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Review article

Telehealth improves quality of life of COPD patients: systematic review and meta-analysis

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Abstract

Background: Telehealth is electronic information and telecommunications technology for medical personnel and doctors to handle patient health. This electronic information can include digital images, videos, or text files stored on a computer. Telehealth is beneficial for improving the general psychology of chronic patients. However, no assessment of the impact of telehealth on individuals suffering from chronic obstructive pulmonary disease has been done. As a result, in order to assess the impact of telehealth treatments on the quality of life of patients with chronic obstructive pulmonary disease, researchers reviewed the literature.

Methods: The inclusion criteria were articles published in open access in English between 2014 and 2023, with the full text of the original article. COPD patients were the participants in this study, the intervention was telehealth, the outcome was quality of life, and the research design was a randomized controlled trial. This review has been registered on Prospero, registration number CRD42024496062.

Results: The review was carried out in five databases: PubMed, Scopus, Proquest, Emerald Insight, and ScienceDirect. Articles that met inclusion criteria were assessed using the Joanna Briggs Institute Critical Appraisal Checklist. Data was synthesized using Review Manager version 5.4. Ten RCT studies (1,297 patients) met the inclusion criteria. This review showed that there was a significant effect on the quality of life after intervention using telehealth, with moderate heterogeneity of 70% [SMD = 0.27 CI 95%, (0.03, 0.50), (*P* 0.02)].

Conclusion: Telehealth interventions can improve patients' quality of life. Telehealth can be integrated into the medical service system to treat chronic obstructive pulmonary disease patients.

Keywords: COPD; Mobile application; Quality of life, Telehealth; Telenursing

Abbreviations:
COPD: Chronic Obstructive Pulmonary Disease; PIOS: Population, Intervention, Outcome, Study Design; RCT: Randomized Controlled Trial

Introduction

Chronic obstructive pulmonary disease (COPD) is inflammation of the lungs that lasts long term. COPD is generally characterized by difficulty breathing, coughing up phlegm, and wheezing (Yang et al., 2021). This is caused by inflammation in the lung parenchyma and respiratory tract due to dangerous particles (MacLeod et al., 2021). Modifications in the structure of the airways in COPD patients are caused by damage to the parenchyma and pulmonary fibrosis, which results in impaired respiratory flow (Eapen et al., 2021). WHO states that COPD is the third most elevated cause of passing in the world and is responsible for the passing of 3.23 million people in 2019.

All-inclusive, the predominance of COPD is anticipated to increase within the upcoming decades due to the growing number of smokers and the elderly populace. The global rate of COPD in 2017 was 251 million cases, of which 3.17 million were fatal. In the Asian region, the number of confirmed cases at the moderate to severe level reached an incidence rate of 6.3%, especially in 12 Asia Pacific countries. The prevalence of COPD in Indonesia, based on data from the Indonesian Ministry of Health in 2019, is 3.7% per one million population, with the highest prevalence at ages over 35 years (Li et al., 2020).

COPD is frequently experienced in elderly patients and is related to a few chance components such as smoking, air pollution, and age (Graziani and Tsakos, 2020).. Pathogenicity in sufferers is generally characterized by chronic inflammation and narrowing of the airways, as well as damage to the air sacs which results in shortness of breath (Prasad, 2020). Mild COPD sufferers do not usually experience symptoms, but this can be dangerous because if the risk factors for COPD are not avoided, the disease will progress. Symptoms experienced by COPD patients include shortness of breath, chronic cough (>2 weeks), cough with phlegm, increased shortness of breath, cough followed by sputum, and breathing accompanied by wheezing. Several non-specific symptoms are lethargy, weakness, insomnia, and depression. So it will affect the quality of life of COPD patients (Lu et al., 2021).

