Systematic Review

Education on Inhaler Technique by Pharmacists To Improve The Quality of Life of COPD Patients: A Systematic Review and Meta-Analysis

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Abstract

Background: This systematic review aimed to analyze the importance of education on using inhalers by pharmacists in improving quality of life, correct inhaler use steps, and medication adherence in patients with Chronic Obstructive Pulmonary Disease (COPD).

Methods: The databases used to search for articles in this systematic review include Scopus, ScienceDirect, and Pubmed. The papers submitted were published between 2009 and 2022, with the most recent search being conducted in December 2022. This review included a randomized controlled trial evaluating education on inhaler use techniques by pharmacists to improve COPD patients' quality of life in inpatient and outpatient settings. This systematic review follows the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) writing guidelines.

Results: This systematic review used six articles from five different countries. The articles involved share similar characteristics so that analysis can be carried out. The total number of research subjects included was 913 subjects. Most studies show an increase in the quality of life among COPD patients who are given education on how to use inhalers by pharmacists using print or digital media. Measurements using the St. George's Respiratory Questionnaire (SGRQ) showed a decrease in scores at the 6-month and 12-month periods (-0.75 [95% CI = (-1.46) - (-.005)]. Furthermore, two articles reported that education on the technique of using inhalers by pharmacists can also increase the accuracy of using inhalers, and three articles reported increasing medication adherence.

Conclusion: Interventions such as education on using inhalers by pharmacists in inpatient and outpatient settings can improve the quality of life of COPD patients, the accuracy of the steps in using inhalers, and medication adherence.

Keywords: COPD, hospital pharmacist, inhaler technique education

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INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a heterogeneous lung condition characterized by chronic respiratory symptoms (shortness of breath, coughing, sputum production) caused by abnormalities of the respiratory tract (bronchitis/bronchiolitis) and alveoli (emphysema), resulting in persistent, progressive, and airway obstruction.[1] COPD is a leading cause of death and disability worldwide. According to The Global Burden of Disease Study 2019, COPD is the sixth leading cause of death, up from 11th in the previous ranking.[2] COPD prevalence reached 212.3 million in 2019, with 3.3 million deaths and 74.4 disability-adjusted life years (DALYs).[3] The rise in COPD cases worldwide can be attributed to various risk factors, including smoking status, cigarette smoke exposure, occupational exposure to particulates, gases, and smoke, household air pollution from solid fuels, ambient ozone pollution, and low and high temperatures.[4]

Chronic obstructive pulmonary disease prevalence is expected to rise in the coming years, and the World Health Organization predicts that COPD will be the third leading cause of death in the world by 2030.[5,6] Based on this, effective COPD management in the form of lifestyle changes and long-term commitment to treatment in patients already receiving treatment is required to prevent increased morbidity.[5,7]

According to the Global Initiative for Chronic Obstructive Lung Disease (GOLD), inhalation therapy

is the primary treatment recommended to improve symptoms in COPD. Several studies have found that poor adherence to inhaler use is caused by inappropriate use of inhalers and poor inhalation techniques. Non-compliance with inhalation therapy results in decreased lung function, more exacerbations, and an increased risk of hospitalization.[8,9]

According to one study, data on non-adherence to therapy in COPD patients reached 79.4% of 504 patients, and only 6.3% of 765 patients can use inhalers properly.[10,11] Therefore, education in inhaler use plays a vital role in managing COPD patients. It should be emphasized that patient education about inhaler use is carried out when prescribing inhaler devices, and it is recommended that inhaler use be assessed at each visit. Repeated education and assessments are required to maintain proper inhalation technique and patient compliance regularly.[9,12]

Only one systematic review with a randomized controlled trial study reported that the pharmacist's role in the hospital has contributed to various aspects of COPD management, both inpatient and outpatient.[13] Therefore, this systematic review aimed to evaluate specifically the impact of providing education on the technique of using inhalers by hospital pharmacists in improving the quality of life of inpatient and outpatient COPD patients. The purpose of selecting inpatients and outpatients is to assist patients in enhancing treatment safety, patient outcomes, and drug quality over time and to prevent readmissions in inpatient settings.[14,15]

METHODS

Search databases such as Pubmed, ScienceDirect, and Scopus were used to search literature. The articles in this search were those published in 2009-2022, with the last examination in December 2022. The combination of keywords used in the investigation in this article were Pharmacy, COPD, Inhaler, Hospital, Outpatient, and Quality of life.

