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Prevalence of stress among nursing students
A protocol for systematic review and meta-analysis

Yan-xue Zheng, MSN[a] [iD], Jia-Ru Jiao, Master's Candidate[a], Wen-Nv Hao, MB, RN[b,*]

Abstract

Objective: Our main purpose is to evaluate the prevalence of stress among nursing students systematically.

Methods: Adhering to the preferred reporting items for Systematic Reviews and Meta-analyses guidelines, we carefully searched ten databases, including PubMed, Cochrane, Web of Science, Scopus, ScienceDirect, SpringerLink, EMBASE, CNKI, Wanfang, and China Biomedical Literature Service System, to collect cross-sectional studies on nursing students. Two researchers independently screened the literature, extracted the data, and evaluated the risk of bias in the included studies.

Results: From 1397 studies, 27 cross-sectional studies were included, including 7116 subjects. Meta-analysis showed that the prevalence of low-level stress was 0.24% [95% CI (0.24% to 0.25%)], the prevalence of middle level stress was 0.35% [95% CI (0.35% to 0.35%)], and the prevalence of high-level stress was 0.10% [95% CI (0.10% to 0.10%)]. The results of subgroup analysis showed that stress levels are different in different genders, diagnostic criteria for stress, years of publication, and regions.

Conclusions: This review identified the stress levels of nursing interns, which were mainly moderate. This result makes nursing administrators and nursing educators pay more attention to the mental health problems of nursing interns, which can actively take measures to promote the physical and mental health of nursing students, improve the quality of nursing students' practice, and further promote the development of the nursing profession.

Abbreviations: AHRQ = the Agency for Healthcare Quality and Research,ASNS = Assessment of Stress in Nursing Students,CNKI = China National Knowledge Infrastructure, IES = The Impact of Event Scale, NSPCC = Nursing Students' Perceived Clinical Stressors Scale, PQSS = the Persian Questionnaire of Stressful Sources, PSS = the Perceived Stress Scale, SE = the standard error.

Keywords: meta-analysis, nursing students, stress prevalence, systematic review

1. Introduction

Stress is a common human experience blamed for many ills.[1] Stressors can be broadly defined as situations or events that potentially affect health outcomes[2] because there is a gap between students' needs in a specific clinical case and their resources or ability to cope with a task or situation.[3]

Stress, according to Selye, is a response to environmental stimuli.[4] In the physical environment, stress results when 1 body exerts demands on another, such as 1 object placed on top of another thing: if the second object cannot withstand the pressure from the first object, the stress or anxiety it is exerting can cause the second object to collapse.[5] Similarly, in biological systems such as the human body, unmitigated or uncontrolled stress can lead to physical and mental collapse, which ultimately can result in adverse health outcomes.

Recent research concerning healthcare-related fields and stress has indicated that nursing students experience higher stress levels compared to other majors[6] and that these levels are on the rise.[7] Additionally, student nurse clinical experiences may adversely affect their learning outcomes, academic performance, overall health, well-being, quality of life,[8] clinical routine,[9] and even suicidal behavior. Eight hundred thousand people commit suicide every year, and even more attempt to do so.[10] Despite advances in neuroscience and understanding of the pathophysiology of human behavior, suicide remains a baffling challenge.[11] Scientific evidence suggests that the synergic role of genetics, exogenous and endogenous stressors, epigenetic and neuromodulators also play a role in the occurrence of suicide.[12]

There is a shortage of data addressing the prevalence of stress in nursing students. Therefore, identifying the majority of stressors in the clinical setting is necessary for providing measures

that enable the development of healthy coping mechanisms that minimize stress and maximize student clinical learning.[13,14] The purpose of this study is to provide a review of research that addresses the problem of stress in nursing students and to examine the effects of gender and world region on the prevalence of anxiety among nursing students.

2. Materials and methods

2.1. Eligibility criteria

To collect data on the incidence of stress, including in the review were quantitative cross-sectional studies, which had: (a) Published in the English or Chinese language; (b) Analyzed the prevalence of stress among nursing students with sufficient statistical information; (c) Based on a sample of nursing students or on a mixed sample in which the results for nursing students are provided separately; (d) Utilized standardized validated instruments for assessing the prevalence; (e) Peer-reviewed studies available in full text.

2.2. Literature retrieval strategy

To ensure the comprehensiveness of the literature, and our leading research object is nursing students, so ten databases, including PubMed, Cochrane, web of science, Scopus, ScienceDirect, SpringerLink, EMBASE, CNKI, Wanfang, and China Biomedical LiteratureService System, were searched to collect cross-sectional studies on nursing interns. The retrieval time was from the establishment of the database to June 2021. The retrieval is carried out by combining subject words with free words and is adjusted according to the specific database. Chinese keywords include nursing students, pressure, influencing factors, etc. English critical words, including stress, nursing students, etc. The foreign language retrieval strategy is (anxiety* OR"life stress*"OR "psychological stress*") AND(nurs* n2 student OR undergraduate nurse OR "Students, Nursing+" OR "Students, Nursing, Practical").

Taking PubMed as an example, the specific search strategy is shown in Figure 1.

2.3. Literature screening and data extraction

Two researchers (ZYX and JJR) independently screened literature, extracted data, and cross-checked it. In case of disagreement, it shall be settled through discussion or negotiation with a third party (HWN). When selecting the articles, first read the title. After excluding the unrelated articles, please read the abstract and full text to determine whether they are included. Data extraction includes: ①basic information of the included studies: first author, year of publication, total sample size, survey period, the source region and influencing factor grade, etc. ②Outcome indicators: the number of cases with different stress levels and the total number of issues; ③the related elements of bias risk assessment.

