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Research Trends in Mindfulness for Adolescents: Based on CiteSpace Visualization Analysis

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Abstract

Mindfulness has been increasingly used to improve the mental health of adolescents. This study focused on evaluating the latest research status of mindfulness for adolescents through CiteSpace and on identifying research hotspots and frontiers. We extracted the English literature of mindfulness for adolescents from the Web of Science (WoS) and the Chinese literature from the China National Knowledge Infrastructure (CNKI) databases, covering the period from 1999 to 2022. A total of 1317 papers were obtained. CiteSpace was used to generate online maps of worldwide cooperation among countries, institutions, and authors. Hotspots and frontiers were systematically summarized. There is a paucity of collaboration among institutions in the Chinese literature compared to the English literature. The research themes of the literatures of the two languages have overlaps and also discrepancies at different times. Future research may focus on the mechanism of mindfulness and appropriate groups for application. Collaboration among authors should be strengthened.

Keywords: mindfulness, adolescent, CiteSpace, research trends, visualization analysis.

1. Introduction

Mindfulness is an ancient and modern research topic that is related to the cross-culture between the East and West. The origin of mindfulness can be traced back to the teachings of Sakyamuni Buddha 2500 years ago [1]. By observing and realizing the physical and mental feelings at the present time, without judgment, we develop an equal mind that fully accepts all feelings without greed and hatred, so that people can reach the ultimate awareness [2][3]. In cognitive psychology, mindfulness is regarded as a set of habituation training programs for intentional attention, with positive effects on memory, attention regulation, executive function, and emotion regulation [4][5].

At present, mindfulness training has been widely applied to clinical treatment and practical research in many fields and

has attracted the research interests of cognitive psychologists [6][7]. Research has shown that focusing one's awareness and attention can provide real sensations and perceptions, thereby reducing physical and psychological distress, improving coping skills, and increasing an individual's subjective vitality [8][9]. Wang and Huang analyzed the psychological mechanisms of mindfulness in areas such as emotions [10]. The findings suggest that during the process of mindfulness, individuals' perception, attention, and emotions undergo adaptive changes. For adolescents, the ability to integrate perception, focus attention, and regulate emotions is particularly important. Erbe and Lohrmann searched the literature on mindfulness up to autumn 2014 for terms such as adolescent, meditation, mindfulness, and stress [11]. The study shows that mindfulness has a positive impact on the mental health of adolescents, pointing out the feasibility, acceptability, and effectiveness of its application to adolescent groups in different cultural contexts. Research has shown that mindfulness can improve subjective well-being and quality of life by increasing an individual's experience of positive emotions and decreasing the experience of negative emotions [12][13].

Adolescents are at high risk of depression and anxiety due to factors like developmental disorders, academic stress, and the socialization transition of adolescent growth [14]. There has been a great deal of practical exploration of mindfulness training for adolescent rehabilitation clinically. Researchers have examined the effectiveness of mindfulness interventions in adolescents' mental and physical health problems from a variety of areas, and its efficacy has been confirmed by numerous studies [15][16][17]. However, we have questions about how we should evaluate the effectiveness of mindfulness interventions among adolescents; what topics adolescent mindfulness studies focus on; what areas of interaction are sources of information for youth positive thinking research; and what are the contraindications to adolescent mindfulness training?

Based on the approach of bibliometrics and using the visualization analysis software CiteSpace[18][19], this study comprehensively analyzes the development status, research hotspots, and evolutionary paths of adolescent mindfulness research in China by combining the domestic and international adolescent mindfulness-related literature, in order to provide a scientific guideline for further strengthening the research of adolescent mindfulness.

2. Methods

The literature was searched online through the Web of Science (WoS) database and the China National Knowledge Infrastructure (CNKI) database.

The time span of English literature was from 1 January 1991 to 31 December 2022. The following search terms were used: (TS = ('mindful*') AND ('child*' OR 'adolescen*' OR 'school' OR 'youth' OR 'young' OR 'teenage*' OR 'juvenile*'OR 'puberty' OR 'kid*') AND Language = English AND Document type = Article). The earliest English literature on adolescent mindfulness research was published in 1991. The time span of Chinese literature was from 1 January 2011 to 31 December 2022. The following search terms in the Chinese language were used: subject (TS) = (mindful) and TS = (children + adolescence + pupil + junior high school student + senior high school student + school + primary school + middle school + junior high school + senior high school). Chinese journals, conferences, and dissertations are included

because of the small number of documents. The earliest Chinese literature on adolescent mindfulness research was published in 2011.

Finally, 1121 documents from the WoS database and 196 documents from the CNKI database were extracted.

3. Analysis of the current situation of adolescent mindfulness research

3.1. *General analysis of the literature*

The earliest literature on adolescent mindfulness research was published in 1991. As indicated in Figure 1, the number of yearly publications can be roughly divided into the following three stages: 1) The slow start phase from 1991 to 2009. The literature in these 19 years was all in English, with 19 articles in total. 2) The rapid growth phase from 2010 to 2016. There was a significant increase in the overall number of yearly publications, reaching double digits. Notably, the first Chinese literature on adolescent mindfulness was published in 2011. 3) The high growth phase from 2017 to 2021. The number of articles published globally exceeded 100 per year, and in 2021 the number was close to 200. 4) In 2022, there was a slight decrease in the number of articles published globally, whereas Chinese literature remained increasing. The number of published articles in Chinese consistently reached double digits each year, experiencing a year-on-year increase.

