

## Knowledge Discovery on “Chest Mobilization Exercises” for Network-Clustering and Future Trends from Document Databases: A Bibliometric Analysis

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### Abstract

This study aimed to discover the knowledge from the research documents with the key word "chest mobilization exercise" and examine trend topics, network clusters, and co-occurrence words from the SCOPUS and PubMed databases.

The search term "Chest mobilization exercise" from the PubMed and SCOPUS databases was cited. RStudio software was used to perform bibliometric and visual analysis under the normalization process with Salton's Cosine, network clustering via trend topic with the walktrap algorithm, and visualization with co-occurrence, trend topic, and network clustering analysis by Kamada-Kawai algorithm.

Twelve documents were published between 2005 and 2023 comprising two reviews, two case study documents, seven non-associated lung diseases, and one associated lung disease document. The bibliometric result from 12 documents published in various journals showed co-occurrence word on human (9,5%), adult and article (8,5%), male (7,4%), clinical article (6,4%), breathing exercise, controlled study, exercise, female, forced vital capacity, quality of life (5,3%), exercise tolerance, forced expiratory volume, lung function, physiotherapy, randomized controlled trial (4,2%), breathing, breathing muscle, bronchiectasis, cerebral palsy, chest mobilization, dyspnea, follow up, human, massage, muscle strength, pulmonary rehabilitation (3,2%), analysis of variance, burn, case report, chronic obstructive lung disease, complication, daily life activity, diaphragm, and lung clearance (2,1%), etc., respectively. Five network clusters were identified; (1) adult, male, clinical article, controlled study, exercise, forced vital capacity, exercise tolerance, forced expiratory volume, lung function, physiotherapy, randomized controlled trial, breathing muscle, follow-up, humans, complication, diaphragm, peak expiratory flow, physiology, procedures, sternocleidomastoid muscle, and thorax wall; (2) human, article, breathing exercise, female, quality of life, breathing, chest mobilization, dyspnea, muscle strength, pulmonary rehabilitation, case report, maximal inspiratory pressure, muscle training, thorax, treatment duration; (3) daily life activity, lung clearance; (4) percussion and vibration; and (5) chronic obstructive lung disease and mobilization. Finally, Trend topics reported in breathing exercises, human, quality of life and adult, forced vital capacity and article, clinical article, male, controlled study, and then exercise.

The knowledge discovery from the keyword “chest mobilization exercise” in documents has related to exercise, breathing exercises, and pulmonary rehabilitation in chronic obstructive pulmonary disease with outcomes of lung function, quality of life, dyspnea, muscle strength, quality of life, and daily life activity under the clinically controlled study.

**Keywords:** Data mining, Knowledge discovery, Pulmonary rehabilitation.

### Introduction

One of the many physical therapies that enhance chest wall mobility is chest mobilization exercise, which can be achieved by gymnastics [1] or manual stretching [2]. Increased chest wall expansion and intercostal muscular stiffness [3] that enhanced lung airflow [4] have been proposed as clinical benefits for pulmonary rehabilitation. Therefore, chest mobilization exercise is very important for pulmonary rehabilitation or physical therapy in various conditions that have the main problem of chest wall mobility. Previous evidence on chest mobilization exercises had been studied with chronic thoracic pain, case report [5], respiratory parameters, chronic non-specific low back, randomized controlled trial [6], lung function, chest wall expansion, and stroke [7]. Subjects with severe chronic obstructive pulmonary disease (COPD) and respiratory muscle function were studied in an updated research document on chest