2.4. Bias risk assessment of included studies

Two researchers independently evaluated the risk of bias in the included studies and cross-checked them. They decided or consulted a third party (HWN) when they had different opinions. Descriptive cross-sectional studies are usually used to describe the prevalence and incidence of disease. Hence, the Agency for Healthcare Quality and Research (AHRQ)[15] evaluates cross-sectional studies/prevalence studies. AHRQ consists of 11 items. If the answer is "no" or "unclear," the item score is "0"; If the answer is "yes," the item score is "1". A score of 8 to 11 is considered high quality, 4 to 7 moderate quality and below 4 poor quality. After the independent evaluation, 2 researchers will discuss and reach a consensus. If there is any disagreement, the third researcher will arbitrate, or the research group will discuss and decide.

2.5. Statistical analysis

Endnote X9 was used to summarize the literature. Excel software was used for data extraction management, statistics, and

#1("Students, Nursing"[Mesh]) OR (((((((Pupil Nurses[Title/Abstract]) OR (Student, Nursing[Title/Abstract])) OR (Nurses, Pupil[Title/Abstract])) OR (Nurse, Pupil[Title/Abstract]) OR (Pupil Nurse[Title/Abstract])) OR (Nursing Student[Title/Abstract])) OR (Nursing Students[Title/Abstract]))

#2("Stress,Psychological"[Mesh]) OR (((((((((((Psychological Stresses[Title/Abstract]) OR (Stresses, Psychological[Title/Abstract])) OR (Life Stress[Title/Abstract])) OR (Life Stresses[Title/Abstract])) OR (Stress, Life[Title/Abstract])) OR (Stresses, Life[Title/Abstract])) OR (Stress, Psychologic[Title/Abstract])) OR (Psychologic Stress[Title/Abstract])) OR (Stressor, Psychological[Title/Abstract])) OR (Psychological Stressor[Title/Abstract])) OR (Psychological Stressors[Title/Abstract])) OR (Stressors, Psychological[Title/Abstract])) OR (Psychological Stress[Title/Abstract]))

Total retrieval type：#1AND#2

Figure 1. Search strategy.

descriptive analysis of outcome indicators. Revman 4.1 software was used to merge the prevalence of low, medium, and high-stress levels in each study, and subgroup analysis was carried out according to the source area, gender, and time of examination. The chi-square test and I² index were used to determine whether there was heterogeneity among studies, and the heterogeneity of effect sizes was analyzed. The fixed-effect model was adopted if there was no heterogeneity among studies ($P > 0.1$, I² $< 50\%$). The random-effects model was used to combine effect sizes with heterogeneity among studies ($P < 0.1$, I² $\geq 50\%$). The data extracted was utilized to compute the standard error of the prevalence of stress (SE) for each included study, using the below equation number of nursing students (n) and the majority of stress in nursing students (p). This was conducted for the overall prevalence and the prevalence among the subgroups identified.

$$SE = \sqrt{\frac{P \times (1 - P)}{n}}$$

2.6. Ethical consideration

Ethical approval was not required based on already published secondary data and the meta-analysis nature.

3. Results

3.1. Literature screening process and results

A total of 1397 articles were identified. Three hundred thirteen duplicate reports were removed, leaving 1084 papers for further screening. Subsequently, 2 reviewers read titles and abstracts to eliminate 970 unqualified articles in nonEnglish or Chinese; conference summary, guide, index abstracts; qualitative studies; reviews or meta-analyses; and irrelevant to the topic. In total, 114 articles were included for full-text review. Eighty-five complete pieces were eliminated from these, such as unable to obtain the complete text, duplicate content or incomplete data, inconsistent research object and content, and noncross-sectional
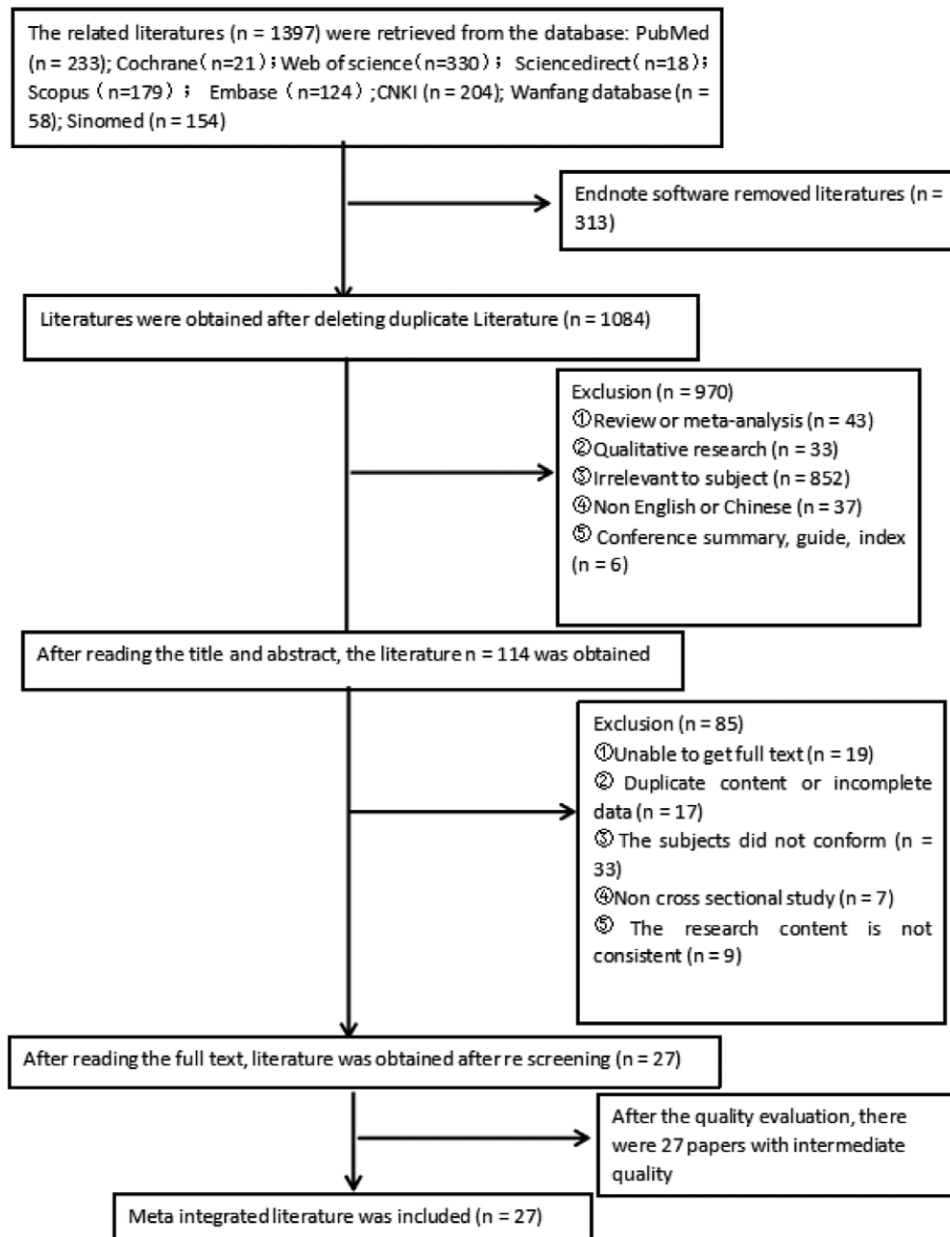