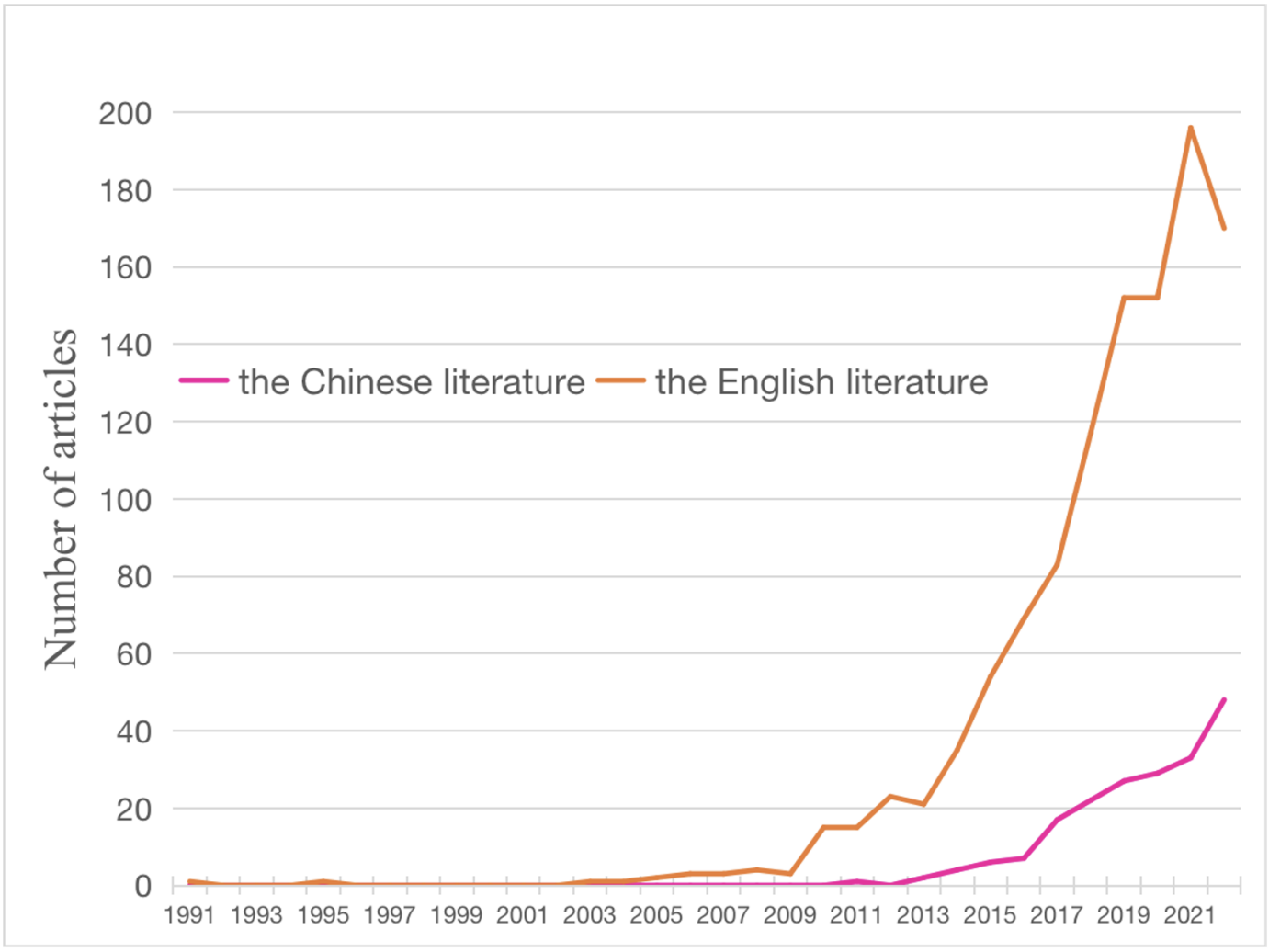

Fig. 1. The number of English and Chinese literature by year (1991-2022).

3.2. *Analysis of countries, institutions, and authors*

The volume of publications and mutual collaborations between different countries, research institutions, and leading authors was used to form a cooperation network between countries, where the size of each node represents the volume of publications and the connecting lines represent the cooperation between countries. The country cooperation network shows that the United States (505 articles), China (134 articles), Canada (111 articles), Australia (101 articles), the United Kingdom (87 articles), Spain (63 articles), the Netherlands (46 articles), Italy (33 articles), Germany (28 articles), and Iran (27 articles) were the top ten countries in terms of the total number of articles published. Figure 2 shows that 56 nodes and 149 links were generated between the years 1991 and 2022.

Fig. 2. Country cooperation network (English literature).

Figure 3 shows the spatial network of 434 nodes and 776 links between research institutions corresponding to the English literature. The institution cooperation network shows that the Pennsylvania State University (47 articles), University of Amsterdam (32 articles), Colorado State University (28 articles), University of Toronto (24 articles), Beijing Normal University (17 articles), University of North Carolina (17 articles), University of Deusto (17 articles), University of Melbourne (17 articles), University of Hong Kong (16 articles), and University of Oxford (16 articles) accounted for 21% of the total number of articles published. The spatial network of research institutions corresponding to the Chinese literature has 144 nodes and 51 links (Figure 4). Chongqing Normal University (8 articles), Nanjing Normal University (6 articles), Hebei Normal University (6 articles), Central China Normal University (6 articles), Zhengzhou University (5 articles), and Tianjin Normal University (5 articles) are the main institutions. The remaining institutions all published less than 5 articles. Thus, in the Chinese literature, there is a low concentration of institutions in adolescent mindfulness research and a limited amount of cooperation between institutions. This suggests that there is still a long way to go for adolescent mindfulness research in China.