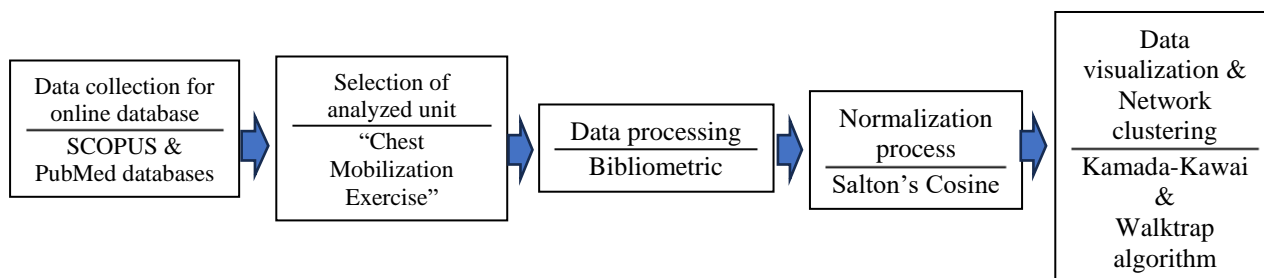
wall mobilization [8]; breathing exercises, respiratory function, trunk stability, endurance, and stroke [9]; Thai massage, scapular stabilization exercise, and randomized clinical trial [10]. Furthermore, none of the research was categorized or grouped after the data visualization and analysis procedures. Some instances of clustering analysis on additional terms were shown in earlier studies. The utilization of clustering analysis has been investigated in various fields, including TCM syndrome characteristics of chronic hepatitis B using the K-means clustering analysis method [11], traditional Chinese medicine patent with density-based spatial clustering of applications with noise (DBSCAN) algorithm [12], edible and health foods of traditional Chinese medicine pastel [13], and future research topics in three-way clustering algorithms [14]. In addition, the visual clustering network-based intelligent power lines inspection system was published [15]. From all

analysis tools, Bibliometric tool analysis is one of the several possibilities for the study of the research hotspots and trends based on multiple databases [16]. This tool may be employed to detect network clustering, co-occurrence, and co-citation analysis that assists in constructing thematic regions as data mining analysis with various methods [17]. Thus, identifying the knowledge from documents in SCOPUS and PubMed databases was the aim of this study. Moreover, displaying the co-occurrence terms, clustering identifiers, and trend topics from the specific keyword "chest mobilization exercise" was the main objective of this report.

### Methodology

This study is a qualitative and quantitative research design related to data mining analysis and visualization specifically the Bibliometric method under RStudio Software (version 4.3.2) [18]. This is one of a large-scope research project that was approved by the Human Ethics Committee at the Faculty of

Associated Medical Science, Chiang Mai University, Chiang Mai, Thailand (STUYD CODE: AMSE-67x-004). Based on the SCOPUS and PubMed databases, the search term or inclusion criteria were narrowed down to the particular keyword "Chest Mobilization Exercise" in the document source, with an emphasis on the English language and literature type. Types of literature classified as letters, reports, conferences, and proceedings data were the exclusion criteria. Generally, the methodology of bibliometric analysis followed the prior guidelines set out by Cobo et al [19] for the analysis of scientific categories as performance and science mapping [20]. In the preceding data analysis process, there are eight processes, encompassing data collection, selection of examined units, data processing, normalization process, development of science mapping, analysis methods, visualization strategies, and interpretation [21].



The flowchart of the five steps of data collection, analysis, data processing, normalization, and clustering processes [21].

This study used the bibliometric analysis technique [22], following Steps 1 through 5 as shown in the flowchart. Steps I and II involved gathering data (pre-processing) from document publications on "Chest Mobilization Exercise" on the SCOPUS and PubMed databases. Before being transferred and entered in Step III (data analysis) of the Bibliometric tool in the RStudio software, every file was converted into a "CSV" file format. The bibliographic metadata for the analytical system contained information gleaned from SCOPUS and PubMed, including author, affiliation, document type, journal, language, publication year, title, total citation, abstract, corresponding author, keywords, and keywords plus. Next, the bibliometric analysis data processing was carried out to determine the primary most relevant sources keyword occurrences, most relevant terms, or most frequently occurring words. During processing, Salton’s Cosine was employed in the normalization stage (stage IV) [23], and the Walktrap distance algorithm was applied to examine the network clustering and trend topic [24]. The analysis results were created and presented with mapping visualization as network clustering mapping, treemap, or trend line from the Kamada-Kawai layout algorithm [21,25].