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Considering the large impact of COPD, researchers are trying to find new strategies for better and more cost-effective treatment of COPD patients, namely by utilizing information technology. One form of utilizing information technology to support health services and care management is telehealth (Jiang et al., 2022). Telehealth allows health services and care to be provided remotely, as well as the development of new interventions according to patient needs (Marcos et al., 2022). Telehealth practices can be applied to a variety of care domains, including telehealth for illnesses and emergencies, including outpatient care, call center services, and discharge planning, telehealth can be done by utilizing different online stages associated to electronic gadgets that collect and transmit wellbeing information patients such as wellbeing instruction, crucial signs, oxygen saturation, pulmonary function tests, or other symptoms from telehealth tools. Health officials will review this data and responded appropriately. Several developed countries have implemented telehealth in COPD care management (Gaveikaite et al., 2020).

Another systematic review has been carried out regarding the audit of the impact of telemedicine on the readmission of COPD patients. This review examines the effectiveness of interventions for COPD patients and identifies good findings for communicating with patients after hospital admission to avoid their readmission (Mashhadi et al., 2021). A previous systematic review by Ma et al. (2022) aims to determine the effectiveness of telemedicine but focuses on chronic diseases in general.

Therefore, there has not been a systematic review of the effectiveness of telehealth to provide a better understanding of these interventions. The researchers adopted a systematic review approach to determine the effectiveness of telehealth in improving the quality of life in COPD sufferers.

Materials and methods

Search strategy

The recommended reporting items for systematic reviews (PRISMA) standards were followed in this investigation. The review was registered in PROSPERO with registration number (CRD42024496062). The inclusion criteria were articles published in open access in English between 2014 and 2023, with the full text of the original article. COPD patients were the participants in this study, the intervention was telehealth, the outcome was quality of life, and the research design was a randomized controlled trial. Exclusion criteria were patients with psychiatric disorders, literature articles, systematic reviews, and scoping reviews. PubMed, Scopus, ScienceDirect, Proquest, and Emerald Insight were among the journal databases used as search tools. Keywords used by advanced search engines are shown in Table 1.

Table 1. Keywords used by advanced search engines

Data based	Search strategy	Hasil
Scopus	"COPD" AND "mobile application" OR telehealth AND "quality of life" AND "randomized controlled trial"	1.585
PubMed	((((“COPD”[Mesh]) AND “Telenursing”[Mesh]) OR “mobile application”[Mesh]) AND “Quality of Life”[Mesh]) AND “Randomized Controlled Trial”	86
Emerald	COPD AND (telenursing) OR (mobile health) AND (quality of life) AND (randomized controlled trial)	706
Science Direct	"COPD" AND "mobile application" OR Telenursing AND "quality of life" AND "randomized controlled trial"	351
ProQuest	COPD AND (telenursing) OR (telehealth) AND (quality of life) AND (randomized controlled trial)	825

Selection of relevant studies

To ascertain specific eligibility requirements for the study, the PIOS framework was utilized. The individuals in the population were adult COPD patients with diagnoses. Nurse-led telehealth refers to the continual education or counseling about managing one's own health that is arranged and provided by a nurse through a mobile app, website, or mobile phone. In this study, the intervention was compared to standard care, which was defined as a post-discharge face-to-face conversation with a physician or nurse, without any telehealth teaching. The patient is then educated, assisted, or counseled by the nurse after this operation.

After searching for the article then in the entry in EndNote X9 bibliography software and eliminating duplication, two reviewers independently screened the article titles and abstracts. The abstracts of selected articles were further analyzed. If there is doubt about including a research paper in the second stage of the paper selection, the author will review the entire paper (full text). If necessary, this is resolved by a discussion with other reviewers.

Critical appraisal

Two reviewers independently evaluated the methodological quality of the qualifying studies using data from the Joanna Briggs Institute (JBI) critical assessment reporting system. The reviewers of each study assigned a rating of "yes", "no", "unclear", or "not applicable" to each of the assessment tool's major criteria. To classify quality, and the JBI tool's proportion of "yes" responses to the critical evaluation findings is used to compute the overall score. The data extraction table contains the JBI Critical Evaluation Tool Checklist for Randomized Controlled Trials, which has a score greater than 70%. Gaps discovered during the research quality assessment process were resolved, if necessary, through discussions with other reviewers.