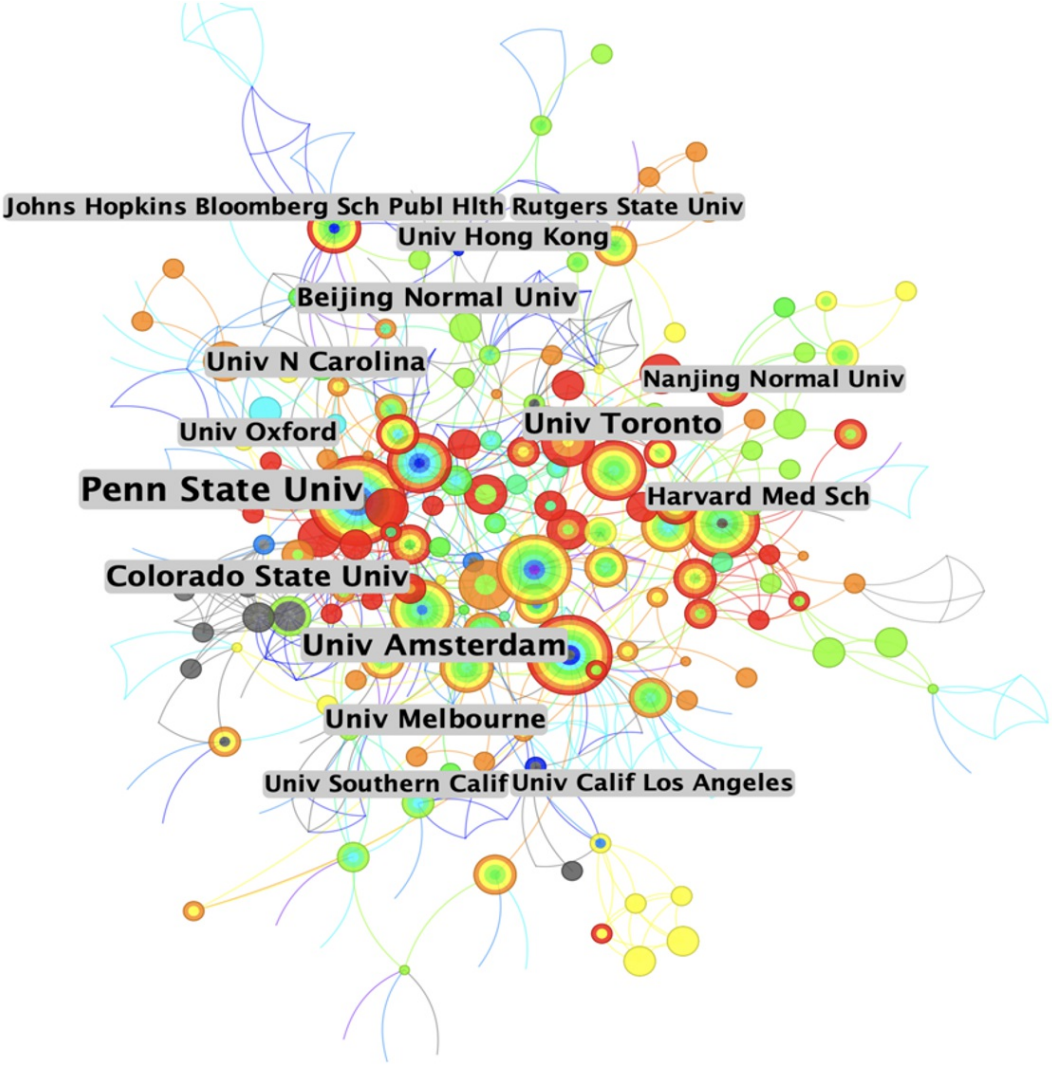

Fig. 3. Institution cooperation network (English literature).

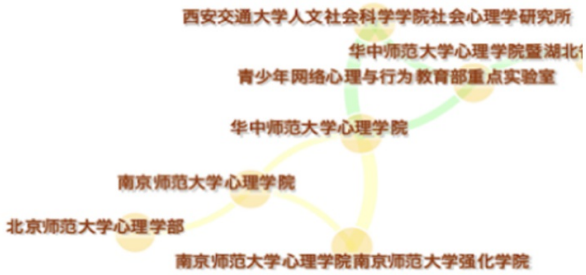

Fig. 4. Institution cooperation network (Chinese literature).

Figures 5 and 6 show the volume of author postings in the English and Chinese literature and the collaborative relationships between authors respectively. The top 5 authors in the English literature include Mark T. Greenberg (24 articles), Susan M. Bogels (24 articles), Nirbhay N. Singh (18 articles), Esther Calvete (15 articles), Wei Xu (13 articles). There are 22 authors who have published more than 5 articles. They accounted for 20% of the total number of articles published. Figure 5 shows that authors who published more articles had more collaborative relationships with other authors. Figure 6 shows that the top 5 authors in the Chinese literature are Xu Wei (4 articles), Duan Wenjie (3 articles), Zhou Zongkui (3 articles), Zhang Jieting (3 articles), and An Yuanyuan (3 articles). In the Chinese literature, there are fewer published articles and fewer collaborative relationships among authors than in the English literature.

