

# Evolving Trends in College Students' Health Education: A Bibliometric Analysis

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**Abstract:** This study offers new insights into college students' health education (CSHE) regarding its research status, hot spots, and trends by conducting a comprehensive bibliometric analysis of this field in the past decade (2014 to 2024). Specifically, we analyzed publication trends and used the bibliometric method with CiteSpace software to explore collaborative networks, detailed co-citation status, and co-occurrence dynamics based on 1358 Web of Science Core Collection articles. Our results indicate increased relevant publications and the collaboration networks show complex institutional and regional partnerships. At the same time, co-citation and co-occurrence analyses highlight interdisciplinary research themes that encompass public health. The study particularly underscores the emerging importance of mental health, global health, and innovative educational approaches. These findings reveal trends in CSHE research and provide crucial insights for future studies, stressing the need for interdisciplinary collaboration and creative strategies to tackle student health challenges. Moreover, in practice, this study contributes to promoting and practicing targeted health intervention policies and countermeasures aimed at enhancing student well-being, such as establishing dedicated health education courses, providing specialized training for teachers, conducting regular health assessments, and providing funding for CSHE.

**Keywords:** college student, health education, global health, CiteSpace, systematic review

## Introduction

Health education refers to planned, organized, and systematic social education activities that enable individuals to establish health awareness, consciously adopt behaviors and lifestyles beneficial to health, eliminate or mitigate risk factors that affect health, prevent diseases, improve quality of life, and evaluate educational outcomes.<sup>1-3</sup> Besides, CSHE is critical.<sup>4</sup> Firstly, college students are crucial in social change in today's society, and their health is closely related to social prosperity. Providing health education to college students can cultivate them into physically and mentally healthy adults who contribute positively to social development. Secondly, current college students are at a critical age in establishing correct health habits and attitudes; health education is appropriate and beneficial for their future work and life. Thirdly, today's college students face many new challenges and risks, such as academic pressure, employment pressure, psychological stress from sudden public health events, alcohol abuse, and substance abuse. Health education can provide them with the necessary new knowledge and skills to help them make the right choices.<sup>5,6</sup>

In college students' health education (CSHE), different stakeholders have unshirkable responsibilities. For example, colleges and universities are essential: the school's emphasis on health education will likely determine whether college students can receive proper health education; hence, colleges are encouraged to provide particular health education programs or courses to students.<sup>7</sup> Besides, college teachers also play a pivotal role: with correct views and essential health knowledge, teachers can effectively provide specific health education knowledge to college students.<sup>8,9</sup> In addition, education governors are also influential: administrative orders or regulations can be initiated to incorporate health education into classroom teaching and add more physical education courses into the school curriculum. This practice significantly promotes college students' physical and mental health and their understanding of health-related topics.<sup>10,11</sup> Their roles and importance are supported by statistics: countries implementing school health education

programs are 4.4% lower in chronic diseases and 7% lower in arthritis among citizens,<sup>12</sup> demonstrating the importance of CSHE.

In addition, different approaches have been implemented to enhance the effectiveness of CSHE. For instance, traditional propaganda education has been widely and long-term used. Besides, online health education is gradually used to provide college students with high-quality knowledge about their mental and physical health (eg, cardiovascular health education).<sup>13,14</sup> In addition, social media interaction is a new approach to CSHE; collecting information through social media can help identify students' bad habits, facilitating targeted and effective health education.<sup>15</sup> Furthermore, integrated education (combining health education with other tools or forms) is also practical; in remote areas limited by language, culture, and text, health education incorporating local ethnic performances or drama can also play an excellent educational role and attract the attention of college students.<sup>16</sup> In practice, for example, college and local communities collaborate to promote drug prevention courses for college students in Singapore; various activities are included (such as courses, lectures, drama performances, and sharing sessions by former drug abusers), leading to low drug use rate among university students.<sup>17–19</sup>

Scholars are gradually becoming aware of the importance of CSHE. Therefore, there is increasing academic attention in research and practice, and the related empirical research and theoretical discussions have gradually become more enriched. Current studies have explored various detailed aspects of CSHE, covering various topics such as disseminating health knowledge, interventions in health behaviors, and mental health management. Generally, these studies discuss the significance, approaches, influencing mechanism, impacts, and policies of CSHE, providing valuable insights. However, despite this progress, no researchers have yet attempted to systematically review and comprehensively summarize the literature on CSHE from a visualized bibliometric perspective, making it difficult to explicitly know the current status, progress, and possible trends of CSHE research. In other words, some questions remain:

- (1) Is this research field booming and prospering?
- (2) What are the associated relations and statuses among participants in this field?
- (3) What are the current research dynamics and authorities?
- (4) What are the evolving hotspots and potential trends?

This paper utilizes CiteSpace, a global-recognized advanced visualized bibliometric analysis software, to address the research gaps and answer the above four questions. CiteSpace is instrumental in reviewing and summarizing the research status, dynamics, and trends of CSHE over the past decade. It provides a relatively comprehensive framework on CSHE from various detailed angles for a better understanding of CSHE. Importantly, CiteSpace also plays a key role in pinpointing future research characteristics, thereby guiding more efficient and effective research.

Specifically, the software CiteSpace will be used to answer the above questions (except the first question, where the statistical results of the annual publication numbers, journals, and corresponding categories are obtained automatically from the database). CiteSpace will conduct collaboration analyses from the institution, region, and author perspectives to depict the association statuses; co-citation analyses from the journal, reference, and author perspectives will be conducted to know the research dynamics and authorities; co-occurrence analyses from the category, keyword, and keyword burst perspectives help to understand the evolving trends of this field. Based on these results, a framework is constructed to explicitly show the critical information of each research question, the research logic and focus of each section, and the hot topics and evolving trends of this field. The explicit and comprehensive information guides future scholars to accelerate academic cooperation and exploration more effectively and efficiently. Besides, based on the bibliometric analysis results and the knowledge framework we construct, we pinpoint the future possible research and practice directions and characteristics, depicting that this field will have more multidisciplinary collaboration, comprehensive and complex research topics, new theories and methods to emerge, and innovative health education approaches; such evolving trends have significant theoretical and practical implications for academia, education, and health practitioners, guiding them to take more precise actions for CSHE.

## Methodology

### Data Selection

This study used the Web of Science Core Collection database as the primary source for collecting article data. This database integrates the Science Citation Index Expanded, Social Sciences Citation Index, and Art & Humanities Citation Index. The reasons for choosing this database include:

- (1) Cross-Disciplinary Peer-Reviewed Articles Collection: The Web of Science includes widely recognized and accepted peer-reviewed articles in various academic fields, adding significant credibility and depth to this research.
- (2) Rich Article Details: It provides detailed information on articles, including authors, affiliations, countries, publication journals, and citation information, facilitating comprehensive data analysis and in-depth exploration.
- (3) Global Accessibility: The popularity and accessibility of the Web of Science database ensure that research findings can reach the global academic community, thereby expanding the influence and attention of the research.<sup>20</sup>

We employed specific search criteria to retrieve relevant articles during data collection on January 31, 2024. Specifically, we utilized the following search parameters.

**Topic:** The search topic included the title, abstract, and keywords to identify related articles. These keywords were chosen based on the following procedures: (1) three research members discussed the definition and connotation of CSHE and then independently searched articles and dictionaries to find all the possible terms' synonyms, aiming to make our keywords more precise and comprehensive; (2) the members held meetings and together discussed to filter out the words which are irrelevant to the research topic and then consulted two experts in this field to make sure the remaining ones were correct; (3) we made pilot search to make sure the results were correct (articles were about CSHE) and large enough (limited number of documents is less valuable in bibliometric analysis).

**Time Frame:** It was set between January 1, 2014, and January 31, 2024. Discussions with experts in education and medicine led to a consensus that in the recent decade (2014–2024), there has been a gradual increase in the awareness and importance of health education, particularly among university students who increasingly prioritize their health. During this period, academic papers on CSHE surged, deciding to set the time frame within the latest decade as valuable and appropriate.

**Document Type and Language Limitations:** We limited the document type to articles and reviews, and the documents had to be in English. Since most prestigious and influential journals are published in English, we used English as the publication language. Besides, we did not limit specific types of studies (such as correlation analysis, case studies, and meta-analysis), subjects (such as social sciences, medicine, science, and engineering), authors' regions, or papers' minimum citation thresholds, aiming to provide a comprehensive view about CSHE research to readers.

**Duplicate Entries or Data Inconsistencies:** duplications, data without authors, or inconsistent data (such as prefaces, corrections, retractions, and papers without the meaning or connotation of CSHE) were deleted. Specifically, two members independently screened the titles and abstracts and determined irrelevant articles; the third member decided if there were disagreements. The articles were selected for the following reasons: firstly, the data includes ideas or concepts of CSHE that can explain the relationship between health education and other factors; secondly, the data are valuable for researching CSHE and can provide support and reference for related research.

In the end, we selected 1358 articles from the database.

Specifically, these documents meet the standards of the guidelines for bibliometric reviews of the biomedical literature (BIBLIO guideline), as follows.

(1) **Choosing a Citation Style:** Determine which citation style to use. CiteSpace requires complete records and cited references with “.txt” when exporting literature. We exported data (selected full record and cited references) in the Web of Science Core Collection and saved it in “.txt” format.

(2) **Describe Citation Formats:** Describe details of resources. The selected literature should include the author, publication year, title, and publisher; therefore, data with the above essential information are included.

(3) **List references:** Explain how to organize the reference list. The web-page displayed the reference order automatically (sorted by relevance). Reference order is unimportant for CiteSpace analysis.

(4) Handle Special Cases in Citations: Describe how to deal with sources without authors, multiple authors, or multiple works by the same author in the same year. Sources without authors were excluded; duplicated works were counted once. Corrections, retractions, and preface were excluded.

(5) Examples: Provide specific citation examples for better understanding. The data example in the “.txt” file is shown in Figure 1.

(6) Ethical and Legal Considerations: Emphasize the importance of correct citation. We excluded retracted or withdrawn papers.

(7) Updates and Review: indicate the update time. We claimed that the data were collected on January 31, 2024.

## Choice of Analytical Methods

We adopted bibliometric analysis to understand research dynamics in specific fields. Various tools were considered, including RefViz, HistCite, SATI, and CiteSpace. We chose CiteSpace version 6.2.R7 for its robust functionality and ease of use. It clusters and categorizes data to showcase knowledge networks and research hot spots, offering multidimensional analysis (such as authors, countries, and cited journals), quantitative analysis, and data download, which enhances research efficiency.<sup>21</sup>

We process the data (1358 papers) using CiteSpace (V.6.2.R7) with the following procedures. (1) Import the data into CiteSpace in “.txt” format. (2) Set the parameters in Time Slicing from January 2014 to January 2024, with Years Per Slice = 1. (3) In Node Types, choose parameters (including author, institution, country, reference, cited author, cited journal, and keyword) respectively according to the analysis procedures. (4) In the selection criteria, set the g-index value  $k=25$  or Top  $N=50$ .<sup>22,23</sup> (5) In Pruning, select Pathfinder, Pruning Sliced Networks, and Pruning the Merged Network. All other settings should remain at their default values.