Figure 2. literature screening process and results.

Table 1

Basic characteristics of included studies.

Reference	Study design	Date collection	Country	Instruments	Subjects	Pressure level (examples)		
						Low	Medium	High
Marcela Corrêa Barboza1 (2012)	Cross-sectional	July to September 2009	Brazil	Visual analogue scale	47	28	105	201
Ewa Kupcewicz (2020)	Cross-sectional	May 2018 to April 2019	Poland	Perceived Stress Scale (PSS-10)	1002	98	78	91
			Spain			39	128	140
			Slovakia			41	128	20
Leticia Oliveira Bosso (2017)	Cross-sectional	February to March 2016	Brazil	Assessment of Stress in Nursing Students (ASNS)				
Rafati, F (2020)	Cross-sectional	November 2018 to January 2019	Iran	Nursing Students' Perceived Clinical Stressors Scale (NSPCSS)	430	35	230	157
Lahcen Bandadi (2020)	Cross-sectional	Not reported	Morocco	Perceived stress scale (PSS)	320			
Maya Sahu 2019	Cross-sectional	2017	India	Perceived Stress Scale (PSS)	102	23	69	10
AMostafa Amr (2011)	Cross-sectional	2008-2009	Egypt	Perceived Stress Scale (PSS)	373	223		150
Kleiveland, Benedicte (2015)	Cross-sectional	between Januaryand April 2014	Norway	The Impact of Event Scale (IES) / The Quality of life scale	227	150	77	
Rezaei, B (2020)	Cross-sectional	May in 2016	Iran	The Persian version of Cohen PPerceived Stress Scale (PSS) andthe Persian Questionnaire of Stressful Sources (PQSS)	108	2	29	39
Karin Blomberg (2014)	Cross-sectional	2011	Sweden	Numerical rating scale	185	44		79
Iwona Bodys-Cupak (2016)	Cross-sectional	Not reported	Poland	Perceived Stress Scale 10 (PSS-10)	39			
Yi Luo (2018)	Cross-sectional	November 18, 2015to January 6, 2016	China	C-PSQ	1519		497	253
Emad A. PhD (2020)	Cross-sectional	Not reported	Saudi Arabia	Depression Anxiety Stress Scales	54	4	8	3
Xue-qin Sun (2008)	Questionnaire	June 2006 - June 2007	China	Psychological StressorScale (self-design)	110			27
Mei Chen (2012)	Questionnaire investigation	September to December 2011	China	Questionnaire on nursing student internship stress source and pressure level (self-design)	95	39	54	2
Lu-ping Ding (2016)	Questionnaire investigation	February to April 2015	China	Nursing Student Internship Pressure Scale (Xiao Meilian)	460	359	84	17
Li-hong Li (2013)	Questionnaire investigation	Not reported	China	Pressure gauge (self-designed)	55	10	29	16
Jing Wang (2007)	Questionnaire investigation	2005-2006	China	China Health Care Pressure Source Scale (Cao Ying)	107	63	41	3
Ni-na Li (2019)	Questionnaire investigation	Not reported	China	China Health Care Pressure Source Scale (Cao Ying)	129	64	62	3
Tian-yang Chen (2019)	Questionnaire investigation	Not reported	China	Pressure source gauge (self-design)	90	23	45	22
Ping Lin (2007)	Questionnaire investigation	The 20th week of clinical practice	China	Pressure source gauge (self-design)	86	9	58	19
Li-rong Yu (2005)	Questionnaire investigation	July 2004 to May 2005	China	Student Study Pressure Survey (self-designed)	111	43	63	2
Di Zhang (2012)	Questionnaire investigation	Not reported	China	China Health Care Pressure Source Scale (Cao Ying)	189	135	52	2
Jing Huang (2019)	Questionnaire investigation	The first is from mid July to early August, and the second is from late October to mid November	China	Scale of trainee student stress source (Zhang Guixiang)	334	66	267	1
Fang Huang (2016)	Questionnaire investigation	Not reported	China	China Health Care PressureSource Scale (Cao Ying)	120	77	42	1
Shuang Fu (2012)	Questionnaire investigation	May 2009 to March 2010	China	The Psychological Stressor Scale	310	76		
Qu Guo (2017)	Questionnaire investigation	October 2012 to October 2014	China	Survey of male Stress source in TCM colleges (designed by itself)	76	24		