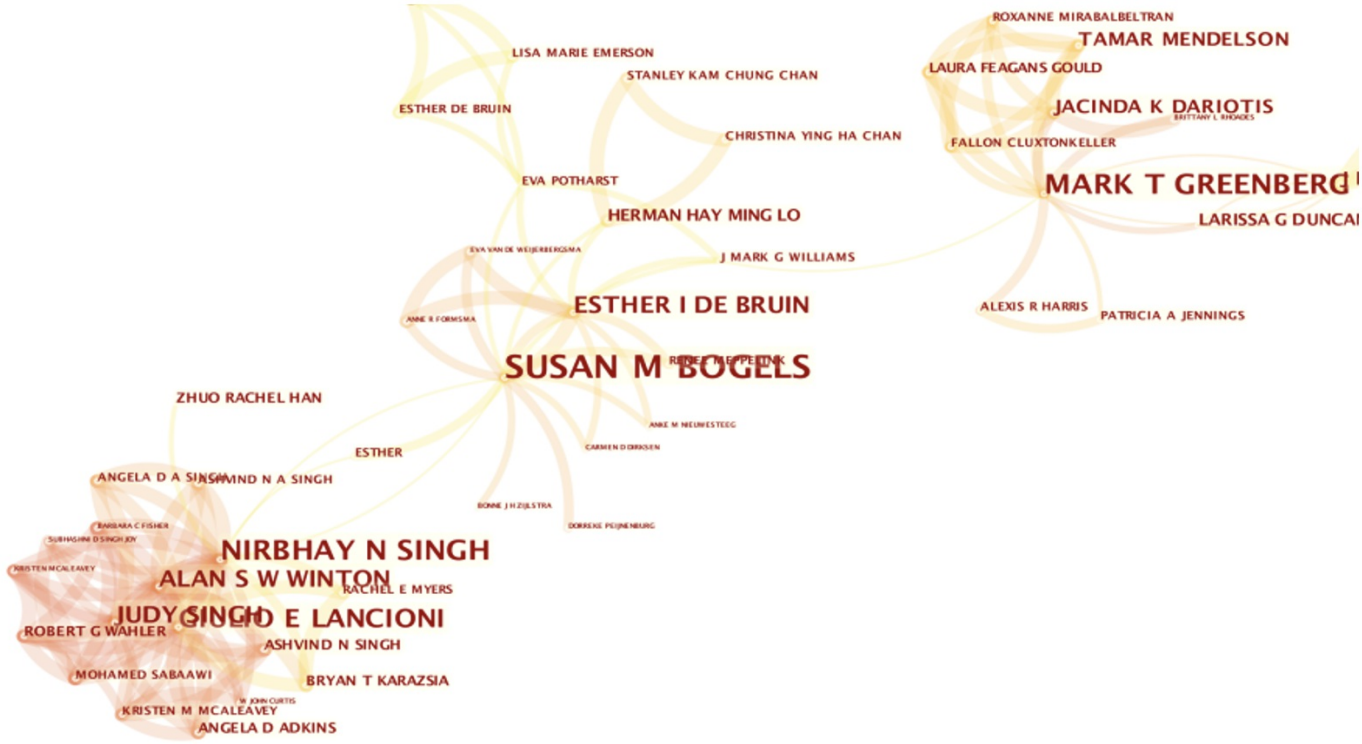

Fig. 5. Author cooperation network (English literature).

Fig. 6. Author cooperation network (Chinese literature).

3.3. *Analysis of subject areas*

Figure 7 shows the disciplinary copolymerisation graph, which is a network of the distribution of disciplinary areas and relationships in adolescent mindfulness research. It contains 87 nodes and 305 connections between the nodes, and the network density is 0.0815. Each node is a subject name, and the connecting lines indicate the association between subjects. The top 10 disciplines can be considered research hotspots in the field of adolescent mindfulness, among which the top 5 disciplines were psychology, psychiatry, clinical psychology, developmental psychology, and multidisciplinary psychology. The field with the highest number of research outputs was psychology, with 536 articles, accounting for 26% of the total number of publications. The second most productive field was psychiatry, with 307 articles. 247 articles were published in the field of developmental psychology, and 90 articles were published in that of multidisciplinary psychology. The distribution of disciplinary areas and relationships in the Chinese literature was not presented because of the

unavailability of the data analysis method in CiteSpace.

Fig. 7. Subject areas distributions and relationships network (English literature).

3.4. *Discussion*

The results of the descriptive analysis illustrate research progress on mindfulness in adolescents over three decades, with a notable surge in the latter half of the first decade of the 21st century. This suggests that research on mindfulness in adolescents is becoming a hot topic of interest for researchers and that the practice of clinical interventions and training using mindfulness as a primary tool has gained widespread acceptance. With more and more young people getting involved in the practice of mindfulness, a sufficient number of participants are available for mindfulness research.

In terms of the regional and linguistic distribution of publications, English and Chinese were the main languages of publication for research on mindfulness in adolescents in our data analysis. The United States was the main English language publishing region, with Canada, the Netherlands, and China being among the countries with a high number of publications. The Pennsylvania State University, the University of Amsterdam, the University of Toronto, and the Chinese University of Hong Kong were the main publishing institutions. From an authorial perspective, three important clusters of authors emerged. They were centered on Susan M. Bogels, Mark T. Greenberg, Nirbhay N. Singh, and Giulio E. Lancioni,

respectively. These three author clusters collaborated with each other quite frequently. This shows that a concentrated academic community of mindfulness research has formed on a global scale. Interaction among academic groups is contributing to the formation of an academic community devoted to this research theme.

The total number of relevant literature published in the Chinese language in China was smaller than that abroad. There were also fewer institutions in mainland China engaging in relevant research, with only a few universities such as Nanjing Normal University and Sun Yat-sen University actively conducting such research. As for the core authors, Wei Xu, along with An Yuanyuan, Zhou Zongkui, Zhou Hui, Duan Wenjie, and Zhang Jieting, formed a relatively concentrated group of authors. Wei Xu was one of the top 5 authors who published research articles in Chinese. However, there was limited interaction among research institutions and author communities, suggesting that a community atmosphere of adolescent mindfulness research has not yet formed in mainland China in the research outcomes in the Chinese language.