### Results

#### Distribution by Time and Journal Publication

Twelve original "Chest Mobilization Exercise" publications were discovered in ten sites or journals between 2005 and 2023. Table 1 displays every paper along with the author's name, journal, research title, and year of publication.

The journals or sources that were most pertinent were: Burns, Chiropractic and Manual Therapies, Clinical Medicine Insights: Circulatory, Respiratory and Pulmonary Medicine, Current Research in Physiology, Japanese Journal of Chest Disease, Journal of Physical Therapy Science, Open Access Emergency Medicine, Pharmacognosy Journal, Physical Medicine and Rehabilitation, Progress in Palliative Care, and Medicina (Kaunas).

Data analyzed on the most globally cited documents reported that the six top documents were Journal of Physical Therapy Science (10 cited), Burns (5 cited), Clinical Medicine Insights: Circulatory, Respiratory and Pulmonary Medicine (4 cited), Open Access Emergency Medicine (2 cited), Progress in Palliative Care (1 cited), and Pharmacognosy Journal (1 cited).

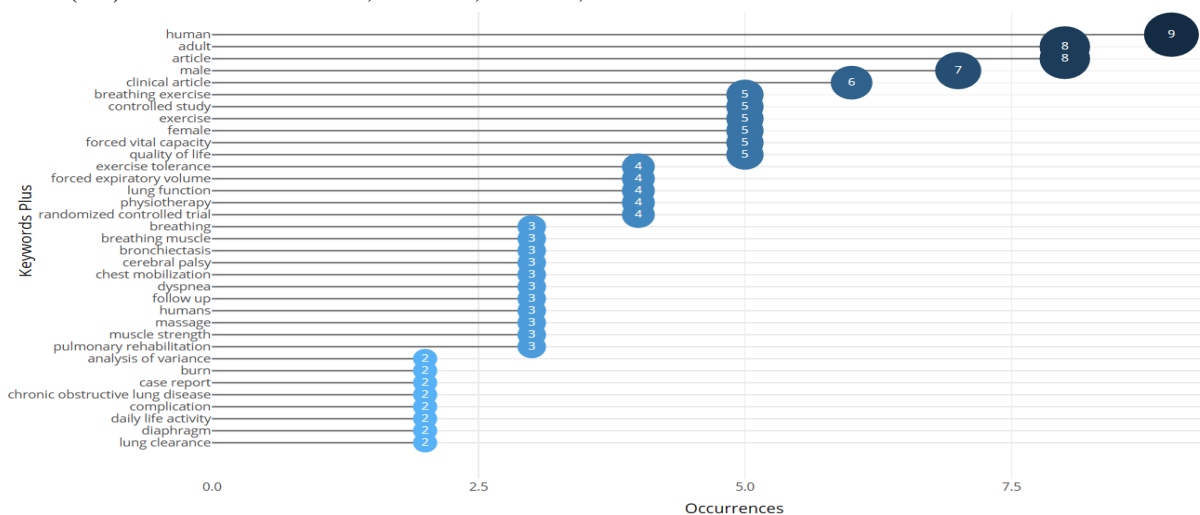
**Table 1:** Cited document results in SCOPUS and PubMed database between 2005-2023.

