only including good-quality studies[279]. To our knowledge, previous reviews have not considered this approach; nonetheless, our review still identified the largest number of studies compared with others.

The evidence we found is largely of moderate or low certainty, primarily downgraded due to substantial inconsistency and/or indirectness. In our

GRADE assessment, we did not consider the risk of bias as we excluded low-quality studies from this review. It's noteworthy that no existing risk of bias tools are specifically designed for assessing the quality of prevalence studies. Of available tool options for observational designs, we utilized the Agency for Healthcare Research and Quality tool. We employed a narrative approach to synthesizing factor evidence, precluding quantitative evaluation of heterogeneity. In assessing the certainty of factor evidence, we adopted qualitative and conservative methods to judge inconsistency. We did not downgrade for inconsistency if over 75% of studies showed consistent results for a factor. We downgraded once for inconsistency if 60% to 75% of studies were consistent, while 25% to 40% reported conflicting results. We downgraded twice if less than 60% were consistent, with over 40% conflicting. Again, without meta-analysis in synthesizing factor evidence, we cannot estimate optimal information sizes for facilitating the judgement of imprecision. In this review, we used the rule of thumb as noted in the GRADE guideline and considered a sample size of 400 or less as being small, in which we downgraded once for imprecision. In terms of indirectness, we aimed to generate evidence applicable to nurses in general; thus, we downgraded for indirectness if evidence identified was only for nurses from a specific hospital ward, or with a restricted age range. We did not consider publication bias, as comprehensive literature searches were performed, and Egger's test did not suggest evidence of small effects.

7.3 Study 3: Validity and reliability of the Compassion Fatigue Short Scale among nursing interns

Nursing students play an essential role in shaping the future nursing workforce, facing the dual challenges of CF and the COVID-19 pandemic, which significantly impact their career development [59,60,78,280]. In China, a notable gap exists in tools specifically designed to measure the severity of CF among these students, highlighting the need for reliable and validated self-

reported measures. Addressing this need, our study assessed the reliability and validity of the Chinese version of the CFSS, adapted by Sun et al. [25] for Chinese medical workers and firefighters. The validation among nursing interns indicated a partial misfit in CFA for the CFSS's two-factor model, yet EFA supported its overall validity. The CFSS exhibited strong convergent validity, excellent internal consistency, and reliable test-retest reliability. Criterion validity was supported by significant correlations with ProQOLS scores. Regression analysis identified major orientation and career intentions as significant predictors of CFSS scores in this group. These findings provide substantial evidence of the scale's efficacy in evaluating CF symptoms among Chinese nursing interns, marking a critical step towards ongoing CF level monitoring and intervention planning.

7.3.1 Construct Validity of the Scale

The CFA results showed that the model fit was not particularly ideal in certain aspects, raising some doubts about the complete applicability of the original two-factor model of the CFSS scale in nursing interns. This suggests that maintaining the two-factor structure without removing any items might deviate slightly from the expectations of the original model in this population. The findings were in line with those of the Turkish nurse version and the Chinese medical-worker version[25,26]. However, this statistical approach has not employed in the original version[13] and in the Turkish healthcare-professional version[216].

Therefore, to better adapt to the needs of this specific group, we conducted an EFA to re-explore and potentially redefine the factor structure and underlying components. Notably, despite some limitations of the original two-factor model suggested by the CFA results, the EFA results confirmed that the CFSS's two-factor structure remains applicable in the nursing intern population, thereby reinforcing the model's suitability for this group. This finding aligns with Adams et al.'s[13] original division of the scale's 13 items into two subdimensions. Consistent with this approach, no items

were excluded in the Turkish versions for nurses and healthcare professionals or in the Chinese version for medical workers [24-26]. Our study further demonstrated that the two-factor model explained 65.52% of the total variance, which is higher than the 51.0% in the Chinese medical-worker version [25], 51.46% in the Turkish nurse version, and 61.16% in the Turkish healthcare-professional version. Generally, a multifactor model is deemed sufficient if it explains at least 50% of the variance[281], indicating the robustness of our model. Thus, the various versions of the CFSS show consistent structural integrity and adequately account for variance across different cultures and professional groups.

7.3.2 Convergent Validity of the Scale

In assessing convergent validity, the CR and AVE for both subscales confirmed that the items within each subscale effectively represent their intended constructs, establishing them as distinct yet related factors. However, such convergent correlations have not been explored in other versions of the scale.

7.3.3 Criterion Validity of the Scale

Despite the clinical importance of high levels of CF, a standardized diagnostic approach remains undeveloped in healthcare settings. The ProQOLS was employed as an alternative due to the absence of a gold standard for CF assessment. In our study, moderate to strong correlations were observed between both the subscales and the total CFSS score with the three ProQOLS subscales, indicating satisfactory criterion validity. This finding aligns with DİNÇ, et al[26], who validated this conclusion among nurses. However, as ProQOLS primarily measures the impact of CF symptoms on quality of life rather than symptom severity, future in-depth validation studies are warranted. Besides, Yıldırım el al[24] assessed the criterion validity of CFSS among healthcare professionals using the BO Measure-Short Version Scale and the STS Scale, corresponding to CFSS subdimensions.

They reported significant positive correlation between these scales. Notably, at the time of conducting this study, no STS scale suitable for nursing interns in China was available. Recently, Li et al[282] adapted the STS scale, originally developed by Bride et al.[283], into the Chinese version and validated its reliability and validity, thus offering a new avenue for validating CFSS criterion validity using this parallel form method.

7.3.4 The Reliability of the Scale

The CFSS and its two subscales demonstrated good to excellent internal reliability in our study, comparable to previous studies [13,24,25]. The overall scale's Cronbach's αwas 0.91, akin to the Turkish healthcare-professional version[24], and slightly higher than the original version (α = 0.90)[13] and the Turkish nurse version (α = 0.876)[26]. Similarly, Sun et al[25] reported Cronbach's α values of 0.87 and 0.90 for two groups of medical workers. Additional measures including AIID, CT-TC, and split-half reliability were utilized. These measures validated the CFSS as a reliability tool for detecting CF in nursing interns, an aspect not explored in other versions. The test–retest reliability over 3-4 weeks was satisfactory, indicating the temporal stability of CFSS-T scores. Such assessment has not been conducted in other versions [13,24,25] and future research is needed to reinforce these findings.

7.4 Study 4: Prevalence of compassion fatigue in junior college nursing interns: A cross-sectional study

7.3.1 Main findings

We performed this cross-sectional study to (1) explore the prevalence of CF among Chinese nursing interns in the associate program; (2) compare the CF level among nursing interns from different sociodemographic and institution characteristics; (3) find out the relationship between nursing

interns' CF and their professional identity. The results of our study suggested the average level of CF among nursing interns is low, but about one of every five students is at high risk for CF and more participants have BO than STS. Female participants, who specialize in midwifery reported higher CF than male nursing interns, who specialize in nursing. Nursing students who have an internship in a secondary hospital showed higher CF than those who have an internship in a tertiary hospital. We also found that the more night shifts they undertook, the higher level of CF they reported. 13.9% of participants reported that they intend to withdraw from the nurse or midwife profession, who reported much higher CF than those who intend to stay in this profession. In addition, correlation analysis identified a significant medium association between CF and professional identity.

7.3.2 The status of CF

Although CF among clinical nurses has received widespread attention. There is limited published research focusing on nursing students[66,284]. This study found that 19.5%, 24.5% and 17.2% of participants presented with a high risk for CF, BO and STS by using the median as cut-off value, respectively, which indicate that the CF level among nursing interns is low. This result were in line with the findings of Han Binru et al. (2017) who found that 37.8% and 21.9% of nursing interns report high levels of BO and STS, respectively[285]. Likewise, Cao el al (2021) reported very low the prevalence of high levels of BO and STS among nurse interns (0.9% and 1.1%, respectively)[66]. Although these studies used different the measurement tool and classification methods, but they all reported a low-level CF among nursing interns.

CF is caused by continual exposure to stress and trauma during clinical practice. Therefore, the CF level among healthcare providers is associated with the time and nature of their work. It is reasonable of the low level of CF among nursing interns as nursing students receive only 8 to10 months

of clinical internships in different departments. Another reason for the low level of CF among nursing interns could be that nursing students are protected from medical errors under the strict supervision of clinical teachers, which could mitigate their stress from work[286]. However, nearly 20% of participants who existed a high level of CF still merited attention by educators and clinical managers. The clinical internship provides students with opportunities to practice their knowledge and skills learned in classrooms. However, this process would be stressful for some nursing students as they are lack of clinical knowledge and self-confidence. Nursing interns could be at the bottom of the social hierarchies of the stressful clinical settings. Studies are reporting that nursing interns are at the risk of experiencing bullying from staff nurses, clinical instructors, as well as patients and families, which could be the reason for BO, high CF, low career identity. Further studies are needed to explore the reasons for the high level of CF among these participants. Interventions should be developed to assist them in building their competencies and confidence, the actualization of their role as nurses, and the understanding of their responsibilities in care, which could enhance their enthusiasm for helping others[69].

7.3.3 Comparison of CF by Participants' characteristics

When we investigated the distribution of CF among the participants, we found female participants, from a midwifery specialty, have an internship at secondary hospitals and had more night shifts, and those who intend to switch to another profession after graduation are associated with a higher level of CF.

In the aspect of specialty, participants whose specialty in midwifery shows higher CF than a specialty in nursing. During the clinical internship, both nurse and midwife students face the challenge of demanding workloads, challenging placements, and witnessing traumatic events, with subsequent stress sometimes affecting CF. Compared with nursing students, students who specialize in midwives are more like to work in the units related

to birth, which are considered happy events that bring positive emotions. However, there are factors such as loss of control, inability to cope with pain, various complications, and traumatic birth that can turn the childbirth process into a stressful and traumatic experience[287,288]. A recent study shows that midwifery students are facing a high level of STS rate which should be supported by mental health nurses to cope with traumatic stress[289]. However, further studies should explore the difference between midwifery and nursing interns.

In the aspect of level of intern hospital, nursing interns in the secondary-level hospital had higher CF than nursing interns in the tertiary hospital. The classification of hospitals in China is a three-tier system: Primary, Secondary, or Tertiary hospitals. Secondary hospitals are responsible for providing comprehensive health services and managing simple diseases. Tertiary hospitals provide specialist health services and serve as medical hubs providing care to multiple regions. Reports show that compared with tertiary-level hospitals, the secondary-level hospitals face the greater challenge of staff shortages, less advanced relative to the staff's level of education, and the sophistication of medical equipment. These challenges lead to higher workloads and a higher risk of BO for healthcare workers in secondary-level hospitals and also hurt the quality of medical outcomes for patients. Same as nurse staff, nursing interns will experience the same stress in secondary-level hospitals which will increase their CF and BO[290].

In the aspect of number of night shifts, nursing interns who undertook more night shifts reported higher scores of CF. This finding is consistent with early studies[291,292]. Same as nurse staff, nursing interns also need to take different work shifts. Evidence shows that shift work can cause nurses' job BO and a series of health problems[293,294]. The shift works also has a negative impact on nurses' job satisfaction and job performance[295,296]. In addition, nursing students in the post-internship stage are faced with the pressure of job hunting and examinations, and they are more concerned about the impact of scheduling. Research shows that there about 63% of nursing students reported that shift work had decreased work enthusiasm

and job satisfaction, and also have a negative impact on their communication with patients[57]. Therefore, managers should appropriately refer to the opinions of nursing students, arrange flexible shifts, improve the practice efficiency of nursing students, and reduce the negative pressure of scheduling on nursing students.

In the aspect of intent to be a nurse or midwifery, there are about 14% of participants reported that they intend to withdraw from the nursing profession[297,298]. These participants have significantly higher CF than those who would like to stay in this profession. Clinical internships provide nursing students with chances to practice the knowledge learn from the classroom and also provide them with a chance to gain an insight into the real nurse's roles and meanwhile expanding the expectations of their future careers. A qualitative interview shows that two reasons for nursing students' dropout in the late stage of their study are: lacking a safe learning environment in clinical placements and psychological support and realizing that the training and the future profession did not match their expectations and wishes[299]. CF could be a reason for nursing intern intent to withdraw from the nursing profession. Conversely, nursing interns whom intent to show less enthusiasm for their work and patients, as a result, are more exposed to negative emotions, including CF. This finding is further tested by the negative correlation between CF and professional identity.

7.5 Study 5: Impact of internship nursing students' stress exposure on compassion fatigue: insights from the ABC-X Model

To the best of our knowledge, this is the first study to investigate the factors contributing to the onset and progress of CF among internship nursing students using the ABC-X model. This study not only validates and expands the applicability of the ABC-X model in the field of nursing education, but also provides new insights into the understanding of the development of CF. Our findings indicate that the overall level of CF among Chinese

internship nursing students is moderate. Further analysis revealed that internship nursing students' stress exposures not only directly affect CF, but also indirectly affect sleep quality through psychological capital and perceived stress. However, it is noteworthy that we did not find empathy to play a mediating role in the relationship between stress exposures and CF.

7.4.1 The level of compassion fatigue

This study reveals an average CF score of 50.2, which is slightly higher than the average of 44.99 reported in a survey involving 2,256 nursing interns[78]. However, the level of CF in our study is lower than the average score of 60.61 obtained from a survey conducted on internship students majoring in nursing and midwifery in tertiary grade A hospitals[77]. These discrepancies may be attributed to the differences in data collection methods. Unlike other studies conducted during the peak of the COVID-19 pandemic, our study was carried out in the post-pandemic period[77,78]. Existing studies have demonstrated fluctuations in the levels of CF among healthcare professionals at different stages of the COVID-19 pandemic crisis[300-303]. Additionally, factors such as the level of the hospital where the students were interning, educational level, and the proportion of students from rural backgrounds may also influence levels of CF[66,78,304]. Although there are variations in the specific levels of CF among nursing students, the overall level remains moderate. Given that CF can significantly increase dropout rates among nursing students and lead them to leave the profession shortly after graduation[58-63,78,305], ongoing monitoring and effective interventions to address CF in nursing students are crucial.

7.4.2 The relationship between stress exposures during the internship and compassion fatigue

Based on the findings from SEM analysis, we observed that in nursing interns, work-related stress events and negative life events are significantly

interrelated and negatively correlated with psychological capital, while positively correlated with affective empathy, perceived stress, and CF, thereby supporting Hypotheses 1, 2, 3, 6, and 10. According to Stevan Hobfoll's Conservation of Resources theory, individuals instinctively strive to protect and preserve their psychological resources in stressful environments[306]. Nursing interns facing intertwined work and life stressors were found to expend substantial amounts of time, energy, and emotional support, thus triggering a vicious cycle of resource loss. This depletion of resources led to a reduction in psychological capital, weakened their coping capabilities, and increased perceived stress. Additionally, continuous energy expenditure and loss of recovery power may lead to CF[307]. At the same time, sustained stress enhances the emotional empathy of nursing interns, enabling them to deeply empathize with patients' suffering, but excessive empathy can lead to an overly responsible and worrisome attitude towards patients[125,308]. In the long term, this deep emotional involvement may intensify their emotional burden and deplete further psychological resources. These insights not only provide nursing students with crucial information for identifying and addressing potential stressors during clinical internships, but also underscore the necessity of implementing effective stress management strategies, such as maintaining and enhancing psychological capital, to prevent and mitigate CF and other negative emotional impacts.

