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The Benefit of Application-Based Education Using the Healthy Lungs Version 2.0 on Inhaler Adherence Among Patients with Chronic Obstructive Pulmonary Disease at RS Prof. Dr. Chairuddin P. Lubis

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ABSTRACT

Introduction: Chronic obstructive pulmonary disease (COPD) is a leading cause of morbidity and mortality worldwide. Inhalation therapy is central to management; however, suboptimal adherence and incorrect inhaler technique contribute to poor disease control and recurrent exacerbations. Application-based education provides continuous, standardized, accessible instruction that may improve adherence to inhaler therapy. The Healthy Lungs application 2.0 was developed in the Philippines for COPD patients to evaluate its educational effectiveness on inhaler adherence at RS Prof. Dr. Chairuddin P. Lubis, University of North Sumatra, Indonesia.

Methods: An analytical study with a case–control approach enrolled 50 patients with COPD selected by consecutive sampling. Inhaler adherence was assessed with a structured questionnaire before and after the application-based intervention. Normality was examined with the Kolmogorov–Smirnov test, and pre- versus post-intervention adherence was compared using the Wilcoxon signed-rank test, with significance set at $p < 0.05$.

Results: The respondents were predominantly elderly (43%) and male (58%). Before the intervention, low adherence predominated (50%); afterwards, the proportion with high adherence rose to 42%, with most respondents improving and few declining. The Wilcoxon test demonstrated a significant difference in adherence before and after the intervention ($Z = –3.196$; $p = 0.001$), with a large effect size (Cohen's $d = 1.05$).

Conclusion: Education delivered through the Healthy Lungs app significantly improved inhaler adherence among patients with COPD, supporting its use as an adjunct to conventional inhaler counseling.

Keywords

Chronic Obstructive Pulmonary Disease, Inhaler Adherence, Digital Education, Healthy Lungs Application

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INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a pulmonary disorder characterized by respiratory symptoms and persistent, generally progressive, airflow limitation. It is associated with an exaggerated chronic inflammatory response in the airways and lung parenchyma caused by exposure to noxious gases or particles and remains a persistent global health concern. This condition continues to be a major concern owing to its rising morbidity and mortality worldwide [1,2].

COPD is a major noncommunicable disease with an increasing global burden of morbidity, mortality, and economic impact. Its prevalence in the United States is approximately 10.1%, where it ranks as the fourth leading cause of death, with mortality increasing by 32.9% between 1979 and 1991. In Southeast Asia, the

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estimated prevalence is 6.3%, with the highest rates reported in Vietnam and China [3]. The economic burden of COPD management is substantial, reaching approximately USD 50 billion in 2010, largely driven by hospitalization costs [1]. In Indonesia, the prevalence of COPD among individuals older than 30 years is 3.7%, with persistently high exacerbation rates, and most patients present with moderate-to-severe disease [4]. According to the Global Initiative for Chronic Obstructive Lung Disease 2024 report, COPD is the third leading cause of death worldwide, with a global prevalence of approximately 10.3%; smoking remains the principal risk factor, although the incidence among nonsmokers continues to rise [5]. Inhalers are drug-delivery devices administered by inhalation, allowing medications to reach the lungs directly as the target organ, and are widely used across acute and chronic respiratory diseases [6]. In COPD, inhalation therapy remains the primary treatment modality because it achieves high local drug concentrations with a lower risk of systemic adverse effects, particularly through metered-dose inhalers (MDIs) and dry-powder inhalers (DPIs) [7,8]. However, therapeutic success depends heavily on adherence and correct inhaler technique, both of which frequently remain suboptimal despite education and demonstrations by healthcare professionals; consequently, patients repeatedly return to healthcare facilities because of incorrect inhaler use [9]. The Paru Sehat application was developed as a digital educational solution to provide independent and continuous access to inhaler-use education for patients with COPD.

To evaluate the effectiveness of an educational program delivered through the Healthy Lungs application on inhaler adherence among patients with COPD at RS Prof. Dr. Chairuddin P. Lubis, Universitas Sumatera Utara.

METHODS

This analytical study used a case–control approach and was conducted at RS Prof. Dr. Chairuddin P. Lubis, Universitas Sumatera Utara. The participants were patients with COPD who met the inclusion and exclusion criteria. Samples were obtained by consecutive sampling, yielding a total of 50 patients with COPD who used the Paru Sehat application. Inhaler adherence was assessed before and after the educational intervention delivered through the application.

The level of inhaler adherence was assessed using a structured questionnaire administered through direct interviews. Measurements were performed twice: before the intervention (pre-education) and after the intervention (post-education) using the Paru Sehat application. Data were analyzed using SPSS. Univariate analysis was used to describe the respondents' characteristics. Normality was tested using the Kolmogorov–Smirnov test; because the data were not normally distributed, differences in adherence before and after the intervention were analyzed using the Wilcoxon signed-rank test. Statistical significance was defined as $p < 0.05$.

RESULTS

Demographic Characteristics of Respondents

Most respondents were categorized as early elderly (26 individuals; 43%), whereas the adult age group represented the smallest proportion (7%). By sex, the respondents were predominantly male (35 individuals; 58.0%) compared with female (25 individuals; 42%).