It's essential to consider the potential biases or limitations inherent in the CiteSpace bibliometric analysis, as they can significantly impact the results. Firstly, CiteSpace might overlook new and milestone research that has yet to be widely

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PT J
AU Yokoro, H
   Wakimoto, K
   Otaki, N
   Fukuo, K
AF Yokoro, Miyuki
   Wakimoto, Keiko
   Otaki, Naoto
   Fukuo, Keisuke
TI Increased Prevalence of Breakfast Skipping in Female College Students in
COVID-19
SO ASIA-PACIFIC JOURNAL OF PUBLIC HEALTH
LA English
DT Article
DE health education; health promotion; primary health care; health
management; adolescent health; public health; nutrition; dietetics;
public health nutrition; family medicine
AB Going outside the house was nationally restricted among countries affected with coronavirus disease 2019 (COVID-19). This study aimed to determine the prevalence of breakfast skipping among female college
students during the COVID-19 emergency period. The cross-sectional survey was conducted from May 15, 2020, to June 1, 2020, among 164 female junior college students through the online survey using Google Form.
Population of breakfast skipping during the emergency (26.7%) was significantly increased compared with that before the emergency (18.9%;  $P < .001$ ). Interestingly, breakfast skipping during the emergency was a
significant independent determinant for  $\geq 1$  to 2 kg of weight loss during the emergency (odds ratio = 7.89; 95% confidence interval = 1.88-26.75;  $P < .004$ ) in participants who did not skip breakfast at the pre-
emergency. The prevalence of breakfast skipping during the COVID-19 pandemic was significantly higher than that before the emergency in female college students. Breakfast skipping during the emergency was associated
with short-term weight loss.
CI [Yokoro, Miyuki] Mukogawa Womens Univ, Jr Coll Div, Dept Dietary Life & Food Sci, 6-46 Imbiraki Cho, Nishinomiya, Hyogo 6638558, Japan.
[Yokoro, Miyuki; Wakimoto, Keiko; Otaki, Naoto; Fukuo, Keisuke] Mukogawa Womens Univ, Res Inst Nutr Sci, Nishinomiya, Hyogo, Japan.
[Wakimoto, Keiko; Otaki, Naoto; Fukuo, Keisuke] Mukogawa Womens Univ, Sch Food Sci & Nutr, Dept Food Sci & Nutr, Nishinomiya, Hyogo, Japan.
C3 Mukogawa Women's University; Mukogawa Women's University; Mukogawa
Women's University
BP Yokoro, H (ORCID), Mukogawa Womens Univ, Jr Coll Div, Dept Dietary Life & Food Sci, 6-46 Imbiraki Cho, Nishinomiya, Hyogo 6638558, Japan.
EM yokoro@mukogawa-u.ac.jp
CR Bonnet JP, 2020, OBEsITY, V28, P1098, DOI 10.1002/oby.22791
Gellera A, 2014, J NUTR SCI, V3, DOI 10.1017/jns.2014.51
Lipsitch M, 2020, NEW ENG J MED, V382, P1194, DOI 10.1056/NEJMp2002125
Pendergast FJ, 2016, INT J BEHAV NUTR PHY, V13, DOI 10.1186/s12966-016-0451-1
Rodriguez-Pérez C, 2020, NUTRIENTS, V12, DOI 10.3390/nut12061730
Scarmozzino F, 2020, FOODS, V9, DOI 10.3390/foods9090975
Sidor A, 2020, NUTRIENTS, V12, DOI 10.3390/nut12061657
Yasuda J, 2018, NUTR RES, V28, P26, DOI 10.1016/j.nutres.2018.09.006
NR 8
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Z9 9
U1 2
U2 15
PU SAGE PUBLICATIONS INC
P1 THOUSAND OAKS
PA 2455 TELLER RD, THOUSAND OAKS, CA 91320 USA
SN 1819-0395
EI 1941-2479
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J1 Asia-Pac. J. Public Health
PD MAY
PY 2021
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IS 4
BP 438
EP 440
AR 1818539521998861
DI 10.1177/1818539521998861
EA MAR 2021
PG 3
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WE Science Citation Index Expanded (SCI-EXPANDED); Social Science Citation Index (SSCI)
SC Public, Environmental & Occupational Health
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Figure 1 Data Example.



cited, and studies in emerging fields may be underrepresented in the analyzed network. Secondly, CiteSpace might emphasize those active in publishing collaborative research, potentially under-representing researchers who work independently or engage less in collaborations. Thirdly, CiteSpace can handle cross-database analysis, which means it may ignore some vital literature in other databases. We selected the data from the Web of Science Core Collection, meaning that the findings may not be as representative as the facts, and some biases may occur (though this data set is much more representative and comprehensive than other individual data sets).

## Methods

This study was conducted in five steps, as follows:

(1) Statistical Feature Analysis: Analyze the annual publication volume, leading journals, and topic categories to understand journal popularity and influence. This section aims to answer the first research question: Is this research field booming and prospering? Analyzing these basic statistics allows us to witness the development of the field and encourages us to engage in research within it.

(2) Collaboration Network Analysis: Analyze collaboration networks among institutions, regions, and researchers in detail to assess the current state of research interaction. It aims to answer the second research question: What are the associated relations and statuses among participants in this field? These results help scholars grasp current research connections and find potential partners to address issues related to CSHE.

(3) Co-Citation Network Analysis: Analyze the co-citation network from the perspectives of journals, references, and authors to understand the focus and progress of the research. This section aims to answer the third research question: What are the current research dynamics and authorities? The analysis results showcase the field's knowledge accumulation and provide scholars with findings about the current research dynamics.

(4) Co-Citation Analysis: Through co-citation analysis, we evaluated the evolution of college health education and predicted potential future research hot spots. This section aims to answer the fourth research question: what are the evolving hot spots and potential trends? The findings can assist researchers in gaining insights into current and future research progress, enabling them to continue future work more effectively.

(5) Proposed Future Research Directions: Based on the research framework constructed from the analysis results, propose future research focuses and inspire researchers' interest and research ideas. This section aims to provide readers with a comprehensive knowledge structure (which shows the field's research evolution logic) and highlights vital topics (namely representative and widely focused terms); besides, this section also aims to convince readers what and how to do to enhance CSHE research and practice effectively.

Here, we want to underscore how the findings and the framework will steer future research and practice in CSHE. As show in [Figure 2](#), the framework has the potential to inspire scholars to initiate more multidisciplinary, comprehensive, and complex research with new theories and methods. For instance, the framework will guide readers on what subjects and categories to focus on in CSHE research (such as psychology and environmental science), what emerging topics to cover (such as pandemics and social emergencies), what methods to use in research (such as empirical study and data mining), what approaches to use in the CSHE process (such as integrated education combining social media and virtual intelligence), and what topics will be hot in the future (such as disease prevention and education equality). The findings of the framework will also guide future CSHE practice, such as proposing universities to provide mandatory courses, teachers to focus on specific health education issues for different groups, health industry professionals to provide consultations, and policymakers to initiate enhancement programs and supports.

## Results

### Statistical Analysis of Publications

The statistics of publications from the annual publications, journals, and categories aim to justify the question we propose: Is this research field booming and prospering? Delving into this research gap may convince us to explore this prosperous field.

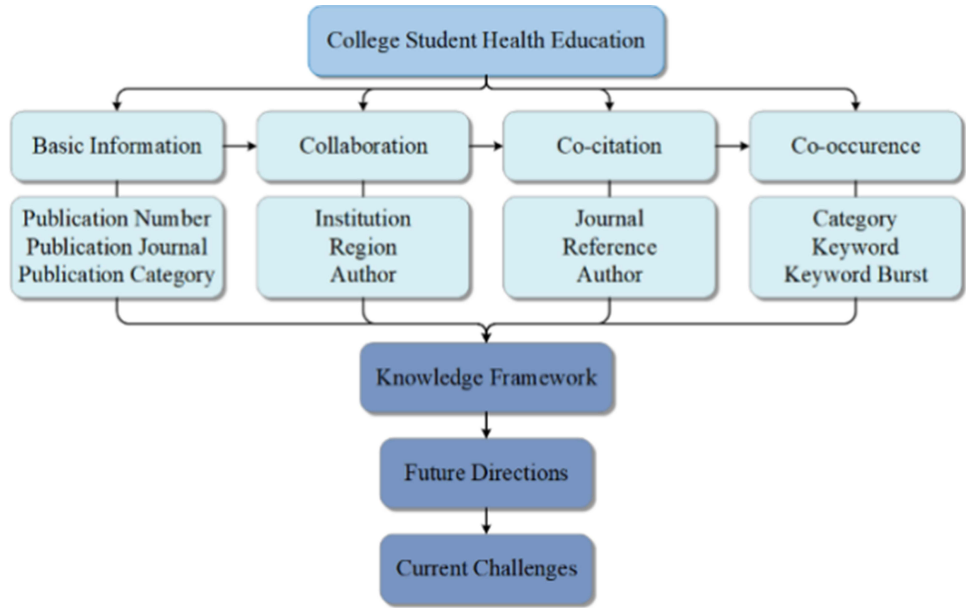


Figure 2 Research Process.

Number of Publications by Year

Figure 3 shows the trend in CSHE publications. We can see that the overall trend shows growth over the past ten years despite a slight decrease in the number of publications in 2018 and 2023 compared to the previous year. Significantly, 835 papers have been published from 2020 to 2023, exhibiting a notable surge in publication volume during both 2021 and 2022. This upsurge could potentially be attributed to the emergence of COVID-19 in 2020. With college students studying remotely and in isolation due to pandemic control, more researchers began studying college students’ mental health and health education activities related to COVID-19, leading to a surge in publication volume during these two years. This shows the timeliness, innovation, and research attention in CSHE. The number of publications in 2024 significantly decreased compared to the previous year, as data collection was cut off in January 2024, which excludes articles published in the following months. However, based on the publication trend, the number of publications in 2024 may increase compared to 2020, the year before the pandemic. That means CSHE will continue to be a prominent topic, and we encourage researchers to persist in focusing on and conducting comprehensive research in this field.

We used regression analysis to draw a trend line, predicting the future growth trend of CSHE publications. Due to data collection issues, the data for 2024 was incomplete, and we excluded this incomplete data to avoid bias in the overall

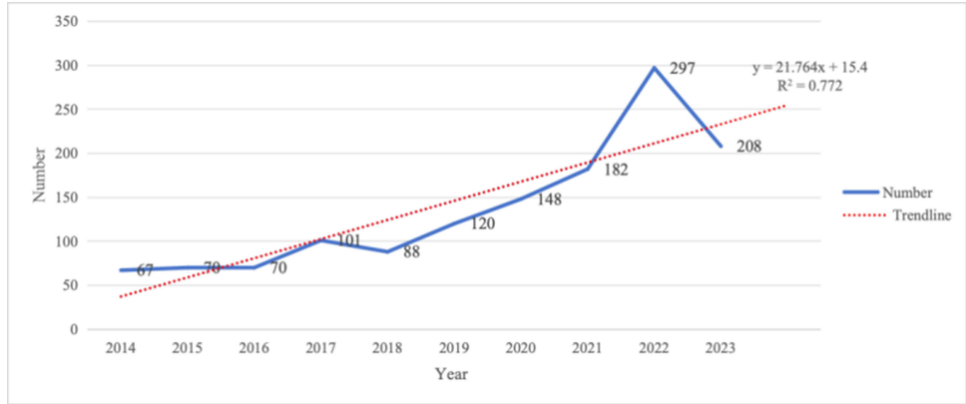


Figure 3 Number of Publications by Years.

trend analysis. The formula is:  $y = 21.764x + 15.4$ ;  $R^2 = 0.772$ , where  $y$  is the number of publications for the corresponding year,  $x$  represents the year point, and  $R^2$  is an indicator of the fit of the trend line. The higher the  $R^2$ , the more reliable the trend line is. The trend-line confirms our prediction that publications related to CSHE will increase annually, demonstrating that the attention to CSHE is growing and that more emerging research will appear.

### Number of Publications by Journal

In the past decade, research on CSHE has been published in 417 journals. Table 1 lists the top 10 journals that have published the most papers related to this topic. It is noteworthy that: (1) The top 10 journals have published a significant number of papers (419), but their impact factors (IF) are relatively low, mostly between 2 and 5. For instance, among the top three journals, the Journal of American College Health (94 papers) has a 5-year IF of only 2.7, Frontiers in Public Health (72 papers) has a 5-year IF of 5.5 (the highest among the top 10 journals), and BMC Medical Education (52 papers) has a 5-year IF of 3.9. The low impact factors of these journals indicate that researchers often have multiple options when choosing journals and may not consider impact factors as the sole criterion. However, we admit that the influence of journal impact factors on research quality and dissemination must be considered. Impact factors are often regarded as indicators of a journal's credibility and the significance of its published works; journals with higher impact factors may attract more citations, providing a broader platform for research and enhancing their prominence and influence in the field, though the absolute publication numbers may be limited. For example, from 2014 to 2024, only one in five papers on CSHE were published in the American Journal of Public Health and BMJ Global Health, respectively, despite their high impact factors of 10.1 and 7.1; though their publication numbers rankings are low, we cannot infer they are less influential in this domain; in fact, one paper about CSHE on the American Journal of Public Health was cited 28 times, was perceived as high-quality and was widely known by the public. (2) The top 10 journals account for only 28.394% of all publications in this field, meaning many more potential journals are available for researchers. Researchers should not be limited to only the top 10 journals but consider multiple factors such as research content, target audience, and research impact to select journals closely related to their research area. This approach helps increase the visibility of research outcomes and attract the attention of more scholars and researchers in related fields. Therefore, although the top 10 journals may have certain advantages and recognition, researchers should focus more on the quality, professionalism, and relevance of the journal to their research content. Choosing a journal should be well-thought-out, not solely reliant on rankings and impact factors.

