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Review article

Psychological well-being of young adults during COVID-19 pandemic: Lesson learned and future research agenda

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ABSTRACT

Psychological and mental well-being has become a topic of concern worldwide after the hit of the COVID-19 pandemic. It has triggered enormous global health care vulnerabilities and resulted in full and partial lockdowns to prevent the new case. This research study provides a comprehensive overview of the published international scientific studies on the effect of COVID-19 on the psychological well-being of young adults. This study aims to review the top-cited authors, documents, journals, productive countries, the most used keywords, and trending themes in this area. Articles related to psychological well-being during the COVID-19 pandemic from January 2020 to December 2022 were extracted from the Scopus database with specified keywords. In total, 482 documents were retrieved as original articles and bibliometric analysis, thematic analysis and content analysis are performed and analyzed. The results show that the United States has contributed the largest publications followed by the United Kingdom and Italy. Through the cluster analysis, it is found that many articles have been published and considered the psychological and mental impact of COVID-19. Young adults from both developed and developing countries are majorly affected by the COVID-19 pandemic. The pandemic prioritizes the importance of global psychological well-being and health care. This study focused on different aspects, such as stress, resilience, and the mental health of young adults. The research findings of this study put forth the urgent need to provide preventive policies and intervention procedures to address the psychological health of young adults and proposed a conceptual framework.

1. Introduction

The first outbreak of COVID-19 was reported in this Wuhan city of, China in 2019. It is the first highly human infectious disease and has spread worldwide [1]. According to the shreds of evidence, the condition is transmitted through close contact with humans and

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droplets. “On March 11, 2020, the World Health Organization (WHO) declared the novel coronavirus a global pandemic”. COVID-19 has a destructive impact on societal, economic, environmental, psychological and public health vulnerabilities [2]. Since 2020, numerous research has been conducted to investigate the consequences of the coronavirus global public health crises vulnerability on mental and psychological health or well-being [3–5].

According to previous research, COVID-19 has a profound and severe impact on the psychological well-being of the deadly coronavirus on the medical staff, general public, survivors, and infected family members in a family [6,7]. The psychological consequences of coronavirus have led to stress, anxiety, fear, poor sleep and depression among teenagers and adolescents [8]. The mental and psychological effects of COVID-19 on young adults and teenagers are considered far more massive compared to adults, as they are more vulnerable to the unfavourable effects of anxiety and stress [9]. The major outbreak of COVID-19 at the global level has also been reported in the closure of schools, institutes and universities and learners are required to stay at home [10]. There is a sudden shift in the education pattern from “face-to-face learning” to entirely “technology-enabled knowledge” where both the learners and teachers face various challenges [11]. The lockdown imposed by government officials results in reduced personal interactions, meeting with peers, stay-at-home restrictions, daily monotonous routine, reduced physical activity, fear of being sick and boredom among young adults [12].

Meanwhile, the efforts of researchers and scientists are acknowledged, and the extent of psychological and mental health remains pertinent by computing recent trends and future research avenues. If the required and necessary interventions are not implemented correctly, the psychological and mental vulnerability may continue at post-COVID-19 times [8]. The cumulative studies on the examination of mental well-being and COVID-19 research provide extensive evidence of mental well-being and various ways of minimizing psychological vulnerabilities at the global level [13,14]. Hence, the studies on COVID-19 and its effect on mental well-being are essential to identify the most affected group of individuals or the section of society and thus require immediate global intervention.

Although, since 2020, a plethora of COVID-19 pandemic-related studies are exponentially increasing, almost as rapidly as the spread of the coronavirus [15]. The articles are mainly published in various fields like environment, business management, and medical science. There is still a vast scope of research that is still needed in the area of psychology and psychiatry. In the scientific database, several bibliometric studies relating to mental health and the COVID-19 pandemic have already been published [16,17]. The present study is the first bibliometric analysis of “the effect of the COVID-19 pandemic on the psychological well-being of young adults”. The young adults categorized as youth also according to the United Nation definition are from age 15–24 years. The exploration of the past literature studies was deemed required to contribute to the knowledge and to address the research gaps that can be answered in future research. The study aims to identify the scientific research growth, most contributing journals, countries, institutions, influential authors, and citation trends in this area. This study will provide an enriching understanding that answers four Research Questions (RQs) mainly through bibliometric analysis.

RQ1. What are the influential publications and journals in this research area?

RQ2. Who are the most contributing authors, organizations, and countries in this domain?

RQ3. What is the co-authorship network of authors and countries?

RQ4. What are the emerging research themes in this research area?

Based on these research questions, we have conducted a bibliometric analysis of the existing literature to associate past research exploring the psychological well-being of young adults due to COVID-19. The identified insights from this literature can be meaningful in various ways. Firstly, emerging and seasoned researchers who know about the impact of COVID-19 on the psychological well-being of young adults can gain a comprehensive overview and up-to-date apprehension about the most read, cited and influential article in this domain (RQ1). Secondly, researchers can identify the influential authors, institutes and countries (RQ2), co-authorship network of authors and countries (RQ3) as well as trending topics in the area (RQ4).

Further, the paper has been categorized in the following manner: Section 2 delineates the literature review; Section 3 elaborates on the research methodology, including research design, search strategy, and method for data analysis; Section 4 elaborates on the analysis and results; Section 5 explains the cluster analysis of the articles; Section 6 proposes a conceptual framework and Section 7 provides a discussion, implications of the study and propose future research directions; Section 8 offers the conclusion of the study.

2. Literature review

The major research work also reveals the importance of comprehensive behavioural studies for developing public policies and services to support young people during unrest situations like COVID-19. The section discusses the prominent studies conducted in the mentioned area of research. Alat et al. (2021) examined the effects of two positive psychological-a) effects of “psychological capital” b) “internal locus of control on the mental health” of Indian citizens during the initial period of the lockdown on a sample population of 667 participants [18]. Tiwari et al. (2021) investigated the effect of constraints on reported psychological distress and health outcomes in children by their mothers who served as full-time carers. The data was gathered by telephonic semi-structured interview using “Narrative Thematic Method” [19]. Cowden et al. (2021) conducted a longitudinal study on US adults and their mental and psychological well-being during COVID-19. The research discussed the key advantages of integrating mental health assessment and addressing those issues [20]. Choi et al. (2021) conducted an online survey to examine the daily well-being of Koreans during COVID-19. The key emphasis is to evaluate psychological satisfaction levels. The research shows the dynamic change in the well-being of Koreans due to mental stress and emotional changes during the pandemic times [21]. Meherali et al. (2021) conducted a systematic literature review on the psychological behaviour of the youth during uncertain times. The study incorporates 5828 documents under

various categories. The review shows the influence of COVID-19 on the psychology of young children and adolescents and discussed various forms of mental stress. The study also stressed the requirement to have geographically oriented studies as the result of surveys may vary due to the changed demographics of the respondents [22].

Lu et al. (2021) examined the prevalence of "post-traumatic stress disorder" (PTSD) symptoms, insomnia, and distress among healthcare workers in Taiwan during COVID-19 [23]. Serafini et al. (2020) conducted a review analysis of COVID-19 infection on mental health issues including anxiety, nervousness, misery, foiling and uncertainty. It is observed that the impact of quarantine related to COVID-19 is adversely affecting and developing psychiatric disorders among youth [24]. Evans et al. (2021) conducted a study in Spain and found that young adults in their country have suffered a huge level of mental breakdown and anxiety than older age groups [25]. Similar conclusions were drawn by various studies conducted in China [8,26]. Brahmi et al. (2022) developed a conceptual framework for integrating Education 4.0 technologies with students' well-being as a new course of learning. The results outlined the various variables that contribute to the positive aspect of Education 4.0 in the academic culture [27].

Amran (2020) explained young respondents' mental experience amidst of Covid-19 pandemic typically is a combination of (1) self-conflict, which results in the development of negative thought processes, disturbed daily activities and disturb biological cycles and massive 0 wastage of time on the internet. (2) Conflict with family members [28]. Ramasubramanian et al. (2020) studied the factors related to stress that has influenced a particular population in the state of Tamil Nadu using the "Peritraumatic Distress Index" (CPDI) [29]. Chakraborty et al. (2020) have explored the symptoms of depression during the COVID-19 lockdown and the related factors connected with it among dental students and practitioners in India [30]. In the literature, many studies have adopted different methods and measures to identify the level of fear, anxiety and stress among young adults, refer to Table 1.

Further, the previous studies failed to track any studies investigating the underlying configuration latent in this research area. Such a research gap motivated us to combine qualitative and quantitative methods to merge the available literature and provide a roadmap for future avenues. The present study is the first "systematic-literature review-cum-bibliometric analysis" of COVID-19 and the psychological well-being of young adults to canvas the field thoroughgoing. This study encapsulates the literature development in this

Table 1
An overview of previous studies.