In terms of subject areas, the discipline that dominated in the study of adolescent mindfulness was psychology. Disciplines related to psychology, such as developmental psychology and clinical psychology, were also prominent disciplines. Another dominant discipline was psychiatry. This shows that research on the topic of adolescent mindfulness has been approached by researchers mainly from a developmental, clinical, and therapeutic perspective. There was less research in the fields of experimental psychology, cognitive psychology, and neuroscience. Based on the distribution of disciplines, it is easy to understand that current research on adolescent mindfulness is focusing more on applied research.

4. Analysis of adolescent mindfulness research hotspots

4.1. *High-frequency keyword co-occurrence analysis*

In order to explore and identify the research hotspots in the field of adolescent mindfulness research, we extracted the keywords of each article and conducted a co-occurrence analysis. The keyword co-occurrence analysis of the English literature on mindfulness research is shown in Figure 8, which contained 354 nodes, 2066 connections among the nodes, and the network density is 0.0331. The top 10 keywords were considered to be hotspots (Table 1). The top 5 keywords were “intervention” (266 times), “children” (215 times), “depression” (177 times), “stress” (173 times), and “adolescent” (168 times). Those keywords in the rankings all appeared more than 100 times.

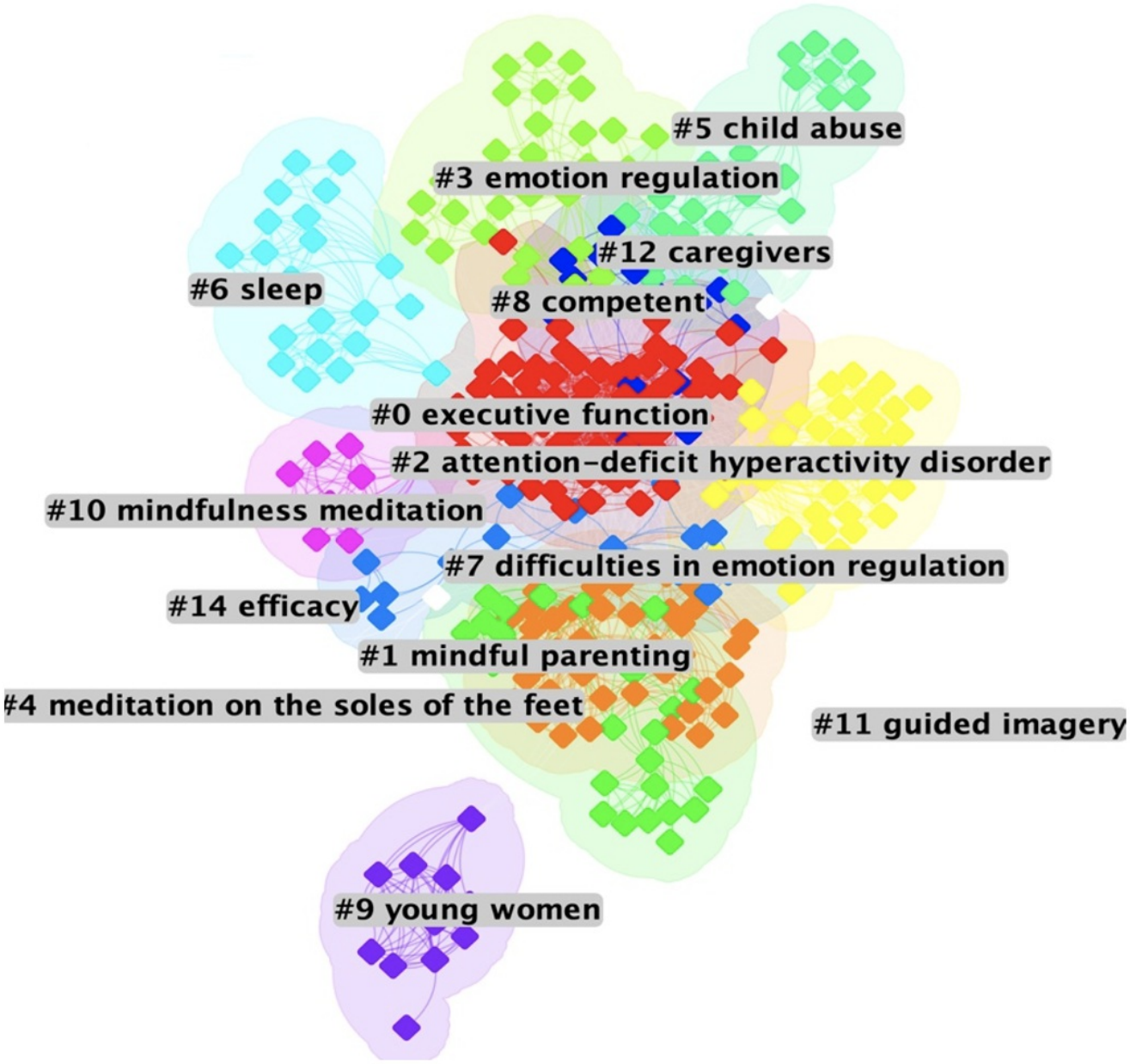

Fig. 8. The co-occurrence graph of keywords (English literature).

Table 1. Top 10 keywords related to adolescent mindfulness.

Rank	The English literature			The Chinese literature		
	Keyword	Frequency	Centrality	Keyword	Frequency	Centrality
1	intervention	266	0.11	mindfulness	75	1.03
2	children	215	0.23	mindfulness training	32	0.22
3	depression	177	0.04	teenager	29	0.27
4	stress	173	0.09	junior high student	24	0.18
5	adolescent	168	0.11	senior high student	22	0.11
6	stress reduction	161	0.02	depression	14	0.06
7	mental health	160	0.11	mindfulness level	11	0.09
8	meditation	159	0.05	attention	11	0.03
9	anxiety	139	0.03	mental resilience	11	0.03
10	validation	134	0.06	mindful parenting	10	0.09

The keyword co-occurrence analysis of Chinese literature on mindfulness research is shown in Figure 9. There were 157 nodes, 393 connections among the nodes, and the network density was 0.0321. The top 10 keywords are considered to be hotspots (Table 1). The top 5 keywords were “mindfulness” (75 times), “mindfulness training” (32 times), “teenager” (29 times), “junior high students” (24 times), and “senior high students” (22 times).