Table 2

Bias risk assessment results of included studies.

	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	Score	grade
Marcela Corrêa Barboza1 (2012)	Y	Y	Y	N	N	Y	Y	UN	Y	Y	N	7	Medium
Ewa Kupcewicz (2020)	Y	Y	Y	Y	N	N	Y	Y	Y	Y	UN	8	High
Leticia Oliveira Bosso (2017)	Y	Y	Y	Y	N	N	Y	N	Y	Y	N	7	Medium
Rafati (2020)	Y	Y	Y	Y	N	Y	N	UN	N	Y	UN	6	Medium
Lahcen Bandadi (2020)	Y	Y	Y	Y	N	N	Y	UN	Y	Y	N	7	Medium
Maya Sahu (2019)	Y	Y	Y	Y	N	N	N	Y	Y	Y	UN	6	Medium
AMostafa Amr (2011)	Y	Y	Y	N	N	Y	Y	N	Y	Y	N	6	Medium
Kleiveland (2015)	Y	Y	Y	Y	N	N	N	UN	N	Y	UN	5	Medium
Rezaei (2020)	Y	Y	Y	N	N	N	Y	UN	UN	Y	N	6	Medium
Karin Blomberg (2014)	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	6	Medium
Iwona Bodys-Cupak (2016)	Y	Y	Y	Y	N	N	N	N	N	Y	UN	5	Medium
Yi Luo(2018)	Y	Y	Y	Y	UN	N	N	N	N	Y	N	5	medium
Emad A. Shdaifat, PhD (2020)	Y	Y	Y	Y	UN	UN	N	N	N	Y	N	5	Medium
Xue-qinSun (2008)	Y	N	Y	Y	N	N	N	N	N	Y	N	4	Medium
Mei Chen (2012)	Y	N	Y	Y	N	N	N	Y	Y	Y	UN	5	Medium
Lu-ping Ding (2016)	Y	N	Y	Y	UN	N	N	N	N	Y	N	5	Medium
Li-hong Li (2013)	Y	N	Y	Y	N	Y	N	N	Y	Y	UN	5	Medium
Jing Wang (2007)	Y	N	Y	Y	N	Y	N	N	N	Y	N	4	Medium
Ni-na Li (2019)	Y	N	Y	Y	N	N	N	N	N	N	N	4	Medium
Tian-yang Chen (2019)	Y	Y	Y	Y	N	N	N	N	N	N	N	4	Medium
Ping Lin (2007)	Y	N	Y	Y	N	N	N	N	N	Y	N	4	Medium
Li-rong Yu (2005)	Y	N	Y	Y	N	N	N	N	Y	Y	N	5	Medium
DiZhang (2012)	Y	Y	Y	Y	N	Y	N	N	Y	Y	UN	6	Medium
Jing Huang(2019)	Y	Y	Y	Y	N	Y	N	Y	N	Y	N	7	Medium
FangHuang (2016)	Y	Y	Y	Y	N	N	N	N	N	Y	UN	5	Medium
ShuangFu (2012)	Y	N	Y	Y	N	N	N	N	Y	Y	UN	5	Medium
QuGuo (2017)	Y	N	Y	Y	N	N	N	N	Y	Y	N	5	Medium

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research type. Finally, 27 studies[16–42] met the inclusion criteria in Figure 2.

3.2. Basic characteristics of included studies

In total, 27 articles were included in this review. Studies were internationally spread from Brazil (n = 2), China (n = 15), Egypt (n = 1), India (n = 1), Iran (n = 2), Morocco (n = 1), Norway (n = 1), Poland (n = 1), Saudi Arabia (n = 1), Sweden (n = 1), mixed regions: Poland, Slovakia, and Spain (n = 1). The included literature was published from 2005 to 2020. The sample size of the study subjects was 1519 at most and 47 at least, and the findings of these studies are based on a total of 7116 participants. The 27 articles all used cross-sectional studies, and all quantitative studies used validated scales for data collection. The most popular scales for measuring stress level were the Perceived Stress Scale (PSS), Assessment of Stress in Nursing Students (ASNS), Nursing Students' Perceived Clinical Stressors Scale (NSPCC), the Persian Questionnaire of Stressful Sources (PQSS), etc. The basic characteristics of the included studies are shown in Table 1.

3.3. Basic risk assessment results of included studies

The bias risk assessment results of the included studies are shown in Table 2. Among the 27 articles, the quality assessment grade of 1 literature was high, and 26 kinds of literature were medium.

3.4. Meta-analysis results

3.4.1. The total incidence rate.
27 studies[16–42] were included, including 7116 patients. The results of meta-analysis showed that the prevalence rate of low-level stress was 0.24% [95% CI (0.24% to 0.25%)], the prevalence rate of medium level stress was 0.35% [95% CI (0.35% to 0.35%)], and the prevalence rate of high-level stress was 0.10% [95% CI (0.10% to 0.10%)], as shown in Figures 3–5.