Document	Country	Targeted Population	Sample	Methodology	Measure of psychological and mental health	Objectives	Findings
(Wang et al., 2020) [3]	China	General Public	1210	Survey	"Impact of Event Scale-Revised (IES-R) and Depression, Anxiety and Stress Scale (DASS-21)"	Evidence-driven methods to reduce psychiatric symptoms	Identification of factors to improve mental health
(Liu et al., 2020) [42]	China	Adults	285	Survey	Pittsburgh Sleep Quality Index (PSQI)	To investigate the prevalence and predictors of "posttraumatic stress symptoms" (PTSS)	Proposed effective and professional mental health services to improve the quality of sleep
(Ettman et al., 2020) [44]	United States	US adults	1441	Survey	Patient Health Questionnaire-9 cutoff of 10 or higher	Compare depression pre and during COVID-19	Three-fold higher times depression during the pandemic
(Son et al., 2020) [41]	United States	Higher Education students	195	Survey	Interview-Survey	Effect of the pandemic on mental well-being	Proposed preventive strategies to improve mental health
(González-Sanguino et al., 2020) [40]	Spain	Spain Young public	3480	Cross-Sectional study	"Post-traumatic stress disorder (PTSD)"	To study the psychological impact of pandemic	Predictive models show the reason for symptomatology was spiritual well-being,
(Ahmed et al., 2020) [26]	China	Young people	1074	Online survey	Self-reported measures	To collect epidemiological data	Proposed multi-faceted approach
(Liu et al., 2020) [68]	United States	Young adults	898	Cross-sectional online study	Self-reported measures	To identify factors of PTSD symptomatology	Proposed guidance for clinical management
(Pieh et al., 2020) [69]	Austria	Young adults	1005	Online survey	"(WHO-QOL BREF), (WHO-5), (PHQ-9), (GAD-7), (PSS-10), (ISI)"	To identify the effect of gender, income, age, work, and physical activity.	A lockdown has a severe impact on young adults, women, low-income and unemployed people
(O'Connor et al., 2021) [70]	United Kingdom	Adults	3077	A quota survey design and sampling	Self-report	To investigate mental well-being during the initial 6 weeks of lockdown	The initial phase was more dangerous than the later phases
(Groarke et al., 2020) [71]	United Kingdom	Adults	1964	Cross-sectional online survey design	Logistic regression analysis	To identify the prevalence and predictors of loneliness	Proposed supportive interventions and prioritise mental health for young people

research field and eventually aids policymakers and researchers.

3. Research methodology

3.1. Database, keywords and inclusion criteria

To arrive at the information pertinent to this review study, the data were extracted in December 2022 from Scopus, the world's core collection platform of scientific studies and citations. The database consists of a collection of top-tier and reputed journals and is most relevant for bibliometric [31,32]. Since the first epidemic case was confirmed in 2019, thus, the literature on psychological and mental well-being was constricted from January 2020 to December 26, 2022 (when the search process was completed). The two search keywords are joined by "AND", a "Boolean operator", to ensure the appropriate and precise metadata has been considered in the final analysis. A string of relevant keywords ("Psychological factors" OR "Psychological Impact" OR "Psychological well-being" OR "Psychological health" OR "Mental stress" OR "Mental well-being" AND "Young Adults" AND "COVID-19″) were applied to search in articles in "(title, abstract, or keywords)", yielding 580 initial results. To finalize the articles, we have considered the following inclusion criteria.

1. Articles published in the English language;
2. Articles published the duration 2020 to December 2022;
3. Articles should be from peer-reviewed journals;
4. Articles focused on the area of psychological well-being and young adults;
5. Articles must be in the short or full version (not an editorial or abstract).

The complete procedure for article selection is shown in Fig. 1.

3.2. Analysis method

Bibliometric analysis is one of the most extensive methods to trace the abundance of knowledge in the research field [33]. Systematic literature reviews help synthesize the content in the literature to identify the research gaps and provide direction for future research directions [34]. The present study uses various analysis tools such as citation network analysis, keyword analysis, page rank analysis, conceptual structure analysis, thematic map of the keywords and content analysis.

Content analysis is generally based on the grounded theory that helps to establish the theoretical linkage of young adults' well-being during the pandemic, providing a conceptual model of this concept [35]. Generally, the content analysis of the influential themes is performed by the bibliometric method. It is also used to calculate the citation and co-citation analysis [36]. Moreover,

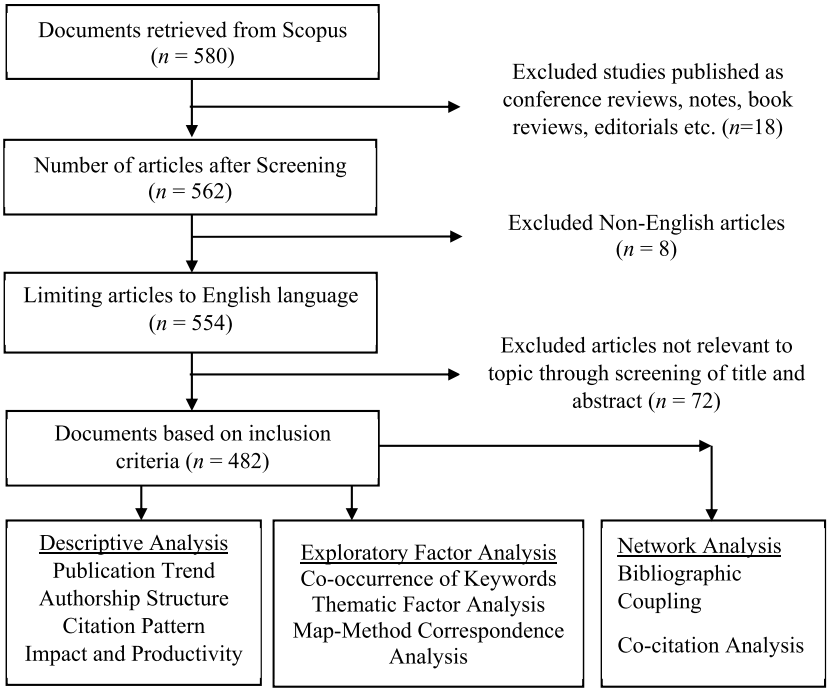

Fig. 1. Procedure for article selection.

thematic analysis was conducted to identify different intellectual perspectives of underlying young adults' experiences to uncover salient research themes [35]. Unlike previous work that applied bibliometric analysis via quantitative methods [37]. For the analysis, VOSviewer.Var1.6.6 software was used to visualize and analyze citation linkages, bibliometric maps and link strengths between scientific articles. Bibliometrics and Biblioshiny packages were installed in the R studio software for the scientific mapping of the articles and for calculating page rank analysis [38]. NVivo software was used for cluster analysis because of its editable features, and the software is mainly for qualitative analysis. Fig. 2 shows the flowchart of the research methodology.

3.3. Quality assessment

The quality assessment tool investigates the quality of the scientific article by addressing unethical research studies. In this article, we have used the "Database of Abstract of Reviews of Effects (DARE)" tool as proposed by Ref. [39]. It consists of five criteria that are shown in Table 2. To validate the authenticity, two independent reviewers performed the quality assessment process, and any doubt was fixed via discussion.

4. Analysis and results

4.1. Main information

The basic information of the COVID-19 Pandemic on the psychological well-being of young adults documents. The summary of bibliographic data is shown in Table A1 (refer to Appendix-A), in which the information about the bibliographic data, author's report, and document content are discussed.

4.2. Most influential articles

The most contributing articles for the psychological well-being of young adults due to COVID-19 in terms of their respective citations are presented in Table A2 (refer to Appendix-A). The top cited articles are mainly in the field of medicine, psychology and environment González-Sanguino et al., 2020 [40]; Son et al., 2020 [41]; Ahmed et al., 2020 [26]; Liu et al., 2020 [42]; Pieh et al., 2020 [43]. Wang et al. (2020) [3] article is the most cited publication in the field, with an average of 1370.6 citations per year and a total citation of 4112 since its publication in 2020. The study is followed by (Liu et al., 2020) [42] and (Ettman et al., 2020) [44] articles in Psychiatry Research and JAMA Network open Journal, which have been cited 744 and 650 times now. Noteworthy, the top 10 most-cited documents in this field have a cumulative total of 8362 citations, indicating this research field's significance in the scientific community.

4.3. Top influential journals

A corpus of 482 articles was published in 225 journals. Table A3 (refer to Appendix-A) shows the top 10 journals in this research area and their citation structure. The top three prolific journals are the "International Journal of Environmental Research and Public Health", "PLOS ONE" and "Frontiers in Psychiatry", with 79, 40 and 16 articles, respectively. Moreover, in the context of influence, the "International Journal of Environmental Research", "Psychiatry Research", "PLOS ONE" and "Journal of Medical Internet Research" lead the pack with 54,150, 1528, 1195 and 901 citations, respectively. Noteworthily, the cite scores of Psychiatry Research, "Journal of

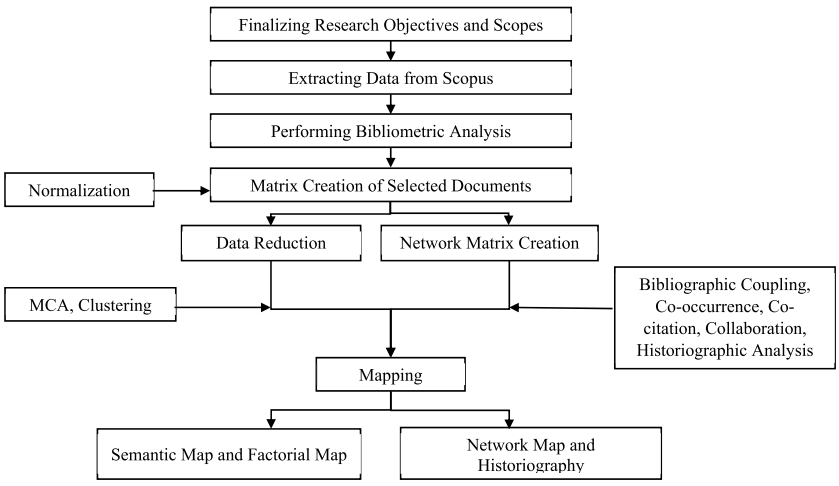

Fig. 2. Flowchart of research methodology.