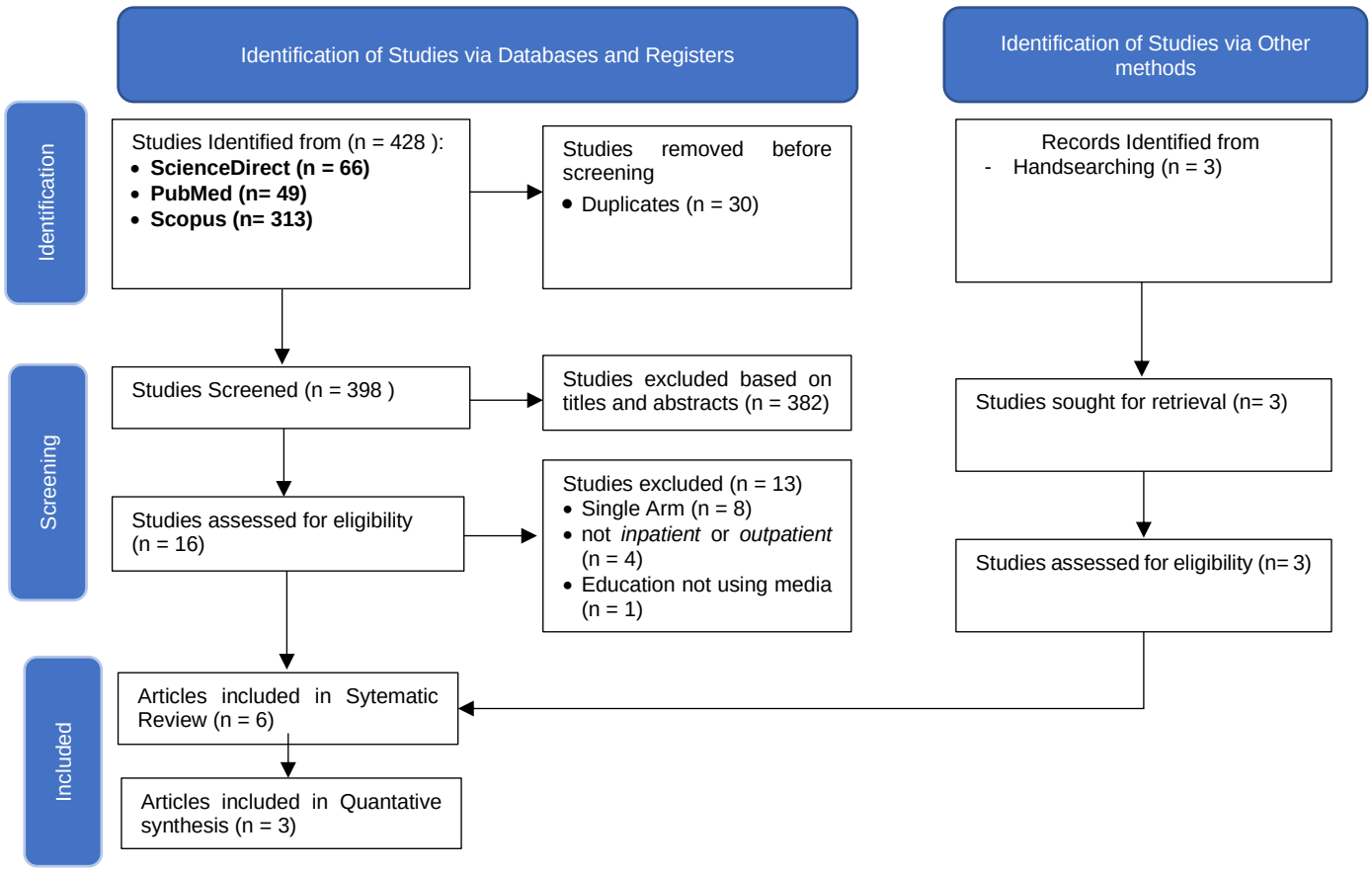

Figure 1. PRISMA Flowchart

The inclusion criteria used in this review were the PICO criteria as follows:

a. Participation/Population: COPD inpatients and outpatients
b. Intervention/Exposure: Pharmacists provide verbal or face-to-face instruction on the proper use of inhalers, supplemented by leaflets, videos, and other media.
c. Comparator/Control: Education on inhaler use techniques by pharmacists only verbal or face-to-face.
d. Outcome: The primary outcome is assessing the quality of life of COPD patients using the COPD Assessment Test (CAT), St. George Respiratory Question (SGRQ), and Other Instruments of Quality of Life. The secondary outcomes in this systematic review are correct inhaler technique and medication adherence.

The exclusion criteria set in this review were non-English speaking articles, non-open access articles, non-original research articles, and non-randomized controlled trial (RCT) articles.

Two reviewers (SA and VP) extracted all research articles using Microsoft Excel and Mendeley. Differences in data extraction were resolved by the third reviewer (RS). The reviewers screened the articles that met the inclusion and exclusion criteria set by agreement with a Kappa value of 0.86. The data extraction process was then depicted in the flowchart of The Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA), as listed in Figure 1.

To reduce the risk of bias, the stages of article screening are carried out by two independent reviewers using The Medical Education Research Study Quality Instrument (MERSQI) Score.[16] The Medical Education Research Study Quality Instrument (MERSQI) can be used to assess the quality of experimental studies. It consists of ten items with six domains of study quality. The domain of study quality encompasses study design, sampling, data type (subjective or objective), validity, data analysis, and results. The maximum score for each domain is 3, with a top score of 18, and the possible scores range from 5 to 18.[17]

The studies included in this review were summarized using the narrative description method. This review focused on improving the quality of life in COPD patients who receive education on using inhalers via media such as leaflets or videos. The quality of life assessment instruments used were the St-George Respiratory Questionnaire (SGRQ) and the COPD Assessment Test (CAT). In the CAT and SGRQ assessment instruments, COPD patients are said to have a good quality of life if their CAT and SGRQ scores are low, with a maximum CAT score limit of 40 points and an SGRQ score limit of 100 points.

We analyzed the RCT data using Review Manager 5.4 (RevMan 5.4.1), which was made available by Cochrane. Analyzed data consists of continuous data measured using Standardized Mean Difference (SMD). Standardized Mean Difference (SMD) was utilized because the included studies collected data at different scales or units. Subsequently, using the random-effects method, observe the effect. Quantitative evaluation of heterogeneity using Cochrane I^2 statistics. A random effects model is applied if I^2 is greater than 50 percent, indicating statistically significant heterogeneity; otherwise, the effects model is maintained. We performed subgroup analysis in high heterogeneity (I^2 >50%) to identify good heterogeneity causes.

RESULTS

Based on article searches through database searches, 428 articles were obtained, and three were obtained through other search methods. The search for these articles yielded six articles that met the PICO criteria established in this review. The articles included in this study had good agreement reached by three reviewers (SA, VP, RS) with a Kappa value of 0.86. The study quality was examined using The Medical Education Research Study Quality Instrument (MERSQI) Score and is presented in Table 1. Based on the assessment of study quality using the MERSQI score, six studies included in this review received an average score of 14. This score falls within the MERSQI's potential range of 5–18.[17]