7.4.3 The mediating and chain mediating effects of psychological capital, empathy and perceived stress

Using a moderated mediation model within a structural equation modeling framework, we explored how work-related stress events and negative life events indirectly affect CF through the independent and sequential mediating roles of psychological capital and perceived stress. Specifically, our analysis supported Hypotheses 3, 4, 10, 11, and 14, indicating that nursing interns with lower psychological capital and/or higher perceived stress

are more susceptible to CF under clinical and life stressors. These findings align with the fundamental propositions of the Stress and Coping Model, which suggests that individuals implement various coping strategies in response to stress events[90]. These strategies influence their perception of stress and consequently lead to psychological outcomes such as CF. Additionally, research by Sun et al. supports this view, finding that nursing students' positive psychological capital significantly enhances their capacity to manage stress and maintain mental health[197]. These insights underscore the necessity of further strengthening the development of psychological capital and optimizing stress perception strategies in nursing education. Enhancing these areas can help interns more effectively tackle the challenges of professional life, thereby preventing and alleviating symptoms of CF and enhancing their overall well-being.

In this study, we were unable to identify a mediating role for emotional and cognitive empathy between work-related stress and negative life events and CF among nursing interns, contradicting Hypotheses 5, 7, and 8. Figley's model of empathic stress and fatigue suggests that empathy, fundamental for assisting others and bearing the "cost of caring," typically leads to CF[4]. This unexpected result implies that the relationship between empathy and CF is more complex than anticipated. Possible explanations include: Firstly, CF generally arises from prolonged, intensive patient contact and sustained high-stress environments[307]. In contrast, nursing interns, who are typically in the learning and vocational adaptation phase, face relatively lighter duties that do not involve complex or urgent clinical situations. Such duties may not generate enough stress to trigger significant CF, especially compared to seasoned nurses dealing with severe cases and life-or-death decisions[32]. Secondly, the emotional empathy capacities of nursing interns may not be fully developed, implying they might struggle to profoundly experience patients' pain and emotions. If interns are not sufficiently sensitive emotionally, they are less likely to fully empathize, reducing the likelihood of experiencing the resultant emotional toil and CF[126,309]. These findings suggest that the relationship between empathy

and CF can be influenced by various factors, urging further exploration of individual and environmental influences such as emotional regulation[126], feelings of guilt[125], and social support[310], to better understand this complex phenomenon. Additionally, considering the unique environments and experiences of nursing interns, developing targeted training and support programs may be crucial for preventing and managing CF.

Despite not observing a mediating role of empathy between stress exposure and CF during internships, we noted a significant negative correlation between affective and cognitive empathy (Hypotheses 9). This observation suggests that even if empathy does not directly cause CF, the imbalance between affective and cognitive empathy could pose future emotional management challenges in the professional lives of nursing interns. Previous research indicates that clinicians often struggle to balance detachment and emotional connection, potentially leading to health and care quality reductions, stress, fatigue, and avoidant coping strategies[311,312]. This underscores the importance of training nursing interns to balance emotional and cognitive empathy from an early stage in their education. Enhancing cognitive empathy training and properly managing emotional empathy investments can help interns more effectively handle emotional challenges in the workplace, potentially alleviating long-term career CF.

8. CONCLUSIONS

8.Conclusions

In the current thesis, a total of five separate studies were conducted to achieve three major goals. Consequently, we have drawn a series of conclusions based on the findings from these studies.

i. In the first study, we conducted the initial bibliometric analysis of the scientific output in the compassion fatigue (CF) and psychological resilience (PR) fields using CiteSpace® software. Moreover, we also illustrated the change of this research topic as the COVID-19 pandemic. The number of publications in the CF and PR field presented an ascending trend over the past decade, particularly during the COVID-19pandemic. Overall, USA was the most influential country in this research topic, as it not only published the largest number of articles but also had close co-operation with other countries. Curtin University in Australia was the most prolific institution. Frontiers in Psychology was the most productive journal on this field. The turnover intention of health care providers has been a research focus in recent years. Nursing practitioners and social workers are currently the key target groups and will likely remain so in the near future. The mental problems of nurses and social workers are the main research topics. However, this field is at an initial development stage, particularly for developing countries. Further studies and more collaborations among institution and authors should be encouraged to explore effective interventions for the cultivation of PR and the reduction of CF.

ii. The second study found that both registered nurses and nursing students during their internships exhibit moderate levels of CF. There is evidence of moderate or low-certainty suggesting that the common factors associated with BO and STS at work in registered nurses include a poor work environment, a lower social support, a lower job satisfaction, a heavier workload stress, and a lower

psychological capital. Besides, low psychological capital is a common factor associated with BO and STS in nursing students during the internship. However, due to the limited evidence, further research is necessary.

iii. The third study extended and re-evaluated the Chinese version of CFSS in a different population context. Our findings supported the validity and reliability of the Chinese version of CFSS as a measurement tool of CF for nursing interns.

iv. The fourth study found that the CF level among Chinese nursing students is lower than that among the nurse staff. Female participants, with midwifery specialty, having internships at secondary hospitals, and more night shifts and those who did not intend to work as a nurse or midwifery reported a high level of CF. Further studies are needed to explore the reasons for the high CF level among these participants.

v. The fifth study revealed that internship nursing students experience moderate CF. Internship nursing students' exposure to stress is significantly associated with an increased risk of CF. Internship nursing students' perceived stress and psychological capital act as mediators, moderating the relationship between stress exposure and CF. However, no mediating effect of empathy was observed in this study.

9. LIMITATIONS

9.Limitations

As previously described, this thesis encompasses five separate studies, each conducted with the objective of enriching the existing body of knowledge and attempting to bridge the gaps between current evidence and clinical practice. While these studies have yielded several positive findings, it is essential to acknowledge the limitations of this thesis. These limitations are outlined below in accordance with the sequence in which the four major conclusions were derived.

i. In the first study, three main limitations must be further interpreted. First, we only collected data from the Web of Science® Core Collection when retrieving literature. Future studies should retrieve more databases to identify additional papers. Second, only articles and reviews were included in our analysis. Therefore, we have miss related articles in other document types. Third, bibliometrics is a quantitative analysis of academic publications, whereas articles with high citation counts don't necessarily equate to articles with the high quality or high correlation with target field. Researchers should use multi-method evaluations to obtain a more in-depth understanding of this research field.

ii. In the second study, it is important to acknowledge the review's limitations. Firstly, there are only 8 studies focusing on internship nursing students, which limits the ability to make comparisons between the outcomes of internship nursing students and registered nurses. Secondly, the included studies reported diverse types of data on factors relating to compassion fatigue (CF) and its two dimensions at work, preventing the performance of a meta-analysis by factors. Alternatively, we employed narrative synthesis approaches for summarizing factor evidence. Thirdly, it is well acknowledged that using funnel plots for assessing publication bias in single-arm meta-analysis has limitations[313]. Consistent

with common practice in prevalence-specific systematic reviews, we did not perform a publication bias assessment, although it was pre-planned. It is worth noting that, to minimize publication bias in this review, we comprehensively searched multiple English and Chinese databases. Fourthly, no specific GRADE method was developed for assessing the certainty of prevalence evidence. We followed to generic GRADE principles for assessing the certainty of the evidence in this review. The methods for synthesizing prevalence data are still under development. To guide future reviews, we advocate for empirical evaluations of relevant publication bias assessment approaches in this area and further development of specific GRADE methodologies.

iii. In the third study, it is important to acknowledge the limitations. Firstly, the data for CFA were sourced from a survey on CF prevalence among junior college nursing interns, not primarily intended for CFSS CFA. Age information was not collected; however, given that most Chinese college students are typically 17-19 years old, its absence likely does not significantly bias the results. Secondly, the reliance on online survey methods might have led to the exclusion of students with infrequent internet access or those who did not respond within the designated data collection period, potentially resulting in a sampling bias. Thirdly, the majority of respondents were female junior college students from Hunan province, limiting the representation across China's diverse cultural and gender demographics. Future research should aim to include a broader male student population from various colleges and universities. Fourthly, owing to the lack of established diagnostic standards for CF, specific cut-off values for the CFSS could not be determined. Addressing this gap, future research needs to focus on the development and validation of explicit diagnostic criteria for CF. This advancement will enable the precise determination of cut-off values for the CFSS, especially within the context of nursing

intern populations.

iv. In the fourth study, there are three main limitations. First, the cross-sectional study design and self-report data as opposed to objective measurement, and therefore our results may be negatively by potential bias. Second, convenience sampling was used in this study, which might be a source of selection bias. Third, the CFSS used in our study didn't provide a cut-off value, and it is not convenient to divide the degree of CF. Therefore, further studies are needed to determine the cut-off value, so that the questionnaire can be more widely used. What's more, further studies can use the qualitative method to explore the reasons the part of nursing interns who reported high CF.

v. In the fifth study, despite its meaningful contributions, there are notable limitations. Firstly, the nature of cross-sectional design limits our ability to establish causal relationships between variables. Future research employing a longitudinal design is warranted to elucidate the mechanisms through which adverse life events and occupational events drive the onset and progress of CF. Secondly, we assessed the stressors of the internship exposure by examining whether students encountered common work-related and negative life events. Although the frequency and intensity of these events were not measured in detail, this method effectively identified key stress events and provided preliminary insights into their cumulative impact. This approach aids in understanding the composite effects of multiple stressors during the internship period, although it may not fully capture the individual impact of each event. Thirdly, our study was limited by the recruitment of nursing interns exclusively with associate degrees, which may restrict the generalizability of our findings. Nursing interns with different educational backgrounds may experience varying degrees of CF when confronted with similar stressors

and negative life events during their internships. Further comprehensive research is needed to explore the potential variations in this regard. Fourthly, our study primarily focused on the influence of individual resources on CF. However, according to the ABC-X model, factor B also encompasses resources from family, society, and other avenues. This constraint hinders an in-depth exploration of the complexity of CF mechanisms among nursing interns, thereby affecting the external validity and generalizability of the study.

10. IMPLICATIONS FOR CLINICAL PRACTICE

10.Implications for clinical practice

Based on the findings from these five studies, several implications for clinical practice are drawn.

i. Study 1, indicates that healthcare administrators should be aware of the rapid growth in research on compassion fatigue (CF) and psychological resilience (PR), particularly the recent literature highlighting key research hotspots and frontier issues in this field. CF and PR research is primarily concentrated in psychology, nursing, and social work. Healthcare institutions should develop targeted mental health interventions based on advancements in these fields to alleviate the psychological stress of healthcare workers. Research demonstrates that resilience training, self-care, and mindfulness practices significantly reduce CF. Therefore, these methods should be promoted and implemented in clinical practice to enhance the psychological resilience and job satisfaction of healthcare workers, thereby reducing turnover rates.

ii. Study 2 yields several important implications. Firstly, since both registered nurses and nursing students during the internship present moderate levels of CF at work, it becomes crucial to support nursing students in addressing CF experienced during their internship time. Secondly, as it is noted above that psychosocial domains-related factors play an important role in CF and its two dimensions, we recommend providing targeted psychological health education and training for nursing students before their internships. This could enhance their awareness of CF and related psychological issues. Intervention strategies for nursing students during the internship could consider cultivating and strengthening their psychological capital. Such measures are crucial for enhancing their psychological adaptability to

internship challenges, thereby reducing the risk of CF and laying a solid foundation fortheir future professional career. Also, continuous monitoring of interns' psychological health is advisable to detect early signs of CF. Thirdly, this present review highlights the dominance of literature in registered nurses in this area. Whilst research targeting at intern nurses remain limited, thus more research is urgently needed. Fourthly, we found uncertain evidence regarding demographic characteristics as factors related to CF, BO, and STS in both nurses and nursing students during the internship, indicating a need for high-quality data about these factors.

iii. Study 3, validates the reliability and validity of the Chinese version of the CFSS among Chinese nursing interns. Despite some model fit issues, the overall results strongly support its application in this population. The CFSS demonstrates excellent convergent validity, internal consistency, and test-retest reliability, and it is significantly correlated with ProQOLS scores. This indicates that the CFSS is a robust tool for assessing and monitoring CF levels among nursing interns. By utilizing this tool, nursing educators and clinical managers can more effectively identify and intervene in symptoms of CF, thereby promoting the professional development and mental health of nursing interns. These findings provide a crucial foundation for enhancing nursing education and management practices, ultimately contributing to the overall well-being and job satisfaction of future nursing professionals.

iv. Study 4, provides several important insights. Approximately one-fifth of junior college nursing interns are at high risk for CF, and BO is more prevalent than STS. This suggests that nursing administrators should closely monitor the mental health of nursing interns and implement effective interventions. Resilience training, self-care, and mindfulness practices have been shown to significantly reduce CF and should therefore be promoted and

implemented in clinical practice to enhance the psychological resilience and job satisfaction of nursing interns, thereby reducing turnover intentions. The study also indicates that nursing interns in secondary hospitals, those working night shifts, or those specializing in midwifery have higher levels of CF. Nursing administrators should pay particular attention to the scheduling of night shifts, consider the interns' preferences, and arrange flexible working hours to minimize the negative impact of shift work. Additionally, establishing a safe learning environment and providing psychological support systems can help alleviate the stress and challenges faced by interns during their clinical placements. Furthermore, the study reveals that interns intending to leave the nursing profession exhibit significantly higher levels of CF than those planning to continue in the field. This underscores the need for nursing educators to help interns develop a strong professional identity and use appropriate interventions to boost their enthusiasm and commitment to nursing, thereby reducing turnover intentions. Overall, these interventions can effectively enhance the psychological resilience and job satisfaction of nursing interns, reduce the incidence of CF, and improve the retention rates of nursing talent within healthcare institutions.

v. Study 5, provide several important clinical practice implications. Firstly, stress exposure not only directly impacts CF among internship nursing students but also indirectly affects CF through psychological capital and perceived stress. This underscores the importance of enhancing stress management and psychological capital in clinical practice to prevent and mitigate CF and other negative emotional impacts. Secondly, the consumption of psychological resources while coping with work and life stressors reduces nursing interns' coping abilities and increases perceived stress. Therefore, establishing routine monitoring mechanisms to timely identify and intervene in CF is crucial. Nursing education should

Implications for clinical practice

emphasize balanced training in emotional and cognitive empathy, which will help interns manage emotions more effectively throughout their careers and reduce the risk of CF. Although emotional and cognitive empathy did not show a mediating role, their negative correlation suggests that balancing these aspects is important for emotional management. Furthermore, to support nursing interns' smooth transition into their professional roles, long-term career development support should be provided from the internship phase. This includes psychological support, career planning guidance, and burnout prevention training, which will enhance their career satisfaction and job quality. Finally, future research should further explore the impact of individual and environmental factors on the relationship between empathy and CF. For instance, investigating the roles of emotional regulation, guilt, and social support in the link between stress exposure and CF will help develop more targeted interventions.