Synthesis data

A narrative synthesis was carried out to describe the collected studies. The mean value and standard deviation of the post-intervention findings were provided as the results of a meta-analysis that further synthesized the possible research. Standardized mean differences (SMD) were computed to quantify the effect of the intervention on the experimental group compared to the control group when studies employed various outcome measures. The impact of telehealth on COPD patients' quality of life was statistically analyzed using Review Software Review Manager (version 5.4.1). Analyzing and computing the I^2 test allowed for the statistical determination of the heterogeneity of the included research. Value range: 25–74% for medium, 75–100% for high. In the systematic review, P Value < 0.05 was used as the threshold for statistical significance.

Results

Study selection

The literature search yielded 3,553 items that were located in the database. 3,166 items remained after duplicates were eliminated. After titles and abstracts were reviewed, 3,129 papers were eliminated. During the full-text examination, 26 articles were excluded because the population, intervention, outcome, and study design did not match those to be reviewed. Researchers then carried out a quality assessment of 11 articles and excluded 1 article that had a score of less than 70%. The systematic review contained ten papers in total that satisfied the inclusion criteria (Diagram 1).

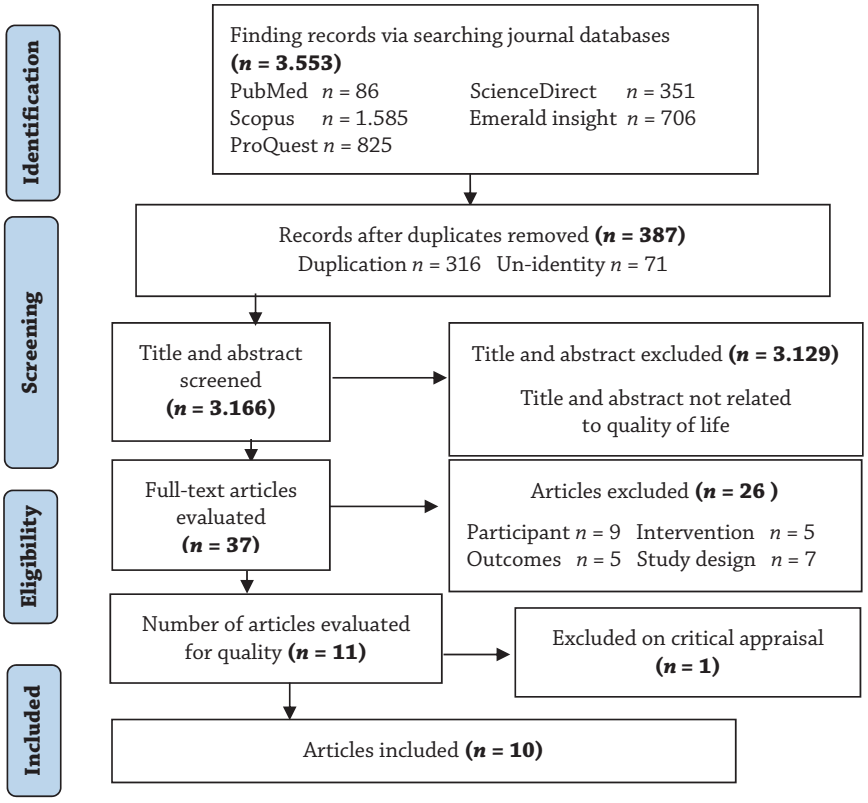

Diagram 1. PRISMA diagram

The following is a list of JBI Critical Appraisal Items for Studies of RCTs: Q1: Did participants' assignment to treatment groups follow genuine randomization? Q2: Was the assignment to treatment groups kept a secret? Q3: At baseline, were treatment groups comparable? Q4: Were participants unaware of their assigned treatment? Q5: Were those administering the therapy unaware of the assignment of the treatment? Q6: Aside from the intervention of interest, were treatment groups handled in the same way? Q7: Did outcome assessors overlook the assignment of treatments? Q8: Did treatment groups' results get the same measurements? Q9: Were results measured in an accurate manner? Q10: Was there any follow-up, and if not, was the reason for the variations in follow-up across the groups sufficiently examined and explained? Q11: Were the individuals examined within the groups they were assigned at random? Q12: Did the right statistical analysis come into play? Q13: Was the trial design adequate, and were any deviations from the standard RCT design like parallel groups and individual randomization taken into consideration during the conduct and analysis of the study?