Table 1. Results of The MERSQI Score

Domain	MERSQI Item	Score	Wang et al, 2020	Suhaj et al, 2015	Xin et al, 2016	Khdour et al, 2009	Jarah et al, 2011	Kebede et al, 2022
Study Design	Single-group cross-sectional or single-group post-test only	1						
	Single group pre-test & post-test	1.5						
	Non Randomized, two groups	2						
	Randomized Controlled Trial	3	✓	✓	✓	✓	✓	✓
Sampling	Institutions studied :							
	1	0.5	✓	✓	✓	✓	✓	✓
	2	1						
	3	1.5						
	Respons rate, %							
	Not applicable	-						
	<50 or not reported	0.5						
	50-74	1						
	≥75	1.5	✓	✓	✓	✓	✓	✓
Type of Data	Assessment by participants	1	✓	✓	✓	✓	✓	✓
	Objective measurement	3						
Validity of Evaluation Instrument	Internal structure							
	Not applicable	-						
	Not reported	0						
	Reported	1	✓	✓	✓	✓	✓	✓
	Content							
	Not applicable	-						
	Not reported	0						
	Reported	1	✓	✓	✓	✓	✓	✓
	Relationships to other variables							
	Not applicable	-						
	Not reported	0	✓	✓	✓	✓	✓	✓
	Reported	1						
Data Analysis	Appropriateness of analysis							
	Inappropriate for study design or type of data	0						
	Appropriate for study design or type of data	1	✓	✓	✓	✓	✓	✓
	Complexity of analysis							
	Descriptive analysis only	1						
	Beyond Descriptive analysis	2	✓	✓	✓	✓	✓	✓
Outcome	Satisfaction, attitudes, perceptions, opinions, general facts	1						
	Knowledge, skills	1.5						
	Behaviors	2						
	Patient/health care outcome	3	✓	✓	✓	✓	✓	✓
	Total Possible score	18	14	14	14	14	14	14

The studies in this review were conducted in various countries, including India, Ireland, Jordan, Norway, and China. All of the studies used a randomized study design with two groups. All subjects in the study had been diagnosed with COPD using the Global Initiative for Chronic Obstructive Lung Disease (GOLD) criteria and were over 45 years old. The COPD Assessment Test (CAT) and St. George's Respiratory Questionnaire (SGRQ) were used in all studies to assess COPD patients' quality of life.

Table 2 displays data from the articles used in this review on the characteristics of COPD patients. According to the table, several articles are missing economic conditions, education level, type/level of work, and smoking status.

Table 2. Characteristics of COPD Patients

Authors	Location	Setting	COPD risk factors (excluding age)			
			Education	Type/Level of Work	Economic Conditions	Smoking Status
Khdour et al, 2009[18]	Northern Ireland	*Outpatient*	Moderate (71.70%)	Lower (63.55%)	n/a	Ex-Smokers (65.30%)
Jarab et al, 2012[19]	Jordan	*Outpatient*	Lower (90.20%)	Lower (60.15%)	n/a	Current Smokers (56.55%)
Suhaj et al, 2015[20]	India	*Outpatient*	n/a	n/a	Lower (36.60%)	Current Smokers (55.35%)
Xin et al, 2016[21]	China	*Outpatient*	Lower (70.45%)	n/a	n/a	Current Smokers (74.40%)
Wang et al, 2020[22]	China	*Outpatient*	Lower (47.00%)	n/a	n/a	n/a
Kebede et al, 2022[23]	Norway	*Inpatient*	n/a	n/a	n/a	n/a

Table 3. The Outcome of Quality of Life Using St. George Respiratory Questionnaire (SGRQ)

Authors	Type of Intervention	Time	Control Group*	Intervention Group*	*P*
Khdour et al, 2009[18]	Booklet regarding the use of inhalers and COPD management	Baseline	64.20	63.60	0.690
		Six months	64.20	59.20	0.040
		12 months	65.30	61.80	0.170
Jarab et al, 2012[19]	Booklets regarding the use of inhalers and knowledge about COPD	Baseline	44.80	45.20	0.760
		Six months	42.70	42.30	0.510
Suhaj et al, 2015[20]	Patient Information Leaflets (PILs)	Baseline	50.60	50.90	0.949
		Six months	49.20	47.20	0.618
		12 months	52.40	42.70	0.024
Xin et al, 2016[21]	Inhaler use educational leaflet Face to face COPD related education	Baseline	68.40	68.50	0.913
		Six months	68.30	61.70	0.001
		12 months	67.80	61.62	0.001
		18 months	68.50	61.31	0.001
		24 months	68.50	60.40	0.001