### Number of Publications by Category

Table 2 outlines the top 10 disciplinary categories in the research domain of CSHE. Publications in this field are primarily in medicine while also covering some other disciplinary domains. There are some details: (1) The field of Medicine and Related Disciplines includes six main categories, totaling 915 papers: Public Environmental Occupational Health (35.877%) with 489 papers; Nursing (9.098%) with 124 papers; Health Care Science Services (7.924%) with 108 papers; Health Policy Services (5.723%) with 78 papers; Medicine et al (4.916%) with 67 papers; and Psychiatry

**Table 1** Number of Publications by Journal

Ranking	Journal	5-years IF	Count	Percentage (%)
1	Journal of American College Health	2.7	94	6.897%
2	Frontiers in Public Health	5.5	72	5.282%
3	BMC Medical Education	3.9	52	3.815%
4	International Journal of Environmental Research and Public Health	4.799	35	2.568%
5	PLoS One	3.8	35	2.568%
6	Frontiers in Psychology	4.3	32	2.348%
7	Nurse Education Today	4.5	32	2.348%
8	BMC Public Health	4.7	26	1.908%
9	Healthcare	3	21	1.541%
10	Health Education Journal	1.6	20	1.467%

Table 2 Number of Publications by Category

Ranking	Category	Count	Percentage (%)
1	Public Environmental Occupational Health	489	35.877%
2	Education Educational Research	224	16.434%
3	Education Scientific Disciplines	147	10.785%
4	Nursing	124	9.098%
5	Health Care Science Services	108	7.924%
6	Health Policy Services	78	5.723%
7	Medicine General Internal	67	4.916%
8	Multidisciplinary Psychology	54	3.888%
9	Environmental Sciences	52	3.815%
10	Psychiatry	49	3.595%

(3.595%) with 49 papers. (2) The field of Education Disciplines includes two main categories, totaling 371 papers: Education Educational Research with 224 papers (16.343%) and Education Scientific Disciplines with 147 papers (10.785%). (3) Psychology: Multidisciplinary Psychology contains 54 papers (3.888%). (4) Environmental Sciences contains 52 papers (3.815%). The journal Public Environmental Occupational Health holds a prominent position in this research domain, with most publications demonstrating a strong correlation between CSHE and public, environmental, and occupational health. The majority of the top 10 categories focus on medicine and related disciplines, indicating a strong emphasis on these fields in CSHE. However, there is also an interdisciplinary convergence with other categories, highlighting the research’s comprehensive and multidisciplinary nature in CSHE.

Collaboration Analysis

Collaboration analysis aims to understand the connections among institutions, regions, and authors in this research domain. This section helps to solve the following research gap: What are the associated relations and statuses among participants in this field? These collaborations can help scholars find partners to tackle complex scientific problems.

Institutional Collaboration Network

The collaboration among global institutions is shown in Table 3, with seven of the top 10 institutions in the United States and the remaining three in the United Kingdom, Australia, and Egypt. Specifically: (1) Dominance of US Institutions: Seven of the top ten are American institutions, indicating a strong focus on CSHE in the US The leading institution is the University of California System, with 31 collaborations. It was also the earliest to start collaborative research in 2014. The collaborative research is notable for its innovative approaches to college health education, such as incorporating art to enhance effectiveness.<sup>24</sup> Additionally, amidst the COVID-19 pandemic, researchers focus on mental health education activities tailored for college athletes, emphasizing holistic well-being, and providing a range of mental health

Table 3 Institution Collaboration Network

Ranking	Institutions	Country	Count	Centrality	Year
1	University of California System	USA	31	0.16	2014
2	University of Sydney	Australia	27	0.08	2015
3	University of North Carolina	USA	26	0.1	2016
4	University of London	UK	18	0.21	2016
5	Johns Hopkins University	USA	17	0.07	2015
6	University of Texas System	USA	16	0.03	2014
7	Harvard University	USA	15	0.19	2014
8	State University System of Florida	USA	15	0.1	2014
9	University System of Ohio	USA	14	0.09	2017
10	Egyptian Knowledge Bank (EKB)	Egypt	14	0.04	2015

resources.<sup>25</sup> (2) The University of Sydney (Australia) is the second most collaborative institution, with 27 collaborations, and focuses more on the oral health education process for medical students. One collaborative study from this institution suggests that Australian medical school graduates have limited knowledge of essential oral health, so teaching basic oral health knowledge to medical students is crucial and should be incorporated into medical school curricula.<sup>26</sup> The institution also advocates for globalized health education, particularly in developing countries, to achieve health equity, reduce health disparities, and impact college students' future careers.<sup>2</sup> (3) The University of London (UK) has the highest centrality (0.21), with 18 collaborations. Their primary collaborative research focuses on exploring new ways of mental CSHE, involving young college students in designing and implementing mental health education to improve intervention effectiveness.<sup>27</sup> Another collaborative study from this institution provides experimental validation for the efficacy of Health Promoting Schools in enhancing CSHE. These schools were established based on the recommendations of the World Health Organization.<sup>28</sup> (4) The University System of Ohio (US) began collaborative research in 2017. Its most recent research direction includes evaluating health education courses for college students to guide teachers in better teaching health education courses.<sup>29</sup>

Figure 4 shows the institutional collaboration cluster map. Different cluster colors represent different research themes; each cluster contains many research institutions. The top three research theme clusters that collaboration institutions are most interested in are #0 competency-based education (primarily CSHE with medical knowledge to improve medical students' practical skills to meet future healthcare needs), #1 college health (where the primary audience for health education is general college students), and #2 program evaluation (evaluating health education courses and programs in colleges for better health education). Specifically, (1) In Cluster #0 (competency-based education), the collaboration between the University of California System and Harvard University stands out. The University of California System mainly collaborates on dental health education for dental students. This research suggests that dental health education for dental students better meets future job demands and promotes the development of dental health education.<sup>30</sup> Harvard

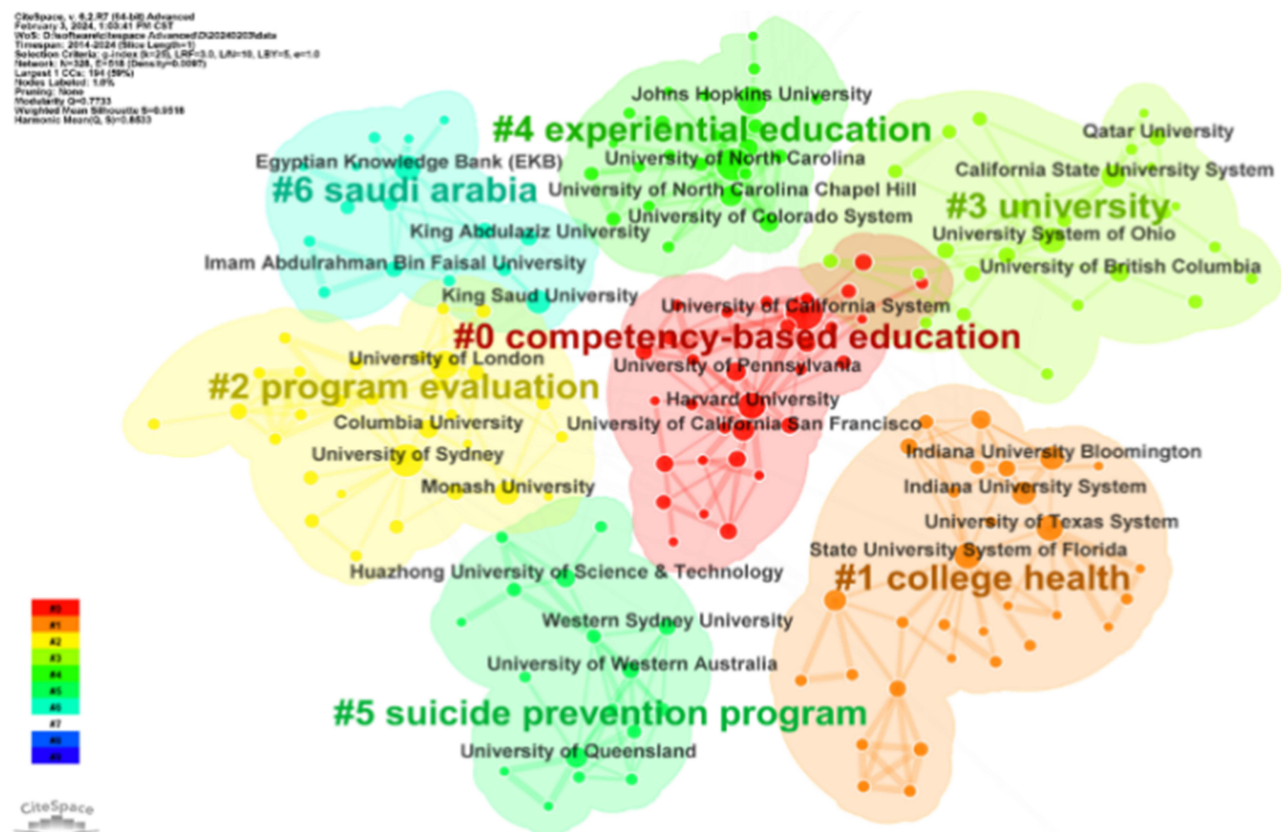


Figure 4 Visualization of institution collaboration network (N=328, E=518).



University’s collaborative research shows that Chinese medical schools lack attention to health education, encouraging policymakers and educators to have a global vision to promote global health education in Chinese medical schools and take measures to address educational differences between schools.<sup>31</sup> (2) In Cluster #1 (college health), the State University System of Florida and the University of Texas System collaborate more actively. The State University System of Florida’s latest collaborative research found that students (including college students) can learn about health education through AI like ChatGPT. Although AI cannot replace human educators, it can be a new way of health education.<sup>32</sup> The University of Texas System’s latest collaborative research explores college students’ understanding of influenza and willingness to get vaccinated. The study shows that after receiving health education, college students’ vaccination rates have increased.<sup>33</sup> (3) In Cluster #2 (program evaluation), the University of Sydney and Columbia University have prominent collaborations. The University of Sydney’s latest research evaluates college students’ sleep health to develop sleep plans and educate them about sleep health knowledge. The study found that college students participating in a 10-week sleep health education course can significantly improve their sleep quality.<sup>34</sup> Columbia University’s representative research evaluates its Master of Public Health curriculum, suggesting new public health courses be designed to meet CSHE needs.<sup>35</sup>

The figure also shows that many institutions have relatively close collaborative relationships within the same research theme, and different institutions have different research themes of interest. We anticipate that through advancing research in the field of college health education, institutions can engage in broader academic exchanges, fostering more profound collaborative relationships among researchers with diverse interests. By sharing research findings, we aim to propel college health education’s development collectively.

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Regional Collaboration Network

Table 4 shows the collaboration among different regions, revealing several insights: (1) The most collaborative is the US (0.12), which ranks first in collaboration on CSHE research domain, with 448 collaborations since 2014. This result means that US institutions are leading in collaboration in this field. (2) Eight regions started collaborative research as early as 2014, including the US, China, Australia, the UK, Canada, Saudi Arabia, Germany, and South Korea. This result indicates a broad early engagement in collaboration in this field. (3) Collaborators with high centralities, such as Germany, Saudi Arabia, and Australia, exhibit a centrality value of 0.16, 0.16, and 0.13, respectively. This signifies their substantial and authoritative engagement in collaborative endeavors within this field. (4) Developing Countries’ Role: Among the top 10 regions, two developing countries (China and Saudi Arabia) show relatively high centrality (0.12 and 0.16, respectively), demonstrating notable collaboration and influence in this field. China ranks second in

Table 4 Region Collaboration Network

Ranking	Regions	Count	Centrality	Year
1	USA	448	0.12	2014
2	P.R.China	327	0.12	2014
3	Australia	119	0.13	2014
4	England	75	0.04	2014
5	Canada	62	0	2014
6	Saudi Arabia	49	0.16	2014
7	Spain	32	0.04	2015
8	Germany	28	0.16	2014
9	Italy	24	0.04	2015
10	South Korea	23	0	2014

These findings suggest that while developed regions primarily lead collaborative research in this field, developing countries are increasingly influential. Scholars from developing countries can establish collaboration with scholars from developed regions and seek suitable partners within developing countries to enhance their impact in this field. Figure 5 shows the visualization of the regional collaboration network, with node size reflecting the level of focus. Several prominent nodes include the US, China, Australia, and Saudi Arabia. Key findings from analyzing these nodes include (1) United States: The US mainly focuses on school health education. Representative studies suggest that providing health education in universities is one of the most effective means of improving public welfare, and this research contributes to advancing the theory and practice of university health education programs.<sup>6</sup> Additionally, community colleges' provision of health education to college students is essential as it can increase public health interest, expand the public health workforce, and meet diverse needs.<sup>36</sup> Other notable studies focus on the impact of oral health education on college students' quality of life, showing that active participation in related oral health education can effectively improve students' quality of life.<sup>37</sup> (2) China: China's collaboration focuses on the widespread issue of social anxiety among college students, with research showing that health education can help reduce this anxiety.<sup>38</sup> (3) Australia: Australia mainly focuses on college students' living habits. Research suggests that health education can help students adopt healthy habits, reducing the prevalence of overweight and obesity and the risk of non-communicable diseases.<sup>39</sup> Additionally, online mental health education courses can increase students' self-efficacy, reducing the risk of self-harm and suicide. (4) Saudi Arabia: Research in Saudi Arabia focuses on college students' health awareness, such as how appropriate health education can reduce smoking rates and improve health.<sup>40</sup> Another study examines how evaluating students' understanding of public health can enhance their comprehension of public health models.<sup>41</sup>

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**Figure 5** Visualization of region collaboration network (N=87, E=102).