3.4.2. Prevalence of stress in different genders.
Men and women were enrolled in 10[16,17,20,26,28,30,36,38–40] low-level stress studies, 8[16,17,25,28,30,36,38,40] medium level stress studies, and 8[16,17,20,25,26,28,36,41] high-level stress studies. The results of random-effects model meta-analysis showed that the prevalence rates of low, medium, and high levels of stress in male nursing students were 0.14% [0.14 to 0.14], 0.44% [0.44 to 0.44], 0.16% [0.14 to 0.14], and that in female nursing students were 0.14% [0.14 to 0.14], 0.44% [0.44 to 0.44], and 0.16% [0.14 to 0.14]. Chi square test showed that the differences between the subgroups were statistically significant (P < 0.00001).

3.4.3. Prevalence of pressure levels of different diagnostic criteria.
Taking PSS-10[43] as the diagnostic criteria, the low, medium, and high-pressure levels were included in 6[17,20–22,24,26] studies, and the soft, medium and high levels of anxiety were 0.15%, 0.37%, and 0.36%, respectively. The Chinese nursing students' stressor scale compiled by Cao Ying[44] as the diagnostic criteria, the low and medium pressure levels were included in
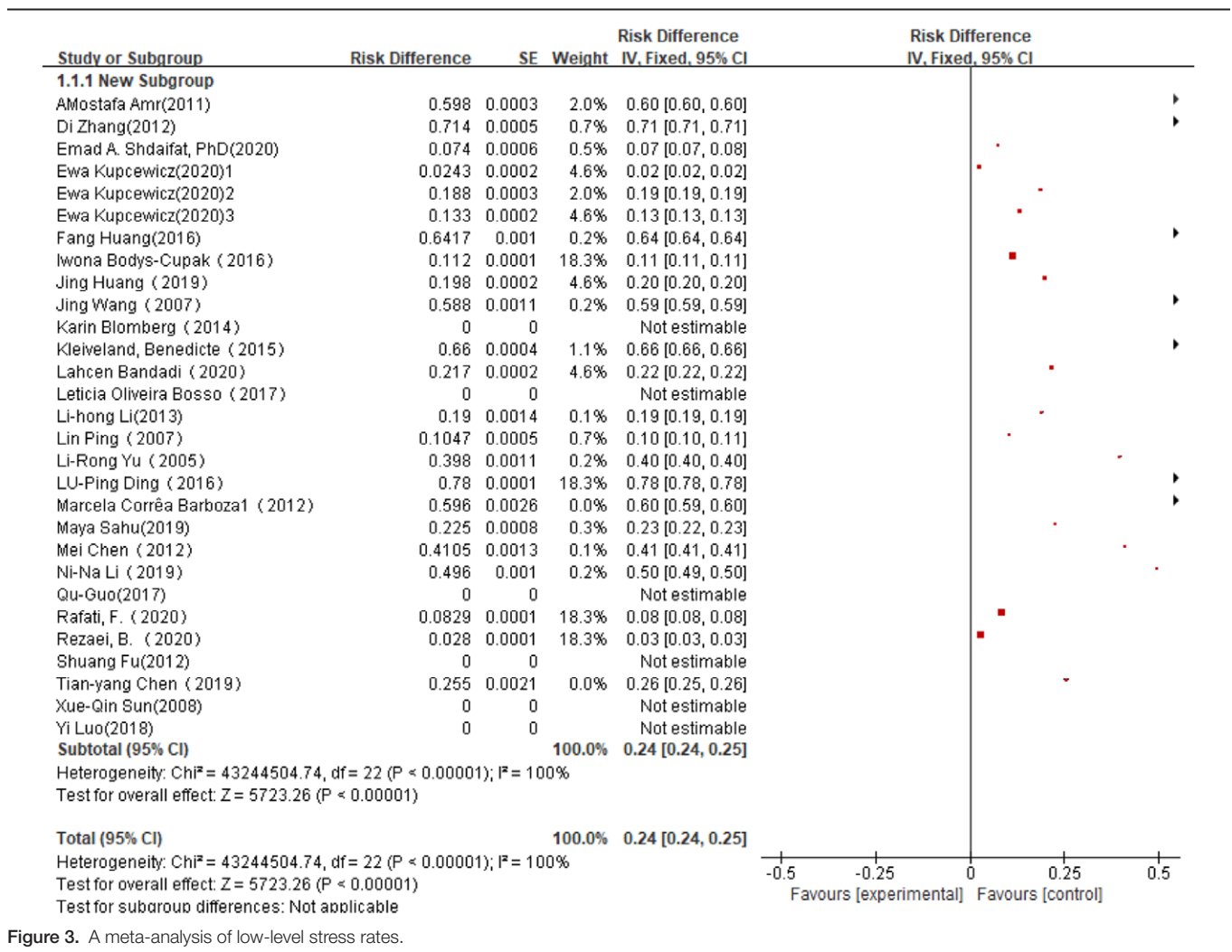

Figure 3. A meta-analysis of low-level stress rates.

4[33,34,38,40] studies. The high levels of pressure were included in 3[33,38,40] studies, and the low, medium, and high levels of anxiety were included in 3[33,38,40] studies. The prevalence of high-level stress was 0.66%, 0.32%, and 0.06%, respectively.