Authors	Journal	Title	Years
Tamaki A, et al	Japanese Journal of Chest Diseases	Respiratory physiotherapy	2005
Leelarungrayub J, et al	Clinical Medicine Insights: Circulatory, Respiratory and Pulmonary Medicine	Short-term pulmonary rehabilitation for a female patient with chronic scleroderma under a single-case research design	2016
Park SJ, et al	Journal of Physical Therapy Science	Comparison of the effects of core stabilization and chest mobilization exercises on lung function and chest wall expansion in stroke patients	2017
Yoon SY, et al	Pulmonary Medicine and Rehabilitation	Pulmonary rehabilitation in a patient with bronchiectasis and underlying cerebral palsy: a case presentation	2018
Nambi G, et al	Burns	Yoga in burn: role of pranayama breathing exercise on pulmonary function, respiratory muscle activity and exercise tolerance in full-thickness circumferential burns of the chest.	2021
Namwaing P, et al	Open Access Emergency Medicine	Factors associated with duration of intercostal chest drainage in patients with primary spontaneous pneumothorax and the role of pulmonary rehabilitation.	2021
Banerjee J, et al	Progress in Palliative Care	Could kinesiology tapping of the inspiratory muscles help manage chronic breathlessness? An opinion paper	2022
Kanthain R, et al	Pharmacognosy Journal	Efficacy of combined relaxed deep breathing with chest mobilization exercise and Vernonia cinerea-hard candy on smoking cessation and oxidative stress in active teenage smokers.	2022
Yokoyama Y, et al	Current Research in Physiology	Effect of chest mobilization on intercostal muscle stiffness	2022
Buttagat Y, et al	Chiropractic and Manual Therapies	Effects of the combination of traditional Thai massage, scapular stabilization, and chest mobilization in subjects with forward head posture: A single-blinded randomized clinical trial.	2023
Lee Y, et al	Medicina (Kaunas)	Effects of chest mobilization and breathing exercises on respiratory function, trunk stability, and endurance in chronic stroke patients after Coronavirus disease.	2023
Tusi AYY, et al	Respiratory Medicine	Effect of chest wall mobilization on respiratory muscle function in patients with severe chronic obstructive pulmonary disease (COPD): A randomized controlled trial.	2023

**Co-occurring Words and Trend Topics Analysis**

Figure 2 displays the findings of a bibliometric study conducted on 12 documents using the specific phrase “chest mobilization exercise.” 198 entries and various occurrences from 12 documents were displayed in the most frequent word analysis. As depicted in **Figure 1** and treemap in **Figure 2**, the results revealed that 35 examples occurred: 9 (5%) were related to humans, 8 (5%) to adults, 6 (4%) to clinical articles, 7 (4%) to males, and 6 (4%) to controlled studies, exercise, females,

forced vital capacity, and quality of life; 5 (3%) to breathing exercise, exercise tolerance, forced expiratory volume, lung function, physiotherapy, and randomized controlled trial; 3 (2%) to breathing, breathing muscle, bronchiectasis, cerebral palsy, chest mobilization, dyspnea, follow-up, humans, massage, muscle strength, and pulmonary rehabilitation; and 2 (1%) to analysis of variance, burn, case report, chronic obstructive lung disease, compliance, daily life activity, diaphragm, and lung clearance.



**Figure 1:** Occurrences of words from the most-occurrence word analysis from 12 published documents between 2005 to 2023.