Author Collaboration Network

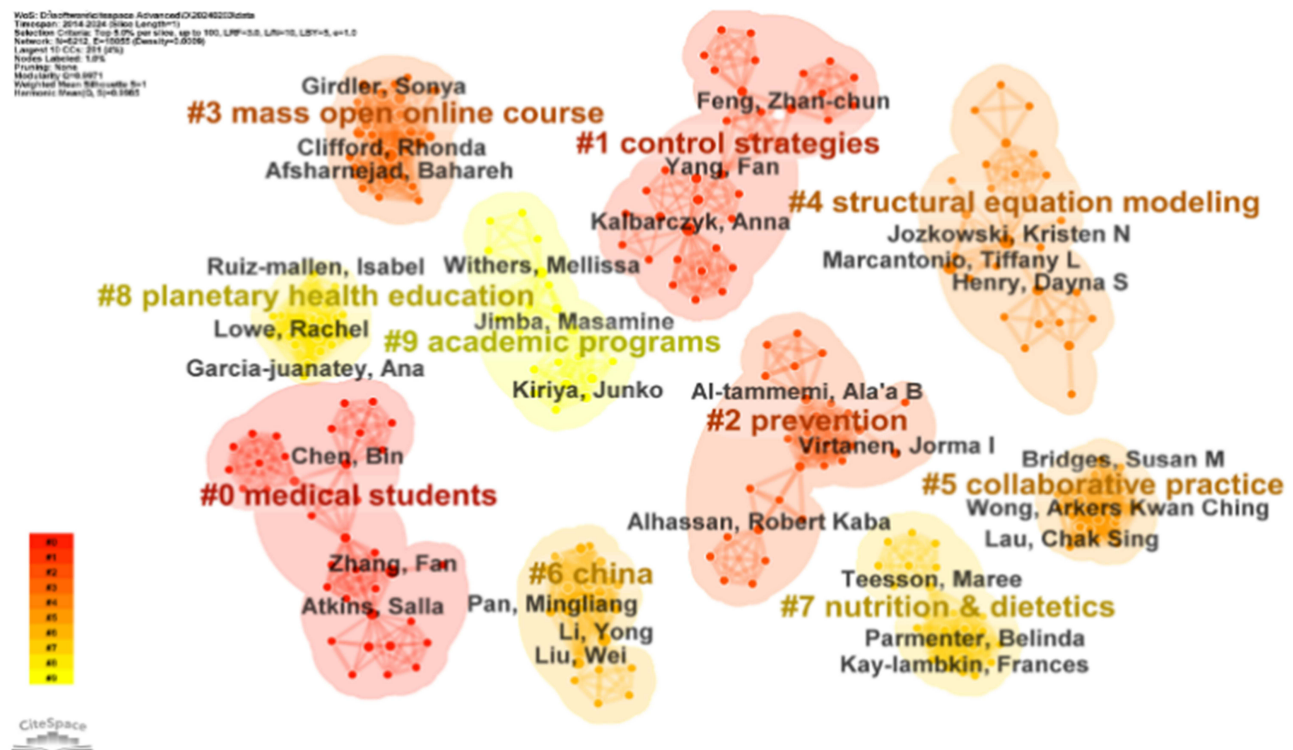
Table 5 shows the global collaboration network among authors in this field. Out of 6212 authors, only 322 authors collaborated more than twice. The top three most collaborative authors are Kristen N. Jozkowski, Spencer B. Olmstead, and Denise C. Nelson-Hurwitz, with 7, 7, and 6 collaborations, respectively. Specifically: (1) Kristen N. Jozkowski: The primary focus of the most collaborative author’s research is health education in colleges, specifically consent education. Their work aims to equip college students with proficient communication skills about pre-sexual activity consent.<sup>42</sup> Their research results have played a crucial role in subsequent studies on sexual consent and assault prevention, serving as the theoretical basis for the research by Tiffany L. Marcantonio’s team. Following this, Tiffany L. Marcantonio published a paper analyzing issues of sexual consent, assault, and refusal with large language models. This achievement highlights the academic value of Kristen N. Jozkowski’s team’s research findings and reflects their significant influence and foresight in the related research fields.<sup>43</sup> (2) Spencer B. Olmstead: Focuses on sexual health education in CSHE. One representative collaborative study shows that health education interventions successfully increased students’ knowledge about contraception and understanding of sexually transmitted infections, including HIV/AIDS.<sup>44</sup> Spencer B. Olmstead’s research findings also inspire subsequent research on sexual health education conducted by Savannah R. Burke, who confirms that sexual health education significantly impacts college students’ lives, even influencing their sexual orientation.<sup>45</sup> (3) Denise C. Nelson-Hurwitz: Conducts collaborative research on health education in different racial groups. This author links health education with racial theory in college courses, enabling marginalized students to access health education better to address health inequities.<sup>36</sup> Inspired by the research findings, subsequent research teams have discovered educational disparities among different ethnicities. For instance, Christopher Mena found that Mexican Americans have long faced discrimination and unequal treatment in music education.<sup>46</sup>

Furthermore, all the top ten collaborators have a centrality of 0, indicating that these collaborators do not have significant external collaboration. We hope prominent collaborators can increase external collaboration to enhance their influence in college health education and explore new research directions.

Figure 6 shows a cluster view of the collaboration network among authors in this field. As shown in the figure, there are evident collaboration groups among authors in the same research direction. Specifically, (1) #0 Medical Students: This cluster focuses on health education for medical students. The collaboration of Bin Chen’s team mainly studies the connection between the prevalence of tuberculosis and health education among medical students, confirming that health education can effectively prevent tuberculosis and advocating universities to carry out related health education.<sup>47</sup> Fan Zhang’s team focuses on mental health education for students during COVID-19, finding that medical students have advantages in reducing mental anxiety compared to regular students, but overall health literacy is low. The team calls for universities to intensify efforts to

Table 5 Author Collaboration Network

Ranking	Author	Count	Centrality	Year
1	Kristen N Jozkowski	7	0.00	2015
2	Spencer B Olmstead	7	0.00	2017
3	Denise C Nelson-Hurwitz	6	0.00	2018
4	Lisa Kehl	5	0.00	2018
5	Yong Li	4	0.00	2021
6	Anna Kalbarczyk	4	0.00	2015
7	Sube Banerjee	4	0.00	2017
8	Rhonda Clifford	4	0.00	2022
9	Stephanie Daley	4	0.00	2017
10	Zhongrong Yang	4	0.00	2015
11	Fan Zhang	4	0.00	2014
12	Tiffany L Marcantonio	4	0.00	2021
13	Kristin M Anders	4	0.00	2017
14	Jiun-Hau Huang	4	0.00	2015
15	Giulia Civitelli	4	0.00	2020
16	Maurizio Marceca	4	0.00	2020
17	Gianfranco Tarsitani	4	0.00	2020



**Figure 6** Visualization of author collaboration network (N=6212, E=18055).

promote health literacy and campus mental health projects.<sup>48</sup> (2) #1 Control Strategies: This cluster focuses on specific strategies for CSHE, with notable collaboration groups led by Zhan-Chun Feng and Fan Yang. Zhan-chun Feng's collaborative research shows that the psychological health status of Chinese students is influenced by academic pressure, job satisfaction, and family environment, and the mental health status is not optimistic. Therefore, they recommend that schools change their education strategies and increase relevant health education courses to help students improve their mental health status.<sup>49</sup> Fan Yang's team's representative collaborative research uses a global health education project as a case study, showing that many socio-ecological factors affect students' health education internship decisions and experiences. The research provides critical decision-making guidance for teachers and students and suggests schools provide the necessary support, including available funds, explicit preparation, and communication facilitation throughout the internship process.<sup>50</sup> (3) #2 Prevention: This cluster focuses on the preventive role of college health education. The Al-Tamimi team has collaborated on developing different health education prevention strategies for various types of students, and the results suggest that health education and promotion activities for preventive health care measures need to focus on subgroups such as young men and retirees.<sup>51</sup> The latest research by Robert Kaba Alhassan's team advocates strengthening public health education and preventing sexually transmitted infections in developing countries' health systems through innovative methods such as mobile phones and the internet. They believe new health education methods are more readily accepted by students.<sup>52</sup>

In conclusion, authors should participate in interdisciplinary collaborations within their research fields to enable more comprehensive investigations. Additionally, it is crucial for teams working in these research areas to actively foster cooperation within and between research groups while also actively seeking opportunities for collaboration with researchers who work independently.

## Co-Citation Analysis

Co-citation analysis helps to understand the progress of research, providing insights into notable journals or literature, current research focuses, and prominent researchers in the field. This section justifies the following question: What are the current research dynamics and authorities? This research gap helps us know this domain's milestones and status.

Journal Co-Citation Network

Table 6 outlines the most frequently co-cited journals in CSHE. There are three new findings. (1) Impact Factor and Co-Citation: Journals with a high impact factor tend to have high co-citation counts. For example, The Lancet and JAMA-Journal of The American Medical Association have the highest impact factors among the co-cited journals, at 118.1 and 81.4, with 277 and 160 co-citations, respectively. The rankings of these two Journals are second and tenth. Furthermore, only one of the top ten journals, the Journal of American College Health, has a 5-year impact factor (IF) of 2.7. This result highlights the significant influence of journals that publish numerous papers on college health education. (2) Centrality: The correlation between journal impact factors and centrality is weak, as evidenced by the example of The Lancet, which has the highest IF but a centrality of 0. In contrast, despite its low IF of 2.7, the Journal of American College Health demonstrates the highest centrality of 0.75 among the top ten co-cited journals. Similarly, BMC Public Health holds a high centrality of 0.73 with an IF of 4.7. These findings highlight these journals' significance and potential impact in fostering connections within the co-citation network. (3) Initial Co-Citation Time: The International Journal of Environmental Research and Public Health and PLoS One were first co-cited in 2014 and 2015, respectively, while the remaining eight journals began being co-cited in 2014. This indicates that these frequently co-cited journals were recognized at an earlier stage.

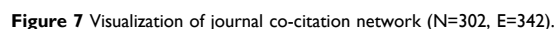
In summary, these highly cited journals provide valuable references for future research on CSHE. Researchers can enhance their impact in this research domain by strategically selecting journals with high impact factors or high centrality for publication.

Figure 7 shows the visualization of the journal co-citation network. We observe a diverse range of co-cited journals, the top 10 clusters encompassing health, education, policy, and other fields relevant to CSHE. There are some details about these clusters. (1) Cluster #0 health Education: Focuses on health knowledge dissemination and health awareness cultivation, with representative journals like the Journal of Health Communication, Journal of Adolescent Health, and Health Education Research. Articles in the Journal of Health Communication emphasize promoting vaccines' safety, effectiveness, and importance through health education during COVID-19, encouraging students to vaccinate.<sup>53</sup> A representative article published in the Journal of Adolescent Health emphasizes the importance of including sexual consent in health education, highlighting its potential to reduce instances of sexual violence among students significantly.<sup>54</sup> Health Education Research has published an article on new ways of health education for students using online social media, advocating for innovative health education methods that promote healthy living among students.<sup>55</sup> (2) Cluster #1 health Literacy: Focuses on understanding health knowledge and prevention, with representative journals such as BMC Public Health, PLoS One, and Journal of American College Health. A representative article in BMC Public Health argues that superstitions and beliefs negatively impact women's disease prevention behaviors, so popularizing knowledge about common female diseases is essential for effective disease prevention.<sup>56</sup> A study published in PLoS One indicates that there is a growing occurrence of cardiovascular and metabolic diseases like hypertension and diabetes among people living with HIV infection.<sup>57</sup> This raises concerns about the potential development of cardiovascular disease and its potential impact on the effectiveness of HIV treatment. The dissemination of knowledge on cardiovascular

Table 6 Journal Co-Citation Network

Ranking	Journals	5-year IF	Count	Centrality	Year
1	PLoS One	3.8	300	0.04	2015
2	Lancet	118.1	277	0	2014
3	BMC Public Health	4.7	266	0.73	2014
4	Journal of American College Health	2.7	229	0.75	2014
5	International Journal of Environmental Research and Public Health	4.799	226	0.03	2016
6	Academic Medicine	7.4	205	0.17	2014
7	BMC Medical Education	3.9	193	0.01	2014
8	Journal of Adolescent Health	6.7	183	0	2014
9	American Journal of Public Health	11.1	175	0.07	2014
10	JAMA-Journal of The American Medical Association	81.4	160	0.04	2014





diseases can improve the effectiveness of HIV care. Journal of American College Health focuses on students' anxiety and depression during COVID-19, noting that social support and disseminating relevant health knowledge can improve students mental state.<sup>58</sup>

These clusters indicate that co-cited literature in the CSHE field covers many aspects, demonstrating the breadth and comprehensiveness of research in this area. This is primarily because various factors, such as medicine, psychology, and education, influence CSHE, resulting in multidisciplinary research. This offers valuable insights for researchers, enabling them to expand their perspectives beyond specific disciplines and explore broader fields or novel subfields when studying theories or applications in college health education.