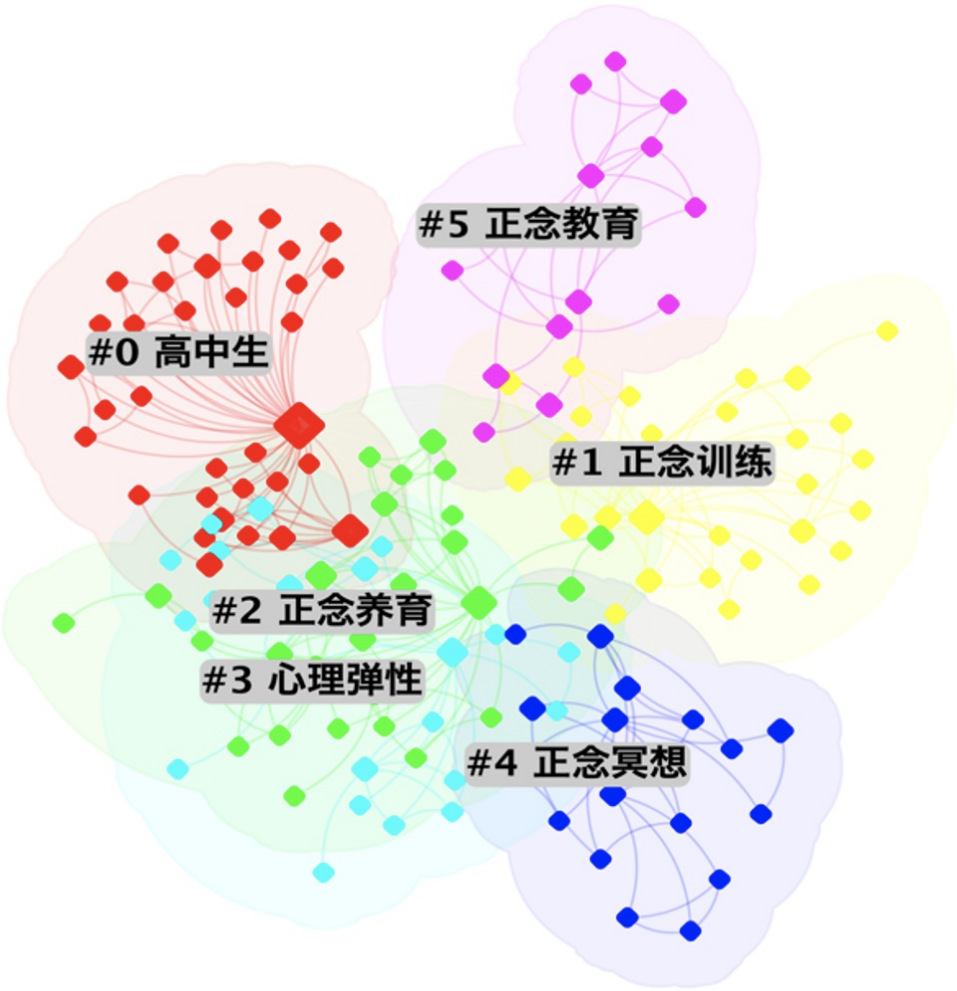

Fig. 9. The co-occurrence graph of keywords (Chinese literature).

4.2. *High-frequency keyword clustering analysis*

CiteSpace further measures the quality of clustering graphs by describing the level of clustering and clarity of the network structure through two metrics: modularity (Q) and silhouette (S). The S values represent the homogeneity among the members of a cluster, and when S is greater than 0.7, the clustering result is convincing [20].

The keyword clustering diagram for the English literature (Figure 8) shows that a total of 15 clusters were formed in large size. The Q value is 0.5797, and the S value is 0.8634, indicating that the class cluster results were significant. The results showed that the current English keywords focused on “executive function”, “competent”, “mindful parenting”, “caregivers”, “young women”, “efficacy”, “emotion regulation”, “sleep”, and “attention-deficit hyperactivity disorder”.

The keyword clustering diagram for the Chinese literature (Figure 9) shows that a total of 6 clusters were formed in large size. The Q value was 0.5142, and the S value was 0.876, indicating that the findings were reliable and significant. The results showed that the main keywords in the current domestic research on mindfulness were “mindfulness training”, “senior high students”, “mindful parenting”, “mental resilience”, “mindfulness meditation”, “minfulness education”.

4.3. *Discussion*

The results of the co-occurrence analysis of high-frequency keywords indicated that current national and international research on mindfulness focused on selecting adolescents or younger age groups as research subjects. The key words “stress reduction”, “stress”, and “anxiety” were high-frequency words in the English literature, while “depression” ranked as the 6th and 7th most frequent word in the Chinese and English literature respectively. This shows that researchers have seen the positive effects of mindfulness as an intervention for emotion regulation. In addition, the Chinese literature focused more on attention and positive parenting than the English literature, while mental health was covered more in the English literature than in the Chinese literature.

The results of the cluster analysis of high-frequency keywords also confirm the importance of mental health in the English literature. The clusters “sleep”, “child abuse”, and “executive function” appeared in the English literature, but not in the Chinese. Foreign researchers have studied adolescent mindfulness more from a clinical and therapeutic perspective. The clustering of the Chinese literature suggested that there was a strong focus on the application of mindfulness in parenting and education for mental health improvement in adolescent mindfulness research by domestic researchers.