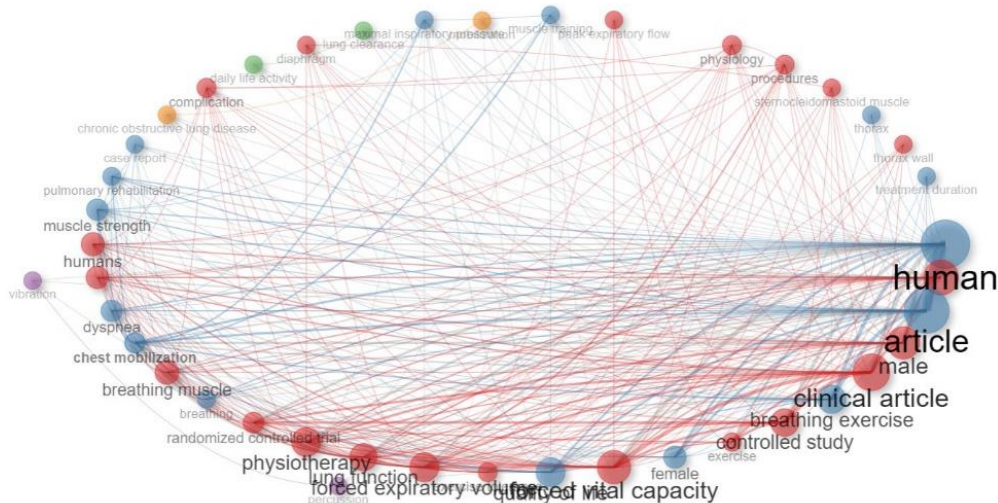


**Figure 2:** Treemap visualization of example 35 occurrence words and percentages from “chest mobilization exercises” citation between 2005 to 2023 in the SCOPUS and PubMed databases.

**Network Approach Analysis**

Using Salton normalization and the Walktrap clustering algorithm, a study of the network approach was conducted.

Kamada & Kawai's network layout was displayed in five clusters (Table 2) and 42 entries (Figure 3).



**Figure 3:** Network clustering visualization with Walktrap distance algorithm of 42 subdisciplines from 12 cited documents.

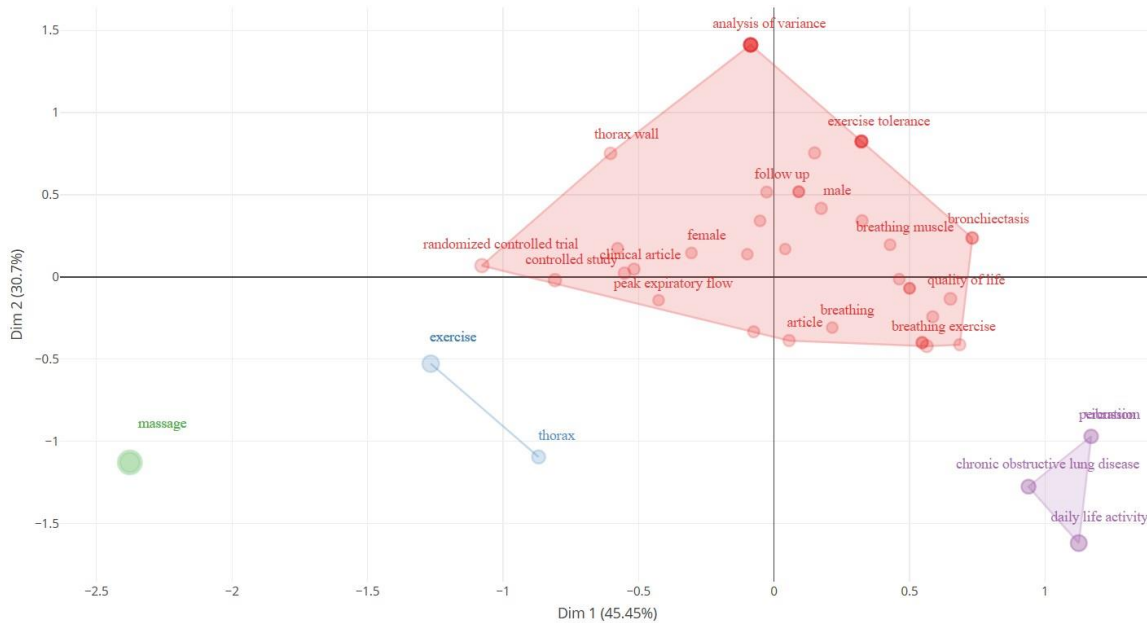
**Table 2.** Network Clustering and 42 entries from “chest mobilization exercise.