### Co-Citation Network of References

Table 7 shows the 12 most cited CSHE research references, excluding anonymous authors. There are three key insights. (1) Citation Count: The most cited articles are written by W.J. Cao and K. Jogerst, with ten citations each. W.J. Cao's 2020 article in *Psychiatry Research* focuses on the impact of COVID-19 on Chinese students' mental health, recommending continuous monitoring of students' mental health during the pandemic.<sup>59</sup> Based on this research, subsequent researchers have further explored the mental health changes of college students in the pandemic era. For example, one study revealed how anxiety during COVID-19 affected satisfaction with remote learning, showing that the more anxious the college students were, the worse their mental health and the lower their satisfaction with remote learning. This research warns educators to constantly pay attention to the mental health of college students to improve their satisfaction with learning.<sup>60</sup> Researchers also investigated how college students' academic performance during COVID-19 affects their mental health. One study found that students' concerns about academic performance were negatively correlated with their mental health and that economic, familial, and gender factors had more significant impacts on mental health; therefore, researchers are calling on governments and schools to provide corresponding psychological counseling services to reduce the psychological burden on college students.<sup>61</sup> K. Jogerst's 2015 article in the *Annals of Global Health* is another highly co-cited article, which identifies the cross-specialty global health competencies of health

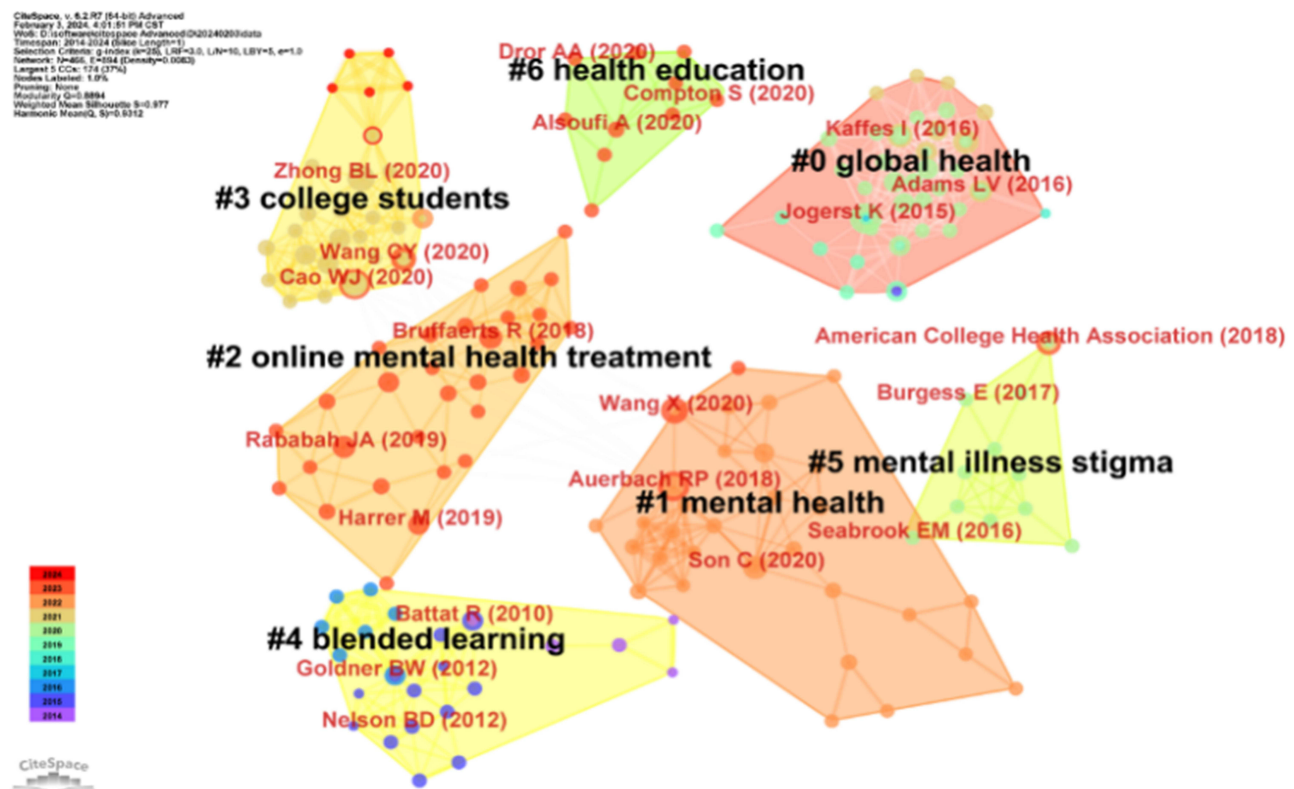
Table 7 Reference Co-Citation Network

Ranking	References	Count	Centrality	Year
1	Psychiatry Research, WJ Cao (2020) <sup>59</sup>	10	0.02	2020
2	Annals of Global Health, K Jogerst (2015) <sup>62</sup>	10	0	2015
3	Journal of Abnormal Psychology, RP Auerbach (2018) <sup>63</sup>	9	0.03	2018
4	International Journal of Social Science and Education Research, X Wang (2020) <sup>65</sup>	8	0.01	2020
5	Science, GQ Li (2019) <sup>69</sup>	8	0	2019
6	BMC Medical Education, I Kaffes (2016) <sup>70</sup>	7	0	2016
7	International Journal of Environmental Research and Public Health, CY Wang (2020) <sup>66</sup>	7	0.02	2020
8	BMC Medical Education, LV Adams (2016) <sup>71</sup>	7	0	2016
9	International Journal of Biological Sciences, BL Zhong (2020) <sup>67</sup>	7	0	2020
10	Medical Teacher, MJ Peluso (2017) <sup>72</sup>	6	0	2017
11	Journal of Medical Internet Research, C Son (2020) <sup>68</sup>	6	0.01	2020
12	BMC Public Health, HH Xu (2019) <sup>73</sup>	6	0	2019

professionals in the 21st century and further clarifies the requirements required for each competency level.<sup>62</sup> Jogerst’s paper was also cited as the earliest, starting in 2015. (2) Centrality: R.P. Auerbach’s paper, published in 2018 in the Journal of Abnormal Psychology, has the highest centrality (0.03) and has been cited nine times. It mainly reports the preliminary findings of the first phase of the World Health Organization’s World Mental Health International College Student Initiative, highlighting the prevalence and sociodemographic correlates of common mental disorders among students.<sup>63</sup> It is also highly co-cited and has influenced subsequent research: scholars further explored the relationship between college student’s mental health and race, indicating that specific mental counseling services should be provided based on different races and ethnic backgrounds.<sup>64</sup> (3) Initial Co-Citation Time: Five papers were first cited in 2020 but have relatively high centrality and citation counts, including W.J. Cao (10 citations), X. Wang (8 citations), C.Y. Wang (7 citations), B.L. Zhong (7 citations), and C. Son (6 citations), with centralities of 0.02, 0.01, 0.02, 0, and 0.01, respectively. X. Wang’s research focuses on the growing social pressure faced by students in an increasingly competitive society, aiming to promote mental health education.<sup>65</sup> C.Y. Wang seeks to develop evidence-based strategies to reduce adverse psychological effects and mental symptoms during the pandemic, showing that about one-third of respondents reported moderate to severe anxiety in the early stages of COVID-19 in China.<sup>66</sup> B.L. Zhong aims to understand the changes in people’s compliance with control measures during COVID-19, finding that compliance is influenced by whether individuals receive health education about COVID-19, which helps residents maintain a positive attitude.<sup>67</sup> C. Son focuses on the impact of the COVID-19 pandemic on students’ mental health, showing that the pandemic has negatively impacted higher education due to prolonged lockdowns and strict measures, emphasizing the urgent need for intervention and prevention strategies to address students’ mental health.<sup>68</sup>

In summary, these findings demonstrate that highly co-cited papers in this field cover various topics, are of significant reference value for future research, and allow educators and medical professionals to gain a more comprehensive and profound understanding of CSHE from diverse aspects. Scholars can carefully read these highly co-cited papers from different disciplinary perspectives to gain a deeper understanding of CSHE, identify various research directions, or conduct in-depth studies on the same topic.

Figure 8 shows a cluster view of the co-citation network, displaying the main categories of co-cited references. We selected the top 7 clusters: #0 global health, #1 mental health, #2 online mental health treatments, #3 college students, #4 blended learning, #5 mental illness stigma, and #6 health education. These clusters cover subfields under health and education topics, proving the professionalism of research on CSHE. There are some details about the top 5 clusters. (1) Cluster #0 Global Health: This cluster focuses on global health challenges and solutions, including disease transmission, environmental factors, socioeconomic factors, and medical resource allocation and utilization. I. Kaffes and L.V. Adams represent this cluster. I. Kaffes addresses the status, needs, and obstacles of global health education in Germany, advocating for university administrators to increase awareness of global health education in higher education.<sup>70</sup> L.V. Adams lays out a plan for US global health education, advocating for achieving equity in global health education and practice in the future.<sup>71</sup>



**Figure 8** Visualization of reference co-citation network (N=466, E=894).

(2) Cluster #1 Mental Health: This cluster focuses on individuals' recognition, understanding, and coping abilities regarding their emotions and the ability to establish healthy relationships with others. R.P. Auerbach represents this cluster, actively researching mental health. He found that the prevalence of mental disorders among students is gradually increasing worldwide, urging higher education institutions and governments to pay more attention to students' mental health.<sup>63</sup> (3) Cluster #2 Online Mental Health Treatment: This cluster focuses on mental health services and support provided through the Internet and digital technology, suggesting that we can use online resources for mental health maintenance. M. Harrer and R. Bruffaerts represent this cluster. M. Harrer studied internet interventions for students' mental health, suggesting that providing evidence-based treatment to students with mental illnesses via the Internet is an excellent treatment method.<sup>74</sup> R. Bruffaert studied the relationship between mental health issues and academic performance through e-surveys, finding no significant correlation between mental health issues and academic performance.<sup>63</sup> (4) Cluster #4 Blended Learning: Blended Learning combines face-to-face teaching and online learning resources. R. Battat has deeply researched global health education, emphasizing the need for medical educators to use blended learning to provide appropriate global health training for future doctors.<sup>75</sup> B.W. Goldner proposes new educational methods for medical students' health education, advocating for a combination of online and offline methods to improve student satisfaction.<sup>76</sup> (5) Cluster #5 Mental Illness Stigma: This cluster focuses on social biases, discrimination, and stigma against mental health issues. E.M. Seabrook represents this cluster, studying the impact of social networking sites on depression and other mental illnesses, revealing various outcomes in the relationship between depression, anxiety, and social network usage, which depend on the quality of social networks.<sup>77</sup>

These co-cited references form the foundation of CSHE research, and the representative references in each cluster are critical knowledge sources. Overall, valuable references can continually advance this field of research, and scholars can refer to these core references to drive research progress.

### Author Co-Citation Network

Table 8 lists the top 10 most frequently co-cited authors. The top three cited entities are organizations: the World Health Organization (256 citations), the Centers for Disease Control and Prevention (66 citations), and the American College

Health Association (33 citations). There are some details about these frequently co-cited authors. (1) World Health Organization (WHO), Centers for Disease Control and Prevention (CDC), and American College Health Association (ACHA): These organizations were cited from 2014 and have high centrality (0.35, 0.38, and 0.38, respectively). This indicates the involvement of multiple institutions in this field and highlights the authority and influence of their research findings. This level of institutional participation is rare in other research fields, showing that institutions play a significant role in college health education research and practice. As the most co-cited organization, the WHO has influenced subsequent research. For instance, the WHO has developed a conceptual framework outlining health inequalities and how they impact population health. Based on this framework, some researchers have found that despite WHO policies ensuring the quality of healthcare services to promote health equity, disparities still exist among patients with lower back pain; health practitioners need to understand better patients' expectations to provide improved medical services.<sup>78</sup> (2) I Ajzen: The author with the highest centrality (0.77), I. Ajzen has been cited since 2015, with 37 co-citations. His recent research direction is studying the reasons influencing COVID-19 vaccination willingness. He suggests policymakers, doctors, and healthcare providers should emphasize factors supporting a positive attitude toward vaccination, such as preventing severe illness, death, and long-term health damage, rather than applying social pressure.<sup>79</sup> The study's results have a profound impact on subsequent research. For instance, subsequent researchers have investigated the factors affecting COVID-19 vaccination rates, finding that people's perception of disease risk and trust in relevant institutions significantly influence vaccination rates.<sup>80</sup> They have also found that skepticism about the vaccine's effectiveness persists, and resistance to vaccination is increasing.<sup>81</sup> (3) Earliest Citations from 2014: Two authors, A. Bandura (44 citations) and P.K. Drain (23 citations), were first cited in 2014 and have centralities of 0.13 and 0.16, respectively. A. Bandura mainly researches human agency psychology and the impact of personality traits and self-efficacy on students' academic performance.<sup>82,83</sup> P.K. Drain's latest research relates to COVID-19 testing, proposing effective and innovative testing methods.<sup>84</sup> The former article has been co-cited 173 times, indicating that it has longitudinal impacts on the academic community. For instance, researchers have explored the effects of college students' personalities on academic performance, concluding that personality traits affect academic outcomes.<sup>85</sup> Furthermore, based on the COVID-19 testing methods proposed by P.K. Drain, researchers found that home monitoring can alleviate pressure on medical personnel and improve medical services. Still, testing results are influenced by educational status and language.<sup>86</sup>