Note: *SGRQ Total Score

Table 4. The Outcome of Quality of Life Using COPD Assessment Test (CAT)

Authors	Type of Intervention	Control Group*			Intervention Group*		
		Pre	Post	*P*	Pre	Post	*P*
Wang et al, 2020[22]	Brochures regarding COPD and how to use inhalers Video of inhaler use is sent to the patient's cell phone	19.39	18.44	0.461	19.81	15.67	0.021
Kebede et al, 2022[23]	Information sheet regarding inhalers, such as effects (reliever/controller), onset, side effects that often arise, and techniques for using inhalers	24.00	24.00	>0.05	29.00	25.50	0.290

Note:*CAT Total Score

Two studies measured the quality of life instrument with the CAT and four studies with the SGRQ. Research conducted by Jarab et al, Khdour et al, Suhaj et al, and Xin et al showed improved quality of life based on an assessment using the SGRQ instrument.[18–21] However, the increase in quality of life in the study conducted by Jarab et al was not significant.[19]

Other studies conducted by Wang et al and Kebede et al reported that providing education on the use of inhalers using videos or information sheets can improve the quality of life in COPD patients as assessed by the CAT instrument.[22,23] Kebede et al reported a decrease in the median CAT value of the intervention group between baseline and two months following discharge by 3.5 points. However, this result was not statistically significant compared to the control group two months after discharge (P>0.05).[23] Meanwhile, Wang et al reported a substantial decrease in the average CAT score in the intervention group of 4.15 points (P<0.05) compared to the control group, which showed no significant differences between the pre-and post-intervention periods (P>0.05).[22]

The subgroup meta-analysis was conducted between different measurement instruments and assessment periods. Due to the limited availability of studies analyzed using the CAT instrument, subgroup analysis was exclusively conducted utilizing the SGRQ instrument. According to the results of the analysis, administering the intervention can substantially reduce the SGRQ score during the 6th and 12th month assessment periods (-0.75 [95%

CI (-1.46–(-.005)]. The effect of subgroup analysis on I^2 scores was insignificant (Figure 2).

In this systematic review, two studies reported data related to the accuracy of inhaler use technique accuracy in COPD patients. Wang et al found a statistically significant difference between the control and intervention groups after administering the intervention (P<0.05).[22] In contrast, Kebede et al found no statistically significant differences between the intervention and control groups (P>0.05) when the intervention was administered to both groups.[23]

A total of three studies reported medication adherence data on COPD patients. Two methods are used to measure medication adherence, including the medication refill adherence method, which was used in one study, and the Morisky Scale method, which has been used in two studies.[18,19,21] Khdour et al and Jarab et al reported that there was a statistically significant difference (P<0.05) in measuring medication adherence using the Mosrisky scale method after intervention in the control and test groups.[18,19] Xin et al showed similar results using the medication refill adherence method.[21]