Table 2
Analysis of quality assessment.

Criteria	Score	Interpretation
Inclusion & exclusion	Yes	The criteria used are defined in the article
	Partial	Inclusion/exclusion criteria are explained
	No	Criteria cannot be readily inferred
Search Coverage	Yes	Authors have searched in the largest dataset and included additional search strategies
	Partial	Searched a defined set of publications
	No	Searched on one digital library
Assessment of quality	Yes	"Authors have defined quality criteria extracted at each stage"
	Partial	Research questions involve quality parameters are addressed by the study
	No	"No explicit quality assessment of individual article has been attempted"
Study description	Yes	Information about the article is given
	Partial	Only summary information is provided
	No	The results of each article are not specified
Synthesis of study	Yes	The authors have performed a content analysis
	Partial	Synthesis of some data from different studies
	No	No explicit synthesis

Medical Internet Research" and "Journal of Adolescent Health" are highest with a score of 10.1, followed by 8.4 and 6.6.

4.4. Most influential authors

The most influential authors on the psychological impact of COVID-19 on young adults' research are shown in Table A4 (refer to Appendix-A). Table A4 indicates that Arslan, G. Mehmet from Akif Ersoy Üniversity, Burdur, Turkey and Smith, L. Anglia from Ruskin University, Cambridge, United Kingdom, are the two most prolific authors with five articles each. Authors Smith, L. Anglia and Tully, M.A. have worked together in all five articles and Pieh, C. and Probst, T. have worked together in all four articles. TC/TP shows the average citations of articles in which Budimir, S., Pieh, C. and Probst, T. have the highest average citations of 102.2 each. Majorly the authors are from the United Kingdom and Austria.

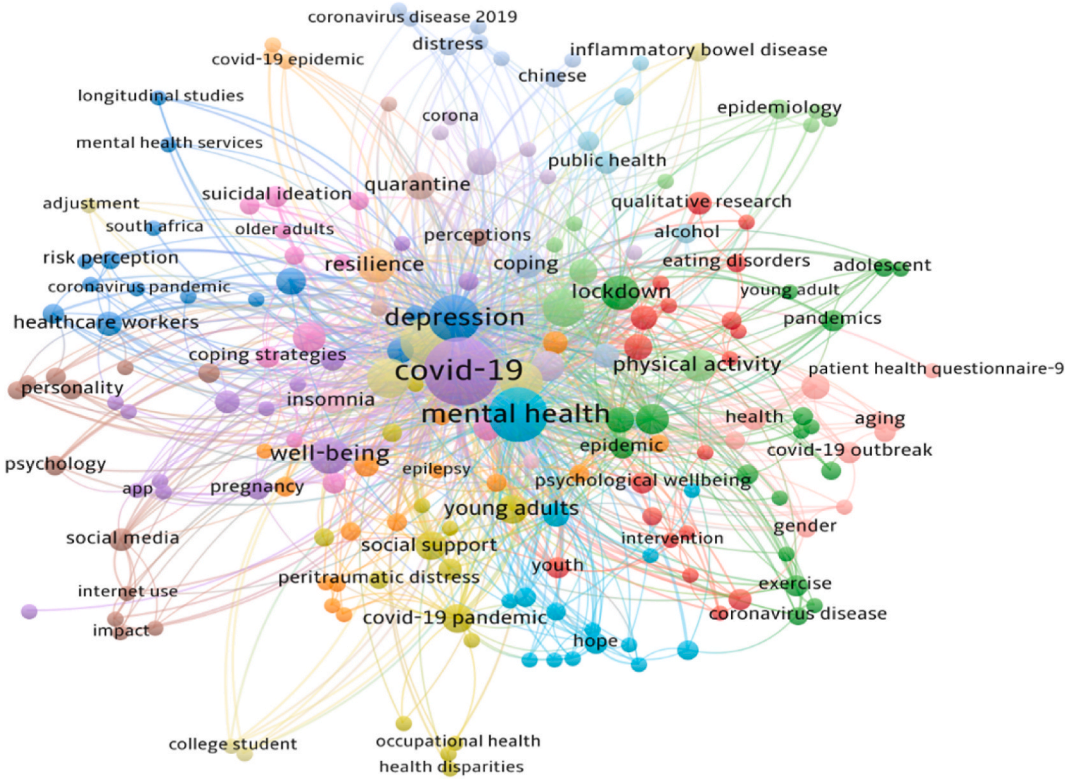

Fig. 3. Co-occurrence of keywords.

4.5. Top contributing institutes

The top ten contributing institutes in this research area are shown in Table A5 (refer to Appendix-A). The Table indicates that the most contributing institution in this field is the University of Melbourne, Australia, with 11 articles, followed by Monash University, Australia with nine articles, Medizinische Universität Wien, Austria, King's College London, United Kingdom (UK), University of Toronto, Canada and the National University of Singapore, Singapore and other with eight articles each. However, the most prolific institute is the National University of Singapore with 4262 citations, followed by Harvard Medical School, United States, with 504 citations respectively.

4.6. Top influential countries

The top ten contributing countries working in this domain are shown in Table A6 (refer to Appendix-A). The Table indicates that the US, UK and Italy are the most prolific countries with 109, 84 and 55 publications, respectively. However, China and the United States emerged as the two most influential countries with 6231 and 4520 citations, respectively, followed by the United Kingdom with 2369 citations. However, the authors from countries like China and Spain yield the highest average citations of 132.5 and 48.1 for 47 and 36 articles. It can be seen from Table A6 that most developed countries published the articles, and only China and Poland are the developing countries working in this domain.

4.7. Keywords analysis

Analyzing the co-occurrence of keywords helps to unpack the significant themes linked with COVID-19 and its impact on the well-being of young adults. The network analysis of the author's keywords co-occurrence accommodates a vast range of topics per the thematic similarity [45]. In co-occurrence analysis models each keyword consists of a node and the co-presence of the other two keywords in an article is an edge connecting the respective nodes. It thus sheds light on the major themes in this research area. The majorly used keywords by the authors in their study emerged from the keyword co-occurrence analysis method. The network analysis of the whole corpus through the VOS viewer software is illustrated in Fig. 3.

The frequently used keywords are COVID-19, depression, mental health, resilience, well-being and lockdown. The visual presentation shows the interconnection of keywords. The word COVID-19 with frequency (290), depression (82), mental health (131), well-being (34), resilience (27), psychological well-being (18) and young adults (16).

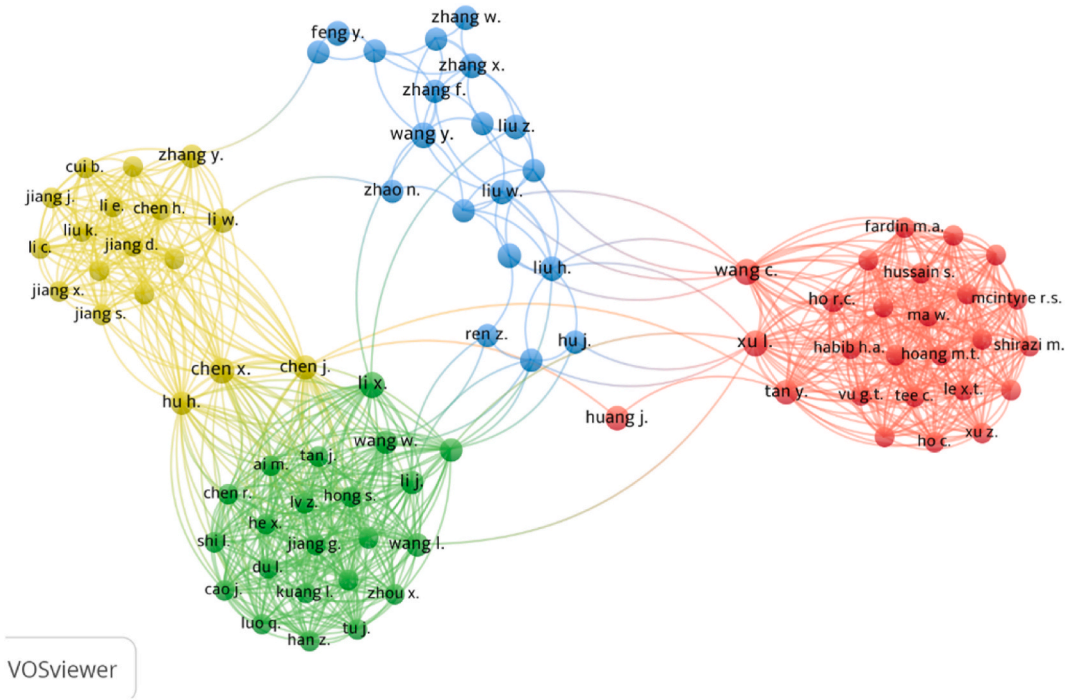

Fig. 4. Analysis of co-authors.