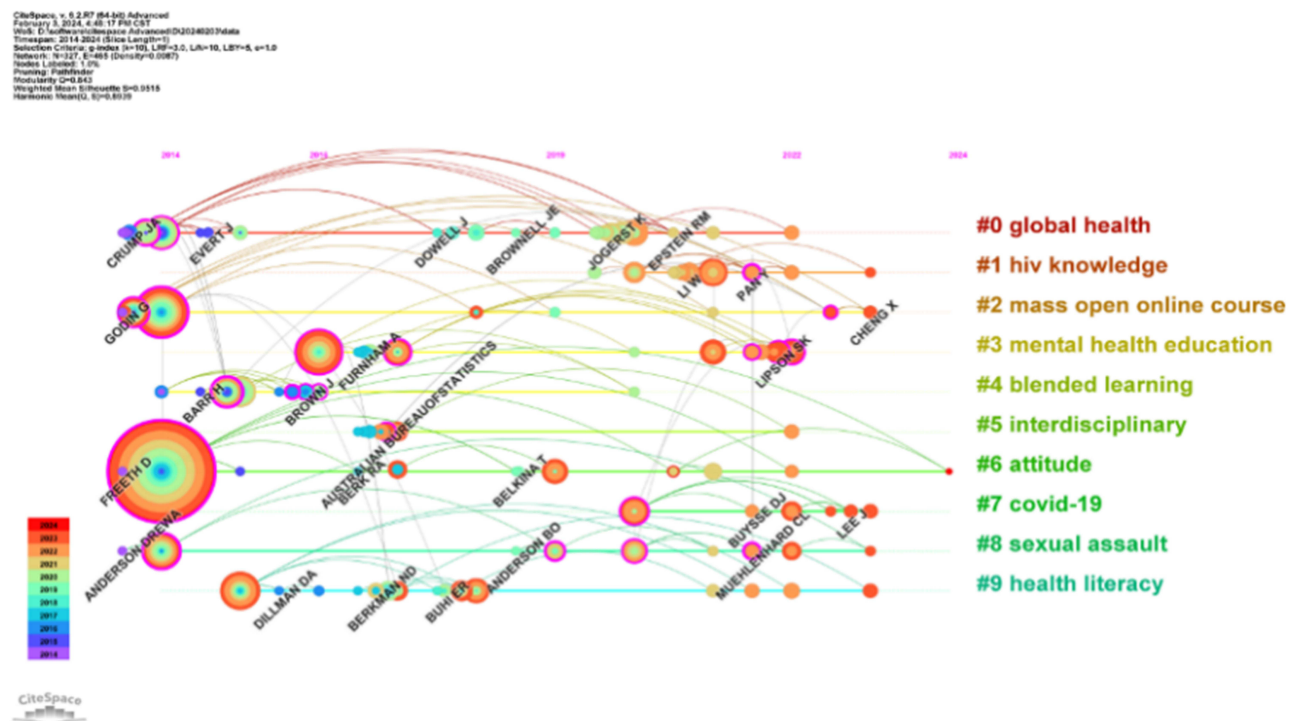
Understanding highly co-cited authors can enhance research efficiency and provide learning opportunities for other researchers. We recommend that co-cited researchers expand their research directions to increase their influence.

The author co-citation network's timeline visualization is shown in Figure 9. The clusters formed mainly in 2014 and have persisted for a long time, until 2024, indicating that these authors have been focusing on them for an extended period. The main topics of these clusters are "attitude" and "COVID-19". #6 Attitude is the longest-lasting cluster (2014–2024), which refers to students' attitudes toward health-related behaviors, values, and beliefs. It includes students' acceptance of healthy behaviors, attention to health issues, perception of health risks, and enthusiasm for health-promoting behaviors. It primarily focuses on students' attitudes toward health education, health professionals' attitudes toward student health education, and the impact of differing attitudes on students' health.<sup>4,87,88</sup> #7 COVID-19 is the

**Table 8** Author Co-Citation Network

Ranking	Authors	Count	Centrality	Year
1	World Health Organization	256	0.35	2014
2	Centers for Disease Control and Prevention	66	0.38	2014
3	V Braun	51	0.1	2016
4	A Bandura	44	0.13	2014
5	J Cohen	39	0.07	2015
6	I Ajzen	37	0.77	2015
7	American College Health Association	33	0.38	2014
8	J Frenk	29	0.02	2015
9	PK Drain	23	0.16	2014
10	Y Zhang	22	0.01	2019





**Figure 9** Cluster visualization of author co-citation network (N=327, E=465).

shortest-lasting cluster (2020–2023) since COVID-19 is a sudden public health event. Health education regarding COVID-19 only happens during special periods, reflecting the timeliness of student health education. #0 Global Health focuses on health challenges and solutions worldwide, not just within a single country or region. It includes coordinating cross-border cooperation, formulating international health policies, addressing global infectious diseases, and promoting public health infrastructure. This cluster has also persisted relatively long (2014–2022), with representative research showing the effects of globalized health education on students. In developing countries, global health education is believed to enhance students' employment potential and reduce health disparities.<sup>2</sup> Global health education for medical students can promote professional development and align with students' employment needs.<sup>30</sup> In developed countries, global health education can promote the continuous development of higher education<sup>70</sup> and meet the growing demand for public health professionals, achieving the goal of public health equity.<sup>71</sup>

Overall, the author co-citation timeline represents the cumulative citations of authors over time. This timeline reflects the authors' influence and research impact persistence. It can be used to assess their contributions and influence in the research field, providing references for future researchers in their studies and determining research directions.

## Co-Occurrence Analysis

Co-occurrence analysis helps scholars capture research hotspots and potential directions, offering valuable guidance for future research. This section justifies the research gap: What are the evolving hotspots and potential trends? Delving into this research gap helps scholars target specific popular topics precisely and continue research or practice more efficiently and effectively.

### Category Co-Occurrence

Table 9 shows the top 10 co-occurring categories in CSHE. These categories mainly relate to medicine, education, environmental science, and psychology. Some details are found. (1) Medicine-Related Categories: Six out of the top 10 categories are related to medicine (Public et al, Nursing, Health Care Sciences & Services, Health Policy & Services, Medicine, General & Internal, and Psychiatry), with 486, 124, 108, 78, 67, and 49 occurrences, respectively. This result indicates that this research topic mainly focuses on the medical field. (2) Centrality: Nursing has the highest centrality (1) within the top 10 co-occurring categories. This category includes various functions, such as providing disease treatment



Table 9 Category Co-Occurrence

Ranking	Category	Count	Centrality	Year
1	Public, Environmental & Occupational Health	486	0.07	2014
2	Education & Educational Research	223	0.19	2014
3	Education, Scientific Disciplines	147	0.75	2014
4	Nursing	124	1	2014
5	Health Care Sciences & Services	108	0.06	2014
6	Health Policy & Services	78	0.03	2014
7	Medicine, General & Internal	67	0.03	2014
8	Environmental Sciences	52	0.1	2016
9	Psychology, Multidisciplinary	52	0.09	2015
10	Psychiatry	49	0.23	2015

and management, offering health advice, and promoting health activities. Nursing significantly influences student health education’s scientific theory and practice. (3) Occurrence Frequency: Public, Environmental, and occupational Health have the highest occurrence frequency, indicating that public health and occupational health regarding student health education are also highly regarded. (4) Environmental and Psychological Categories: The occurrence of Environmental Sciences and psychology is also observed 52 times, indicating the interdisciplinary nature of student health education. Furthermore, it highlights that research frontiers in health education encompass environmental and mental health aspects.

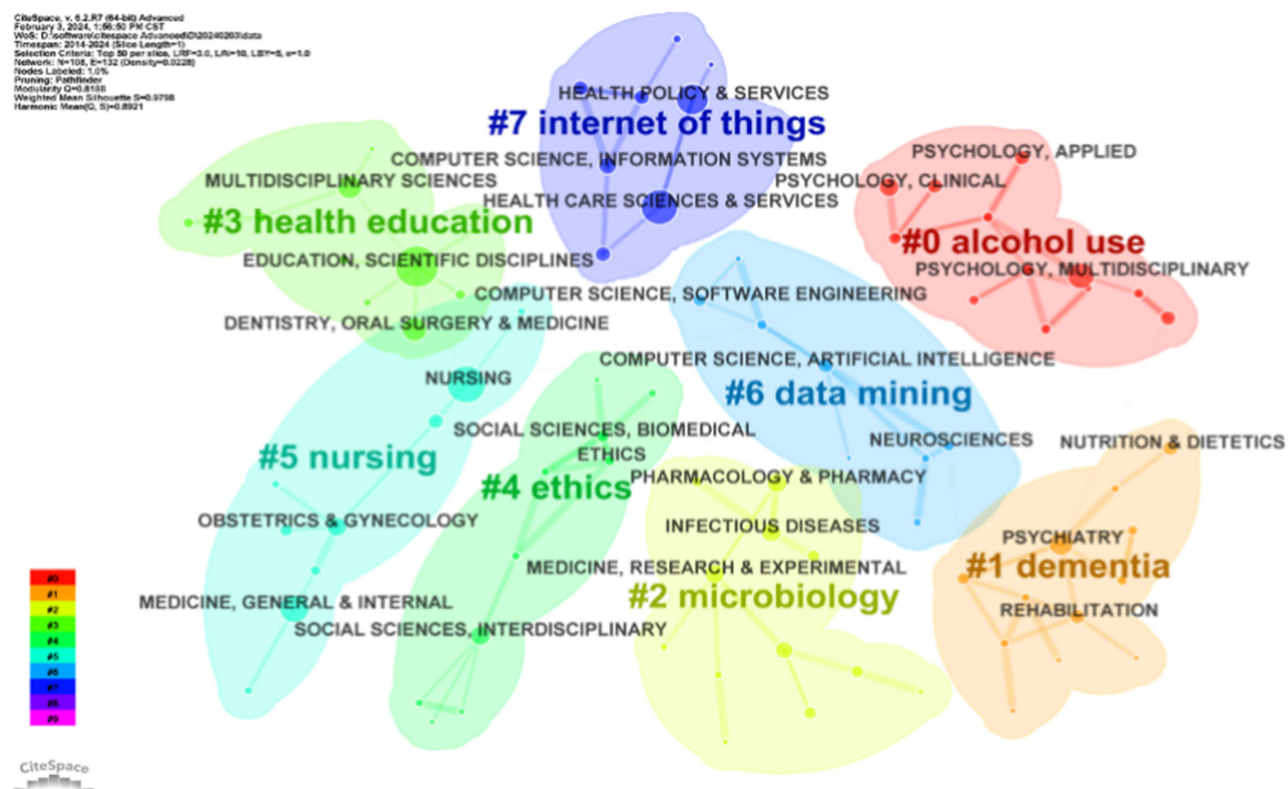
Comparing Table 2 (publication counts by category) and Table 9 (category co-occurrence rates), we can see that the top ten categories are the same, indicating that this research field’s categories have similarities between publication counts and co-occurrence rates.

Figure 10 shows a cluster map of category co-occurrence in CSHE research, helping us explore the disciplinary distribution of this research field. Specifically, there are eight main category clusters: alcohol use, dementia, microbiology, health education, ethics, nursing, data mining, and the Internet of Things. (1) Cluster #0 Alcohol Use: Studies the impact of alcohol use on students’ health. Research has found that health education can reduce alcohol and cannabis use and effectively improve students’ health.<sup>89</sup> (2) Cluster #1 Dementia: Focuses on research on special populations with cognitive and functional impairments. Representative research involves providing health education on dementia care to students, allowing current students (future healthcare workers) to understand and manage this disease in patients.<sup>90</sup> (3) Cluster #2 Microbiology: Combines microbiology with student health education, studying disease prevention and control, drug use and resistance, and food safety. Representative research suggests incorporating information about oral pathogens into health education courses to increase students’ understanding of oral health.<sup>91</sup> Another study confirms that public education programs on microbiology knowledge for students can improve their understanding of specific health issues, such as preventing microbial infections and responsibly using antibiotics.<sup>92</sup> (4) Cluster #3 health Education: Encompasses health education activities to enhance health literacy, including disease health education (including sudden epidemic diseases). Representative research provides health education to students to prevent HIV/AIDS, reducing the incidence and high-risk behaviors.<sup>93</sup> Through health education, students’ ability to obtain health information is enhanced, and they can use this information to improve health literacy and maintain a positive mindset.<sup>67,94</sup>

These findings offer valuable insights, indicating that the subcategories within this research field are not limited to health and education domains. Consequently, researchers should broaden their scope of investigation and diversify their research interests across various categories.