Table 2. Critical appraisal

Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13
Boer et al. (2019)	Y	Y	Y	Y	U	Y	U	Y	Y	U	Y	Y	Y
Farmer et al. (2017)	Y	Y	Y	N	Y	Y	Y	Y	N	Y	U	Y	Y
Moy et al. (2016	Y	Y	N	Y	Y	Y	U	Y	Y	N	Y	Y	Y
Tabak et al. (2015)	Y	Y	Y	Y	Y	N	Y	Y	Y	U	Y	Y	U
Tupper et al. (2018)	Y	Y	Y	Y	U	U	Y	N	Y	Y	Y	Y	Y
Tabak et al. (2014)	Y	Y	Y	N	N	Y	Y	Y	Y	Y	U	Y	Y
Spielmanns et al. (2023)	Y	Y	Y	Y	Y	Y	N	Y	Y	U	Y	Y	Y
Walker et al. (2018)	Y	Y	Y	Y	N	U	Y	Y	Y	Y	Y	Y	Y
Park et al. (2020)	Y	Y	Y	N	Y	Y	Y	N	Y	Y	Y	U	Y
Wang et al. (2021)	Y	Y	Y	N	Y	Y	Y	Y	N	U	Y	Y	Y

Note: Y, yes; N, no; U, unclear.

Sample characteristics

The study involved 1,297 participants who were randomly divided into 731 intervention group participants and 566 control group participants. This review consists of various countries including the Netherlands *n* = 3, China *n* = 1, Denmark *n* = 1, Korea *n* = 1, Switzerland *n* = 1, US *n* = 1, UK *n* = 2. There were 10 articles about different types of telehealth interventions, 7 articles about mobile applications, 3 articles using the web. Intervention frequency for included studies was 3 to 12 months. Study participants were patients with COPD; most interventions have been shown to significantly improve patients' quality of life.

Ten RCT studies met the inclusion criteria in Chart 1. With a high heterogeneity of 70%, the overall review analysis demonstrated a large impact on quality of life after telehealth interventions. Because the research instruments were different, the Standard Mean Difference was used [SMD = 0.27 CI 95%, (0.03, 0.50), (*P* 0.02)]. Funnel plot analysis showed that there was low bias in the 10 studies (Chart 2).

	Experimental			Control					
Study	**Mean**	**SD**	**Total**	**Mean**	**SD**	**Total**	**Weight**	**Std. Mean Difference IV. Random 95% CI**	**Std. Mean Difference IV. Random 95% CI**
Moy et al., 2016	45.6	15.4	154	46.8	15.6	84	13.5%	–0.08 [–0.34, 0.19]	
Walker et al., 2018	0.63	0.225	154	0.64	0.248	158	14.3%	–0.04 [–0.26, 0.18]	
Boer et al., 2019	0.79	0.16	35	0.77	0.21	41	10.1%	0.10 [–035, 0.56]	
Park et al., 2020	50.1	8.33	22	49.03	11.02	20	7.7%	0.11 [–0.50, 0.71]	
Tupper et al., 2018	0.761	0.107	141	0.728	0.121	140	14.1%	0.29 [0.05, 0.52]	
Wang et al., 2021	20.4	6.7	37	18.3	5.4	36	9.9%	0.34 [–0.12, 0.80]	
Farmer et al., 2017	0.08	0.21	93	0.01	0.19	48	12.0%	0.34 [-0.01, 0.69]	
Tabak et al., 2015	2	0.8	14	1.8	0.1	15	6.2%	0.35 [–0.39, 1.08]	
Spielmanns et al., 2023	4.72	1.31	30	4.19	1.18	30	9.1%	0.42 [–0.09, 0.93]	
Tabak et al., 2014	0.81	0.03	12	0.72	0.03	12	3.0%	2.90 [1.70, 4.10]	
Total (95% CI)			**692**			**584**	**100.0%**	**0.27 [0.03, 0.50]**	
Heterogenity Tau² = 0.08, Chi² = 30.26, df = 9 (*P* = 0.0004); I² = 70%									
Test for overall effect Z = 2.25 (*P* = 0.02)									