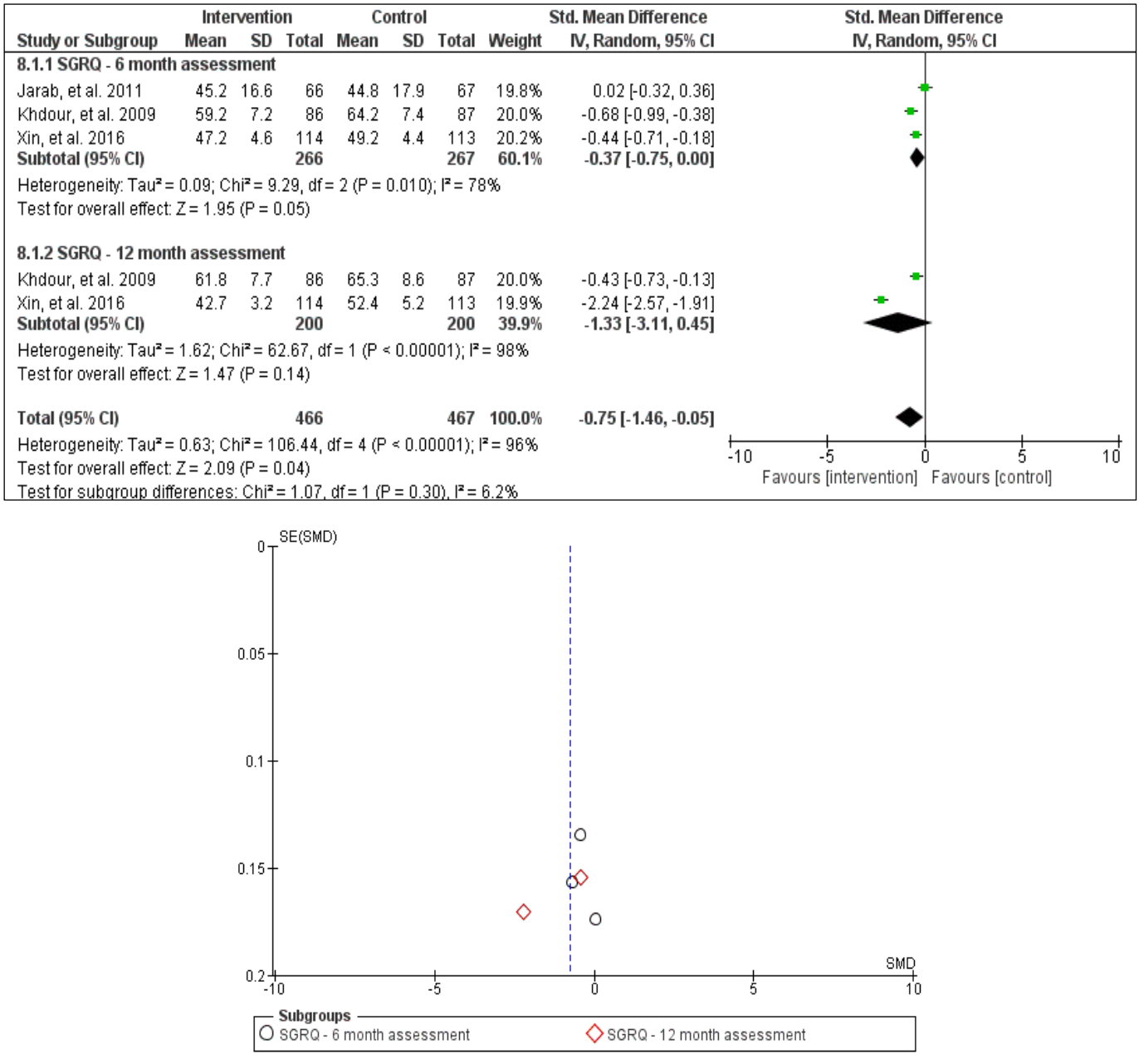

Figure 2. Forest Plot and Funnel Plot of Quality of Life by SGRQ instrument

DISCUSSION

Six articles met the criteria for inclusion and exclusion based on the systematic review's inclusion and exclusion rules. The studies in this systematic review share similar results, even though they were conducted at six locations. This is by data from The Global Burden of Disease Study 2019, which states that the risk factors for COPD include smoking, exposure to cigarette smoke, household air pollution from solid fuels, ambient particulate matter, ozone, and occupational particles.[4]

Four studies used the SGRQ instrument to measure the quality of life of COPD patients, and 2 studies used the CAT instrument to evaluate COPD patients' quality of life.[18–23] GOLD recommends both of these instruments in measuring the quality of life of COPD patients. Compared to the CAT, which only has 8 question items, the SGRQ instrument has 50 more complex questions. Although the question items from the two instruments differ, they have a strong correlation (r=0.73–0.80).[24,25] One study using the CAT instrument showed a non-significant improvement in QoL at the 2-month follow-up period (P>0.01).[23]