Keyword Co-Occurrence

Table 10 describes the keyword co-occurrence frequency, centrality, and earliest occurrence year in CSHE. Frequently occurring keywords reflect the most focused content and recent trends in the field. Specifically: (1) Frequent Keywords: Among the top 10 co-occurring keywords, “college students”, “health education”, “education”, and “health” are closely related to college health education, occurring 354, 284, 132, and 82 times, respectively. Other high-frequency keywords in the top 10 include “Adolescents”, “attitudes”, “behavior”, “mental health”, “knowledge”, and “prevalence”. These



**Figure 10** Cluster visualization of category co-occurrence (N=108, E=132).

keywords highlight the recent focus on student mental health research. Public health emergencies have drawn extensive attention to students' mental health,<sup>95</sup> and the Internet effectively disseminates health knowledge to students.<sup>96</sup> (2) Centrality: "Behavior" and "prevalence" have the highest centrality (0.23), occurring 104 and 77 times, respectively. This means that CSHE research focuses more closely on students' behavior and common epidemics in the student population. For instance, research suggests analyzing students' behavioral habits through big data to provide targeted health education, change students' unhealthy habits, and improve their health.<sup>97</sup> Health education can intervene in students' use of over-the-counter medications to treat epidemics, reducing the risk of allergies and shock.<sup>98</sup> (3) Earliest Occurrence: These keywords primarily emerged in 2014, indicating that researchers have focused on them early on, and this attention continues. These findings show that scholars have long favored and valued this research field.

**Table 10** Keyword Co-Occurrence

Ranking	Keyword	Count	Centrality	Year
1	College students	354	0.04	2014
2	Health education	284	0.04	2014
3	EDUCATION	132	0.16	2014
4	ADOLESCENTS	123	0.07	2014
5	ATTITUDES	123	0.06	2014
6	BEHAVIOR	104	0.23	2014
7	Mental health	103	0.13	2014
8	Knowledge	98	0.04	2015
9	Health	82	0.11	2014
10	Prevalence	77	0.23	2014

Figure 11 shows the timeline map of keyword co-occurrence clusters. The significance of the timeline map of clustered keyword co-occurrence lies in two points: (1) Keywords with relatively internal solid relationships are grouped to form a cluster, displayed in a timeline dimension, illustrating the research's development process. (2) Keywords represent and summarize the publication's core ideas and research content. High-frequency keywords are suitable for tracking the latest research hotspots of each period.

We can see that the keyword co-occurrence in this research field has 13 clusters. The following descriptions offer a comprehensive overview of these clusters. (1) Longest Clusters: Clusters #2 adolescents and #9 college students have the most prolonged duration (2014 to 2024). These two clusters focus on populations related to college students, particularly sexual education for transgender students, to ensure equal access to sexual education.<sup>99</sup> School-based health education enhances students' awareness of sexually transmitted infections and disease prevention, effectively reducing infection and transmission rates.<sup>100,101</sup> Health education for adolescents' food choices can effectively reduce body mass index (BMI), benefiting adolescent growth and development.<sup>102</sup> (2) Shortest Cluster: Cluster #12 HPV vaccine has the shortest duration, indicating that the HPV vaccine is no longer a research focus in student health education. (3) Diverse Occurrence Times: These keywords appear at different times, from 2014 to 2016, showing logical succession in the topics. Based on existing fields, researchers have also explored new areas of CSHE research, and this focus continues.

Overall, long-term health education research covers various aspects, such as students' lifestyles, dietary habits, and mental health.

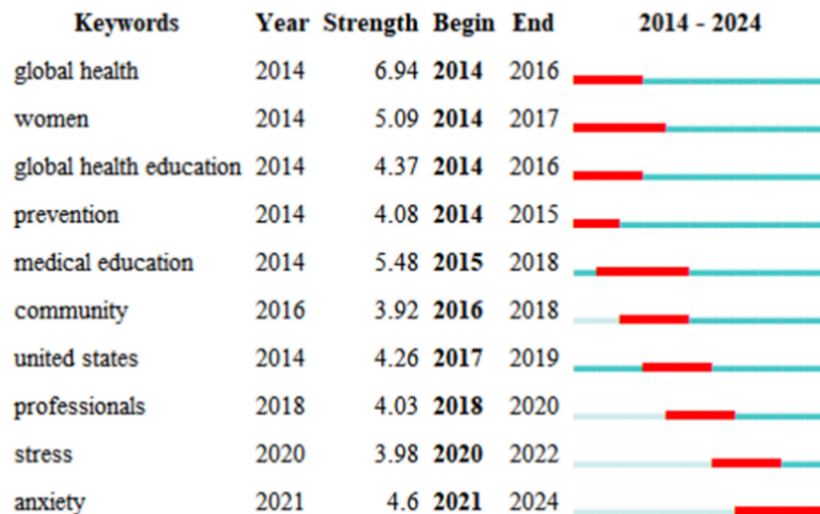
### Keyword Bursts

Keyword bursts indicate research hotspots and emerging trends in a field. Figure 12 shows the top 10 keywords with the highest citation bursts from 2003 to 2023. There are some results. (1) Top Keywords by Burst Strength: The top five keywords by burst strength are “global health” (6.94), “medical education” (5.48), “women” (5.09), “global health education” (4.37), and “United States” (4.26). These keywords focus on global health, gender, global health education, and specific countries in student health education. They represent essential keywords and may mark a turning point in student health education research. (2) Longest Burst Duration: The keywords “women”, “medical education”, and “anxiety” have the most prolonged burst durations (4 years), indicating long-term attention from researchers on women's



Figure 11 Cluster visualization of keyword co-occurrence (N=195, E=274).

## Top 10 Keywords with the Strongest Citation Bursts



**Figure 12** Keywords With Strong Citation Bursts.

health, health education for medical students, and anxiety. (3) Most Recent Burst: “Anxiety”, which emerged in 2021, is the most recent burst keyword, suggesting that after a period of research, scholars have started to focus on specific issues within students’ mental health, like anxiety.

We can see that the strongest, earliest, longest, and most recent burst keywords differ, showing the vast and varied focus within this research field. Additionally, only one burst keyword, “anxiety”, has persisted until now. This result offers insights for scholars: current research in this field needs deeper exploration in specific subfields to contribute to academic achievements in different aspects of CSHE.

## Theoretical Summary

### Knowledge Framework of the Field

It is crucial to systematically analyze and review past research, build a knowledge framework, and enhance the field’s understanding. This paper has researched and analyzed the knowledge foundation, relevance, status, and evolution of CSHE. Thus, it constructs a knowledge framework for this field to provide valuable reference information for future exploration, as shown in [Figure 13](#).

The knowledge framework consists of the statistical basics of the field, clarifying its popularity and significance while depicting popular journals and research categories. These findings encourage scholars to continue in-depth research in this field and provide practical guidance for researchers seeking to publish.

Collaboration information reveals the partnerships between scholars, their institutions, and countries, answering how academic researchers interact and collaborate. The results offer valuable advice for finding suitable collaborators in this field. Co-citation information describes the field’s status from the perspective of co-cited journals, references, and authors. Identifying high-count related words and knowledge categories maps out current research hotspots and time frames, aiding the understanding of research progress. Co-occurrence analysis illustrates the field’s development trends. Clusters of research categories and keyword bursts reveal categories and future research hotspots, offering scholars practical guidance on what areas to focus on.

When exploring the framework in depth, we find that CSHE is widespread and gaining attention yearly. Specifically, journals like the *Journal of American College Health*, *Frontiers in Public Health*, *BMC Medical Education*, and the *International Journal of Environmental Research and Public Health* are receptive to submissions in this field, focusing on public, environmental, and occupational health, college health, and education. Observing knowledge relevance, we may find



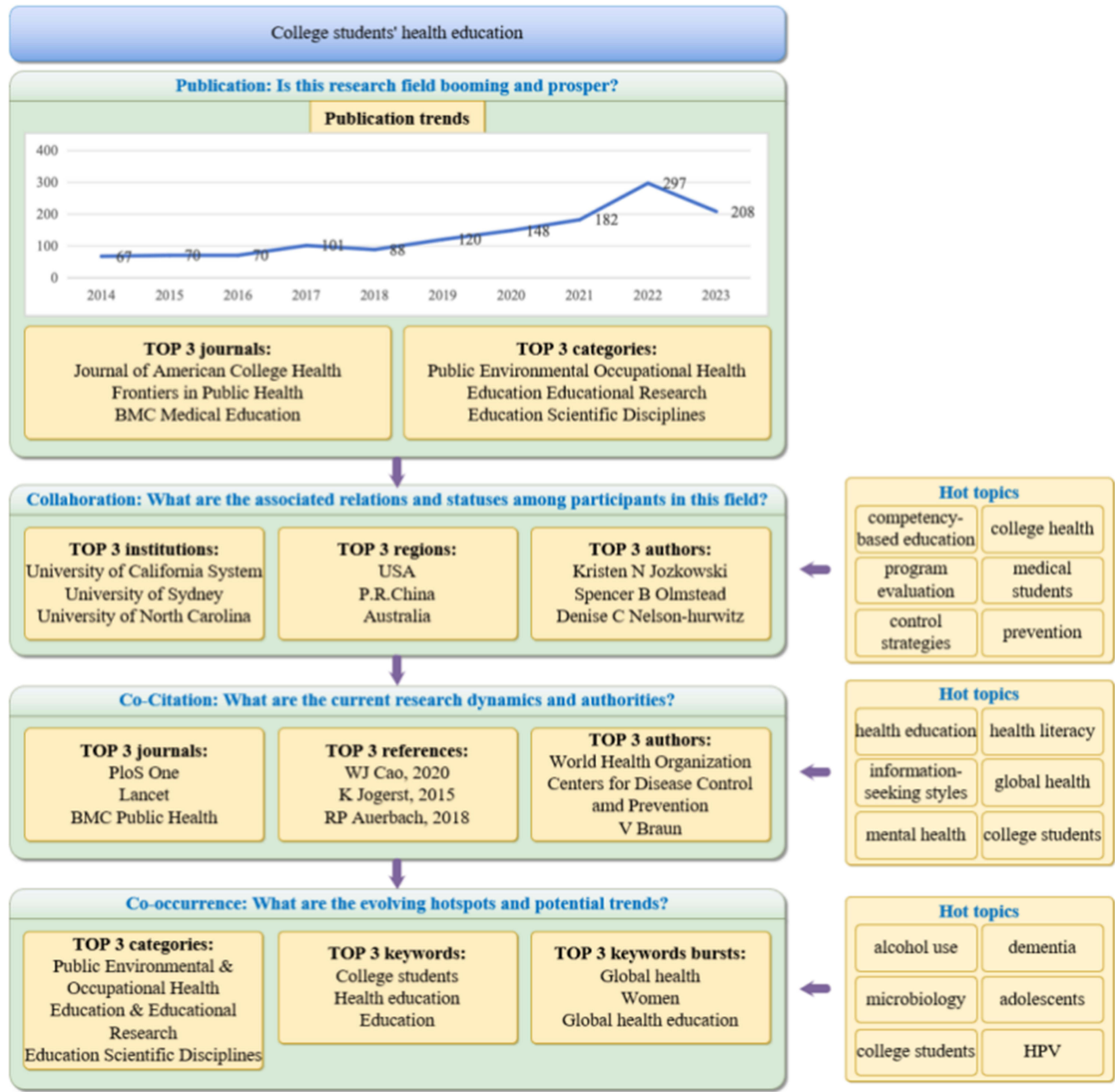


Figure 13 Framework.

dynamic cooperation between institutions, regions, and authors. The active regional collaboration includes the US, China, and Australia; the University of California System, the University of Sydney, and the University of North Carolina are among the most active collaborating institutions. Further observing the current research status, we find slightly different themes. From the perspective of co-cited journals, the themes primarily belong to public health, medicine, public environment, and occupational health. From the co-cited literature's perspective, the themes mainly involve sexual education, physical activity, health education, and mental health education. From the co-cited authors' perspective, they mainly involve mental health and psychiatry research. Delving into the evolution of knowledge provides a clearer understanding of future trends. Mental health education, public health, and occupational health education will likely become more popular and potentially hot topics.



## Future Research and Practice

### Future Research Trends

Research on CSHE has recently increased, revealing new and critical research directions. The focus has also expanded beyond a single direction. Future research will need to focus more on the following changes:

(1) **Multidisciplinary Collaboration:** In the collaboration analysis, numerous categories have been identified, such as nutrition & dietetics, mass open online courses, control strategies, and program evaluation, demonstrating that the research field of CSHE has broad scopes. Therefore, we believe this research field will include various disciplines related (eg, education, psychology, nursing) or less related (eg, management and environmental science) to CSHE. For instance, future collaborative research topics may include the impact of good exercise habits on students' mental health, the effect of job and academic pressure on students, how global health education courses influence students' future career paths, the impact of alcohol, drugs, and medication on students' physical health, and the effects of environmental pollution on students' physical and mental health.<sup>103,104</sup> We recommend scholars expand their research focus or interests, try to collaborate with scholars in other domains, and conduct cross-discipline research; new ideas may sparkle.