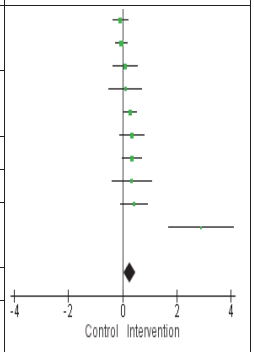

Chart 1. Forest plot

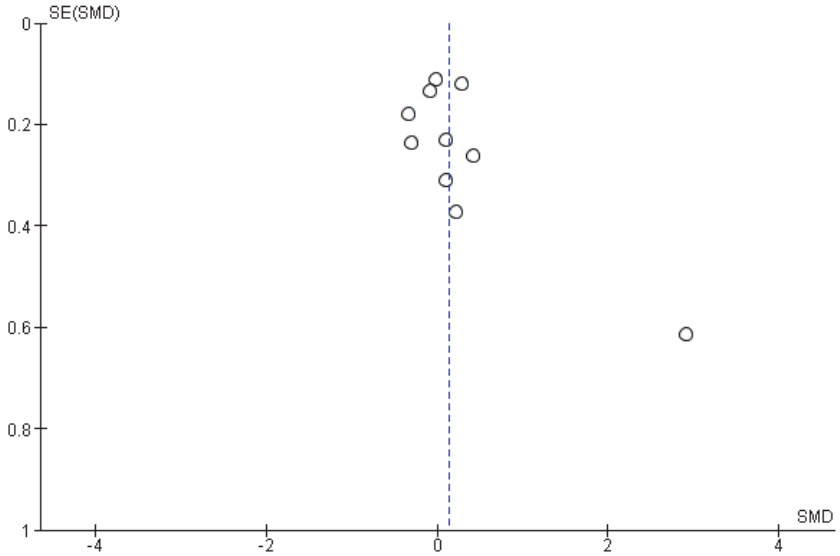

Chart 2. Funnel plot

Table 3. Data extraction

Author (year), country	Design	Participant		Disease type	Intervention	Control group	Measurement tools	Outcome
		E/C	Mean age. total E/C					
Boer et al. (2019) Belanda	RCT	Experiment *n* = 43 Control *n* = 44	Experiment 69.3 (8.8) Control 65.9 (8.9)	COPD	mHealth which contains information about the use of bronchodilators, breathing techniques, cough techniques, how to measure a pulse oximeter, spirometer and a column for consultations regarding health conditions. This intervention was carried out over 12 months and instructed patients to use the application whenever they experienced complaints/ symptoms related to the disease.	Usual care is about 20 minutes of nurse-led self-management based on the Dutch edition of Living Well with COPD.	EuroQol-5 (EQ-5d) measures quality of life	It has not been demonstrated that mHealth treatments considerably increase quality of life.
Farmer et al. (2017) UK	RCT	Experiment *n* = 110 Control *n* = 56	Experiment 69.8 (9.1) Control 69.8 (10.6)	COPD	Using the EDGE application, which offers education and videos about inhaler techniques, pulmonary rehabilitation exercises, self-management techniques for dyspnea, daily monitoring of physiological symptoms, and a consultation column regarding complaints experienced, the intervention was implemented for a duration of 12 months.	Usual care uses pamphlets using EDGE technology, but without using a tablet computer and routine observation.	EuroQol-5 (EQ-5d) measures quality of life	It has been demonstrated that the EDGE Application intervention considerably raises quality of life.
Moy et al. (2016) US	RCT	Experiment *n* = 155 Control *n* = 84	Experiment 67 (8.6) Control 66.4 (9.2)	COPD	Directed to wear a pedometer daily, prompted to send step counting data to the website once a month, and requested to report any negative incidences Established goals, comments, fresh stuff for motivation and education, Internet-based discussion board.	Directed to wear a pedometer every day, prompted to send step-counting data to the website once a month, and requested to report any unfavorable occurrences.	St. George's Respiratory Questionnaire Total Score (SGRQ-TS).	The quality of life was significantly improved by the Internet-Mediated Pedometer during the 4-month follow-up.
Park et al. (2020) Korea	RCT	Experiment *n* = 23 Control *n* = 21	Experiment 70.45 ± 9.40 Control 65.06 ± 11.12	COPD	Smartphone app intervention containing COPD education, exercise, self-monitoring, and social support. This intervention was carried out for 6 months.	Usual care for COPD.	Short-Form 36-Item.	Smartphone app interventions have been shown to produce positive changes to QoL.
Spielmanns et al. (2022) Swiss	RCT	Experiment *n* = 33 Control *n* = 34	Experiment 66.1 (6.8) Control 62.7 (8.2)	COPD	Health education and breathing exercises are included in the Kaia COPD intervention app. Promising effects in CAT and HRQoL were observed after a 20-day intervention in patients with severe COPD symptoms, according to the Kaia application feasibility trial. Someone with training called to discuss and evaluate study intervention compliance.	Usual care for COPD.	(CRQ) is the most commonly used disease-specific measurement tool to assess QoL.	It has been demonstrated that the Kaia COPD app intervention greatly enhances the quality of life for COPD patients.