Inhaler Adherence Before and After Using the Healthy Lungs Application

Adherence was classified into three categories: high, moderate, and low adherence. Before using the Paru Sehat app, most respondents showed low adherence (25 individuals, 50%), followed by moderate (14 individuals, 28%) and high adherence (11 individuals, 22%). After using the application, the distribution shifted markedly: high adherence increased to 21 individuals (42%), whereas moderate and low adherence accounted for 15 (30%) and 14 (28%) individuals, respectively. These findings indicate a shift toward improved adherence following the educational intervention.

Effect of the Intervention on Inhaler Adherence

The Kolmogorov–Smirnov test indicated that adherence scores before and after the intervention were not normally distributed ($p = 0.001$); therefore, the Wilcoxon signed-rank test was used. The analysis showed that 34 respondents experienced improved adherence after the intervention (positive ranks), 10 showed decreased adherence (negative ranks), and 16 showed no change (ties). The predominance of positive ranks indicates a general improvement in inhaler adherence after education using the Paru Sehat application.

The Wilcoxon test yielded a Z value of –3.196 with a significance level of $p = 0.001$ ($p < 0.05$), indicating a statistically significant difference in adherence before and after the intervention. The intervention also showed substantial clinical relevance, with Cohen's d of 1.05 (a large effect size), suggesting a strong and consistent impact on improving inhaler adherence among patients with COPD.

DISCUSSION

Most respondents were in the early elderly age group (26 individuals; 43%), whereas the adult group was the smallest (7%). This is consistent with the report that advancing age is associated with declining cardiorespiratory endurance owing to reduced pulmonary, cardiac, and vascular function. This is also in line with the 2018 Indonesian Basic Health Research report, which demonstrated an increasing prevalence of COPD with age, particularly among individuals aged ≥56 years [10]. The study population was predominantly male (35 respondents; 58.0%) versus female (25; 42%). This agrees with, who identified smoking—the principal risk factor for COPD—as more common among men, and with data from the 2018 Indonesian Basic Health Research survey. Inhaler adherence in COPD remains a considerable clinical challenge, as poor adherence and incorrect technique are closely linked with inadequate disease control, more frequent exacerbations, and reduced quality of life [10].

The present study demonstrated that most respondents experienced improved inhaler adherence after educational intervention through the Paru Sehat application, reflected by the predominance of positive over negative ranks and ties. Statistical analysis confirmed a significant difference in adherence before and after the intervention, supporting the effectiveness of digital education in improving adherence to inhalation therapy. These findings are consistent. who reported improved knowledge among patients with COPD after using the Healthy Lungs application in a quasi-experimental design. International evidence from scoping reviews, meta-analyses, and controlled trials likewise shows that digital interventions combining education, scheduled reminders, and inhaler-use monitoring can effectively improve inhaler adherence over both short- and long-term settings [11,12]. A meta-analysis reported an approximately 18% increase in adherence among patients using digital inhalers compared with standard care, whereas a cluster trial. demonstrated significant short-term improvements through brief educational modules, reminders, inhaler-use monitoring, and gamification [13].

Other studies have similarly shown that digital inhaler devices integrated with educational and monitoring applications are associated with increased controller medication use among patients with COPD (OR 1.61; 95% CI 1.49–1.75) [14]. Recent systematic reviews further indicate that digital interventions based on mobile applications and sensor technology may improve quality of life, self-efficacy, and dyspnea severity over intervention periods of 3 to 12 months [14]. Direct inhaler technique education using a teach-back approach has also improved inhaler skills and reinforced treatment adherence [15]. A scoping review by Machado et al. emphasized the role of mobile applications equipped with educational features, reminders, and symptom tracking in improving self-management and maintaining consistent inhaler use among patients with COPD [16]. In Indonesia, the Healthy Lungs application has shown promising potential for improving knowledge among patients with COPD. International literature consistently identifies improved patient knowledge as a strong predictor of better inhaler adherence. By providing standardized, accessible, and repeatable educational content, the Paru Sehat application may strengthen patients' understanding of their therapy and support better adherence to inhaled treatment [11].

Several limitations should be considered: a single-center study with a modest consecutively sampled cohort may limit generalizability. Adherence was measured by interview-administered structured

questionnaire, which is susceptible to reporting bias, and compared within participants before and after intervention rather than with an independent control group. Longer follow-up and multicenter controlled designs are warranted to confirm the durability of the observed effect.

CONCLUSION

Education delivered through the Healthy Lungs application version 2.0 was associated with a statistically significant and clinically meaningful improvement in inhaler adherence in patients with COPD. These findings support the use of application-based digital education as a useful adjunct to conventional inhaler counseling and warrant confirmation in larger, controlled studies.

DECLARATIONS

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CONSENT FOR PUBLICATION

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All authors have reviewed and approved the final version of the manuscript and have agreed to its publication in the Journal of Society Medicine.

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M.P.A. contributed to the conception and design of the study, data acquisition and analysis, and drafting of the manuscript. A.P.T. and A.P. contributed to the study design, interpretation of the data, and critical revision of the manuscript for important intellectual content. All the authors have read and approved the final manuscript.

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