(2) **More Comprehensive and Complex Research Topics:** In the co-citation analysis, we find numerous topics covering various aspects of CSHE, such as global health, health policy, COVID-19, and health literacy. This indicates that the research within the CSHE field extensively covers various complicated topics. Therefore, we believe that single issues on students' physical health will no longer dominate this research field; future topics will cover different areas, and other emerging hot topics in this field include school, social, environmental, and psychological factors. Specifically, social, environmental, and public health emergencies will affect CSHE, with schools bearing more responsibility.<sup>105,106</sup> We recommend that scholars seek collaboration opportunities with community practitioners, school administrators, and teachers to expand the research scenarios and find more cases. We also recommend scholars focus on CSHE from more complicated context perspectives (such as wars and conflicts) and explore the specific CSHE mechanisms and performances in the corresponding conditions.

(3) **New Theories and Methods:** The appearance of keywords like “internet of things” and “data mining” in the co-occurrence analysis suggests a significant intersection of technology and data analytics with CSHE research. This indicates a trend towards leveraging these advanced technologies and methods to analyze and apply data innovatively to improve CSHE outcomes and enhance research methodologies in the field. Therefore, we believe multidisciplinary theories and techniques for solving problems in this field will be a new trend. Specifically, empirical research based on multiple case studies and data sources will play a more significant role in future research; structural equation model may be used to analyze correlations among factors; new data processing technologies like data mining will be widely applied; coupling coordination theory may be applied to discover the interactions between education performances and other factors.<sup>43,107,108</sup> We recommend that scholars learn the latest theories and methods to solve new CSHE problems or validate existing CSHE studies; the theories and techniques may have been used and proved helpful in other domains, though they are rarely used in CSHE research.

(4) **Innovative Health Education Methods:** The appearance of keywords like “online mental health treatment” and “blended learning” in the co-citation analysis suggests a significant focus on integrating digital and hybrid learning methods in CSHE. This indicates that current research in the field is actively exploring and validating the effectiveness of innovative educational technologies to enhance CSHE efficacy. Therefore, we believe improving CSHE approaches will also be an emerging trend. Traditional health education can no longer meet current needs. Researchers are considering how to use the internet, live streaming, and social media platforms in ways that are more readily accepted or popular with students. Additionally, universities need to consider integrating health education into existing courses, play a more critical role in student health education, address the harm social changes bring to student health, increase students' health awareness, and help special student groups maintain mental health.<sup>109,110</sup> We recommend that researchers broaden their knowledge structures and explore new approaches for CSHE; cross-disciplinary studies may be needed, covering information science and engineering, pedagogy, class management, and health education. Also, we suggest they consider how to integrate new tools, approaches, theories, and ideas into daily teaching.

## Future Practice Suggestions

CSHE requires multi-departmental and multi-disciplinary collaboration, with different requirements for universities, teachers, health industry practitioners, and policymakers. We offer the following recommendations for various stakeholders.

(1) For universities: They should take comprehensive actions to strengthen CSHE. Specifically, they should establish dedicated mandatory health education courses, covering topics such as mental health management, sexual health education, and disease prevention. Besides, colleges can build online platforms offering online health consultations; on the platforms, schools can regularly publish and update health information and self-diagnosis tools, allowing students to monitor their own health status. In addition, universities can establish a “healthy” campus environment, such as providing healthy food options, adding more sports facilities, and setting up smoking-free areas, which will not only promote physical health but also contribute to a positive learning environment.

(2) For teachers: They should teach CSHE courses more wisely. Specifically, teachers can integrate health education elements or knowledge into other classes, such as biology, chemistry, or physics, to discuss human physiology, nutritional science, and health science. For example, while teaching the digestive system in biology, teachers can introduce the importance of a balanced diet. Besides, teachers can focus on different topics and teach different content with other approaches for other groups. For instance, they can use the online teaching approach to teach theories to first-year students, the discussion approach for sex education for girls, and the site visit approach for drug prevention education for students at risk of drug exposure. In addition, teachers can use artificial intelligence to enhance preparation and teaching efficiency; artificial intelligence makes it easier to let teachers know students’ demands and to construct teaching frameworks and outlines.

(3) For health industry professionals (eg, school doctors, counselors): They should provide different professional services. Specifically, regular health assessments for college students should be conducted, including physical and mental health assessments. Timely intervention is necessary if assessment reports show potential health problems of certain students. These regular health assessments are crucial in identifying and addressing potential health issues, underscoring the significance of their services. Besides, they can provide one-on-one counseling services for common problems among college students (eg, academic pressure, interpersonal relationships, job search stress); regular follow-up and review are necessary. In addition, they can regularly organize lectures on specific topics (eg, stress management, prevention of alcohol abuse, smoking, drugs, dietary health); the latest research results and evolvement should be included to make lectures more convincing. Finally, the professionals should receive CSHE training to enhance their knowledge and literacy. Annual training is suggested, and tests during the training are encouraged to enhance training effectiveness.

(4) For policymakers: They should support practitioners from various perspectives. Specifically, policymakers can provide sufficient funding support for CSHE, such as financing health education projects, purchasing teaching equipment, improving sports facilities, and training dedicated health education teachers. Besides, they can develop long-term national or regional CSHE plans with clear goals and milestones to ensure the sustainability and effectiveness of CSHE programs. The plans should have clear time limits and goals that are both challenging and achievable. Moreover, they can formulate CSHE policies, requiring all higher education institutions to provide students with comprehensive health education and support services, including mental health services. Finally, they can establish health education assessment mechanisms, where they can encourage universities to set up and implement a health monitoring system, monitor through regular surveys and health data analysis, assess the effectiveness of health education programs, and regularly provide feedback on CSHE to relevant institutions to optimize educational content and methods.

## Potential Impacts of the Trends

Based on the future research and practices mentioned above, these trends will have the following long-term impacts on CSHE outcomes.

(1) CSHE will be evaluated more comprehensively from various aspects. This comprehensive approach, involving interdisciplinary teams from fields such as education, psychology, medicine, and sociology, will enable a more thorough analysis of college students’ sources of stress and coping strategies. The result will be more effective health educational

programs and intervention strategies, leading to a significant improvement in the mental health levels of college students and providing a solid scientific basis for future health education policies.

(2) Diversified details of CSHE will be focused on. Future health students' practice will focus on college students' dietary patterns and consider how their living environment, cultural background, and economic conditions jointly affect health. This differentiated emphasis will allow teachers to provide specific health education content based on students' circumstances and policymakers to design more targeted health education strategies, ultimately improving the health outcomes of college students from different backgrounds.

(3) CSHE issues will be found much earlier. With the help of new technologies such as data mining, researchers and practitioner students can analyze large-scale data related to CSHE and identify early signs of health issues, thus providing more timely countermeasures. For example, by examining students' health surveys and campus card consumption data, practitioners can early detect potential dietary health issues or sleep dis students and then provide timely interventions and support; relevant cases can also be used in health education courses or programs. Though analyzing personal data may be an ethical concern in some places, such technologies have helped solve CSHE outcomes.

(4) College students will have better learning experiences in health education courses. With the proliferation students' online education platforms, CSHE can be conducted through webinars, interactive classes, and virtual reality technologies. For instance, by using virtual reality technology to simulate different health scenarios, students can learn first aid skills or methods for coping with psychological crises in a safe environment. This innovative learning approach makes learning more enjoyable and enhances students' initiative and practical skills in acquiring health knowledge.

## Comparison

While existing review studies on related topics exist, our study is the first to comprehensively review CSHE. By comparing and contrasting these studies, we can underscore the unique aspects of our research, which contribute to the novelty of the results.

Some studies focused on "college students' health". For example, a study investigated the mental health of college students during COVID-19, identifying prevalent psychological issues like depression, anxiety, and stress.<sup>111</sup> It highlighted the importance of timely psychological counseling and guidance in maintaining mental health among college students. The results align with our findings, and further, our research suggests that addressing mental health issues among college students requires not only immediate assistance but also preventative measures through health education. Moreover, our study extends beyond COVID-19 to include mental health issues related to academic and employment pressures, thus providing a more comprehensive analysis and views.

Some studies review "prevention" issues. For instance, a literature review focused on the role of higher education institutions in preventing drug misuse among college students. The study explored many aspects, from the prevalence and patterns of drug misuse to prevention strategies, emphasizing that policies, environmental factors, and preventive programs influence students' health and academic performances; therefore, stakeholders should take practical action.<sup>112</sup> This concurs with our suggestions on preventing drug, alcohol, and substance abuse among college students, where prevention efforts are not limited to educational institutions alone; parents and communities also play crucial roles. Furthermore, the effectiveness of these preventive measures is influenced by policies, external factors, and actions taken by schools, parents, and communities. Such similarities highlight that our future differentiated, detailed, and implementable practice suggestions for different stakeholders are necessary.

Some studies review "health education" research. For instance, a study examined the barriers to developing oral health education for disabled children, finding that effective prevention and treatment strategies help address dental health issues in disabled children, and tailored treatment and prevention plans are needed to improve oral health conditions.<sup>113</sup> This finding is similar to CSHE results, which advocate for preventive and customized treatment plans to address health issues effectively. However, previous studies mainly focused on oral health. At the same time, our research extensively explores various health issues, including mental and physical health, necessitating comprehensive health education plans to prevent diseases and tailored health education plans for different diseases and demographics.

Some studies explore health education "tools". For example, a study reviewed eHealth interventions and health literacy. It confirmed the effectiveness of remote health education in reducing recurrence rates and enhancing physical

health and life quality in stroke survivors.<sup>114</sup> The finding is aligned with our suggestion that future scholars focus on new technology and education approaches with their application scenarios in CSHE. However, the previous study needs to discuss more detailed practical approaches in health education; our research further clarifies that the diversified health education methods can influence CSHE effectiveness and proposes specific countermeasures for teachers and health industry professionals, which are novelties based on the results.

In summary: (1) there are limited studies reviewing CSHE, and our review study directly contributed to this field; (2) limited studies on relevant topics use visualized software to depict research evolutions, and the use of CiteSpace in this study made the analysis of the literature more precise, persuasive and intuitive; (3) limited studies on relevant topics comprehensively analyze the research domain, while this study provided a sufficiently long-time span to gather more comprehensive documents and further developed a knowledge framework for CSHE, not only aiding scholars in better understanding the development and knowledge structure of CSHE but also providing a theoretical basis for practitioners.

## Conclusion

This study analyzed the bibliometric evolution of CSHE literature using CiteSpace, providing a new perspective for evaluating the research process in this field. The results answer the research questions and meet the research objectives: (1) Is this research field booming and prospering: over the past decade, the volume of publications has continuously and significantly increased. (2) What are the associated relations and statuses among participants in this field: although individual authors tend to have independent research, the networks of institutional and regional collaborations are relatively complex. (3) What are the current research dynamics and authorities? Disciplines such as education, environmental studies, medicine, and psychology are particularly prominent and valued in this field, dominating recent research and maintaining disciplinary diversity. (4) What are the evolving hotspots and potential trends: alleviating psychological distress caused by societal emergencies through health education; mitigating the impacts of drug dependency and environmental pollution on college student's mental and physical health; innovating health education methods through online platforms. Future research topics may be increasingly diverse.

Emerging Research Trends: Research on student health education has recently increased significantly, revealing new and critical research directions. Future research directions include mitigating psychological distress caused by social emergencies through health education, improving the impact of substance dependence and environmental pollution on college students' physical and mental well-being, and innovating health education methodologies via Internet-based platforms. Future research topics will witness a growing diversity in research driven by societal needs. This will require scholars to keep track of shifts in research directions within their respective fields.

This study has the following innovative aspects: (1) Comprehensive Analysis: By combining health education and student education, this study comprehensively analyzed the research development process of student health education, addressing the need for comprehensive analysis in previous research. (2) Research Framework: The study constructed and accurately described the research framework for this field, helping readers and scholars better understand the knowledge structure and evolution. (3) Future Directions: This study proposed crucial future research directions, enriching the knowledge system further and providing significant reference value for scholars to explore this field more effectively.

However, this study has limitations: (1) Language limitation: The study only selected English publications, neglecting papers in other languages. (2) Latest literature limitation: The latest literature during the writing period was somehow overlooked (paper published after January 2024), meaning that the latest evolvement may, to some degree, have underrepresentation, even though the latest literature was used to support the ideas of the future research and practice directions. (3) Bibliometric method limitation: research that has not been widely cited may be underrepresented, researchers who work independently or engage less in collaborations are underrepresented, and being unable for cross-database analysis may ignore some vital literature in other databases, leading to potential data selection biases.

Future research should consider using alternative software and considering multiple databases for comparison and analysis. This approach can lead to more comprehensive and robust findings. Additionally, including publications in other languages and comparing the differences in results, and focusing on the most recent publications and discussing their evolutionary trends can further enhance the depth of the study.

## Data Sharing Statement

The data will be available from the corresponding author.

## Ethics Statement

This research did not involve humans or animals.

## Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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## Disclosure

The authors declare no conflict of interest.

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