Table 3. ***(continued)***

Author (year), country	Design	Participant		Disease type	Intervention	Control group	Measurement tools	Outcome
		E/C	Mean age. total E/C					
Tabak et al., (2015) Belanda	RCT	Experiment $n = 15$ Control $n = 14$	Experiment 64.1 ± 9.0 Control 62.8 ± 7.4	COPD	Telehealth for self-treatment of COPD exacerbations, online exercise regimens, teleconsultations, and a real-time physical activity trainer are all components of telehealth intervention, a blended treatment for COPD patients. For nine months, this intervention was implemented.	Usual care for CPD	EuroQol-5 (EQ-5d) measures quality of life.	Patients with COPD have demonstrated considerable improvements in their quality of life using telehealth therapy.
Tupper et al. (2018) Denmark	RCT	Experiment $n = 141$ Control $n = 140$	Experiment 69.8 (9.0) Control 69.4 (10.1)	COPD	A telehealth tablet that has a webcam, microphone, and measuring tools such as a weight, pulse oximeter, and respirometer. Patients report variations in the color, volume, and dyspnea of their sputum on the tablet computer. During the first four weeks of the trial, measurements of body weight, oxygen saturation, and lung function were done once a week; after that, they were done every four weeks. For six months, 16 weekly consultations with other measures, but no video was conducted.	Usual care for COPD.	15D QoL questionnaire to measure quality of life.	Patients with COPD have significantly and clinically improved quality of life because of telehealth therapy.
Tabak et al. (2014) Belanda	RCT	Experiment $n = 18$ Control $n = 16$	Experiment 65.2 ± 9.0 Control 67.9 ± 5.7	COPD	Telerehabilitation intervention with an exercise trainer for four weeks, at least four days a week, from the time of wake-up until 22.00. The baseline measures must be obtained in the first week, and then participants receive feedback for three weeks to adjust their behavioral actions. When baseline measurements were being taken, participants were asked to carry on with their regular activities.	Usual care for COPD.	Clinical COPD Questionnaire (CCQ).	Health status improved significantly in the intervention group.
Wang et al. (2021) China	RCT	Experiment $n = 39$ Control $n = 39$	Experiment 63.2 ± 7.5 Control 64.4 ± 7.0	COPD	Three components make up the mobile health intervention (Online Appendix): I am aware of COPD. Participants can get information and knowledge help from this module. This lesson gives learners visual assistance to help them learn how to manage the illness. providing participants with inspirational assistance through a peer support chat room and an expert help site	Standard nursing care, including health education (*e.g.*, continuing physical exercise three to five times a week, taking medication), at the time of release.	Test for COPD Assessment (CAT). Survey to evaluate the quality of life effects of COPD.	It has been demonstrated that using mobile health applications, COPD patients' health-related quality of life may be improved.
Walker et al. (2018) UK	RCT	Experiment $n = 154$ Control $n = 158$	Experiment 71.0 Control 71.0	COPD	For nine months, the telemonitoring intervention made daily use of the CHROMED monitoring platform. The platform is made up of a touchscreen computer, a cellular modem, and a device that uses an FOT to detect respiratory mechanical impedance.	Usual care for COPD.	EuroQol-5 (EQ-5d) measures quality of life	It has been demonstrated that telemonitoring intervention considerably improves quality of life.