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Appendix 1

Supplementary Material

File passport : YLJDOCTORALTHESIS

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Appendix 2

Registration of Study

NIHR | National Institute for Health Research

PROSPERO
International prospective register of systematic reviews

Prevalence and related factors of compassion fatigue among nurses and nursing interns: a systematic review and meta-analysis

From	To	Date	Subject
CRD-REGISTER	"940576567@qq.com" <940576567@qq.com>	Mon, 10 Jul 2023 23:25:02 +0100	PROSPERO acknowledgement of receipt [444173]

Appendix 3

Ethical Approval for Studies

湖南中医药高等专科学校医学伦理委员会伦理审查意见表

YX20220718 号

审查项目名称	高职院校护理实习生同情疲劳现状调查及社会心理机制研究		
审查项目类别	□ 省级 课题申报		
提交文件（包括但不限于）	■伦理审查申请表（主研究者签名并注明日期）； ■研究方案（注明版本号和日期），包括申请人遵守法律法规和遵循伦理原则的声明，对研究中涉及的伦理问题的说明； ■知情同意书（注明版本号和日期）；		
研究单位	湖南中医药高等专科学校	所属院部	护理学院
项目负责人	易莉娟	职称	讲师
项目联系人及方式	易莉娟 18908436200		
伦理初审意见	经本伦理委员会初步审查，该项目基本符合世界医学会的《赫尔辛基宣言》和国际医学科学组织委员会颁布的《人体生物医学研究国际道德指南》的伦理原则，同意该项目实施。 盖 章 2022 年 7 月 16 日		
伦理委员会联系人（秘书）	0731-82519277 陈壮		

Appendix 4

Certificate of Research Stay

仁和、精诚、笃行、致远

湖南中醫藥高等專科学校
HUNAN TRADITIONAL CHINESE MEDICAL COLLEGE

February 7, 2021

To Whom It May Concern,

As the Director of the College of Nursing at Hunan Traditional Chinese Medicine College, I am writing to confirm that Yi Lijuan has been engaged in research activities at our Institute from December 18, 2021, to February 30, 2024.

During this period, Yi Lijuan has diligently worked on her doctoral project, specifically conducting three survey-based research studies and one intervention. These activities were aimed at gathering data pertinent to her doctoral thesis, and were carried out in collaboration with our research team.

Sincerely,

Zhao Rong (赵蓉)

Dean of College of Nursing
Hunan Traditional Chinese Medicine College

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Appendix 5

Timeline of Research Activities During PhD Program

Timeline of Research Activities During PhD Program

Date	Activity Description
December 18, 2021	I arrived at the School of Nursing, Hunan Traditional Chinese Medicine College, and commenced research activities.
December 20, 2021 – January 15, 2022	I designed and prepared the first three surveys, including questionnaire development and pilot testing.
December 2021 – January 2022	I conducted the first survey among nursing interns in 10 vocational colleges in Hunan Province, collecting data on the incidence of compassion fatigue.
January 7 – January 13, 2022	I conducted the second survey, collecting data for the reliability and validity testing of the compassion fatigue measurement tool.
February 8 – February 18, 2022	I conducted the third survey, collecting data for the test-retest reliability of the compassion fatigue measurement tool.
February 2022 – November 2022	I organized and analyzed data from the first survey, wrote and published a research paper.
December 2022 - May 2023	I continued to organize and analyze data from the second and third surveys, wrote and submitted research papers.
January 6 – December 2023	I designed and prepared the fourth survey, including questionnaire development and pilot testing.
January 2023 – Present	I am studying at Universitat Rovira i Virgili, with monthly meetings with supervisor Professor Maria to discuss research progress (excluding winter and summer breaks).
March 2023 – February 2024	I continued to organize and analyze data from the fourth survey, wrote and submitted research papers.
March 2024 – June 2024	I completed final data analysis and wrote the doctoral dissertation.

Appendix 6

Published Paper 1

frontiers | Frontiers in Psychology

ORIGINAL RESEARCH
published: 22 June 2022
doi: 10.3389/fpsyg.2022.890327

A Bibliometric Analysis of the Association Between Compassion Fatigue and Psychological Resilience From 2008 to 2021

Li-Juan Yi[1,2†], Yi Liu[3†], Ling Tang[4], Liang Cheng[1], Guo-Hao Wang[5], Su-Wen Hu[1], Xiao-Ling Liu[6], Xu Tian[2] and Maria F. Jiménez-Herrera[2]**

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Aims: A negative association between the lower level of psychological resilience (PR) and increased risk of compassion fatigue (CF) and higher Coronavirus disease 2019 (COVID-19) stress has been revealed. However, bibliometric studies have not been performed to comprehensively investigate this topic. This study aimed to identify the status and trends in the CF and PR field from 2008 to 2021 and during the COVID-19 pandemic.

Methods: We identified relevant literature from the Web of Science Core Collection® database using "resilience" and "compassion fatigue" on September 30, 2021. All search results were exported in plain text format for collaboration network analysis, reference-based co-citation analysis, analysis of journals, and keywords-based co-occurrence analysis, which were performed using Citespace® 5.8.R1.

Results: A total of 388 publications were identified finally, and there has been an increasing trend in the annual number of publications with light fluctuations. The analysis of journals and keywords indicated that nurses and social workers are the main research targets, and their mental problems are the main research topics. The turnover intention of health care providers has been a research focus, particularly during the COVID-19.

Conclusion: The results of the present study help us understand the status of the CF and PR field and its recent developments.

Keywords: compassion fatigue, physiological resilience, Web of Science, bibliometric analysis, COVID-19

HIGHLIGHTS

- The number of publications focused on compassion fatigue (CF) and psychological resilience (PR) increased rapidly, particularly during the COVID-19 pandemic.
- CF and PR are becoming a hot research topic, especially the psychological problems of nurses and social workers.
- The turnover intention of healthcare providers has been focused on during the COVID-19.
- Research on CF and PR is at the initial stage, and more studies should be performed to investigate the effective strategy for cultivating PR.

INTRODUCTION

Compassion fatigue (CF) refers to emotional, physical, and psychological exhaustion distress resulting from repeated or prolonged expression of compassion or empathy, which may occur in individuals working in caregiving professions (Stamm, 1995, 2010; Hernández et al., 2007; Skovholt and Trottermathison, 2011). Currently, different terms, such as vicarious stress, secondary traumatic stress, burnout, and compassion stress, have been used interchangeably with the term CF (Joinson, 1992; Figley, 2002; Gentry, 2002); however, it can be divided into two parts including burnout (BO) and secondary traumatic stress (STS) (Gerami Nejad et al., 2019). A systematic review involving 28,509 nurses from 11 countries revealed a pooled mean BO of 26.64 and STS of 25.24, respectively, suggesting that nurses suffered from significant CF. Meanwhile, the authors also uncovered levels of CF increased gradually from 2010 to 2019, reaching a peak in 2019 (Xie et al., 2021). Besides, a cross-sectional survey study by Khalaila (2021) stated that CF is prevalent among family caregivers and showed a positive correlation between caregiver burden and CF. Long-term effects of CF aggravated the development of job stress and BO and then led to a low level of work engagement, posing challenges for staff retention and influencing patient safety (Craig and Sprang, 2009; Maiden et al., 2011; Thomas, 2013; Mason et al., 2014; Khamisa et al., 2015; Kim et al., 2017; Zhang et al., 2018; Wood et al., 2019; Allday et al., 2020).

Coronavirus disease 2019 (COVID-19), an unprecedented global health crisis (Har and Snbbc, 2020), has infected over 243 million people and caused 5 million deaths as of 25 October 2021 (Johns Hopkins University, 2021). Evidence showed that service providers from different fields are highly susceptible to psychological problems under the high-pressure and high-risk situations, which was also demonstrated under COVID-19 conditions (Shih et al., 2009; Kang et al., 2015; Alharbi et al., 2020b; Louise Duncan, 2020; Ran et al., 2020; Tominaga et al., 2020; Tang et al., 2021). As one of those suffering the most, health professionals are reporting increases in CF, or an inability to care and provide comfort for patients owing to the overwhelming nature of the task at hand (19). According to a newly published online survey, about two in five (n = 306) healthcare professionals experienced medium to high CF and BO, especially those who are directly caring for patients with COVID-19 (Ruiz-Fernandez et al., 2021). Meanwhile, other essential professionals, such as psychological hotline counselors, marriage and family therapists, and education professionals, have also been found to encounter more intense BO and CF than ever during the COVID-19 pandemic (Clark et al., 2021; Pérez-Chacón et al., 2021; Zhang et al., 2021a). Consequently, action to prevent or reduce CF cannot be postponed with the ongoing pandemic.

Despite a rich literature on CF in service practitioners, however, very limited information is available on effective initiatives to alleviate it (Cao et al., 2021b; Khalaila, 2021; Salur and Yildirim, 2021; White et al., 2021; Xie et al., 2021; Yeung et al., 2021; Yi et al., 2021). One potentially promising approach is to strengthen psychological resilience (PR) (Zhang et al., 2021b). PR is a positive adaptation process under adversity, stressors, and traumatic events (Campbell-Sills and Stein, 2010), which has been proven to be a protective factor against the development of CF and COVID-19 stress (Burnett and Wahl, 2015; Li et al., 2021; Iimura, 2022). Resilient caregivers would be more likely to cope more effectively with stress and trauma (Alharbi et al., 2020a; Allday et al., 2020; Flanders et al., 2020; Gonzalez-Mendez et al., 2020; Grauerholz et al., 2020) and are also apt to be more optimistic and flexible (New et al., 2009). PR not only decreases anxiety and depression but also fosters job satisfaction and staff retention (Jo et al., 2020; Cao and Chen, 2021a; Labrague and de Los Santos, 2021; Merlo et al., 2021; Muomah et al., 2021). However, the efficacy of resilience promotion intervention on CF has only been confirmed by very few low-quality trials with a small sample of 11, thus, the CF and PR fields are still a research topic, particularly in the context of the pandemic (Sood et al., 2011; Mealer et al., 2014; Gerhart et al., 2016; Michael et al., 2019; Brassington and Lomas, 2020).

Bibliometrics is a scientific approach to analyzing knowledge carriers with mathematical and statistical methods, and it can reveal the trend of a specific research topic (Nicolaisen, 2010; Vaneck and Waltman, 2010). As a popular information visualization software developed in 2004 (Chen, 2006; Chen et al., 2019), CiteSpace benefits from visually showing now the network patterns of a research topic, such as identifying rapidly growing subject areas and discovering and tracking citation hotspots (Chaomei et al., 2012). Many studies have been carried out on CF and PR over the last decade. However, few research studies have outlined this research domain from the perspective of bibliometric analysis.

In the present study, we aimed to identify annual publications and most representative disciplines and journals in the CF and PR field and to unfold which research frontiers could contribute to collaborations between countries, institutions, and authors. Furthermore, we attempted to describe the intellectual landscape of studies and predict future development trending in this field. Finally, we also presented the above content in the view of the COVID-19 pandemic, aiming to analyze and predict trends and hot spots in this special period.

MATERIALS AND METHODS

Design

This was a descriptive bibliometric analysis and science mappings, which was performed to identify and analyze literature on CF and PR. Meanwhile, we performed a separate analysis to determine the impact of the COVID-19 pandemic on research trends. Certainly, we also made a comparison between the overall findings and the COVID-19 pandemic.

Sample

We retrieved targeted literature from the Web of Science (WOS) Core Collection® from Clarivate Analytics because it allowed us to perform a precise and specific analysis of publications, authors, citations, and keywords (Aggarwal et al., 2016; Ma et al., 2022).

Data Collection

We performed a systematic search in Web of Science Core Collection®, which includes Science Citation Index expanded (SCI-EXPANDED), Social Science Citation Index (SSCI), Arts and Humanities Citation Index (A&HCI), Conference Proceedings Citation Index-Social Sciences & Humanities (CPCI-SSH), and Emerging Science Citation Index (ESCI), to identify relevant literature labeled as article or review. The search was limited from its inception until September 30, 2021. The following search strategy was used to conduct a thorough search: TS ("compassion fatigue" or "vicarious trauma" or "vicarious traumas" or "secondary traumatization" or "secondary trauma" or "secondary traumas" or "secondary traumatization" or "vicarious traumatization") and TS = ("resilience*"). We did not impose any restrictions on our literature search, such as countries, categories, and language. We show the search strategy in **Supplementary Appendix 1**.

Ethical Consideration

No institutional ethical approval and patient's informed consent were necessary because the present study did not recruit animal or human subjects.

Data Analysis

Data analysis was performed by using CiteSpace 5.8.R1 and Microsoft® Excel 2013 (Pan et al., 2018). Specifically speaking, Microsoft® Excel 2013 was used to visually analyze the trends of annual publications. However, CiteSpace was applied to produce visualized maps for analyzing the distribution of research fields, cooperation relationships of authors, institutions, and countries, clusters of co-citing reference publications, and the intellectual landscape of studies about CF and PR by time. Additionally, co-occurring keywords were also analyzed by Citespace to detect research trends and frontiers. We defined the following parameters for CiteSpace: time-slicing was from January 2008 to October 2021 and from December 2019 to October 2021, respectively, with years per slice (slice length = 1). All options in the term source were selected, a node type was selected at a time according to specific conditions, "top 50 levels" as a threshold that are cited or most frequent in the corresponding time slice. For a visualization knowledge figure, node and link were the essential elements. A node represented an element, such as author, keyword, or institution, and the size of a node was proportional to the frequency of appearance or citation, and the color of the node indicated the year. Besides, each node is described with a series of tree rings across the series of time slices. The size of the concentric circles represents the number of publications. Also, the circles of different colors signified the year 2008 to 2021 or 2019 to 2021 from the inside to the outside of the nodes. The link between two nodes represented cooperation or co-occurrence or co-citation relationship. The purple ring represented the betweenness centrality (BC) of literature. If a knowledge map appeared with nodes with high BC value, these nodes were believed to bridge different stages of the development of a scientific field (Chen et al., 2009). Red circles indicate the time slices in which citation bursts or abrupt increases of citations are detected (Kleinberg, 2002).