Cluster	Subdisciplines
1	adult, male, clinical article, controlled study, exercise, forced vital capacity, exercise tolerance, forced expiratory volume, lung function, physiotherapy, randomized controlled trial, breathing muscle, follow-up, humans, complication, diaphragm, peak expiratory flow, physiology, procedures, sternocleidomastoid muscle, thorax wall.
2	human, article, breathing exercise, female, quality of life, breathing, chest mobilization, dyspnea, muscle strength, pulmonary rehabilitation, case report, maximal inspiratory pressure, muscle training, thorax, treatment duration
3	daily life activity, lung clearance
4	percussion, vibration
5	chronic obstructive lung disease, mobilization

**Co-words factorial analysis**

The science mapping from a total of 51 subdisciplines was produced from the bibliometric analysis using the Kamada-Kawai method after the normalizing using Salton's Cosine. The

factorial analysis on co-occurrence terms indicated the five clusters with a word map (Figure 4) as same as the clustering analysis (Table 2).

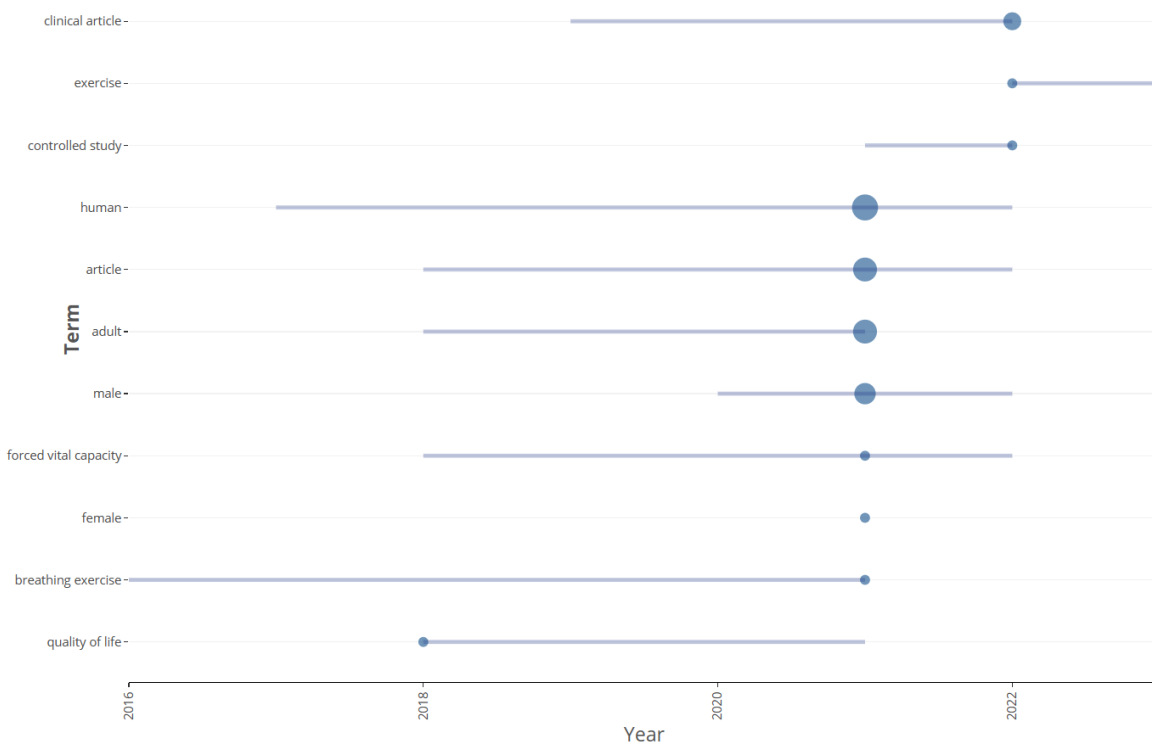


**Figure 4:** Four map network clustering from all 42 subdisciplines or words in 12 published documents between 2005 to 2023.

**Trend Topic analysis**

The data indicated an increasing tendency for the example of the top eleven words based on the frequency of those words since 2005. Breathing exercises (2016–2021), human (2017–2022), quality of life and adult (2018–2021), clinical article (2019–

2022), forced vital capacity and article (2018–2022), male (2020–2022), controlled study (2021–2022), and exercise had been studied since 2022, respectively, are trend topics that have been reported (Figure 5).