5. Analysis of the emerging words from citation burst history

Keywords from the citation burst history are words that appear more frequently or are used more frequently in a shorter period of time. The frequency of keywords can be used to determine the frontiers and trends in the field of study. Figure 10 identifies several key areas over three different time periods of the English literature. Keywords from the citation burst history included “stress reduction” (2012 to 2015), “association” (2020 to 2022), “working memory” (2020 to 2022), “decreases aggression” (2021 to 2016), “abuse” (2021 to 2016), “controlled trial” (2020 to 2022). The keywords from the citation burst history in the Chinese literature were not presented because of the unavailability of the data analysis method in CiteSpace.

Keywords	Year	Strength	Begin	End	1991 - 2022
meditation	2006	6.3	**2009**	2013	
decreases aggression	2010	5.48	**2010**	2016	
trial	2011	5.01	**2011**	2014	
stress reduction	2010	4.55	**2012**	2015	
controlled trial	2015	3.46	**2015**	2016	
abuse	2014	3.24	**2020**	2022	
association	2017	3.23	**2020**	2022	
working memory	2020	3.21	**2020**	2022	

Fig. 10. Emerging words from the citation burst history (English literature).

6. General discussion

In this research, we made use of the CiteSpace software to visualize and analyze a collection of 1105 papers around the adolescent mindfulness theme from 1991 to 2021 in the core journals in the CNKI and WoS databases. The following three conclusions can be drawn: (1) Through the analysis of the annual changes of the literature, authors, and research institutions in this field, we clarified the current situation of research in the field of adolescent mindfulness: the research enthusiasm of adolescent mindfulness in academia has reached a high level since 2017, and the attention to mindfulness meditation for adolescents has been increasing. The area of adolescent mindfulness is still immature domestically. (2) While the domestic literature focused mostly on emotional problems and attention issues, the foreign literature was more clinically and therapeutically oriented. Future research could build on each other and explore adolescent mindfulness practices in different cultures. (3) The theme of the literature on adolescent mindfulness had overlaps and focused at different times. In general, the study of adolescent mindfulness has evolved from the use of mindfulness as an intervention to the exploration of psychological mechanisms.

6.1. *Psychotherapy based on mindfulness*

Originating from Eastern Buddhism, mindfulness has been developed by Western clinical counselors and has now been combined with the field of psychology to produce a number of psychotherapeutic approaches. Mindfulness meditation was brought out of religion and into mind-body healthcare and founded as the Mindfulness-Based Stress Reduction (MBSR) in 1979 [1][3]. The therapy was an 8-10 week course conducted in small groups of 30 participants. They met for 2-2.5 hours a week and were guided to practice positive meditation and discuss stress, coping, and homework. There was usually a full-day (7-8 hours) intensive mindfulness session around the 6th week where they were taught some mindfulness techniques [21][22].

Following the application of MBSR, Segal, Willams, and Teasdale adapted it to cognitive therapy and created mindfulness-based cognitive therapy (MBCT), a therapy used primarily for the treatment of depression and depressive relapse, also in an 8-week group therapy format [23][24]. In this therapy, they argued that the key to mindfulness techniques was the ability to cope with unpleasant cognitions, feelings, and emotions with an attitude of non-evaluation, acceptance, and awareness of the present moment [23]. Negative perceptions were treated as beings that would appear and disappear, unrelated to oneself [25].

Mindfulness has also been used in other therapeutic approaches. For example, Linehan et al. included mindfulness as one of the key elements in the construction of Dialectical Behavior Therapy (DBT) for people with Borderline Personality Disorder (BPD) [26]. They believed that patients with BPD had a pathological fear of emotions. Because patients with BPD were so afraid of their negative feelings, they were eager to use negative adaptation methods to avoid them. Therefore, positive meditation helped them increase their tolerance of negative feelings and thus reduced impulsivity and increased their ability to cope effectively. Mindfulness, as one of the stabilization techniques, has become an important adjunct in trauma therapy. Shapiro, the founder of rapid eye movement desensitization (EMDR), one of the trauma therapies, argued that the mechanism by which EMDR works was to induce a state of “mindfulness” that allowed the patient to take a non-judgmental observer’s view of various psychosomatic reactions [27].

6.2. *The mechanism of mindfulness*

The mechanism of mindfulness is an ongoing subject of research, and researchers have explored the mechanism of mindfulness in depth in terms of both its psychological and brain mechanisms. In terms of the psychological mechanism, the changes that mindfulness training produces are mainly through the influence of basic perceptual functions, attention, memory, emotion, and emotion regulation [28]. In terms of the relationship between mindfulness and attention, research has shown that the core mechanism of mindfulness is attention [29]. Grant and Rainville showed that nociceptive perception of thermal stimuli was significantly reduced after prolonged mindfulness training [30]. The intensity of thermal pain stimuli tolerated by the trained individuals was significantly greater than that of the average individual. It has been shown that mindfulness training can enhance alertness, attentional processing, and cognitive processing in the brain [31]. Mindfulness training has been shown to maintain and protect working memory capacity [32]. Mindfulness can increase subjective well-being and quality of life by increasing individuals' positive emotional experiences and decreasing negative emotional experiences [12]. The psychological mechanism of mindfulness may be through altered attention to negative events and increased tolerance of negative stimuli. The trainee's attention is more focused on the immediate experience of the moment, which contributes to an open attitude. Mindfulness training achieves a variety of clinical and non-clinical benefits through the regulation of emotions.