RESULTS AND DISCUSSION

Annual Trends in Publications and Citations

Overall, 391 records published between 2008 and 2021 were analyzed. Among 391 identified studies, a total of 8 categories were determined, including narrative review (n = 64), animal

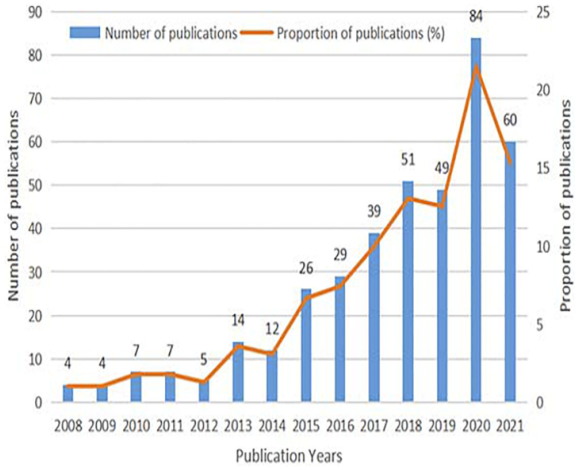

FIGURE 1 | The distribution of the bibliographic records per year.

study (n = 1), systematic review (n = 13), perspective (n = 23), interventional study (n = 40; self-control trial: n = 29, clinical control trial: n = 8; randomized controlled trial: n = 3), study protocol (n = 1), survey study (n = 167), and qualitative study (n = 82). As shown in **Figure 1**, research on the association between CF and PR can be roughly separated into two periods. In the first stage from 2008 to 2012, the first article on target research dates to 2008, and we saw fluctuations in the volume of publications at a level of <10. In the second stage from 2013 to 2021, the number of publications increased rapidly, despite two downward trends detected in 2014 and 2019. This indicated that CF and PR have been gradually becoming hot

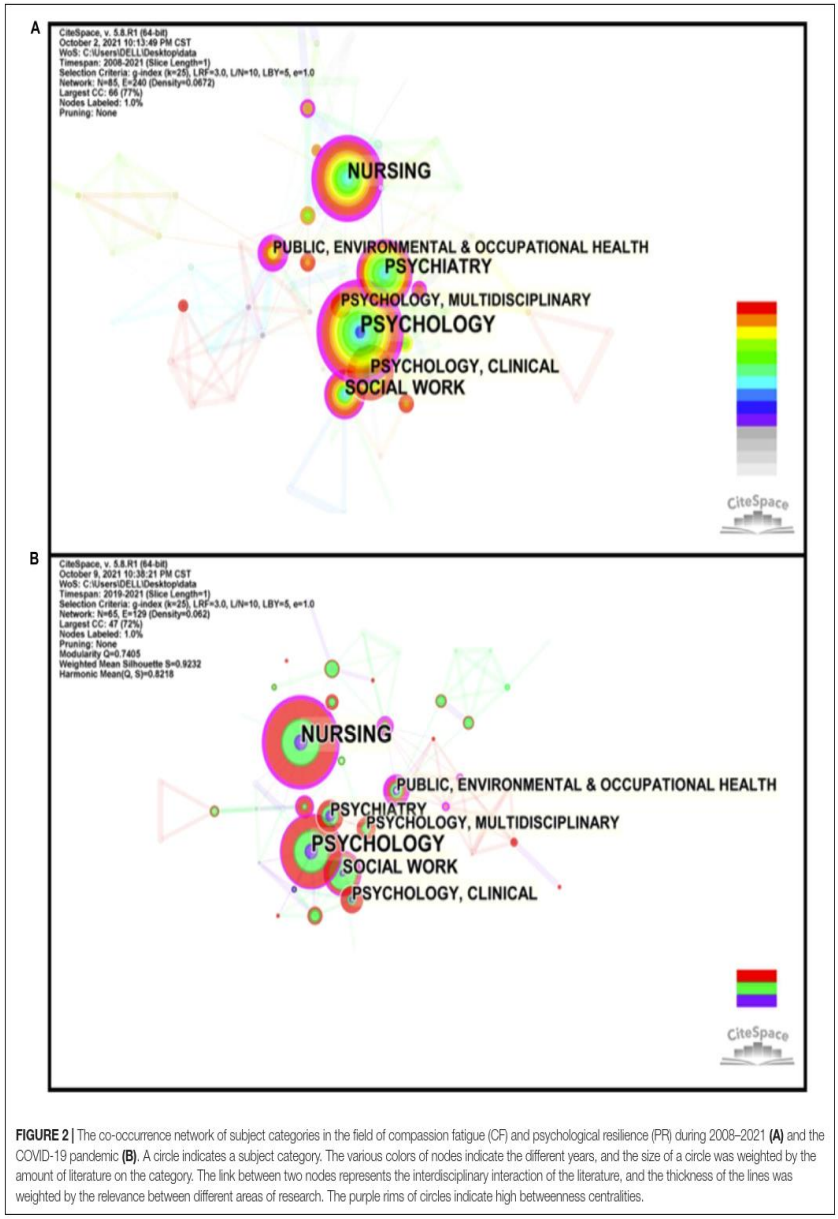

FIGURE 2 | The co-occurrence network of subject categories in the field of compassion fatigue (CF) and psychological resilience (PR) during 2008–2021 **(A)** and the COVID-19 pandemic **(B)**. A circle indicates a subject category. The various colors of nodes indicate the different years, and the size of a circle was weighted by the amount of literature on the category. The link between two nodes represents the interdisciplinary interaction of the literature, and the thickness of the lines was weighted by the relevance between different areas of research. The purple rims of circles indicate high betweenness centralities.

research topics. Besides, to the search date, papers analyzed in this study were cited 5,170 times totally, and the average number of citations was 13.22.

During the COVID-19 pandemic, the number of publications increased rapidly in the field of CF and PR, accounting for 45.01% of 391 publications. Among them, 22 documents are reviews and 154 documents are original articles. The change revealed that CF, as a kind of negative emotional state, has aroused much attention, and more studies have been conducted to explore the impact of a pandemic on the level of CF and PR.

Category Analysis

The top 10 frequency and centrality of subject categories related to CF and PR indexed by the Web of Science Core Collection® were illustrated by a visualizing calculation result using CiteSpace (see **Figure 2A** and **Supplementary Table 1A**). As shown in **Figure 2A**, 85 nodes and 240 links constituted a network of such subject categories. Among them, the most common category is psychology (93 articles), followed by nursing (77 articles), psychiatry (58 articles), social work (48 articles), and Psychology and clinical (45 articles). The first in the centrality was public, environmental, and occupational health (36). Besides, we also had a dual map-based portfolio analysis of 391 articles. Also, the result showed that citing journals (on the left-hand side of the base map) is associated with topics including medicine, psychology, health, education, and clinical and immunology. The majority clusters of the cited journal (on the right-hand side of the base map) were directed to disciplinary areas, such as medicine, psychology, health, education, nursing, and social (shown in **Figure 3**).

During the COVID-19 pandemic, the top 10 subject categories with the greatest number of publications were essentially the same (see **Figure 2B** and **Supplementary Table 1B**). It is worth noting that education and education research (11 publications) entered the top 10. In this special area, a total of five studies focused on the topic of self-care practice and resilience-based interventions. Self-care is the practice of behaviors that promote well-being, counter work-related stress, and develop resilience (Griffiths et al., 2019; Allison et al., 2020; Keesler and Troxel, 2020; Pandya, 2020; Seo et al., 2021). More research is needed to construct optimal methods to foster resilience and explore better interventions to build up self-care strategies. The top 5 research areas for centrality remained the same (see **Figure 2B** and **Supplementary Table 1B**). These reflected that these research categories are very important in bridging cooperative relationships in the CF and PR fields.

Overview of the Research Co-operation

Visualized knowledge mapping provides information on influential research teams and potential collaborators and helps researchers establish collaborative relationships (Liang et al., 2017).

Distribution of Countries and Institutions

According to an analysis of the country distribution of these publications, the top 4 countries for centrality were the United States (0.41), Canada (0.36), England (0.22), and Australia (0.17), all of which also entered the top 4 countries with the largest number of articles (see **Supplementary Table 2A**). These results showed that contributions from the United States, Canada, England, and Australia cannot be ignored in the field of CF and PR. It is worth noting that the United States was not only the most prolific country (153 articles) but also the highest centrality country, revealing United States is highly outstanding for researching CF and PR, both quantitatively and qualitatively. Indeed, it was these countries that were among the first to call

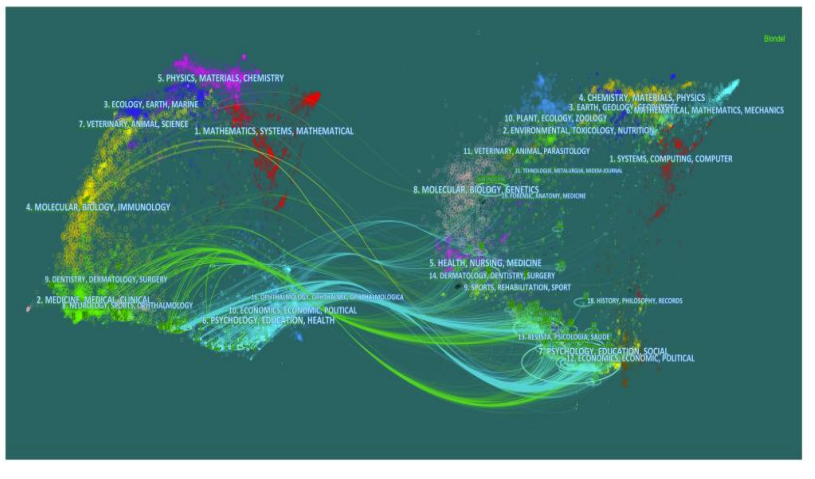

FIGURE 3 | The dual-map overlay of journals. Citing journals are on the left and cited journals are on the right, and the colored paths between them suggested the cited relationships.

for a focus on CF and PR. **Supplementary Table 3A** shows the top 10 institutions by the number of articles published. Most academic institutions, which are active in the field of CF and PR have been formed in these top four countries. Furthermore, the remaining three institutions are in Israel, reflecting that we cannot neglect contributions from Israel in this field. The distribution of countries and institution map was generated, with 317 nodes and 624 links composed of the merged network (see **Figure 4A**). We can see that links between the nodes representing institutions or countries are not much, which means that the interaction and the corporation between institutions or countries in the field of CF and PR are relatively poor.

During the COVID-19 pandemic, as shown in **Supplementary Table 2B**, the United States (71 articles), Canada (19 articles), and England (19 articles) were still pioneers in this field. Also, the majority of the most productive institutions were located

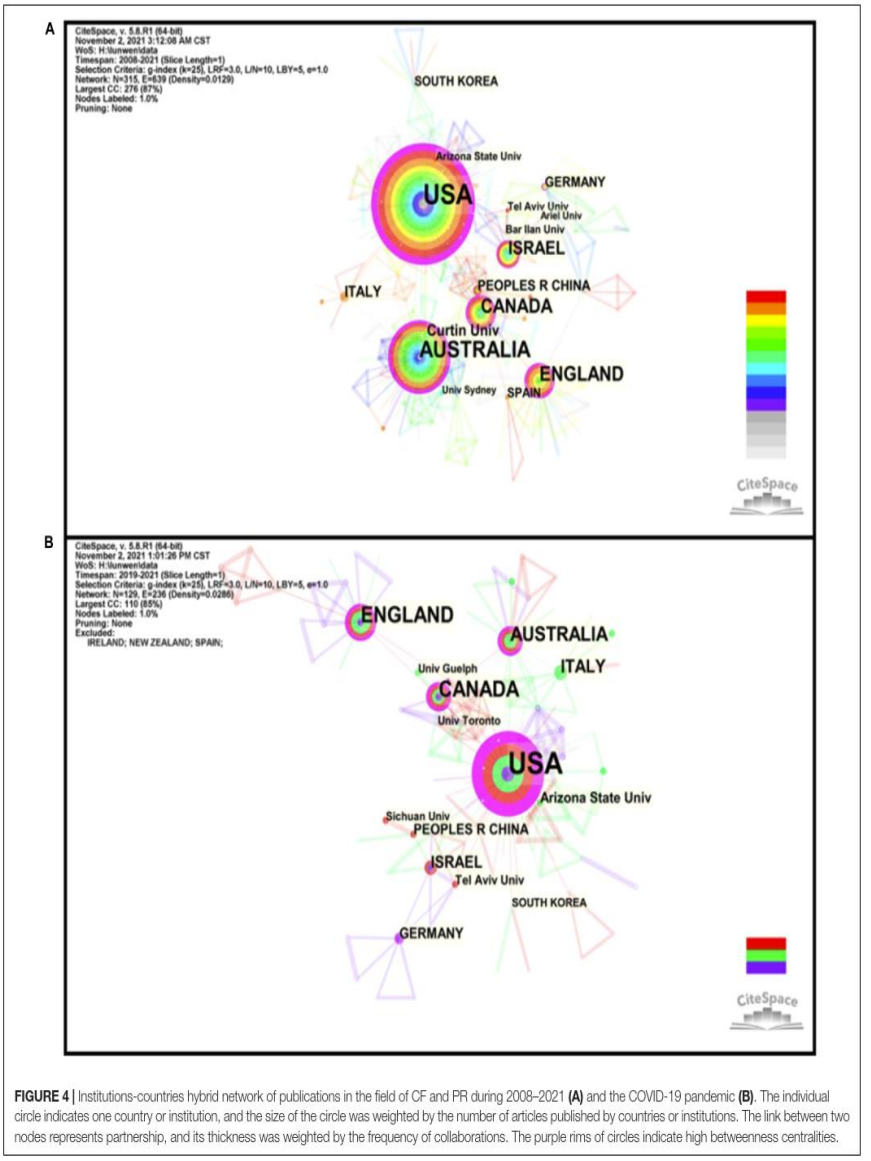

FIGURE 4 | Institutions-countries hybrid network of publications in the field of CF and PR during 2008–2021 **(A)** and the COVID-19 pandemic **(B)**. The individual circle indicates one country or institution, and the size of the circle was weighted by the number of articles published by countries or institutions. The link between two nodes represents partnership, and its thickness was weighted by the frequency of collaborations. The purple rims of circles indicate high betweenness centralities.

in these developed countries (**Supplementary Table 3B**). It is also worth mentioning that Sichuan University, a Chinese institution, entered the top 10. This could be because the outbreak of COVID-2019 first emerged in Wuhan, China, and Chinese scholars are taking an interest in this field. Four studies (Cao and Chen, 2021a,b; Cao et al., 2021a,b) from Sichuan University confirmed the relations between the variables involved in CF and PR and supported the development of strategies to reduce nurses or nursing students' CF, enhance professional quality of life, and, consequently, mitigate organizational turnover intention. All of the centrality scores are zero, which implied there was a lack of collaboration between authors. Also, the distribution of countries and institution maps can also reflect this issue (see **Figure 4B**).