4.8. Co-author analysis of authors

Co-author deals with the scientific collaboration among authors working together in the same field and it helps to understand the structure of scientific communication [46]. The social network analysis of researchers with 25 maximum number of authors per author, with a minimum number of articles of an author, was considered and had (n = 2674) authors, among which 500 authors were selected for the analysis. There are 85 network maps with 4 clusters (L = 818 and TLS = 831). Fig. 4 demonstrates the clusters in red, blue, yellow and green colour.

A cluster with similar colours shows the authors working together in this research area. Cluster 1 is depicted in red colour and has 26 authors. Cluster 2 is depicted in green colour and has 22 authors working on it. Cluster 3 is deposited with blue colour and has 19 authors, whereas cluster 4 can be seen in yellow colour and have 18 authors under it.

4.9. Co-author analysis of countries

Fig. 5 represents the collaborative network among the countries in this research area.

In the analysis, countries that have published at least two documents in the dataset (n = 68) were included. Overall, the collaboration among nations is presented in eight different clusters with different colours, and the interlinked lines with countries represent the strength of research collaboration among them. The gap between the circles of countries indicates how closely the countries are related. In Fig. 5, the UK was reported with the links (L = 53 and TLS = 175), followed by the US with links (L-56 and TLS = 109) and Germany with links (L = 49 and TLS = 107). We have found that Belgium, Japan and Austria are in one cluster, whereas Bangladesh, Malaysia and Singapore are in one cluster and UK, US, Denmark and New Zealand are in one cluster.

4.10. Page rank analysis

The total number of citations in a document computes its popularity but the impact of a research document is measured by the page rank analysis. It represents the number of times a document is cited by highly cited documents. Brin and Page (1998) have introduced the concept of page rank analysis that showcases both the prestige and eminence of a document [47]. The page rank analysis can be computed by the following formula:

$$\mathrm{PR}\ (\mathrm{A}) = \frac{(1-d)}{N} + \mathrm{d}\left(\frac{PR(T_1)}{C(T_1)} + \ldots + \frac{PR(T_n)}{C(T_n)}\right)$$

Here, A indicates an article which has been referred to by other articles, $T_1 \ldots \ldots T_n$, and has references C (T_1). PR (A) represents the page rank of article A in a network of N number of articles. 'd' represents the damping factor between 0 and 1. The total sum of the page rank of all the documents should be equal to 1 which represents the probability distribution. The top ten paper based on Page Rank is shown in Table A7 (refer to Appendix-A) along with the citation count of articles.

4.11. Conceptual structure

In Fig. 6, a total of 50 keywords were divided into two clusters with different colours (red and blue), both the group with additional

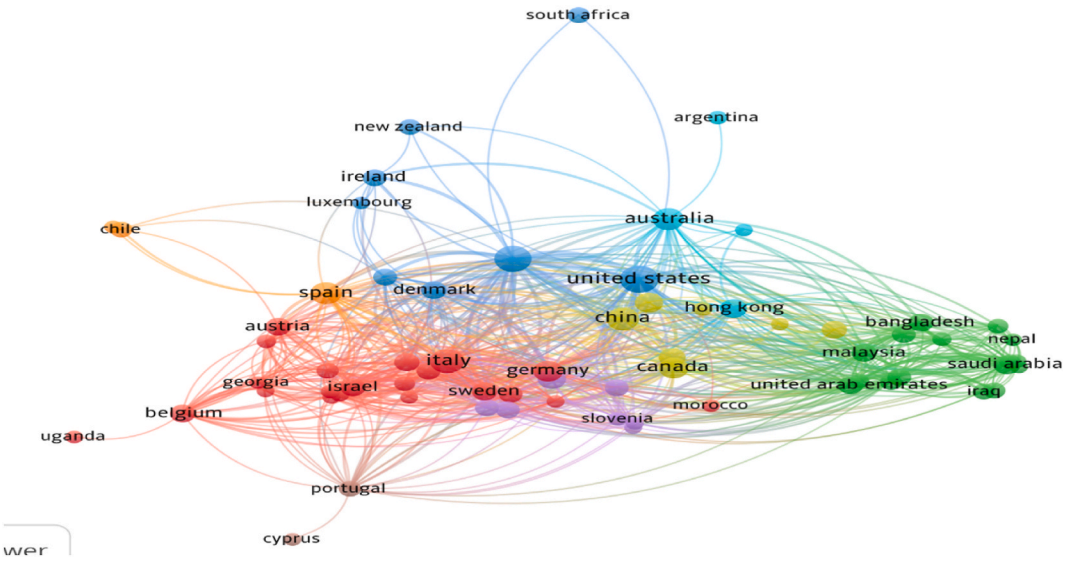

Fig. 5. Analysis of co-countries.

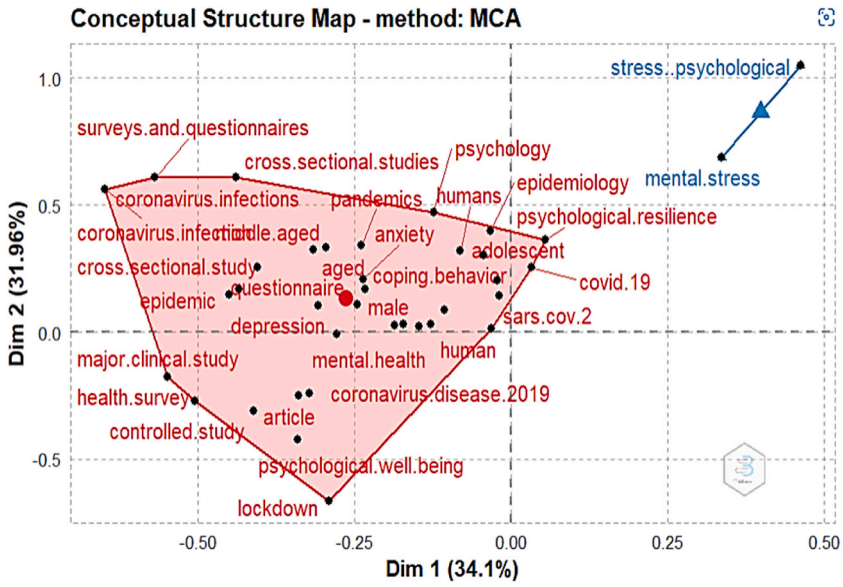

Fig. 6. Conceptual Structure: "Map-method Correspondence Analysis (MCA) on effects of COVID-19 pandemic on the psychological well-being of young adults".

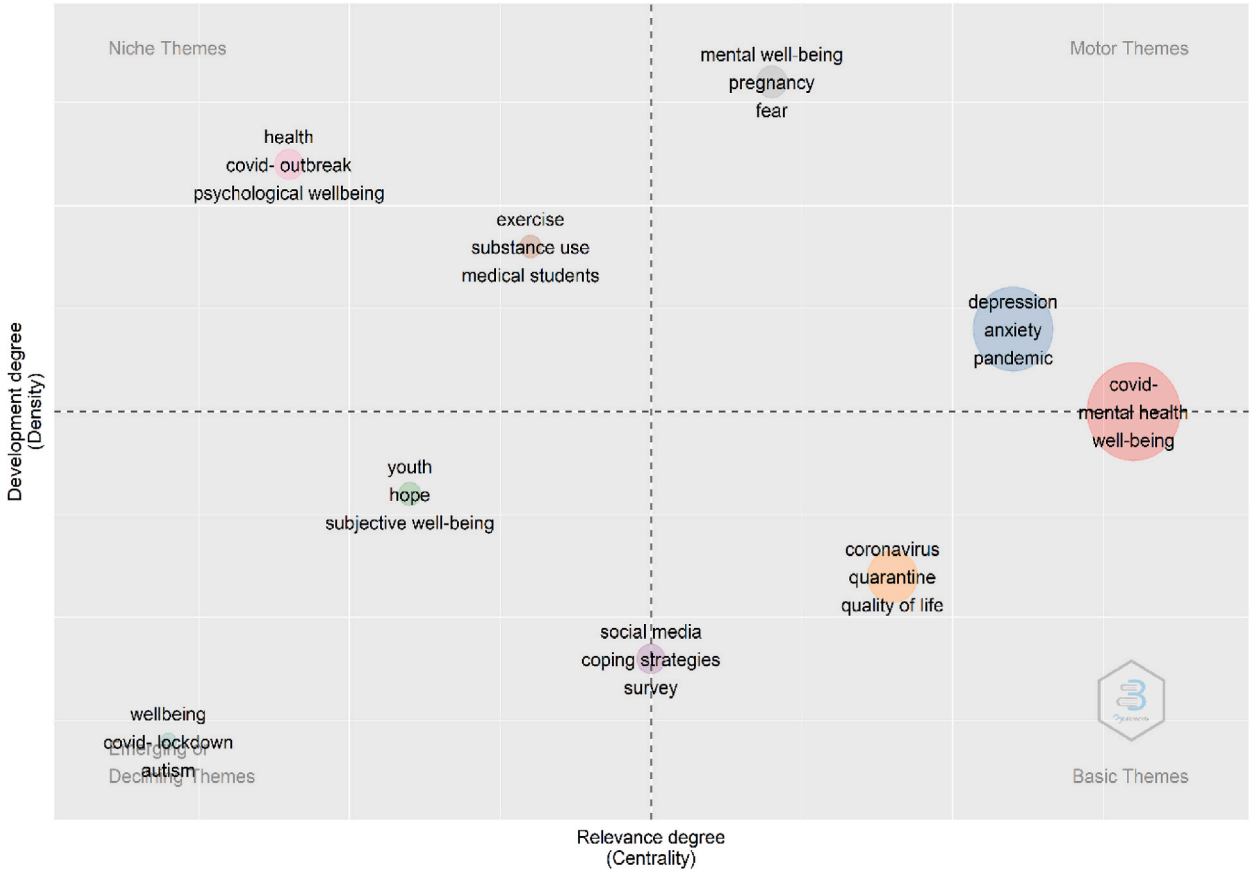

Fig. 7. Thematic analysis of keywords.