Discussion

This review looks at how people with chronic obstructive lung disease can live better thanks to telemedicine. Ten studies were analyzed and synthesized to determine the impact of the intervention. Our meta-analysis showed that following the intervention, patients' quality of life significantly improved. These results are consistent with other evaluations of the literature on how telemedicine might help asthma patients live better lives. Additionally, patients with chronic obstructive pulmonary disease improved their self-management after receiving telemedicine care, which enhanced their overall quality of life (Chongmelaxme et al., 2019). Virtual clinics, disease-related information, and psychological support were offered in both trials. This demonstrates how people with chronic obstructive lung disease can have a higher quality of life when they use telemedicine. After the intervention, the quality of life improved in ten of the included trials. The interventions include teaching about chronic obstructive pulmonary disease, tracking patients' physical activity, ensuring that medications are taken as prescribed, keeping an eye on their vital signs, and providing information to increase health literacy.

Virtual self-monitoring is done so that patients can access it from a distance. Through m-health apps, telehealth may facilitate modifications in health-related behavior and also offer a more comprehensive picture of the patient's state. Applications are helping to increase patient physical activity monitoring, however further study is required to identify the concentration of patient physical activity (Franssen et al., 2020). According to our review, telehealth improved patients' quality of life. The increase in health behavior following the use of m-health is consistent with earlier systematic review findings demonstrating that enhanced health behavior will lead to a higher quality of life. One of the included studies revealed that patients often accessed content with a health behavior education theme. However, as recommended by Lewinski et al. (2022), the use of telehealth should be viewed as an adjunctive intervention to in-person nursing treatments.

Consequences and restrictions

This systematic review has many restrictions. First of all, the blinded participant system degraded the quality of this review. Secondly, the included studies varied in terms of the frequency and type of telehealth treatments they contained, which might have introduced heterogeneity and affected the data that was gathered. Third, the variety of research that is now accessible restricts the investigation of effect mechanisms. Thus, to precisely understand the processes behind the impacts of telemedicine, high-quality randomized controlled trials and rigorous telehealth criteria are required. The results of an analysis of 10 included studies suggest that telehealth therapy can improve the quality of life for individuals with chronic obstructive pulmonary disease.

Conclusion

Our meta-analysis showed that telehealth can help individuals with chronic obstructive pulmonary disease live better lives. In this way, it is similar to quantitative synthesis, which has been shown to improve the quality of life of patients with chronic obstructive lung disease. The evidence quality varies from moderate to excellent. However, the conclusions should be interpreted with caution because there is still variation in the frequency and substance of telehealth standards. To examine the effects of therapies, telehealth has to be further standardized.

Author contributions

HA: Search for relevant literature, collection of data, statistical analysis, idea, design, and production of the article. *EMR:* Evaluation of the text and final approval of the published version. Each author oversees the content and index script, and has critically examined and approved the final draft.

Ethical aspects and conflict of interest

The authors have no conflict of interest to declare.

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