Author Analysis

The map of authors was presented to reveal the most prolific authors and co-authors, and intuitively demonstrate the closeness of collaboration among the authors, which could provide information on influential research groups and potential collaborators and help researchers establish cooperative

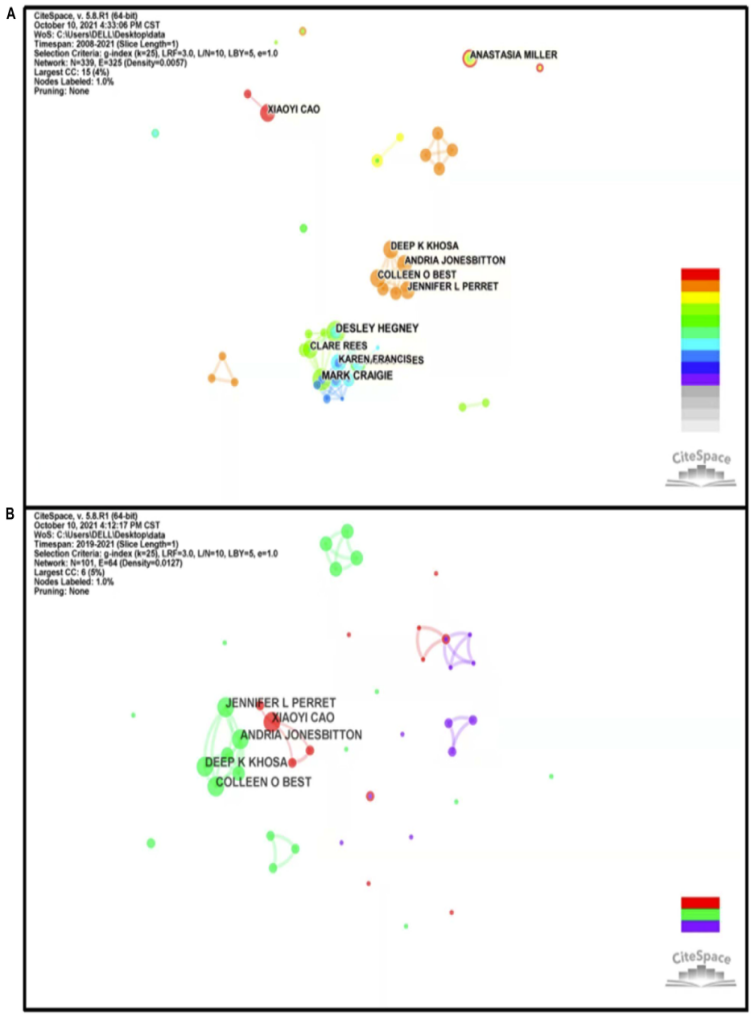

FIGURE 5 | The network of co-authorship in the field of CF and PR during 2008–2021 **(A)** and the COVID-19 pandemic **(B)**. The individual circle indicates one author, and the size of the circle was weighted by the number of articles published by authors. The individual link between two circles indicates collaboration between two authors on the same article, and its thickness was weighted by the frequency of collaborations. The purple rims of circles indicate high betweenness centralities.

relationships. As described in **Supplementary Table 4A**, Craigie M (5 articles) published the most studies, followed by Hegney D (5 articles), Perret JL (4 articles), Rees C (4 articles), and Khosa DK (4 articles). Three of them are from Curtin University in Australia, and the rest are from the University of Guelph in Canada. Those implied authors publishing more articles are inclined to collaborate more closely with others, which is contrary to the results of the country and institution analysis. As one of the representative figures, Craigie Mand led his research team to investigate the influences of anxiety, stress, and depression and how they relate to compassion satisfaction and CF. Besides, they also evaluated the effectiveness of a psychosocial intervention designed to promote resilience among various occupational groups (nurses and rural general practitioners). In addition, we can see there are 339 nodes and 325 links in **Figure 5A**. A network density of only 0.0057 indicated the cooperation between authors in this field was not close enough. This issue can also be reflected by insignificant centrality scores (all of them are zero).

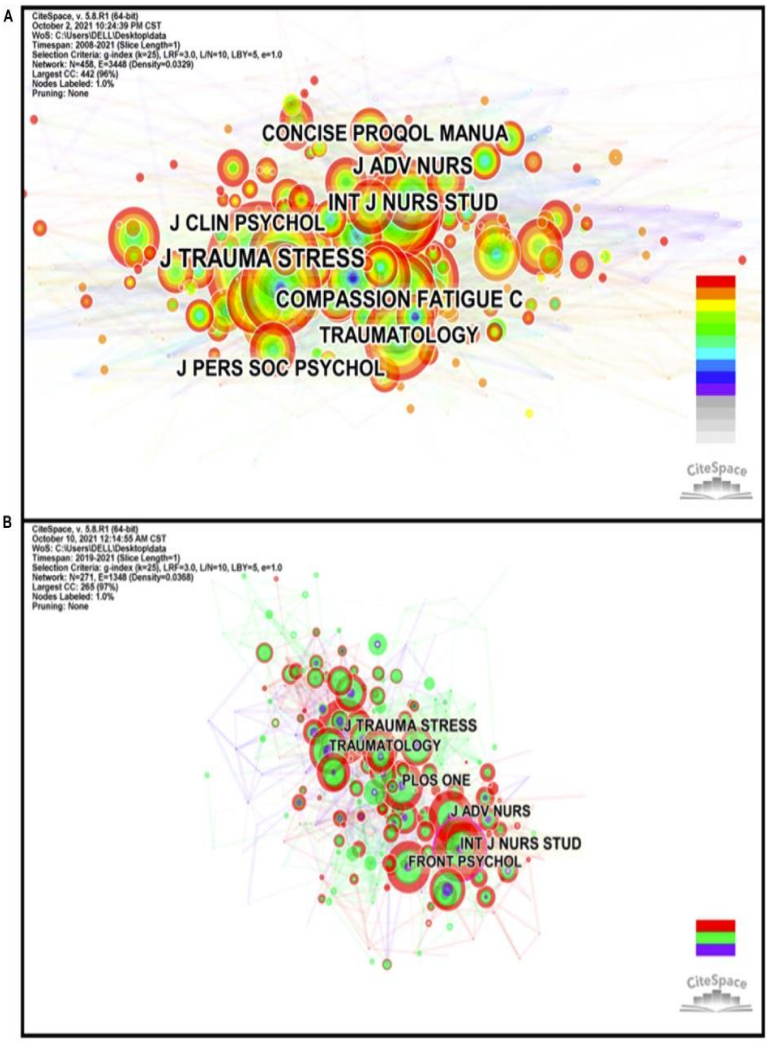

FIGURE 6 | The network visualization map of journal co-citation analysis during 2008–2021 **(A)** and the COVID-19 pandemic **(B)**. The individual circle indicates a journal, and its size was weighted by the number of cited journals. The individual link between two circles meant co-citation relationships, and its thickness was weighted by the frequency of collaborations. The purple rims of circles indicate high betweenness centralities.

TABLE 1 | Main clusters (>15 members) of reference co-citation analysis in the field of CF and PR.

(A) Main clusters (>15 members) of reference co-citation analysis in the field of CF and PR (from 2008 to 2021).						(B) Main clusters (>15 members) of reference co-citation analysis in the field of CF and PR (during the COVID-19 pandemic)					
Rank	Cluster ID	Size	Silhouette	Mean (year)	Theme	Rank	Cluster ID	Size	Silhouette	Mean (year)	Theme
1	0	66	0.739	2014	Nursing	1	0	31	0.835	2018	Health care provider
2	1	38	0.909	2011	Anxiety	2	1	21	0.995	2017	Hardiness
3	2	37	0.905	2017	Turnover intention	3	2	21	0.983	2015	Resilience factors
4	3	32	0.957	2015	Secondary traumatization	4	3	20	0.875	2016	Physicians
5	4	31	0.923	2011	Posttraumatic growth	5	4	20	0.956	2018	Turnover intention
6	5	31	0.894	2017	Health care provider						
7	6	26	0.977	2007	Caregivers						
8	7	25	0.99	2005	Child protection workers						
9	8	21	0.995	2017	COVID-19						
10	9	18	0.97	2013	Well-being						
11	10	17	0.95	2016	Police officers						

WOS, Web of Science; CF, compassion fatigue; PR, psychological resilience.

If more authors can collaborate, more high-quality articles will be produced in the future. Thus, broader cooperation between authors and institutions should be encouraged to facilitate the development of the field of CF and PR.

During the COVID-19, a map of authors was generated including 101 nodes and 64 links (shown in **Figure 5B** and **Supplementary Table 4B**). There are approximately twice as many nodes as there are links in co-authorship, and it implies decreased cooperation. As shown in **Supplementary Table 4B**, only four authors entered the top 10. The top 5 authors were Khosa DK (4 articles), Perret JL (4 articles), Jonesbitton A (4 articles), Cao XY (4 articles), and Best CO (4 articles). Apart from Cao XY, the remaining authors all come from Canada. This was further evidenced that the researchers from Canada have devoted themselves to research in this area.

Analysis of Journals

The analysis of journals will facilitate understanding the direction of specific research topics (Chuang and Ho, 2014). The Web of Science® Core Collection showed that the 391 documents included covered 260 different journals over the past 14 years, all of which are widely distributed. We analyzed the top 15 active journals that published articles (**Supplementary Table 5**), accounting for 17.9% of 391 publications. The average impact factor (IF) of the top 15 journals in 2020 was 2.978. Frontiers in Psychology was the most productive journal (8 articles, 2020 IF = 2.990), followed by the British Journal of Social Work (7 articles, 2020IF = 1.884), and the International Journal of Environmental Research and Public Health (6 articles, 2020 IF = 3.390). Among them, eight of the top 15 journals specialize in social work and psychology, and four are nursing journals. From the analysis of journals, we inferred that studies in CF and PR fields mainly focused on nurses and social workers and their psychological problems, which can also be found from the analysis of categories. Nurses are usually to exposed various stressful work environments in daily work, such as the death of patients, violence, acute conditions, and the suffering of patients, which they are often unable to deal with (Yilmaz et al., 2018; Partlak Günüşen et al., 2021). For clinical social workers on the frontline, they are also faced with a serious human service crisis: clients with mental health problems exacerbated by the stress related to COVID-19 and individuals with no previous behavioral health issues suffering from symptoms due to social isolation, quarantine, and the drastic change in daily life. Therefore, they experience higher levels of CF symptoms than other service practitioners (Cavanagh et al., 2020; Felder, 2021).

The map of cited journals was composed of 458 nodes and 3,448 links, including a total of 10,585 references (shown in **Figure 6A** and **Supplementary Table 6A**). The first in the frequency and centrality were Journal of Traumatic Stress and Anxiety Stress and Coping, respectively. In the journal cited in 167 records of Journal of Traumatic Stress, one literature review published by Dekel got the higher citation counts (Dekel and Goldblatt, 2008), which described the inter-generational transmission of post-traumatic stress disorder (PTSD) from fathers to sons in families of war veterans, and manifested fathers' PTSD is a risk for increased emotional and behavioral problems among the children. Meanwhile, aiming to enhance the understanding of PTSD, the authors affirmed that future research should move from a description of the phenomenon to a better understanding of the factors that intensify or reduce it.

During the COVID-19, a cited journal map was generated by CiteSpace, which included 271 nodes and 1,348 links (shown in **Figure 6B** and **Supplementary Table 6B**). The first in the frequency and centrality were the Journal of Traumatic Stress and the International Journal of Nursing Studies, respectively. In the journal cited in 61 records of the Journal of Traumatic Stress, one review had the larger citation (Carmassi et al., 2020). This article

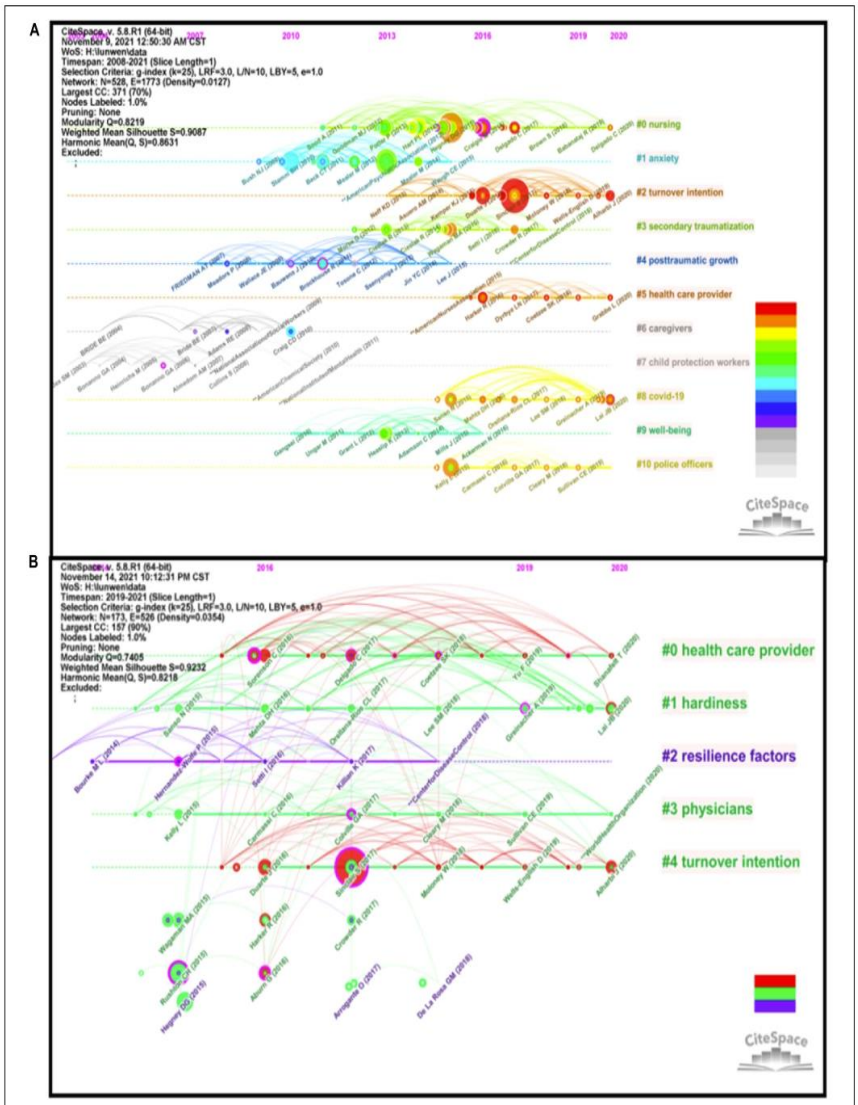

FIGURE 7 | The timeline view of research focused on CF and PR during 2008–2021 **(A)** and the COVID-19 pandemic **(B)**. In the timeline view plot, keywords on the same horizontal line belong to the right cluster. The colors of lines and keywords are corresponding to the colors of the time slice at the top.

summarized related risk and resilience factors for PTSD and post-traumatic stress symptoms in healthcare workers, aiming to constantly improve the effectiveness of intervention strategies.

The Knowledge Base of a Research Field

Reference Co-citation Analyses

The knowledge base is composed of a collection of co-cited documents. A synthesized network of cited references and co-citation clusters of references was developed to reveal the intellectual base of a research area and the corresponding trend (Yuan et al., 2021). **Table 1A** documented 12 major clusters of reference co-citations (each cluster contains over 15 members), which are labeled by noun phrases from keywords of their citers of the cluster (Chen et al., 2010). The size was proportional to the number of members contained in a cluster, and more members indicated more representatives. Thus, clusters #0–#6 are very

TABLE 2 | Main clusters (> 15 members) of reference co-citation analysis in the field of CF and PR.