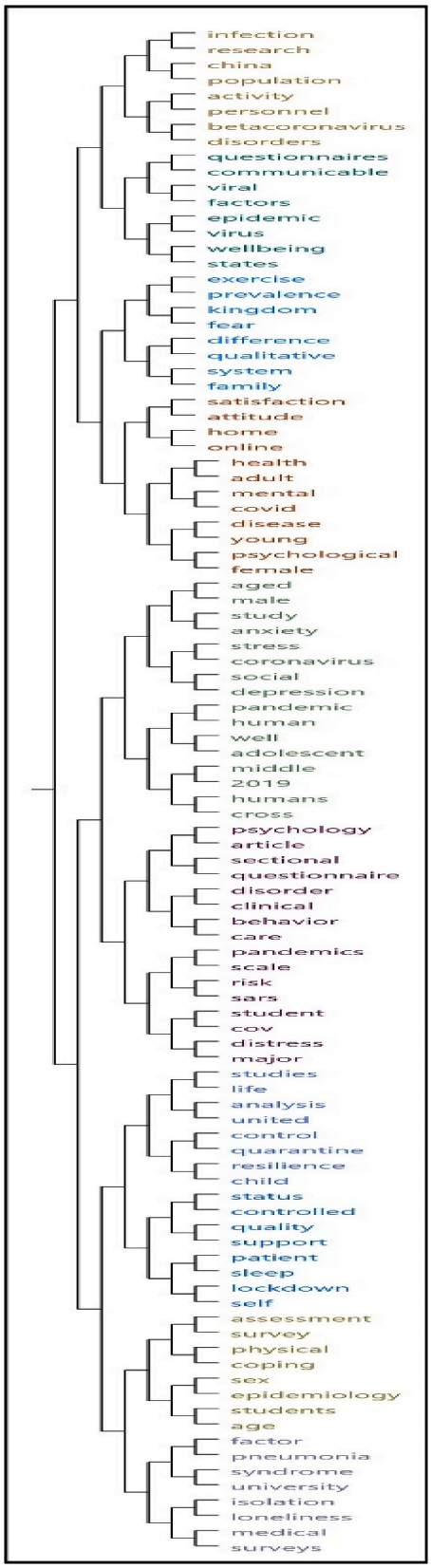

Fig. 8. Tree diagram of Hierarchal clustering.

keywords that explains the theme/s of research on the effect of COVID-19 on the psychological well-being of young adults. In the red colour box, the main themes that appeared are anxiety, mental health, depression, psychological well-being, adolescence, behaviour and so on that are influenced by the blue colour theme which is mental stress and psychological stress. The thematic map of the author's keywords is shown in Fig. 6.

It shows that keywords are divided into four quadrants that reflect a particular theme of the research domain. The upper left quadrant indicates the health and psychological well-being issues due to the outburst of COVID-19. The upper right column shows the effect of COVID-19 among young adults in terms of fear, depression, anxiety and mental health issues.

The lower left and right quadrants show the ways that help come with the stress of COVID-19, focusing on subjective well-being, hope for young adults, and overall well-being and quality of life. Thematic analysis of keywords is shown in Fig. 7.

4.12. Hierarchical clustering analysis and topic modelling method

We have performed the "agglomerative hierarchical clustering method" to identify the latent structure in the available literature.

The "hierarchical clustering method" follows two steps; first, to identify the words with similar meanings, and second, to merge the two similar word clusters. By using a "hierarchical clustering algorithm", factors related to COVID-19 are classified. The colour "tree diagram" of the same keywords according to their degree of similarity is shown in Fig. 8.

In Fig. 8, the keywords used by the authors that reflect the same meaning are placed on a close branch, and words that were grouped earlier share more similarities than those that joined later. For example, "satisfaction" and "attitude" (maroon colour) are connected in the initial link. They are considered a similar term that represents the author's experience level. To assemble the words into similar themes, we divided the tree diagram from 0.5 and found twelve clusters.

Fig. 8 unlocks the recurrent topics and themes based on the Pearson correlation coefficient for the similarity matrix.

5. Cluster analysis

Cluster analysis is considered an integral aspect of the bibliometric study that is useful to analyze the network between

Table 3
Clustering of articles with link strength and total link strength.

Cluster 1 articles	Link	Total Link Strength
(Ahmed et al., 2020) [26]	16	24
(Bojanowska et al., 2021) [51]	17	21
(Faulkner et al., 2021) [49]	16	24
(Haider et al., 2021) [52]	14	21
(Hidalgo et al., 2020) [53]	14	21
(Jacob et al., 2020) [50]	16	24
(Moni et al., 2021) [54]	17	21
Cluster 2 articles		
(Kilani et al., 2020) [55]	11	27
(Hu et al., 2020) [56]	10	25
(Sinha et al., 2020) [57]	15	34
(Dragun et al., 2021) [58]	19	54
(Giuntella et al., 2021) [59]	15	42
Cluster 3 articles		
(Conrad et al., 2021) [60]	14	19
(Gill et al., 2022) [61]	11	16
(Liu et al., 2020a) [42]	14	19
(Liu et al., 2020b) [67]	14	19
Cluster 4 articles		
(Allen et al., 2022) [62]	10	24
(Bou-Hamad et al., 2021) [63]	11	16
(Golemis et al., 2022) [64]	11	16
Cluster 5 articles		
(Chen et al., 2020) [17]	9	19
(Clair et al., 2021) [65]	9	15

publications, authors and co-citations. Cluster analysis helps the author to analyze the interlinked network structure based on published documents [48]. In the present study, the top five clusters have been considered. Table 3 represents the main articles under each cluster and their link strength and total link strength (TLS). TLS refers to the total kink strength of co-citation nodes of a document with other documents.

5.1. Emerging research themes

5.1.1. Cluster 1: physical, psychological, and mental distress amidst COVID-19

In cluster 1, the top articles are published by Ahmed et al. (2020) [26], Faulkner et al. (2021) [49] and Jacob et al. (2020) [50] with a TLS of 24 each. Ahmed et al. (2020) conducted an online survey on 1074 samples of Chinese people and assessed their depression, psychological distress, and alcohol consumption pattern via self-reported measures. They have proposed a multi-faceted approach to address psychological and mental health issues [26]. Faulkner et al. (2021) assess the Physical Activity (PA), mental stress and well-being among young adults in the UK, Ireland, New Zealand and Australia during the initial stages of the pandemic. An online survey and cross-sectional study were conducted among 8425 adults. The primary outcome includes the Stages of change scale for exercise change behaviour, International Physical Activity Questionnaire and Well-being Index. The survey reports an adverse change in exercise behaviour from pre and during the pandemic era, and thus it resulted in poor mental health and well-being [49]. The study by Jacob et al. (2020) investigated a cross-sectional study between physical activity levels and anxiety, depression and mental well-being in the UK among 902 young adults. Measures like The Short "Warwick-Edinburgh Mental Well-being Scale" were adopted. The relationship between PA and mental well-being was studied using regression analysis. The study found a negative association between moderate-to-vigorous PA daily and hostile mental well-being and similar anxiety symptoms. The study concludes that those adults who are physically active have sound and positive mental well-being [50]. Bojanowska et al. (2021) have a TLS of 21, and they have external circumstances that impact the "who I am" (values) and "how I feel" (well-being) among 215 participants in Poland. They have identified negative eudemonic well-being. They observed an increase in security, self-direction, humility and universalism but, on the contrary, a low hedonism [51]. The study provides a unique association between well-being and individual values that are adaptive and react to external circumstances.