**Figure 5:** Trend topics from the words’ frequency over time from 2016 to 2023.

**Discussion**

This study's primary bibliometric analysis is one of numerous software product line engineering techniques that can be completed more quickly, more affordably, and with better quality [26]. The popularity of bibliometric analysis in business research in recent years can be ascribed to the development, accessibility, and availability of scientific databases like SCOPUS and PubMed in this study, as well as tools like Gephi and VOSviewer [20]. Furthermore, this approach facilitates the

identification of gaps in knowledge, the discovery of fresh concepts for inquiry or study, and the positioning of the desired contributions to all domains [20]. When compared to other approaches like meta-analysis and systematic literature review, which have a narrow scope in qualitative analysis, the advantages of this method can be employed in a broad scope and huge datasets with both quantitative and qualitative analysis.

Update evidence using bibliometric software to examine risk management in the space sector from the SCOPUS database [27]. The six clusters of all risk characteristics were described in that paper, and they matched the network clustering identification found in this investigation. This software allows for an interesting evaluation of the scientific literature related to medical research based on data from journals, authors, addresses, abstracts, and published literature references from a variety of databases, including Web of Science, PubMed, Dimensions, and SCOPUS. According to Kokol [28], bibliometric analysis is a fantastic method for obtaining accurate, transparent, and impartial quantitative estimate outcomes. According to the study's findings, "chest mobilization exercises" was the primary term mentioned in 12 original publications from 2005 to 2023, primarily on science mapping and network analysis, that were in the SCOPUS and PubMed databases.

### **Most frequency words and Network clustering**

The results of 12 research documents showed the top ten frequency words of chest mobilization exercise, human, adult, article, male, clinical article, breathing exercise, controlled study, exercise, female, forced vital capacity, and quality of life, exercise tolerance, forced expiratory volume, lung function, physiotherapy, and randomized controlled trial, breathing, breathing muscle, bronchiectasis, cerebral palsy, chest mobilization, dyspnea, follow up, humans, massage, muscle strength, and pulmonary rehabilitation, and analysis of variance, burn, case report, chronic obstructive lung disease, compliance, daily life activity, diaphragm, and lung clearance. This outcome is likely due to the lack of prior research on data citation.

In this study, Cosine normalization was adopted since earlier evidence revealed that Salton's cos is similar to the Person's cosine that was used to evaluate the possible co-cited in the library setting [29]. Furthermore, Luukkonen and co-workers stated that it continues to be the best measure for the display of the vector space computed from the occurrence matrix of absolute data [30]. The Kamada-Kawai architecture with weighted edges based on distance was used in this study's network mapping visualization. It was based on a prior paper that examined network clustering analysis using the Walktrap method and distance [25]. One of the most popular force-directed methods for drawing graphs under reflected symmetry is the Kamada-Kawai layout visualization used in this study [31]. The correlation networks and clustering found in this investigation support the earlier recommendation [32,33]. In many different fields of study, the network clustering technique has been used to analyze network structure [34]. When compared to all algorithms such as Edge, Fast Greedy, Eigenvector, Infomap, Label Propagation, and Louvain, the Louvain algorithm is the simplest unsupervised learning algorithm similar as the K-Means algorithm [35]. However, it works well with large datasets. An upgraded technique, the Walktrap algorithm that based on a hierarchical agglomerative clustering process that works well with small networks as same as the Louvain or Greedy algorithm [9]. Due to a small dataset and low network, this technique is generated using the short-distance random walk concept on a small distance. According to Pons and Latapy [24], this approach converts the initial correlation matrix into a transition matrix, which is a matrix with transition probabilities. In the bibliometric and RStudio analyses, the Walktrap algorithm may be chosen automatically. Network clustering with the Walktrap algorithm was selected

for this study. Because previous reports on different algorithms depended on the modularity, processing time, and cluster members. Nonetheless, prior reviews of the literature indicated that centrality analysis, frequency analysis, and co-occurring frequency analysis might be applied [36,37].