Rank	Author and publication year	Frequency	Title	Journal	IF (2020)	Quartile (2020)	Category
(A) Top 10 highest cited articles in the field of CF and PR (during 2008–2021)							
1	Sinclair et al., 2017	16	Compassion fatigue: a meta-narrative review of the healthcare literature	International Journal of Nursing Studies	5.837	Q1	Nursing
2	Rushton et al., 2015	15	Burnout and Resilience Among Nurses Practicing in High-Intensity Settings	American Journal of Critical Care	2.228	Q4	Nursing
3	Hegney et al., 2015	14	The contribution of individual psychological resilience in determining the professional quality of life of Australian nurses	Frontiers in Psychology	2.988	Q2	Psychology
4	American Psychiatric Association, 2013	13	Diagnostic and statistical manual of mental disorders	NA	NA	NA	NA
5	Hart et al., 2014	10	Resilience in nurses: an integrative review	Journal of Nursing Management	3.325	Q1	Nursing
6	Stamm, 2010	10	The Concise ProQOL Manual: the concise manual for the Professional Quality of Life Scale	NA	NA	NA	NA
7	Potter et al., 2013	9	Evaluation of a Compassion Fatigue Resiliency Program for Oncology Nurses	Oncology Nursing Forum	2.172	Q4	Nursing
8	Hunsaker et al., 2015	9	Factors That Influence the Development of Compassion Fatigue, Burnout, and Compassion Satisfaction in Emergency Department Nurses	Journal of Nursing Scholarship	3.176	Q1	Nursing
9	Kelly et al., 2015	9	Predictors of Compassion Fatigue and Compassion Satisfaction in Acute Care Nurses	Journal of Nursing Scholarship	3.176	Q1	Nursing
10	Flarity et al., 2013	8	The Effectiveness of an Educational Program on Preventing and Treating Compassion Fatigue in Emergency Nurses	Advanced Emergency Nursing Journal		Q4	Nursing
(B) Top 10 highest cited articles in the field of CF and PR (during the COVID-19 pandemic)							
1	Sinclair et al., 2017	16	Compassion fatigue: a meta-narrative review of the healthcare literature	International Journal of Nursing Studies	5.837	Q1	Nursing
2	Rushton et al., 2015	9	Burnout and Resilience Among Nurses Practicing in High-Intensity Settings	American Journal of Critical Care	2.228	Q4	Nursing
3	Hegney et al., 2015	9	The contribution of individual psychological resilience in determining the professional quality of life of Australian nurses	Frontiers in Psychology	2.988	Q2	Psychology
4	Duarte et al., 2016	8	Relationships between nurses' empathy, self-compassion and dimensions of professional quality of life: a cross-sectional study	International Journal of Nursing Studies	5.837	Q1	Nursing
5	Wagaman MA	7	The Role of Empathy in Burnout, Compassion Satisfaction, and Secondary Traumatic Stress among Social Workers	Social Work	2.29	Q2	Social work
6	Kapoulitsas and Corcoran, 2015	6	Compassion fatigue and resilience: a qualitative analysis of social work practice	Qualitative Social Work	1.171	Q1	Social work
7	Alharbi et al., 2020b	6	Personal characteristics, coping strategies, and resilience impact on compassion fatigue in critical care nurses: A cross-sectional study	Nursing and Health Sciences	1.857	Q3	Nursing
8	Harker et al., 2016	6	Exploring resilience and mindfulness as preventative factors for psychological distress burnout and secondary traumatic stress among human service professionals	Work-a Journal of Prevention Assessment and Rehabilitation	1.505	Q4	Public, Environmental and Occupational Health
9	Lai et al., 2020	6	Factors Associated With Mental Health Outcomes Among Health Care Workers Exposed to Coronavirus Disease 2019	JAMA Network Open	8.485	Q1	Medicine, General and Internal
10	Ludick and Figley, 2016	6	Toward a Mechanism for Secondary Trauma Induction and Reduction: Reimagining a Theory of Secondary Traumatic Stress	Traumatology	NA	NA	NA

WOS, Web of Science; CF, compassion fatigue; PR, psychological resilience.

important owing to their larger sizes. As an indicator measuring the homogeneity of a cluster, the silhouette values ranged from 0.739 to 0.995, indicating highly homogeneous (Chen et al., 2010). A timeline visualization was also created to show the major 12 clusters along horizontal timelines, which helped us to form an overview of the evolution process of the CF and PR field over the years (**Figure 7A**). Clusters are numbered from 0, i.e., Cluster #0 is the largest cluster (nursing), and Cluster

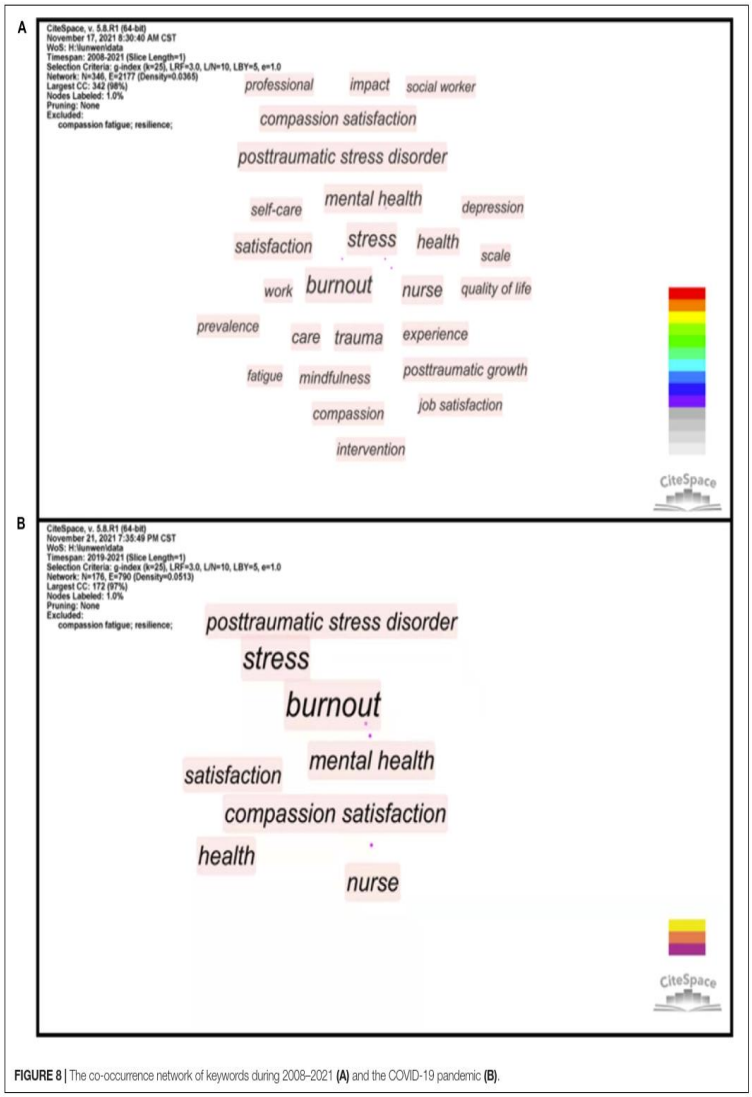

FIGURE 8 | The co-occurrence network of keywords during 2008–2021 **(A)** and the COVID-19 pandemic **(B)**.

#10 is the smallest one (anxiety). For cited reference clusters, the map indicated that most clusters were concentrated from 2003 to 2020. The earlier research direction lay in clusters #7 ("child protection workers") and #6 ("caregivers"), with most publications dated around 2006. This was followed by clusters #4 ("posttraumatic growth"), #1 ("anxiety"), and #9 ("well-being"), with most publications dated around 2000. Then, researchers shift their focus of attention to Clusters #0 ("nursing") and #3 ("secondary traumatization"), with most publications dated around 2015. Clusters #10 ("police officers"), #8 ("COVID-19"), #5 ("health care"), and #2 ("turnover intention") were the focus of the latest publications dated around 2017. Cluster #2 has a high concentration of nodes with citation bursts, which coincides with the fact that this is the latest formed cluster. Besides, Clusters #5 and #8 appear to have recent publications with citation bursts. Interestingly, we found that the sustainability of a specialty varies.

For example, Cluster #0 sustains 11 years and remains active until now, whereas Clusters #0–1, 3–4, 6–7, 9, and 13 are relatively short-lived.

Human service practitioners such as nursing practitioners, physicians, therapists, child protection workers, police officers, and first responders often respond to potentially traumatic events or incidents and are requested to help traumatized individuals as part of their duties (Cluster #0, Cluster #5, Cluster #6, Cluster #7, and Cluster #10) (Musa and Hamid, 2008; Blau et al., 2012; Jacobson, 2012; Giada et al., 2017; Denkinger et al., 2018; Greinacher et al., 2019a; Kamijo et al., 2020; Maran et al., 2020; Vagni et al., 2020b; Smith et al., 2021). Recently, researchers have found that an individual may show positive changes following a traumatic event, such as treasuring life more, enhancement of close relationships, recognizing and elaborating on personal strengths, recognizing new possibilities, and spiritual development (Tedeschi and Calhoun, 1996; Tedeschi and Calhoun, 2004; Ogińska-Bulik and Kobylarczyk, 2015). This phenomenon is referred to as post-traumatic growth (PTG). Nevertheless, exposure to traumatized populations has severely tested their mental and physical health and compromised their well-being (Cluster #9) (Figley, 1995; Conrad and Kellar-Guenther, 2006; Bride et al., 2007; Carmassi et al., 2020). Among them, CF has traditionally been recognized as a common problem, awareness of this issue has been increased significantly since the COVID-19 emergency, which can also be partly reflected by the rapidly increased annual number of publications in the CF and PR field (Cluster #8) (Melvin, 2015; Burnett, 2017; Sinclair et al., 2017; Greinacher et al., 2019a; Ruiz-Fernández et al., 2020; Vagni et al., 2020a; Xie et al., 2021). CF is described as both STS and cumulative BO (Cluster #3)(Stamm, 2010). CF can leave caring professions cumulatively vulnerable to waning quality of care, difficult relationships with colleagues, or even cause more severe mental health symptoms, such as posttraumatic stress disorder, anxiety, or depression (Cluster #1)(Cocker and Joss, 2016; Iimura, 2022). Furthermore, several studies have shown that CF was significantly and positively correlated with turnover intention (Cluster #2) (Sung et al., 2012; Wells-English et al., 2019; Ådland et al., 2021; Cao and Chen, 2021a,b; Magnavita et al., 2021). One study conducted in China demonstrated that more than 60% of nursing practitioners manifested high to a significantly high level of turnover intention during the COVID-19 crisis. Thus, high turnover and poor retention become an important concern, especially for health care providers.

During the COVID-19 pandemic, the largest 5 clusters were discussed in our review (see **Table 1B**). The silhouette values ranged from 0.835 to 0.995, indicating that each cluster is highly homogeneous (Chen et al., 2010). As shown in the timeline overview (**Figure 7B**), the earlier research direction lay in clusters #2 ("resilience factors") and #3 ("physicians"). This was followed by clusters #0 ("health care provider"), #1 ("hardiness"), and #4 ("turnover intention"). Except for clusters #2 and #5, the remaining is still active.

For health care providers, coping with the COVID-19 emergency can be psychologically stressing/is highly related to stress, and severe stress can accelerate the development of secondary trauma (Cluster 0 and Cluster 3) (Vagni et al., 2020a,b). PR is a protective factor preventing frontline healthcare professionals against secondary traumatization symptoms (Cluster 2) (Bartone, 2012; Jamal, 2017; Greinacher et al., 2019b; Ogińska-Bulik and Michalska, 2021). Also, it can weaken the negative impact of CF on health care workers' job satisfaction and turnover intention (Cluster #4) (Alameddine et al., 2021; Antonsdottir et al., 2021; Labrague and de Los Santos, 2021). Furthermore, as a core component of PR, hardiness positively reframes negative experiences as opportunities and challenges to overcome and thus takes action to solve problems. This personality trait is beneficial in buffering exposure to extreme stress, thus, strategies that enhance hardness may be conducive to prompting PTG and well-being (Cluster #1) (Kobasa et al., 1982; Bartone and Bowles, 2021).

Most Cited Articles Analysis

The most cited references are usually viewed as landmarks based on their groundbreaking contributions. By analyzing these articles, the key knowledge foundation of each research field could be identified (Chen et al., 2019). Among the top 10 frequency of cited references, there are two books, two reviews, and six clinical studies. The majority of them (Flarity et al., 2013; Potter et al., 2013; Hart et al., 2014; Hunsaker et al., 2015; Kelly et al., 2015; Rushton et al., 2015; Sinclair et al., 2017) were published in Nursing Journal, indicating that the importance of these articles in this field, which also had a greater influence in this field. The most cited article in our dataset is Sinclair et al. (2017), which is also the more recent article on the list, suggesting that it has inspired intense interest in CF among healthcare providers (Sinclair et al., 2017). Additionally, two descriptive studies (Flarity et al., 2013; Potter et al., 2013), first examined the therapeutic effect of CF resiliency programs designed for oncology nurses and emergency nurses, respectively, and recommended nurses should develop resiliency skills that will enable them to manage CF effectively (see **Table 2A**).

During the COVID-19, only 3 same publications entered the top 10 landmark articles (see **Table 2B**) (Hegney et al., 2015; Rushton et al., 2015; Sinclair et al., 2017). The majority of studies mainly focused on the understanding of the relationship among the variables involved in PR or/and CF (Alex et al., 2015; Hegney et al., 2015; Kapoulitsas and Corcoran, 2015; Rushton et al., 2015; Duarte et al., 2016; Harker et al., 2016; Alharbi et al., 2020a). Besides, Ludick and Figley (2016) explored the mechanism for secondary trauma induction and reduction. He and his team thoroughly described and justified the compassion fatigue resilience model, which provides the best estimate yet in depicting STS reactions. The model is likely to instruct trauma survivors and future trauma-exposed professionals to improve their secondary stress resilience and allows secondary stress management more effectively.

Emerging Trends and Research Frontiers of Caregivers

Keyword Co-occurrence Analysis

There were 348 co-occurrence keywords when we made the keyword co-occurrence analysis of data in set #4 (see

Supplementary Appendix 1). We filtered out two conventional keywords including "compassion fatigue" and "resilience" and manually merged several synonyms, to make statistics clearer and more standardized. Keywords with low co-occurrence frequency did not relate to trending research topics, therefore, we set 20 as the threshold of co-occurrence frequency to filter out these keywords for a better analysis after an overall consideration. **Figure 8A** shows co-occurrence when thresholds were set to 20, including 26 keywords. This figure shows that nurses and social workers are the main target populations. Mental health problems (burnout, posttraumatic stress disorder, and depression) and personal or organizational effects of CF (job satisfaction and quality of life) became the research hotspots. At present, the survey is a common method to estimate the prevalence of CF and explored CF-related risk factors. The practice of self-care is an essential individual approach to building PR and increasing mindfulness, thus, diminishing CF and promoting personal growth (Beng et al., 2015; Kuglin Jones, 2017; Bonamer and Aquino-Russell, 2019; Blackburn et al., 2020).

During the COVID-19 pandemic (**Figure 8B**), there was little change in the distribution of co-occurrence keywords. This phenomenon implied the focus has not changed in the context of the epidemic.

Strength and Limitation

There are several limitations in this study, which should be taken into consideration when interpreting the results. First, we only collected data from the Web of Science® Core Collection when retrieving literature. Future studies should retrieve more databases to identify additional papers. Second, only articles and reviews were included in our analysis. Therefore, we have missed related articles in other document types. Third, bibliometrics is a quantitative analysis of academic publications, whereas articles with high citation counts do not necessarily equate to articles with high-quality or high-correlation with the target field. Researchers should use multi-method evaluations to obtain a more in-depth understanding of this research field. Fifth, only Citespace and traditional bibliometric indicators were used in the current study. Using a variety of research methods can make the results of the study more credible, and, therefore, more methods and indicators should be considered in the future.