Haider et al. (2021) have a TLS of 21 and have explored the association between PA and mental health in Austria at the time of lockdown. A cross-sectional study was performed to identify the sitting time, time spent outside and self-isolation through the self-report of 652 participants. The study concludes a positive relationship between PA, time spent outdoors and mental well-being during the pandemic lockdown [52]. Hidalgo et al. (2020) have a TLS of 21 and analyze the impact of a pandemic on psychological health during the pandemic restrictions in the Spanish adult population (6789) by adopting a sequential exploratory design method. They observed the changes in dysphoric moods (i.e., sadness, depression, anxiety and worry etc.) and some euphoric moods (i.e., feelings of happiness and well-being). The study findings suggested providing psychological support, especially to women and younger people [53]. Moni et al. (2021) have a 21 and performed an online cross-sectional study to investigate the psychological distress, fear and coping strategies amidst COVID-19 on 720 participants. To assess psychological distress, Kessler Psychological Distress Scale, the Fear of COVID-19 Scale, and the Brief Resilient Coping Scale were used. Multivariate logistic regression was applied for the analysis [54].

5.1.2. Cluster 2: lifestyle behaviour during COVID-19

Kilani et al. (2020) have a TLS of 27 and examined the impact of home confinement during a pandemic on lifestyle and well-being through an online multi-categorical questionnaire method. They used the "Food Frequency Questionnaire (FFQ)", "International Physical Activity Questionnaire" (IPAQ), "WHO-5 well-being score", and "Pittsburgh Sleep Quality Index" (PSQI) methods for the survey on 1723 responses. Factors such as sleeping patterns, consumption of food, excessive screen time, joining online classes and meetings, and PA behaviour have resulted in a sedentary lifestyle [55]. Hu et al. (2020) have investigated the change in lifestyle post-COVID-19 and its relationship with subjective well-being (SWB). An online survey was conducted on the 1033 adult population of China using General Wellbeing Schedule (GWS). The covariates for the study are PA, social support, socio-demographic factors and loneliness. The study concluded that participants who perceived a lower number of fruits, vegetables and breakfast harmed their lifestyle. Unhealthy behaviour and adverse lifestyle changes were related to a lower SWB [56]. Sinha et al. (2020) assessed the impact of a pandemic on meal timings, sleep-wake patterns and digital media usage on 1511 Indian respondents. The study showed that the sleeping pattern and diet were significantly delayed during the lockdown period. Young adults reported increased sleep duration, digital media duration and wrong mealtime. They concluded to discord the social cues because it leads to social jetlag with a delayed pattern and thus negatively affects the lifestyle [57].

Dragun et al. (2020) investigated the dietary pattern and psychological well-being of adolescents in Croatia. A survey was conducted among 1326 students to assess the quality of life (QoL), happiness and optimism using the liner model. The study reported no immense differences in dietary habits between pre- and post-lockdown. It shows that a Mediterranean diet (MD) is positively associated with QoL and study timings and negatively with the usage of mobile and TV. A higher MD is associated with less hardship and increased happiness during the lockdown [58]. Giuntella et al. (2021) have conducted a longitudinal dataset linking with survey data of young adults during the pre and COVID-19 pandemic with 682 samples. They considered the factors like PA, sleep, mental health and time use. The study showed that depression ranged from 46% to 61% up to a 90% rate compared to the prior pandemic duration [59].

5.1.3. Cluster 3: Elevated distress in young adults

Conrad et al. (2021) examined the mandated experiences of students when they were relocated to a different place. It is related to grief, loneliness, worry and "post-traumatic stress disorder" (PTSD) symptoms among university learners during the pandemic. They conducted a cross-sectional survey on 791 young adults in the US. The study resulted that one-third of the students reported more grief, loneliness and generalized anxiety symptoms during the pandemic. Those learners who were mandated to relocate have reported poor psychological results compared to those who were not mandated to relocate [60]. Gill et al. (2022) studied the association between stress related to a pandemic and emotional and psychological distress effects among young Canadian adults. Eighty-four respondents were identified, among which 61% reported psychological distress (PTSD). The study suggests a necessity to focus on the mental health of young students [61]. Though the effects of the pandemic currently exacerbate it, the burden may persist after the pandemic ends if left unaddressed, and a similar study has been conducted by Liu et al. (2020) [52].

5.1.4. Cluster 4: wellbeing and life satisfaction

Allen et al. (2022) with a TLS of 24, have examined the required alternations in mental health, sleep, well-being and diurnal preference during the pandemic. An online cross-sectional questionnaire-based study was conducted on 200 participants. The study showed that self-isolation, reduced income and intensity of anxious thoughts cause poor well-being and enhanced loneliness, anxiety and depression [62]. Bou-Hamad et al. (2021) conducted an online survey of 988 Lebanese, and a regression model was applied. The findings suggest that people with higher education report lower health concerns. Individuals with children report higher health worries. Men were less satisfied than women with their lives during the pandemic. Young adults who live alone report more significant social well-being concerns [63].

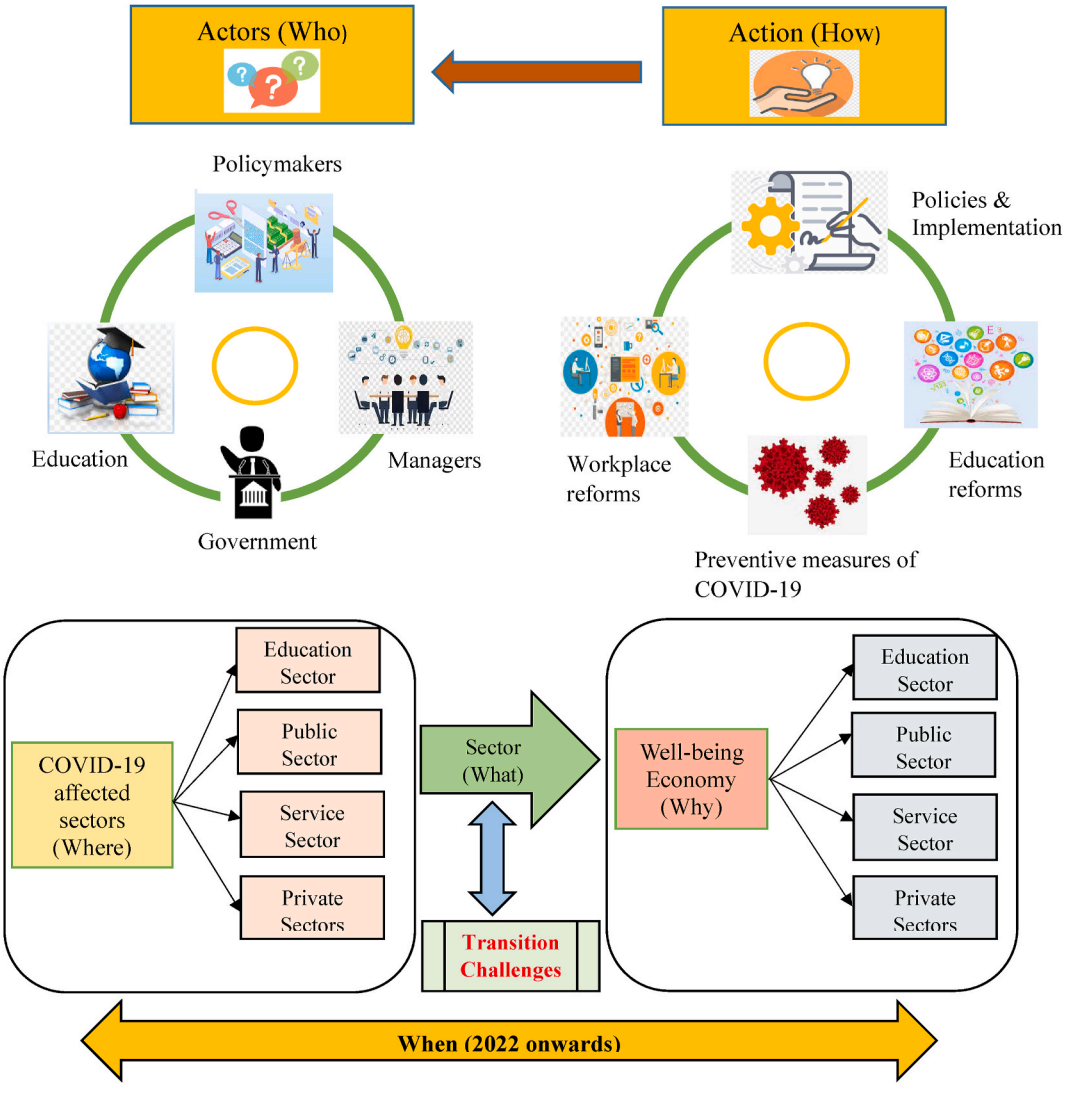

Fig. 9. Conceptual framework for the study.

Golmis et al. (2022) in their study, conducted an online cross-sectional survey on 1559 young adults to identify the association between emotional and behavioural responses during the pandemic. They used "Steele's Social Responsibility Motivation Scale" and the "De Jong Gierveld Loneliness Scale" and asked questions about quarantine-related behaviour. The study concluded a high sense of social responsibility and a trend toward feeling lonely among young adults. Young women reported a higher level of loneliness feeling than men. Measures like an inclination towards religion, sports, PA, and sharing thoughts with others resulted in increased social responsibility, humour, and playing sports will lower the level of loneliness [64].