In this study, network clustering based on database citations was partially demonstrated. Following the process of normalization and clustering evaluation by network and factorial analysis, five clusters are displayed. The first cluster included the following: adult, male, clinical article, controlled study, exercise, forced vital capacity, exercise tolerance, forced expiratory volume, lung function, physiotherapy, randomized controlled trial, breathing muscle, follow-up, humans, complication, diaphragm, peak expiratory flow, physiology, procedures, sternocleidomastoid muscle, and thorax wall, respectively. The second cluster included the following: human, article, breathing exercise, female, quality of life, breathing, chest mobilization, dyspnea, muscle strength, pulmonary rehabilitation, case report, maximal inspiratory pressure, muscle training, thorax, and treatment duration. The third cluster consisted of daily life activity and lung clearance. The fourth cluster included the following: percussion and vibration, and the last cluster consisted of Chronic obstructive lung disease and mobilization, respectively. Presenting the clustering words associated with the research issue in the future is the primary goal of this study, though. "Chest mobilization exercise" emerged as the most common result across research publications cited in the SCOPUS and PubMed databases between 2005 and 2023, according to the network clustering analysis of the study's most frequently used terms. This verifies the future view on chest mobilization exercise which is a potential technology for creating individualized, motivating, and regulated rehabilitation scenarios as prior evidence [38].

### **Trend topics of chest mobilization exercise**

Identifying the research trend in the future of this study is consistent with a previous review document [39]. Even though the 12 mentioned documents were published between 2005 and 2023, it is still possible to examine the frequency of the words with time. Trend topics for chest mobilization exercises were derived from the frequency of the phrases over time from 2005. The top seven words showed an increasing trend in the results. The following trend topics were reported: breathing exercises (2016–2021), human (2017–2022), quality of life and adult (2018–2021), clinical article (2019–2022), forced vital capacity and article (2018–2022), male (2020–2022), controlled study (2021–2022), and exercise had been studied since 2022. However, chest mobilization exercises and breathing exercises are some of the various treatments in pulmonary rehabilitation for chronic lung disease [40]. Furthermore, Park et al, examined the effects of chest mobilization activities on lung function and chest wall expansion [7]. As a result, this leads to a study of on-trend topics and clustering that can forecast future research, particularly on the combination of breathing exercises and chest mobilization exercises with other techniques, as well as pulmonary rehabilitation in chronic lung disease by assessing lung function, quality of life, muscle strength, lung function, dyspnea, and exercise tolerance in human clinics using controlled study designs. Moreover, this result is consistent with a knowledge discovery on pulmonary rehabilitation and virtual reality (VR) in the document database [41] that chest mobilization techniques are an important technique in

pulmonary rehabilitation and should be compatibly studied in case-control research design in the future.

### Limitation of study

The English literature, the SCOPUS and PubMed databases, and a smaller number of research documents including the term "Chest mobilization exercise" were the primary sources of this data citations. The absence of certain databases from this study, including Web of Science, etc., could have an impact on the findings. Furthermore, certain recently published research publications may not show up in the database because they are still in the publishing stage. For this reason, ongoing research should be done considering the compelling data. Therefore, it is not possible to assess the limitations of trend topic analysis and network clustering for upcoming research projects.

### Conclusion

Using the bibliometric method for unsupervised clustering and trending topic analysis, the bibliometric analysis of individual documents on "chest mobilization exercise" from 2005 to 2023 in the SCOPUS and PubMed databases reflect the global network clusters for future research related to other high-occurrence words like “chest mobilization exercise” in chronic lung disease and evaluating the parameters of lung function, dyspnea, muscle strength, quality of life, pulmonary rehabilitation, muscle training, or exercise tolerance in clinics with controlled study designs.

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**Conflict of Interest:** The authors declare no conflict of interest.

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