CONCLUSION

This was the first study to analyze the scientific output of research on the association of CF with PR using bibliometric analysis with CiteSpace® software. Based on publications published from 2008 to 2021, we illustrated the change in this topic as the COVID-19 pandemic. Specifically, the number of publications in the CF and PR field presented an obviously ascending trend during the COVID-19 pandemic, indicating that CF should be especially emphasized for timely and effective delay and even prevent aggravation of psychological status through introducing some positive psychological sources such as PR. Overall, the United States was the most influential country in this research topic, as it not only published the largest number of articles but also had close cooperation with other countries, and therefore, more attention should be paid to enlarge the extrapolation of published findings. Moreover, more studies should also be performed in other countries and fields based on previously published studies. Curtin University in Australia was the most prolific institution, and Frontiers in Psychology was the most productive journal in this field. More researchers and practitioners should be trained under the supervision of specialists in this university, and more journals are also suggested to focus on this topic by launching a special issue. The turnover intention of health care providers has been a research focus in recent years. Nursing practitioners and social workers are currently the key target groups and will likely remain so in the near future. The mental problems of nursing practitioners and social workers are the main research topics. However, it is noted that this field is at an initial stage because limited research focusing on the association of CF with PR has been conducted, which is especially in developing countries. As an emerging research topic, scarce studies have focused on how to effectively prevent and relieve CF. Therefore, further studies and more collaborations among institutions and authors should be encouraged to explore effective interventions for the cultivation of PR and the reduction of CF.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding authors.

AUTHOR CONTRIBUTIONS

L-JY, YL, LT, XT, and MJ-H: conception and design. LC, XT, and MJ-H: administrative support. L-JY, YL, LT, and G-HW: collection and assembly of data. L-JY, G-HW, and S-WH: data analysis and interpretation. All authors wrote and approved the final manuscript.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2022.890327/full#supplementary-material

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Appendix 7

Published Paper 2

International Journal of *Environmental Research and Public Health*

MDPI

Article

Prevalence of Compassion Fatigue and Its Association with Professional Identity in Junior College Nursing Interns: A Cross-Sectional Study

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Abstract: *Background:* The issue of compassion fatigue among clinical nurses has received considerable attention, particularly during the COVID-19 pandemic. Yet, the current status of compassion fatigue among junior college nursing interns remains unclear. Additionally, professional identity can modulate the impact of compassion fatigue or burnout on psychological well-being; however, whether professional identity still works in this group is also unclear. This study aimed to reveal the current status of compassion fatigue among nursing interns in junior colleges and also investigate the association between compassion fatigue and professional identity. *Methods*: This cross-sectional survey evaluated the levels of participants' compassion fatigue (The Compassion Fatigue Short Scale) and professional identity (Professional Identity Scale) in 2256 nursing interns. *Results*: The mean score of compassion fatigue was 44.99, and 19.5% of the participants scored above The Compassion Fatigue Short Scale median scores for compassion fatigue. A moderate negative correlation was detected between compassion fatigue and professional identity. *Conclusions*: The level of compassion fatigue among nursing interns is low but nearly one in five nursing students is at risk of compassion fatigue. More attention should be paid to nursing interns with a high risk of compassion fatigue. Future studies are warranted to explore which pathways could mediate the relationship between professional identify and comparison fatigue.

Keywords: compassion fatigue; professional identity; junior college; nursing intern

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1. Introduction

Nursing is a highly stressful, but compassionate profession. People choosing to be a nurse are empathetic in providing professional help and support according to patients' needs [1]. However, overexposure to patients' traumatic experiences during long-term professional engagements could be a source of psychological distress for nursing practitioners, which could erode their ability to take care of patients at an optimum level, as well as their own physical and psychological health [2,3]. This phenomenon was termed as compassion fatigue (CF) by Joinson in 1992, which refers to the formal caregiver's reduced capacity or interest in being empathic and is considered as the natural consequence of constantly witnessing the traumatizing events suffered by other people [4]. Commonly, CF is composed of secondary traumatic stress (STS) and burnout (BO) [5]. STS is caused by the care provider's exposure to the suffering of others who have or are experiencing stressful events [6,7], and BO refers to the care provider's experience of the reduced self-efficacy associated with workload demands and increased perceived stress [6,8–10].

The CF of clinical nurses has received wide attention and has been the focus of studies [11]. Evidence shows that the prevalence of moderate-to-severe CF could be up to

57.7%, especially high in clinical nurses who work in the intensive care unit, emergency, oncology, psychiatric and paediatric departments [12]. A recent systematic review involving 28,509 clinical nurses revealed that the levels of CF have increased over time in recent years, and clinical nurses in the Asian regions suffered a severe level of CF symptoms [13]. The issue of CF has become even worse during the COVID-19 pandemic when clinical nurses have been more likely exposed to traumatic and life-altering events [14]. In addition, clinical nurses have to offer more complex care and psychological support for patients suffering from COVID-19 under various pressures, such as enormous nursing workloads, the highest risk of contagion and being unable to bear family responsibilities [15]. The development of CF can weaken clinical nurses' ability to feel sympathy and empathy at work, therefore hindering the provision of safe, competent, and ethical care [5,16]. Previous studies showed that a large number of nurses were deeply troubled by diverse negative physiological and psychological symptoms related to CF, such as headaches, insomnia, musculoskeletal disorders, depression and professional helplessness [17–20]. In addition, clinical nurses who suffer from CF can not only manifest low job satisfaction and work engagement, but also show poor job performance and increased medical errors [21–24]. All of these consequences of CF can induce higher absenteeism and turnover of nursing staff, which are escalating problems faced by healthcare systems [25,26].

Nursing students in junior college are an important reserve of further professional nurses globally. In China, approximately half of all registered nurses held an associate degree until 2019 [27]. Most noteworthy, because nursing students are frequently up against real-life trauma situations and similar workplace environments as professional nurses during their clinical training, they are also vulnerable to CF [28–30]. One survey of 972 nursing students found that the prevalence of moderate BO and STS was 97.8% and 55.3%, respectively [31]. However, these studies [31–35] are either specific to undergraduate students or both undergraduate students and junior college students, all of which cannot purely reflect the level of CF among the junior college students. Several studies found that nurses with associate degrees suffered from significantly higher CF than those with bachelor's degrees [36,37]. One possible reason is that nurses with lower education degrees usually have less rich knowledge reserves. When providing supportive care for patients and dealing with traumatic events in a hospital setting, they may have less professional working ability, and then may achieve less satisfaction from work [38,39]. Given all these, revealing the current status of CF among junior college nursing students is crucial.

Among pre-licensure health profession students, including nursing students, high levels of CF or BO were associated with an increased intention to quit their education program that predicts actual attrition [40–44]. During the COVID-19 pandemic, social distancing and isolation requirements had significantly disrupted healthcare students' education and clinical rotations, thus students may be unable to develop essential practical skills needed for patient care. These challenges contributed to elevated BO, and uncertainties about the future career, and the increased intention to quit [42,45–52]. In addition, BO developed during the education program could continue to post-graduation and affect new nurses' well-being and intentions to leave the profession [10]. As a longitudinal study showed that, BO during the internship period was associated with a lower self-rated clinical performance and a higher turnover intentions in one year post-graduation [41]. Obviously, CF or BO will have a negative impact on the career development of nursing students. Hence, understanding how to mitigate CF is of primary importance.

Currently, limited information is available on effective initiatives to alleviate CF. Positive professional identity may be a potential factor that can protect healthcare providers from CF and BO and benefit the maintenance of psychological well-being [12,53,54]. For nursing students, professional identity refers to the process of career planning and confirming their professional role in their current status [55]. A robust professional identity is critical for a nursing student to transform into a confident, successful and resilient healthcare professional [56,57]. Studies shows that professional identity has a positive impact on nursing interns' response to work stress and caring abilities [58,59].

It is known that a lack of professional identity has detrimental effects on the poor retention of the nursing workforce [60–62]. Sabanciogullari et al. [63] found that a professional identity development program significantly decreased clinical nurses' job BO, suggesting strong professional identity can play a protective role for healthcare providers working at hospitals. Although COVID-19 pandemic poses many risks and challenges associated with healthcare and nursing, it can arouse nursing students' desire to help others and awareness of the importance of the nursing profession, which are underlying themes of professional identity [45]. A cross-sectional study revealed that the professional identity score among nursing interns increased significantly since the outbreak of COVID-19 [64]. Hence, researchers can utilize the positive impact of responding to the COVID-19 pandemic to cultivate the professional identity of students, thereby alleviating CF. However, only a few researchers have directly investigated the relationship between professional identity and CF among the clinical nurses, but not in the nursing students to date [12,54,65,66]. Therefore, it is necessary to explore the association between professional identity and CF among junior college nursing interns.

This study addressed the following research questions. (a) What is the status of CF among junior college nursing interns in China? (b) Are there significant differences in CF between nursing interns with different sociodemographic characteristics? (c) Is there a relationship between CF and professional identity among junior college nursing interns in China?

2. Materials and Methods

We conducted a cross-sectional survey to assess the current status of CF among junior college nursing interns in China and explore the association between CF and professional identity.

2.1. Participants

A convenience sampling method was used to select eligible participants from 10 public junior colleges in Hunan Province, China from December 2021 to June 2022. Eligible participants were nursing interns who had completed at least 2 years of nursing-related courses (including nursing students who specialize in general nursing and midwifery), had a clinical internship in a second-level or above hospital, had a clinical internship for no less than 8 months and gave informed consent and voluntary participation in this study. The exclusion criteria were nursing interns whose clinical practice positions were clerical management or administration and not directly in contact with patients.

2.2. Sample Size

The sample size was calculated using the formula: $n = \frac{Z_{\frac{\alpha}{2}}^2 * \sigma^2}{\delta^2}$. There is no study using the CF Short Scale (CFSS) to measure CF among nursing interns. Therefore, the sample size in our study was calculated based on a study reporting the CF among nursing staff in China (standard deviation = 22.88) [67]. Based on the expected error of estimation of 1 and a 5% margin of error, theoretically, a minimal sample size of 2011 was required. A total of 2405 nursing interns were recruited.

2.3. Data Collection

The data collection process was carried out through an online survey. The teaching counselors from each college were invited to perform the recruitment. All invited teaching counselors were informed of the research purpose and detailed survey procedures based on standardized trainings to ensure participants meeting eligible criteria and to avoid bias in the data collection process. Sojump (also named as "Wenjuan Star") software was used to perform the online survey, and the link was sent to participants through WeChat (the most popular and practical instant communication software in China). The average time of the entire answer process is about 15 to 20 min. Completion of the previous question is a mandatory criterion for entering into the next question to ensure the completeness of the questionnaire responses. The purpose and method of this study were explained to

the nursing interns who met the inclusion criteria by trained teaching counselors. Each participant read and signed an electronic written informed consent form before filling out the questionnaires. Moreover, they could quit at any time. Questionnaires with identical answers or regular answers were excluded. After removing 149 invalid responses, we were left with a final count of 2256 (an effective response rate is 93.8%).

2.4. Measures

2.4.1. Demographic Characteristics

The demographic characteristics questionnaire was designed by the research team to collect participants' gender, age, specialty, duration of an associate program, whether being from an only child family, frequency of night shifts, home location (rural or urban), monthly living expenses and employment intentions.

2.4.2. CF Short Scale (CFSS)

Nursing interns' CF was measured by the CF Short Scale. The original CFSS was developed and tested by Adams et al. (2006) [68], consisting of 13 items in 2 dimensions including STS (five items) and BO (eight items). The Cronbach's alpha coefficient of the total scale, STS subscale and BO subscale was 0.90, 0.80 and 0.90, respectively. Each item is scored at a 10-point Likert scale, ranging from 1(never) to 10 (always), with a total score of 13–130. The higher the score indicated the more severe CF. The present study used the Chinese version of the CFSS, which was translated and validated by Sun (2015) [69], to measure CF. In this study, the Cronbach's α of the total scale, STS subscale and BO subscale was 0.917, 0.857 and 0.888, respectively.

2.4.3. Professional Identity

Professional identity was measured using the Professional Identity Scale which was developed by Brown et al. [70]. The Professional Identity Scale is a unidimensional scale and consists of 10 items. Of these 10 items, five are positive and the other five items are negative. Items are rated on a 5-point rating scale from 1 (never) to 5 (always), with a total score of 10–50. The higher score indicated the stronger professional identity. The Cronbach's coefficient of the original scale is 0.71. This study used the Chinese version of this scale, which has been translated and validated by Lu et al. [71] with a Cronbach's coefficient of 0.82, to measure professional identity. The Cronbach's of the scale in this study was 0.803.

2.5. Data Analysis

Data analysis was conducted using SPSS (version 25.0) software (IBM Corp., Armonk, NY, USA). A two-tailed p-value less than 0.05 was deemed statistically significant. First, participants' baseline characteristics were summarized as frequency, percentage, mean and standard deviation (SD). We further classified the score of CFSS into dichotomous variables by using the median of the total score as the cut-off value [72]. Specifically, if participants who reported a total score of CFSS $\geq$ 65, BO subscale $\geq$ 40 or secondary trauma subscale $\geq$ 25, they were considered to be at high risk for CF, BO and STS. Secondly, we used the Kolmogorov–Smirnov test to evaluate the distribution of the total score of the CFSS and Professional Identity Scale, suggesting abnormal distributions of the two scores (CF: $D = 0.092$, $p < 0.001$; professional identity: $D = 0.079$, $p < 0.001$). However, according to the following two reasons, we selected the parametric test to compare the difference of CF between participants with different categories: (1) when the data sample size is big enough, the normality test result is unstable and not always reliable [73] and (2) the central limit theorem also confirmed that the sampling distribution tends to be normal in large samples, despite the shape of the data [74,75]. Therefore, independent t-test and one-way ANOVA was used to assess the difference of CF level between participants from different groups. The significant factors were then included in the linear regression to further test which baseline factors could contribute to the

development of CF. The enter strategy was used when conducting the multivariate linear regression analysis. Pearson correlation was used to explore the association between CF and professional identity. Cohen's rule of thumb has become a de factor standard for this effect size [76], suggesting that r = 0.10 was "small", r = 0.30 was "medium" and r = 0.50 was "large". However, we also performed the non-parametric analysis to examine robustness of the findings.

3. Results

3.1. Participants' Socio-Demographic Characteristics

Participants' characteristics are presented in Table 1. The majority of participants who returned the validated questionnaires were female (n = 2077, 92.1%) and from the nursing specialized field (n = 1660, 73.6%). Most of the participants have undertaken a three-year nursing course (n = 1736, 77%) and have their internship in the tertiary hospital (n = 1708, 75.7%). The majority were from the urban areas (n = 1784, 79.1%), not the only child in their family (n = 1962, 87%) and had monthly expenses between 1000 to 2000 yuan (69.8%). About half of the participants have the experience of being student leaders (n = 1172, 52%) and 86.1% of nursing interns intend to be a nurse or midwifery.