3.4.4. Prevalence of stress level in different survey time.
3[33,35,37] low stress level studies, 4[29,33,35,37] medium stress level studies and 3[33,35,37] high stress level studies were included before 2010 (including 2010). 17[16,17,19–24,26,28,30–32,36,38,40,42] low stress level studies and 16[17,19–22,24,26,28,30–32,36,38,40] medium stress level studies were included after 2010. There were 17 high stress level studies.[17–26,28,30,32,34,36,41,42] Meta analysis of random-effects model showed that the prevalence of low, medium and high level of stress before 2010 were 0.22% [0.22 to 0.22], 0.42% [0.42 to 0.42], 0.02% [0.02 to 0.02], respectively. After 2010, the prevalence of low, medium and high level of stress were 0.25 [0.25 to 0.25], 0.35 [0.35 to 0.35], 0.15 [0.15 to 0.15] respectively. Chi square test showed that the differences between the subgroups were statistically significant ($P < 0.00001$).

3.4.5. Prevalence of stress level in different areas.
Meta analysis of random-effects model showed that the prevalence of low, medium and high levels of stress in Europe was 0.14% [0.14 to 0.14], 0.28% [0.28 to 0.28], 0.37% [0.37 to 0.37] respectively. The prevalence rate of low, medium, and high levels in Asia were 0.29% [0.29 to 0.29], 0.35% [0.35 to 0.35], and 0.05% [0.05 to 0.05]. Others are shown in Table 3.

4. Discussion

The results of this study indicate that the overall prevalence of low-level stress of nursing students is 0.24% [95% CI (0.24% to 0.25%)], the prevalence of medium level stress is 0.35% [95% CI (0.35% to 0.35%)], and the prevalence of high-level stress is 0.10% [95% CI (0.10% to 0.10%)]. This implies that the overall stress level of nursing interns is mainly at the medium level, which is consistent with the research results of Zhu Shuang Li.[45] College is the most active period of individual psychological change and psychological contradictions and pressure. The causes of college students' psychological pressure are related to the current competitive social environment and students' physical and mental development.[46] Chinese studies have found that the biggest stressors for nursing undergraduates are preparation and examination, followed by graduation assignment, social perception of the major, and the number of learning tasks.[47] Other research has found that the biggest source of pressure for nursing undergraduates is the requirement of learning.[48]

Stress has a wide range of effects, affecting sleep, memory, concentration, and appetite.[49,50] Students' mental health can be affected and may even lead to thoughts of suicide. This meta-analysis suggests that nursing students suffer primarily in the medium range during clinical rotations. However, additional life stressors such as illness, family conflict, financial or housing problems can increase this level.

The stress level of male and female interns is similar and at a medium level. However, nursing programs tend to have a female majority, [51] limited to this review. In general, gender studies have found that females have higher overall stress levels than males.[52,53] This may be because male nursing students have better employment prospects and advantages than female nursing students.[54] Female nursing students are busy obtaining various certificates and preparing for postgraduate exams to relieve the pressure after graduation, resulting in excellent learning pressure.[55]In terms of interpersonal communication, female students are more sensitive than male students. They are prone to conflicts in the process of getting along with classmates, resulting
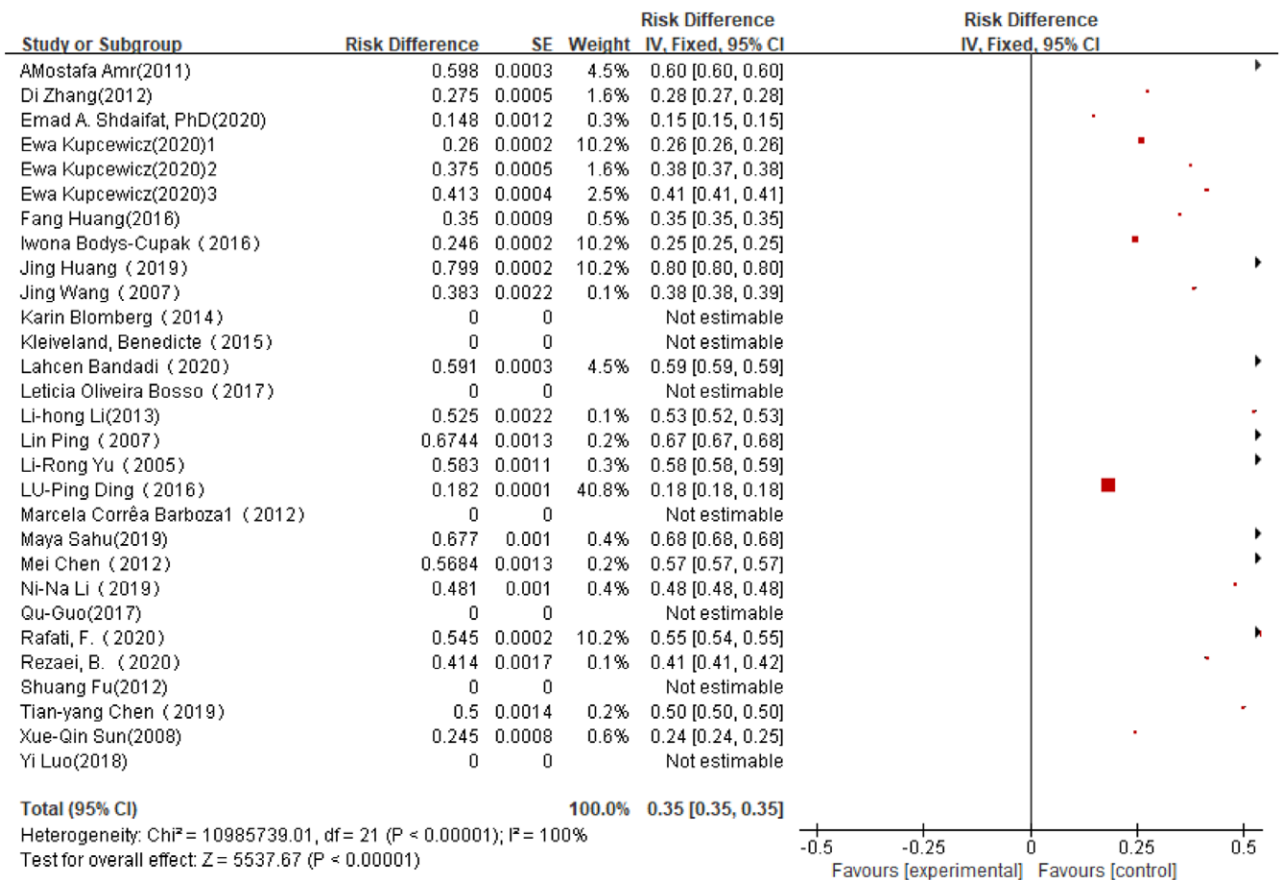