Numerous studies have confirmed that there are significant differences in neurophysiological activity, and brain function and structure between regular mindfulness training practitioners and the general population [28]. For example, mindfulness brings about asymmetric changes in the alpha waves in the frontal areas of the brain, with a significant increase in activity on the left side. This is consistent with the findings on emotional lateralization. Mindfulness leads to greater activation of the left hemisphere, which is responsible for positive emotions [33]. Research on brain structure has found that mindfulness is associated with changes in cortical thickness or grey matter density in brain areas related to attention, learning, memory, and emotion (insula, hippocampus, cingulate gyrus, prefrontal lobe, etc.) [28]. Many studies suggest that the temporal lobe plays an important role in the practice of mindfulness. For example, Sun and Wang confirmed that the complex structure of the temporal lobe allowed for the evaluation of external emotional stimuli, the generation of self-emotional experiences, and the regulation of the external presentation of emotional experiences [24]. Mindfulness meditation is effective in improving individual concentration and increased grey matter density in the prefrontal cortex associated with attention [34][35]. People who engage in prolonged mindfulness meditation similarly show reduced state connectivity between the prefrontal control network and the cuneus and occipital gyrus regions during the resting state; At the same time, the connectivity within the attentional network and between the attentional and medial frontal regions is enhanced [36].

6.3. *Mindfulness in the adolescent population*

Therapies related to mindfulness have been widely used in the adolescent population and have been found to be effective in improving the psychological functioning of junior and senior high school students. It has been shown that trait mindfulness allows junior high school students to enhance their emotion prediction ability and reduce emotion prediction

bias by expanding their attention span and open-mindedness [37]. Zhang et al. found that mindfulness training could significantly increase the level of mindfulness and reduce the level of state anxiety and trait anxiety in junior high school students [38]. Middle school students can improve their levels of mindfulness and reduce anxiety through mindfulness training. Zhu and Li concluded that mindfulness training was beneficial in increasing the level of mindfulness, reducing procrastination behavior, and improving self-esteem and self-efficacy in junior high school students [39]. Mindfulness not only has a direct effect on adolescent self-esteem, but can also have an impact on adolescent self-esteem through self-efficacy [40]. Sun et al. found that adolescents with a high propensity for mindfulness were better able to tolerate negative emotions associated with mobile phone addiction and were better able to deal with negative emotions [41]. It has been shown that mindfulness not only directly contributes to psychological development and recovery in adolescents who are academically oriented, but also indirectly affects students' academic performance through the learning quality quotient [42].

6.4. *Implications for future research in adolescent mindfulness*

Our research results have several implications for future research directions in adolescent mindfulness. Firstly, the use of mindfulness training in the youth population is increasing. However, there are still some problems with related practice and theoretical research. There is currently no universal operational definition of mindfulness, and the core psychological factors of mindfulness are not yet clear. This poses a great challenge to the study of mindfulness, so future research on mindfulness needs to be based on a clear operational definition that fully recognizes its essential characteristics.

Secondly, the mechanism of the role of mindfulness in mental disorders such as anxiety and depression in adolescents needs further probing. As shown in Figures 1 and 2 above, there is a relative lack of research on the efficacy of mindfulness in China and abroad, and the situation is comparatively worse in China. Research on the mechanism of mindfulness is less numerous and less in-depth than research on efficacy. For example, studies have found activation in some brain regions or changes in brain structure [28][33][36], but the psychological significance of these changes is unclear. Research has shown that many brain regions and cortical structures such as the cingulate gyrus, hippocampus, insula, amygdala, prefrontal and temporal lobes are involved in mindfulness, and that these structures are involved in many mental functions like learning, memory, attention, perception, awareness, emotion, and executive control [43]. In other words, the relationship between mindfulness and these brain structures is limited to the degree of correlation, and the findings lack specificity and certainty. It is not clear which brain regions are involved in mindfulness and whether there is a causal relationship between them [43][10].

Finally, the value of the application of mindfulness needs further research and development. Although meditation training has been shown to have positive effects on most groups, Jaseja's studies found that meditation might lead to an increased incidence of epilepsy in epileptic patients [44][45][46]. Therefore, further research is needed to determine whether mindfulness is appropriate for all groups. Researchers found that mindfulness training significantly improved the attention span of children and adults [47][48]. It has also been shown that mindfulness can improve memory and attention span. Whether or not these findings can be used with adolescents with learning disabilities, or be used for individualized

teaching, which also offers possible directions for scholars to endeavor to explore. Besides its educational application, could it be applied to a larger social group? Originating from Eastern meditation, mindfulness is a conscious, non-judgmental method of being able to pay attention to the present state; It is also a state of consciousness or a mental process [35]. Meditation can reduce anger and aggressive behavior in individuals, so can mindfulness. Therefore, the use of mindfulness enhances an individual's capacity for empathy and tolerance, which undoubtedly plays an important role in promoting social harmony. In addition, it is not hard to see from Figures 4 and 6 that the lack of research on mindfulness in China is not only reflected in the number of articles, but also in the collaborative relationships among authors.

7. Conclusions

According to CiteSpace's data analysis, researchers' interest in the area of mindfulness for adolescents is increasing year by year. The research on adolescent mindfulness was found to be generally immature, and further attention should be paid to the mechanism of mindfulness and appropriate groups for application. Collaboration among authors should be strengthened where necessary. This study contributes important information for mindfulness researchers and practitioners to understand research achievements, collaborative networks, and main topics in the research field of mindfulness for adolescents. In terms of future research directions, we need to build on our own cultural roots and carry out the psychological interpretation of mindfulness in the Chinese context.

Statements and Declarations

Fundings

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Data availability statement

The datasets analyzed during the current study are available in the Web of Science (WoS) and the China National Knowledge Infrastructure (CNKI). All data generated during this study are included in this published article.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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