Table 1. The score of CF according to various characteristics.

Variable	Categories	N (%)	Average Score of CF		
			Mean ± SD	t/F	*p*-Value
Specialty	Nursing	1660 (73.6%)	44.23 ± 22.97	−2.671 *	0.008
	Midwifery	596 (26.4%)	47.11 ± 21.35		
Degree	Three years course	1736 (77.0%)	44.9 ± 22.65	−0.374 *	0.709
	Five years course	520 (23.0%)	45.32 ± 22.39		
Gender	Male	179 (7.9%)	40.46 ± 22.45	−2.804 *	0.005
	Female	2077 (92.1%)	45.38 ± 22.56		
The place of birth	Urban area	472 (20.9%)	44.02 ± 21.91	−1.051 *	0.293
	Rural area	1784 (79.1%)	45.25 ± 22.76		
Only child	Yes	294 (13.0%)	43.68 ± 22.85	−1.066 *	0.287
	No	1962 (87.0%)	45.19 ± 22.54		
Monthly expense	<1000 yuan	420 (18.6%)	44.50 ± 21.39	0.248 #	0.780
	1000–2000 yuan	1574 (69.8%)	45.00 ± 22.94		
	>2000 yuan	262 (11.6%)	45.76 ± 22.32		
Experience of being student leaders	Yes	1172 (52.0%)	45.15 ± 22.92	0.352 *	0.725
	No	1084 (48.0%)	44.82 ± 22.22		
Level of intern hospital	Tertiary hospital	1708 (75.7%)	43.96 ± 22.24	−3.858 *	<0.01
	Secondary hospital	548 (24.3%)	48.22 ± 23.34		
No. of night shifts (monthly)	0–2/month	803 (35.6%)	43.67 ± 21.56	5.471 #	0.001
	2–4/month	1037 (46.0%)	44.59 ± 22.49		
	4–6/month	278 (12.3%)	47.27 ± 22.84		
	>6/month	138 (6.1%)	51.19 ± 27.10		
Intent to be a nurse or midwifery	Yes	1943 (86.1%)	42.83 ± 21.36	−11.642 *	<0.01
	No	313 (13.9%)	58.39 ± 25.24		

Note: CF: compassion fatigue; SD: standard deviation; IQR: interquartile range; *: *t*-test statistic; #: one-way ANOVA statistic (F statistic).

Significant differences were found among five factors from the results of the independent *t*-test or one-way ANOVA test (Table 1). Specifically, participants who specialized in midwifery were female, had internships at secondary hospitals and intended to be a nurse or midwife after graduation reported significantly higher CF levels than those who specialized in general nursing (mean difference [MD]: −2.89, 95% confidence interval [CI] −4.91 to −0.83), were male (MD: −4.93, 95% CI: −8.37 to −1.48), had an internship at a

tertiary hospital (MD: −4.26, 95% CI: −6.48 to −2.04) and did not intend to become a nurse and midwifery after graduation (MD: −15.55, 95% CI −18.51 to −12.59). Additionally, participants who experienced more night shifts reported higher levels of CF than those who experienced relatively fewer night shifts.

3.2. The Status of CF

The mean and SD of the score of total CF was 44.99 ± 22.58, with 29.26 ± 15.04 for BO and 15.73 ± 9.41 for STS (Table 2), all of which were considered a positive indication of weak CF among nursing interns. Median values were used as a threshold to divide the total score of CFSS and the two CFSS subscales into two levels. There were 440 (19.5%) participants reporting an overall CF score above 65 and were regarded as having high levels of CF. In addition, 24.2% of the respondents had BO and 17.2% showed symptoms of STS.

Table 2. Distribution of responses to CFSS and its subscales, and median score among nursing interns (n = 2256).

Variables	Mean ± SD	Distribution of Responses (%) [a]	
		Low (N, %)	High (N, %)
CF	44.99 ± 22.58	1816 (80.5%)	440 (19.5%)
BO	29.26 ± 15.04	1711 (75.8%)	545 (24.2%)
STS	15.73 ± 9.41	1867 (82.8%)	389 (17.2%)

Note: CF: compassion fatigue; burnout: BO; STS: secondary traumatic stress; CFSS: the CF Short Scale; IQR: interquartile range; SD: standard deviation; [a]: preset median value as a cut point to classify the total score of CFSS and two subscales into two levels, respectively. If participants with a total score of CFSS greater than or equal to 65, they were considered to be at high risk for CF. If participants had a total score of BO subscale greater than or equal to 40, they were considered to be at high risk for BO, and if participants had a total score of STS subscale greater than or equal to 25, they were considered to be at high risk for STS subscale.

3.3. Multiple Linear Regression Analysis of Influencing Factors

Table 3 displays the results from the multiple linear regression analysis. Five factors (specialty, gender, level of hospital, the number of night shift per month and employment intention) with a *p*-value of <0.05, showing a statistically significant association with a *t*-test or ANOVA, were placed in the multiple linear regression model. The tolerance values ranged from 0.958 to 0.989, indicating no multi-collinearity. The results of linear regression demonstrated a positive association among four personal factors (midwifery, secondary hospital, six night-shifts per month and no intent to be a nurse or midwife) and CF. However, these four variables only explained 6.8% of the total variance CF ($p < 0.001$). It indicates that there are other factors besides demographic and sociological factors and at the level of the inter hospital, there are other factors that should be considered which could explain the CF level of nurse interns

3.4. The Correlation between CF and Professional Identity

The mean and SD of the Professional Identity Scale among nursing interns was 38.45 ± 6.18. The results of correlation analysis identified a weak negative correlation between professional identity and CF ($r = -0.42$, $p < 0.001$), STS ($r = -0.25$, $p < 0.001$), BO ($r = -0.47$, $p < 0.001$) (Table 4). Therefore, this is indicative of a significant relationship between these variables and suggests that as nursing students suffer from CF, the likelihood of obtaining a low level of professional identity is minimal during their internship period.

Table 3. Multivariate linear regression analysis of CF among medical interns (n = 2256).

Variable	Categories	*B*	SE	*Beta*	*t*	*p*-Value
Specialty	Nursing (reference)					
	Midwifery	2.573	1.063	0.05	2.421	0.016
Gender	Male (reference)					
	Female	2.394	1.735	0.029	1.379	0.168
Level of hospitals	Tertiary hospital (reference)					
	Secondary hospital	3.902	1.076	0.074	3.628	<0.01
No. of night shifts per month	2–4/ month (reference)					
	0–2/month	−0.628	1.027	−0.013	−0.612	0.54
	4–6/month	1.393	1.478	0.02	0.943	0.346
	>6/month	1.510	0.549	0.056	2.753	0.006
Intent to be a nurse or midwifery	Yes (reference)					
	No	15.047	1.335	0.230	11.270	<0.01
Constant term		12.304	3.863		3.185	0.001

Adjusted R^2 = 0.068; F = 33.794; *p*-value < 0.000.

Table 4. The correlation between CF and its two domains and professional identity.

Variables	CF	STS	BO	Professional Identity
CF	1			
STS	0.88 **	1		
BO	0.95 **	0.69 **	1	
Professional identity	−0.44 **	−0.26 **	−0.49 **	1

Note: CF: compassion fatigue; STS: secondary traumatic stress; burnout: BO; **: $p < 0.001$ for two-tailed.

4. Discussion

4.1. Main Findings

We performed this cross-sectional study to (1) explore the prevalence of CF among Chinese nursing interns in the associate program; (2) compare the CF level among nursing interns from different sociodemographic and institution characteristics; (3) find out the relationship between nursing interns' CF and their professional identity. The results of our study suggested the average level of CF among nursing interns is low, but about one in every five students is at high risk for CF and more participants have BO than STS. Nursing interns who specialized in midwifery reported higher CF than those who specialized in nursing. Nursing students who had an internship in a secondary hospital showed higher CF than those who had an internship in a tertiary hospital. We also found that the more night shifts they undertook, the higher level of CF they reported. Overall, 13.9% of participants who reported that they intended to withdraw from the nursing or midwifery profession, reported much higher CF than those who intended to stay in this profession. In addition, correlation analysis identified a significant medium association between CF and professional identity.

4.2. The Status of CF

Although CF among clinical nurses has received widespread attention, there is limited published research focusing on nursing students [32,77]. This study found that 19.5%, 24.5% and 17.2% of participants presented with a high risk for CF, BO and STS by using the median as cut-off value, respectively, which indicate that the CF level among nursing interns is low. This result was in line with the findings of Han Binru et al. (2017) who found that 37.8% and 21.9% of nursing interns reported high levels of BO and STS, respectively [78]. Likewise, Cao el al (2021) reported very low prevalence in high levels of BO and STS among nurse interns (0.9% and 1.1%, respectively) [32]. Though these studies used different

measurement tools and classification methods, they all reported a low-level CF among nursing interns

CF is caused by continual exposure to stress and trauma during clinical practice. Therefore, the CF level among healthcare providers is associated with the time and nature of their work. The low level of CF among nursing interns is a possible reason as nursing students receive only 8 to 10 months of clinical internship in different departments. Another reason for the low level of CF among nursing interns could be that nursing students are protected from medical errors under the strict supervision of clinical teachers, which could mitigate their stress from work [79]. However, nearly 20% of participants who had a high level of CF still merited attention by educators and clinical managers. The clinical internship provides students with opportunities to practice their knowledge and skills learned in classrooms. However, this process would be stressful for some nursing students as they lack clinical knowledge and self-confidence. Nursing interns could be at the bottom of the social hierarchies in the stressful clinical settings. Studies report that nursing interns are at risk of experiencing bullying from staff nurses, clinical instructors, as well as patients and families, which could be the reason for BO, high CF and low career identity. Further studies are needed to explore the reasons for the high level of CF among these participants. Interventions should be developed to assist them in building their competencies and confidence, the actualization of their role as nurses, and the understanding of their responsibilities in care, which could enhance their enthusiasm for helping others [35].

4.3. Comparison of CF by Participants' Characteristics

When we investigated the distribution of CF among the participants, we found female participants, those from a midwifery speciality, those with internships at secondary hospitals and who had more night shifts as well as those who intended to switch to another profession after graduation were associated with a higher level of CF.

Regarding area of speciality, participants whose specialty was in midwifery showed higher CF than for those with a specialty in nursing. During the clinical internship, both nursing and midwifery students face the challenge of demanding workloads, challenging placements and witnessing traumatic events, with subsequent stress sometimes affecting CF. Compared with nursing students, students who specialize in midwifery are more likely to work in the units related to birth, which are considered happy events that bring positive emotions. However, there are factors such as loss of control, inability to cope with pain, various complications and traumatic birth that can turn the childbirth process into a stressful and traumatic experience [80,81]. A recent study showed that midwifery students were facing a high level of STS rates which should be supported by mental health nurses to cope with traumatic stress [82]. However, further studies should explore the difference between midwifery and nursing interns.

Regarding level of hospital internship, nursing interns in the secondary-level hospital had higher CF than nursing interns in the tertiary hospital. The classification of hospitals in China is a three-tier system: primary, secondary and tertiary hospitals. Secondary hospitals are responsible for providing comprehensive health services and managing simple diseases. Tertiary hospitals provide specialist health services and serve as medical hubs providing care to multiple regions. Reports show that compared with tertiary-level hospitals, the secondary-level hospitals face the greater challenges of staff shortages, are less advanced relative to the staff's level of education and have less sophisticated medical equipment. These challenges lead to higher workloads and a higher risk of BO for healthcare workers in secondary-level hospitals and also hurt the quality of medical outcomes for patients. As for nursing staff, nursing interns will experience the same stress in secondary-level hospitals which will increase their CF and BO [83].

In the aspect of number of night shifts, nursing interns who undertook more night shifts reported higher scores of CF. This finding is consistent with early studies [84,85]. As for nursing staff, nursing interns also need to take on different work shifts. Evidence shows that shift work can cause BO for the nurses as well as a series of health problems (Hughes

2015; Wang 2019). Shift work also has a negative impact on nurses' job satisfaction and job performance [86,87]. In addition, nursing students in the post-internship stage are faced with the pressure of job hunting and examinations, and they are more concerned about the impact of scheduling. Research shows that about 63% of nursing students report decreased work enthusiasm and job satisfaction from shift work, which also has a negative impact on their communication with patients [78]. Therefore, managers should appropriately refer to the opinions of nursing students, arrange flexible shifts, improve the practice efficiency of nursing students, and reduce the negative pressure of scheduling on nursing students.

In the aspect of intent to be a nurse or midwife, there are about 14% of participants reporting that they intend to withdraw from the nursing profession [88,89]. These participants have significantly higher CF than those who would like to stay in this profession. Clinical internships provide nursing students with chances to practice the knowledge learn from the classroom and also provide them with a chance to gain an insight into the real nurses' roles and meanwhile expanding the expectations of their future careers. A qualitative interview shows that two reasons for nursing students' dropout in the late stage of their study are lacking a safe learning environment in clinical placements and psychological support, and realizing that the training and the future profession did not match their expectations and wishes [90]. CF could be a reason for nursing intern intent to withdraw from the nursing profession. Conversely, nursing interns who intend to show less enthusiasm for their work and patients, as a result, are more exposed to negative emotions, including CF. This finding is further tested by the negative correlation between CF and professional identity.

4.4. The Association between CF and Professional Identity

This study found a negative correlation between CF (including both STS and BO) and professional identity. The negative association between CF and professional identity has also been tested among general nurses [54], operation room nurses [66] and ICU nurses [12]. Professional identity was described as a person's perception of themselves within a profession or the collective identity of the profession, which plays an important role when nursing students decide to choose their career. The formation of a professional identity is an evolving process, shaped by educational experiences, life experiences, work experiences and social media. Clinical internships provide nursing students with a chance to explore and experience real clinical nursing work CF, including both BO and STS, is a resource of work-related stress. It has a negative impact on nursing interns' well-being and then further reduces their passion for the nursing profession. On the one hand, the way nursing interns negotiate their professional identities could soothe or exacerbate the impact of CF on their mental health. A high level of professional identity can improve healthcare workers' psychological state and make them more resistant to CF [91].

4.5. Limitation and Further Studies

There are several limitations in the present study. First, the cross-sectional study design and self-report data as opposed to objective measurement, and therefore our results may be negatively influenced by potential bias. Second, convenience sampling was used in this study, which might be a source of selection bias. Third, although a significant difference was reported among participants with different baseline characteristics, these factors can only explain 6.8% of the CF. Therefore, further studies are needed to explore the predictors of CF. Moreover, further studies could use qualitative methods to explore the reasons for those nursing interns who reported high CF.

5. Conclusions

The study found that the CF level among Chinese nursing students is lower than that among the nurse staff. Participants with a midwifery speciality, having internships at secondary hospitals and had more night shifts as well as those who did not intend to work as a nurse or midwife reported a high level of CF. There is a negative relationship between

CF and nursing interns' professional identity. Future studies are needed to explore which pathways could mediate the relationship between professional identify and comparison fatigue among nursing interns.

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Compassion fatigue in Chinese internship nursing students in junior college: scale validation, prevalence, and psychological mechanisms
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