A total of 3 studies measuring the quality of life using the SGRQ instrument showed insignificant results at a specific follow-up period.[18,19,21] The occurrence of a negligible improvement in quality of life could be caused by several factors, including small sample size, short follow-up duration, repeated education during the follow-up period, whether or not additional educational materials were provided in addition to inhaler use techniques, the level of education, and socioeconomic conditions.[18,19,26,27]

In the original research reported in this systematic review, three articles reported outcomes regarding medication *adherence.*[18,19,21] Medication Adherence is one of the critical factors in suppressing COPD progression, which can also increase mortality and readmission.[28] Of the three articles, two used the Morisky Scale method, while another used medication refill adherence. These three studies showed that pharmacist interventions could significantly increase adherence in COPD patients (P<0.05). This shows similar results to those of Nguyen et al that interventions provided by pharmacists can improve compliance over time.[29]

Adherence in COPD patients can be influenced by three main factors, including medication, unintentional, and intentional. Drug factors are those that are directly related to the drug, such as drug side effects and the ease of inhalers, as well as the correct inhalation technique, which can be difficult for patients to acquire, and other factors that are essential for achieving the optimal inhalation therapy.[30] Intentional factors are non-adherence caused by patient intent, including patient perceptions that treatment is unnecessary, resistance to treatment, inappropriate expectations, focus on side effects, cultural or religious issues, and costs. Unintentional factors include unintentional patient misperceptions of therapy, such as costs, forgetting to take medications, and misinterpreting inhaler usage instructions inhaler.[31]

In this systematic review, two studies reported outcomes using the correct technique of inhalers. A study conducted by Wang et al showed an improvement in the accuracy of using inhalers in the intervention group after monthly education was carried out during the follow-up period (P<0.01).[22] Meanwhile, a study conducted by Kebede et al showed no significant difference between the control and intervention groups in terms of increasing the accuracy of the inhaler technique (P>0.05).[23]

Based on the two articles, there is a finding that repeating education at each visit can improve patients' understanding of how to use inhalers correctly. The two articles provide the same results regarding the steps of inhaler use, which often lead to inhaler misuse. The steps that often cause mistakes are standing straight before using the inhaler, breathing before using the inhaler, and holding breath after inhaling the inhaler. These errors affect effective drug inhalation and increase the risk of hospitalization or emergency room visits.[32]

The final results of our systematic review highlight the significance of hospital pharmacists in administering COPD treatment, with potential implications for medication adherence, inhaler

accuracy, and COPD patients' quality of life. This systematic review updates the previous evaluation by adding a 2022 RCT study. We compare the provision of education by pharmacists in inpatient and outpatient settings to improve quality of life, appropriateness of inhaler use, and treatment adherence in COPD patients. According to our most recent study, there was no discernible difference between the control and the intervention groups regarding pharmacist education to reduce readmissions over the 12-month follow-up period (P=0.30).[23]

This is due to an imbalance in patient characteristics between the control and intervention groups. The intervention group had more study subjects who had readmissions in the last year, a large number of inhalers used, high CAT scores, and many had comorbidities compared to the control group. Some patients had a comorbid disease, and the cause of readmission was pneumonia (n=1), non-infectious exacerbation of asthma (n=1), pleural effusion (n=1), scheduled invasive test (n=4), congestive heart failure (n=1), fall (n=1), erysipelas (n=1), chest pain (n=1), and atherosclerosis (n=1).

LIMITATION

The limitations of this systematic review are the limited research on hospital pharmacists or clinical pharmacists regarding education on inhaler use and COPD management in outpatients and inpatients involving two research groups and pre-post intervention assessments. The advantage of this systematic review is that only prospective RCT-based articles are included for analysis.

CONCLUSION

Hospital pharmacists' education on inhaler use can enhance the accuracy of inhaler steps and medication adherence in COPD inpatients and outpatients. Therefore, the quality of life of COPD patients can be improved. Future studies should compare the results of RCTs on inhaler education with clinical outcomes, like testing the lung function of COPD patients in inpatient or outpatient settings.

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CONFLICT OF INTEREST

This review has no conflict of interest.

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