5.1.5. Cluster 5: isolation and mental health

Chen et al. (2020) investigated the mental health of college students during isolation due to COVID-19. An online survey was conducted among 992 Chinese students during the duration of self-isolation. The seven dimensions of well-being were measured, including mental stress, risk perception, stress management information, academic stress behavioural patterns, family relationships, and peer relationships. The study revealed the long duration of the self-isolation policy harms young people's mental health [17]. Clair et al. (2021) examined the effects of social isolation among young adults during the COVID-19 pandemic. The survey was collected from 309 adults. The measure consisted of a 42-item survey from the "Revised UCLA Loneliness Scale". The study found that social isolation resulted in poor life satisfaction in all domains [65].

6. Framework for the study

To assist policymakers and practitioners, the present study has proposed a conceptual framework to operate the intellectual area of pandemic and well-being economy by synthesizing the previous studies (see Fig. 9).

The acronym for this conceptual framework is 5W1H which highlights the role of actors (who), the actions required to solve the problem (how), in the related sector (where), the risk faced by the actors (what), the time-factor of the variables (when) and reasons to implement the measures to prevent mental and psychological imbalance among young adults due to pandemic (why). In simple terms, this framework presents a structured and holistic comprehension of the critical domains of a phenomenon under evaluation and has already been applied to various research areas [66]. In the study, we have proposed the agenda of a Well-Being Economy (WBE), which helps shape the post-COVID-19 era.

7. Discussion of findings

Concerns like the psychological and mental well-being of young adults during health emergencies like COVID-19 have various effects on health, education, job creation, etc. The impact of the pandemic on psychological and mental well-being has been ubiquitous. By doing the bibliometric and visualization analysis of the extracted dataset from Scopus, this study has focused on the psychological well-being of young adults during the COVID-19 pandemic and discovered the current situation along with contributing journals, authors, countries and institutions working in this research domain.

There is a massive contribution made by both the developed and developing countries in this research area, and approximately 91% of documents in Scopus are extracted for analysis. In total, 103 countries have significantly contributed to psychological well-being vulnerabilities associated with COVID-19 global health emergency in young adults. Which UK and US played a crucial role in the publication, but the citation of the Chinese publication was much higher than UK and US, with a total of 6231 citations. The European countries are mainly the occupied countries in scientific research apart from five of the top ten countries from Asia. The major publications are China, Turkey, Singapore, and India have shown their significant contribution to global research. The published research shows that the output of the document during the pandemic has a definite kind of association with the severity of the COVID-19 situation.

The analysis of institutions signifies that universities and colleges are the prominent support of scientific research. The articles related to the outbreak of the COVID-19 pandemic on the psychological well-being of young adults were published in 225 different journals, and the top ten influential journals published 39.6% of all publications. The top two cited journals were the "International Journal of Environmental Research" and Public Health" with 5450 citations and "Psychiatry Research" with 1528 citations. Two journals with the most publications in this research area are the "International Journal of Environmental Research" and "Public Health" and "PLOS ONE". All the journals publish articles in render to psychological and mental well-being studies during the post-covid-19 times. During the pandemic's peak, these Journals faced various challenges in balancing timeliness and scientific correctness, and the dissemination of precise and rational knowledge became critical. For, say, discussing the behaviour and suicidal cases of young adults during the pandemic, the Journal of Lancet Psychiatry reverse the considerable assertion of suicide cases and holds on cohering to the facts. The Journal of Psychiatric Research pointed out the association between COVID-19 and suicidal thoughts among US youth.

Based on research findings, the highly cited articles were published by Ref. [3], who surveyed the psychological impact, stress, and depression at the initial stage of COVID-19. The International Journal of Environmental Research and Public Health has the highest publication and citation in this research domain. The highly cited articles have worked on the specific details in their study and focus on "mental health", "resilience", "lifestyle behaviour", and the peripherals of psychological symptoms like stress, anxiety, and sleep disorder among young adults. The published documents in Scopus were mostly from the stream of medicine and psychology. Visualization of the author's keywords from the VOS viewer software showed that psychological health-related indications, such as fear, mental distress, well-being and psychological impact, are the primary keywords used by the authors in their study. However, in the conceptualization structure, the main theme keywords have psychiatric properties supporting validity tools to measure vulnerabilities.

This research study is the first systematic-cum-bibliometric study on the impact of COVID-19 on the psychological well-being of

young adults unconventionally without adding any related health outbreaks like Ebola and H1N1 as considered in the various studies [67]. The results of this study widened the aspects of COVID-19 and psychological well-being to the researchers. Moreover, Asia, America and Europe are prominently dominating in major categories explored, whether contributing to the scientific literature and institution contribution in the Scopus. The study will provide a comprehensive overview to the academicians, researchers and policymakers about the research productivity, characteristics, influential variables and research outcome in this research domain.

Table 4
Proposed research proposition based on cluster analysis.

Cluster 1: Physical, Psychological, and Mental distress amidst COVID-19	
Proposition 1	To implement a multi-faceted approach at social, personal and international levels to adhere to the mental and psychological problems.
Proposition 2	Restriction on excessive media exposure, consulting online counselling sessions, particular focus and care for vulnerable people and concentration on economic rehabilitation to overcome pandemic distress.
Proposition 3	Public health interventions should encourage the PA habits of the most vulnerable group of people affected by the adverse effects of self-isolation and physical distancing
Proposition 4	To navigate the values of individuals (hedonistic values) from the early phase of the pandemic to the post-COVID-19 era
Cluster 2: Lifestyle behaviour during COVID-19	
Proposition 5	Identifying factors that promote a smooth and healthy lifestyle among young adults.
Proposition 6	A longitudinal study can be conducted to understand better a pandemic's lasting effects on lifestyle behaviour and their changes
Proposition 7	Lifestyle modification can be associated with MD adherence through lifestyle medicine and should be prioritized
Proposition 8	Analyzing the relationship between PA and happiness to enhance the well-being of people.
Cluster 3: Elevated distress in young adults	
Proposition 9	How does the reallocation affect young adults' well-being, especially those at the university level?
Proposition 10	Universities should identify the factors that support students during traumatic experiences that mitigate worse mental well-being outcomes
Cluster 4: Wellbeing and life satisfaction	
Proposition 11	Policymakers should design a framework that includes the variables to enhance the well-being during the transition to the 'new normal post-pandemic
Proposition 12	To design a national strategy and collaboration with public health professionals to alleviate the COVID-19 pandemic's adverse effects on mental well-being in the long term
Proposition 13	To raise awareness about loneliness among young adults and the importance of developing programs and campaigns to nurture adaptive coping strategies against loneliness.
Proposition 14	To identify whether spirituality or religion improves well-being or lowers the feelings of loneliness among young people
Cluster 5: Isolation and mental health	
Proposition 15	A longitudinal study can provide a clear picture of the impact on young people's mental health.
Proposition 16	Intervention strategies and measures can be explored to improve the QoL of young people.

Based on the reviews of various articles as presented in the cluster analysis section, we proposed the following propositions for future research on the proposed cluster themes (refer to Table 4).

7.1. Implications of the study

7.1.1. Theoretical implications

The study provides valuable theoretical implications for the present study. Many types of research have been conducted to understand the effect of the COVID-19 pandemic on young adults. However, no systematic sum bibliometric analysis was conducted to integrate the extant studies. Therefore, this study was carried out to fulfil the purpose of assimilation and synthesis of previous literature at the juncture of pandemics and the well-being of young adults. With this outline, the authors demarcate the history of past studies in this emergent domain because of thematic areas among the remaining. The study's primary contribution is synthesizing emerging areas of research and their subsequent gaps and future research avenues. Therefore, future research can take the idea of moving towards the WBE and contribute to the existing knowledge domain. The thorough knowledge will play an essential role in developing the theory concerning WBE and COVID-19: A pathway for the post-COVID-19 era.

7.1.2. Practical implications

The present study has considered the critical implications of policymakers, managers and academicians toward young adults in society. Managers and academicians must understand the mental health of students and employees in educational institutes and the workplace. The study thoroughly offers three practical implications. First, academicians and educational institutes should conduct emotional check-ins by asking how they feel. Organize activities to reduce stress and anxiety, such as belly breathing, yoga, sports, etc. Adolescents of different age groups and sex have different emotional reactions and somatic symptoms, so related steps and cures should be taken. Managers and employers should promote a healthy environment among their employees and implement the culture of a "well-being holiday" every month. Policymakers and governments, it has been warned by international organizations to tackle the mental health complications related to COVID-19.

7.2. Future research directions

Based on the extensive review of various articles, we propose seven future research directions as provided in Table 5.

8. Conclusion

The scope of the COVID-19 outbreak's effects on the psychological well-being of young adults and its vulnerabilities is highlighted in this study, which also increases understanding of the most significant publications, authors, and nations. From the global aspect, the findings become pertinent to the policymakers to formulate policy interventions to prevent the impact of post-COVID-19 psychological health challenges. The rapid increase in the publications indicates growing concern about young adults' psychological and mental well-being. In future research, a systematic literature review and meta-analysis can be performed to explore the theoretical development and contribution of the literature. The study reveals many research scopes and opportunities for health care during and post-COVID-19 pandemic. Soon, the proposed conceptual framework presented at the end of the study can be tested empirically.