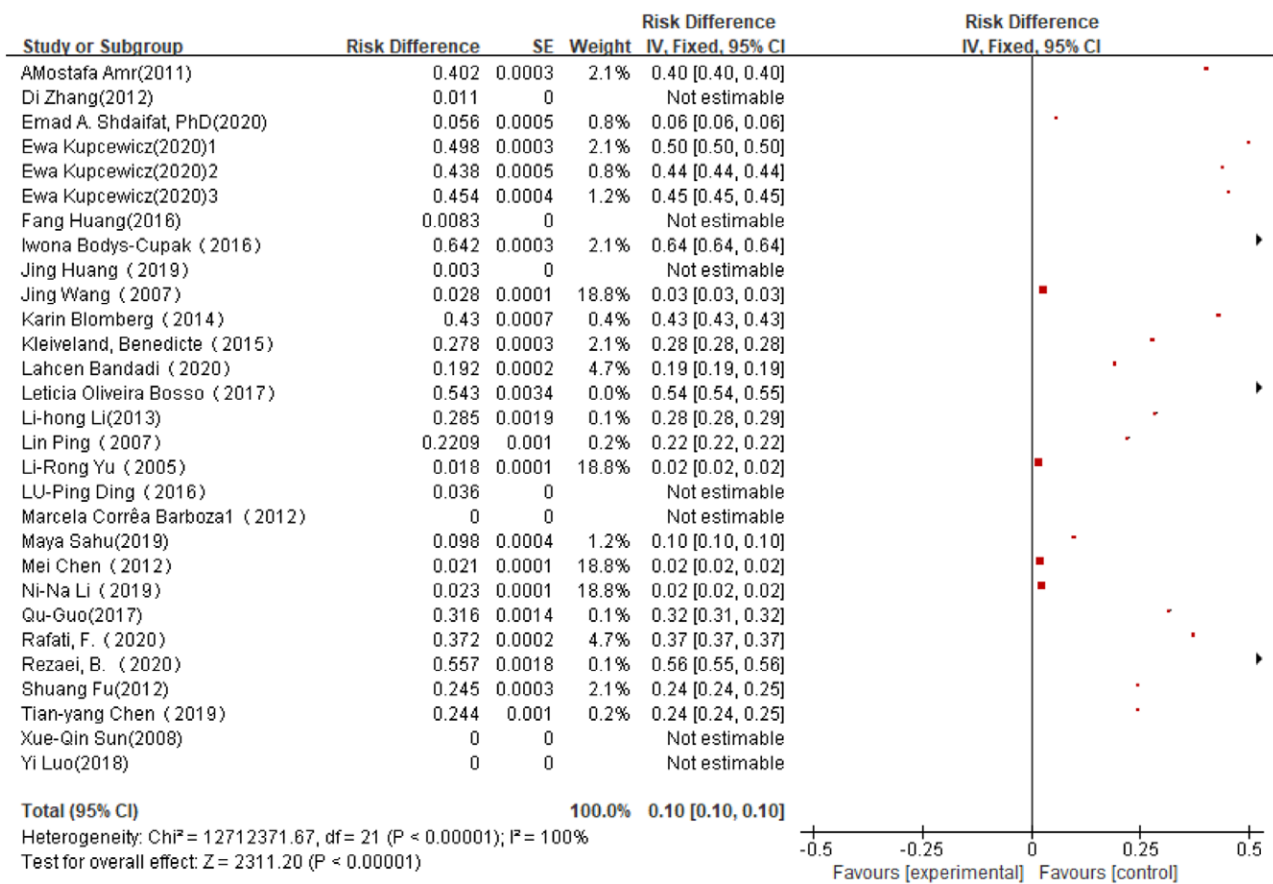**Figure 4.** A meta-analysis of medium level stress rates.

Figure 5. A Meta-analysis of high-level stress rates.

Table 3

Subgrop analysis.