With the given directions and contributions, the study also attributes some inherent limitations in the case of bibliometric analysis. In our study, we have used only Scopus as a database, which may also lead to ignoring relevant articles from other databases, resulting in incomplete data. Future studies can consider the Web of Science, PubMed, and Google Scholar. We have considered only the articles published in English that may exclude some significant articles in different languages. In the study, we have only considered the "young adults" category and thus a major section of the age group can be such as infants, children, elders, old age people etc. can be studied in future research. In addition, the global pandemic of COVID-19 is still not over, so the present research findings do not represent the complete and exact of the COVID-19 upsurge and its psychological well-being impact on young adults since the suggested framework in this study can be considered for conducting empirical research in future.

Declaration

Author contribution statement

All authors listed have significantly contributed to the development and the writing of this article.

Data availability statement

No data was used for the research described in the article.

Additional information

No additional information is available for this paper.

Table 5
Future research directions.

S. No.	Future research directions
FR1	To focus on adult and adolescent samples rather than considering the general population to identify the consequences of COVID-19 on mental and psychological health.
FR2	Future research studies should standardize and validate the psychometric variables that are aligned with assessing mental and psychological well-being outcomes in young adults instead using a Single-item Scale or study-specific questionnaire.
FR3	There is a need to investigate the age and gender differences that were not yet examined in depth in most of the studies. Such factors should get incorporated into the demographic variables and thus helps in policy framing.
FR4	A little is informed about the long-term effect of the worldwide pandemic outbreak on the psychological health of young adults. It includes adults from the period of online education to employees from work from home.
FR5	There is a need to conduct a cross-sectional study of young adults assessing the consequences of the pandemic during the pre-COVID-19 to COVID-19 post-COVID-19 era.
FR6	At present, there is no study or data published on the effect of COVID-19 vaccination on the psychological and physical and mental health of young adults.
FR7	It is observed that a lack of clarity and detailed information is required in the case of empirical studies due to the time barrier and the urgent requirement to provide the foremost empirical results regarding an emerging field of research. Addressing this future avenue will contribute to having robust evidence on the effect of COVID-19 on the overall health of young people.

Declaration of competing interest

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

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Appendix-A

Table A1
Summary of bibliometric data

Main Information	
Database	Scopus
Period	2020–2022
Total Sources	225
Total Documents	482
Average citations per document	37.54
Total references	22,313
Document Type	
Total articles	463
Total review articles	18
Authors	
Total authors	2955
Author appearances	3235
Single-authored documents	11
Multi-authored documents	2944
Document Content	
Authors keywords	924
Keyword plus	2416
Author Collaboration	
Document per author	0.163
Authors per document	6.14
C-Authors per documents	6.73
Collaboration Index	6.26

Table A2
Most influential articles

Author(s)	Article title	Source	Year	TC	C/Y

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Table A2 (*continued*)

Author(s)	Article title	Source	Year	TC	C/Y
Wang, C., Pan, R., Wan, X., Ho, C.S., Ho, R.C.	"Immediate psychological responses and associated factors during the initial stage of the 2019 coronavirus disease (COVID-19) epidemic among the general population in China"	International Journal of Environmental Research and Public Health	2020	4112	1370.6
Liu, N., Zhang, F., Wei, C., Wang, Y., Liu, W.	"Prevalence and predictors of PTSS during COVID-19 outbreak in China hardest-hit areas: Gender differences matter	Psychiatry Research	2020	744	248
Ettman, C.K., Abdalla, S.M., Cohen, G.H., Vivier, P.M., Galea, S.	Prevalence of depression symptoms in US adults before and during the COVID-19 pandemic"	JAMA Network Open	2020	650	216.7
González-Sanguino, C., Ausín, B., Castellanos, M.Á Ugidos, C., Muñoz, M.	"Mental health consequences during the initial stage of the 2020 Coronavirus pandemic (COVID-19) in Spain"	Brain, Behavior, and Immunity	2020	604	201.3
Son, C., Hegde, S., Smith, A., Wang, X., Sasangohar, F.	"Effects of COVID-19 on college student's mental health in the United States: Interview survey study"	Journal of Medical Internet Research	2020	567	189
Ahmed, M.Z., Ahmed, O., Aibao, Z., Siyu, L., Ahmad, A.	"Epidemic of COVID-19 in China and associated Psychological Problems"	Asian Journal of Psychiatry	2020	503	167.7
Liu, C.H., Zhang, E., Wong, G.T. F., Hyun, S., Hahm, H.	"Factors associated with depression, anxiety, and PTSD symptomatology during the COVID-19 pandemic: Clinical implications for U.S. young adult mental health"	Psychiatry Research	2020	372	124
Pieh, C., Budimir, S., Probst, T.	"The effect of age, gender, income, work, and physical activity on mental health during coronavirus disease (COVID-19) lockdown in Austria"	Journal of Psychosomatic Research	2020	327	109
O'Connor, R.C., Wetherall, K., Cleare, S., Ferguson, E., Robb, K.A.	"Mental health and well-being during the COVID-19 pandemic: Longitudinal analyses of adults in the UK COVID-19 Mental Health & Wellbeing study"	British Journal of Psychiatry	2020	244	81.3
Groarke, J.M., Berry, E., Graham-Wisener, L., McGlinchey, E., Armour, C.	"Loneliness in the UK during the COVID-19 pandemic: Cross-sectional results from the COVID-19 Psychological Wellbeing Study"	PLOS ONE	2020	239	79.7

Table A3
Top contributing journals

Journal	Publisher	TP	TC	h-index	Cite Score
"International Journal of Environmental Research and Public Health"	MDPI	79	5450	19	4.3
"PLOS ONE"	Public Library of Science	40	1195	13	4.6
"Frontiers in Psychiatry"	Frontiers Media S.A.	16	189	06	4.3
"BMJ Open"	BMJ Publishing Group	11	100	05	3.3
"Psychiatry Research"	Elsevier	10	1528	10	10.1
"Journal Of Medical Internet Research"	JMIR Publications Inc.	09	901	07	8.4
"BMC Psychiatry"	Springer Nature	08	77	05	4.0
"Frontiers in Psychology"	Frontiers Media S. A	07	93	03	3.5
"Journal Of Psychiatric Research"	Elsevier	07	252	04	4.3
"Journal Of Adolescent Health"	Elsevier	04	189	04	6.6

Table A4
Top ten influential authors

Author	Affiliation	Country	TP	TC	NCP	TC/TP	h-index
Arslan, G.	Mehmet Akif Ersoy Üniversity, Burdur	Turkey	5	127	4	25.4	3
Smith, L.	Anglia Ruskin University, Cambridge	United Kingdom	5	298	4	59.6	4
Tully, M.A.	Ulster University, Coleraine	United Kingdom	5	298	4	59.6	4
Barnett, Y.	Nottingham Trent University, Nottingham	United Kingdom	4	294	3	73.5	3
Budimir, S.	Donau-Universitat Krems, Krems an der Donau	Austria	4	409	4	102.2	4
Jacob, L.	Parc Sanitari Sant Joan de Déu,	Spain	4	294	3	73.5	3
Liu, C.H.	Harvard Medical School, Boston	United States	4	492	4	123	4
Pieh, C.	University for Continuing Education Krems	Austria	4	409	4	102.2	4
Probst, T.	Donau-Universitat Krems, Krems	Austria	4	409	4	102.2	4
Yakkundi, A.	Ulster University, Coleraine	United Kingdom	4	294	3	73.5	3

Table A5
Top ten contributing institutes

Institution	Country	TP	TC	NCP	TC/TP	TC/NCP	h-index
University of Melbourne	Australia	11	174	10	15.8	17.4	7
Monash University	Australia	9	328	8	36.4	41	6
Medizinische Universität Wien	Austria	8	129	5	16.1	25.8	4
King's College London	United Kingdom	8	109	6	13.6	18.1	5
University of Toronto	Canada	8	165	8	20.6	20.6	5
National University of Singapore	Singapore	8	4262	8	532.7	532.7	4

(*continued on next page*)

Table A5 (*continued*)

Institution	Country	TP	TC	NCP	TC/TP	TC/NCP	h-index
University College London	United Kingdom	8	209	8	26.1	26.1	7
Charité – Universitätsmedizin	Berlin	8	352	7	44	50.2	6
University of Oxford	United Kingdom	8	166	7	20.7	23.7	6
Harvard Medical School	United States	7	504	6	72	84	5

TP: Total publication, TC: Total citation, NCP: Number of cited publications, TC/TP: Average citation per publication, TC/NCP: Average citation per cited publication.

Table A6
Topmost contributing countries

Country	TP	TC	NCP	TC/TP	TC/NCP	h-index	Status
United States	109	4520	98	41.4	46.1	32	Developed
United Kingdom	84	2369	71	28.2	33.3	25	Developed
Italy	55	1179	43	21.4	27.4	17	Developed
China	47	6231	41	132.5	151.9	16	Developing
Spain	36	1732	28	48.1	61.8	16	Developed
Australia	35	879	34	25.1	25.8	15	Developed
Canada	31	724	26	23.3	27.8	12	Developed
Germany	24	600	19	25	31.5	11	Developed
Turkey	20	374	15	18.7	24.9	9	Developed
Poland	19	461	17	24.2	27.1	9	Developing

TP: Total publication, TC: Total citation, NCP: Number of cited publications, TC/TP: Average citation per publication, TC/NCP: Average citation per cited publication.

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