Project			Number of studies included	Incidence rate (95%CI)	I² value	P value	Effect model
Gender	Male	Low level	11[16,17,20,26,28,30,36,38–40]	0.14[0.14,0.14]	100%	<0.00001	Random
		Medium level	8[16,17,25,28,30,36,38,40]	0.44 [0.44, 0.44]	100%	<0.00001	Random
		High level	8[16,17,20,25,26,28,36,41]	0.16 [0.16, 0.16]	100%	<0.00001	Random
	Female	Low level	11[16,17,20,26,28,30,36,38–40]	0.14[0.14,0.14]	100%	<0.00001	Random
		Medium level	8[16,17,25,28,30,36,38,40]	0.44 [0.44, 0.44]	100%	<0.00001	Random
		High level	8[16,17,20,25,26,28,36,41]	0.16 [0.16, 0.16]	100%	<0.00001	Random
Diagnostic criteria	PSS-10	Low level	6[17,20–22,24,26]	0.15 [0.15, 0.15]	100%	<0.00001	Random
		Medium level	6[17,20–22,24,26]	0.37 [0.37, 0.37]	100%	<0.00001	Random
		High level	6[17,20–22,24,26]	0.36 [0.36, 0.36]	100%	<0.00001	Random
	China Health Care Pressure Source Scale (Cao Ying)	Low level	4[33,34,38,40]	0.66 [0.66, 0.66]	100%	<0.00001	Random
		Medium level	4[33,34,38,40]	0.32 [0.32, 0.33]	100%	<0.00001	Random
		High level	3[33,38,40]	0.06 [0.06, 0.06]	100%	<0.00001	Random
Survey time	Before 2010	Low level	3[33,35,37]	0.22 [0.22, 0.22]	100%	<0.00001	Random
		Medium level	4[29,33,35,37]	0.42 [0.42, 0.42]	100%	<0.00001	Random
		High level	3[3,35,37]3]	0.02 [0.02, 0.02]	100%	<0.00001	Random
	After 2010	Low level	17[16,17,19–24,26,28,30–32,36,38,40,42]	0.25 [0.25, 0.25]	100%	<0.00001	Random
		Medium level	16[17,19–22,24,26,28,30–32,34,36,38–40]	0.35 [0.35, 0.35]	100%	<0.00001	Random
		High level	17[17–26,28,30,32,34,36,41,42]	0.15 [0.15, 0.15]	100%	<0.00001	Random
area	Europe	Low level	4[17,23,26]	0.14 [0.14, 0.14]	100%	<0.00001	Random
		Medium level	2[17,26]	0.28 [0.28, 0.28]	100%	<0.00001	Random
		High level	5[17,20,23,25,26]	0.37 [0.37, 0.37]	100%	<0.00001	Random
	Asia	Low level	15[19,21,24,30–40]	0.29 [0.29, 0.29]	100%	<0.00001	Random
		Medium level	15[19,21,24,28–30,32–35,37,39–42]	0.35 [0.35, 0.35]	100%	<0.00001	Random
		High level	12[19,21,24,28–30,33–36,38,42]	0.05 [0.05, 0.05]	100%	<0.00001	Random

in certain psychological pressure due to improper handling of interpersonal relations.[56] Therefore, in nursing education, we should help female nursing students deal with the interpersonal relationship between students and help them establish a support system to seek the object that can be told.

The low, medium, and high-pressure levels of PSS-10 were 0.15%, 0.37%, and 0.36%, respectively, with medium pressure as the central pressure. The quiet, medium, and high-pressure levels of the China Health Care Pressure Source Scale (Cao Ying) were 0.66%, 0.32%, and 0.06%, respectively, mainly low-level stress. It may be related to the functional area and population of the measurement tool. There is currently no widely used scale for measuring pressure in nursing students: the Assessment of Stress in Nursing Students (ASNS) was shown to be a reliable tool for use with the Spanish students, but it is not widely used in other countries; the Perceived Stress Scale (PSS) is not just a measure for nursing students.

Before 2010, the low, medium, and high-stress levels' prevalence rate was 0.22%, 0.42%, and 0.02%, respectively. After 2010, the standard, medium, and high-stress levels' prevalence rate was 0.25%, 0.35%, and 0.15%, respectively. It shows that the stress level has always been in the middle class, and the prevalence of high-level stress has increased, which may be related to the tense pace of modern life and the acceleration of social development. With the improvements in medicine and nursing education, colleges need to cultivate and improve the overall quality of graduating students and provide counseling on interpersonal communication skills, coping, and guidance for students.

The prevalence of low, medium, and high stress levels in Europe was 0.14%, 0.28%, and 0.37%, while in Asia was 0.29%, 0.35%, and 0.05%. In Europe, high-level pressure was surprising compared to the medium level noted in Asia. The high-stress level in the European studies may indicate the intensity of the program and requirements in these schools and a possible lack of mental health resources for nursing students.

5. Limitations of this review

While this review adopts a systematic process and incorporates a global perspective on ongoing research, it has several limitations. Many studies were excluded due to the inclusion criteria resulting in a small sample size. The results cannot be generalized because only English and Chinese papers were included in the review. The review only examined 7 English and 3 Chinese language databases. Finally, the characteristics of the meta-analysis showed high heterogeneity, and subgroup analysis did not significantly reduce the inter-study heterogeneity.

6. Conclusions

This systematic review has reported that the stress level of nursing students was mainly at a medium level. The results of subgroup analysis showed that stress levels are different in different genders, diagnostic criteria for stress, year of publication, and region. This review has attempted to illustrate that nursing students at minimum suffer moderate stress levels as a group. Nursing programs should address these stress levels to ensure a greater success rate of graduating nurses to increase the worldwide supply. Future studies should address factors that affect the stress level of nursing students, such as the influence of birthplace, family income, social and cultural factors on the stress level of nursing students.

Author contributions

All authors conceived and designed the study. ZYX and JJR organized and conducted the search and participated in the selection of the relevant articles and performed the quality assessment of the studies. HWN supervised the project and made the changes and corrections suggested by the reviewers.

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