

HOMĘTOWSKA, Henryka. Adherence to treatment recommendations of patients with chronic non-communicable respiratory diseases – a narrative review: Adherence in asthma and COPD. *Journal of Education, Health and Sport*. 2023;13(4):179-187. eISSN 2391-8306. DOI <http://dx.doi.org/10.12775/JEHS.2023.13.04.020>
<https://apcz.umk.pl/JEHS/article/view/42213>
<https://zenodo.org/record/7662855>

The journal has had 40 points in Ministry of Education and Science of Poland parametric evaluation. Annex to the announcement of the Minister of Education and Science of December 21, 2021. No. 32343. Has a Journal's Unique Identifier: 201159. Scientific disciplines assigned: Physical Culture Sciences (Field of Medical sciences and health sciences); Health Sciences (Field of Medical Sciences and Health Sciences). Punkty Ministerialne z 2019 - aktualny rok 40 punktów. Załącznik do komunikatu Ministra Edukacji i Nauki z dnia 21 grudnia 2021 r. Lp. 32343. Posiada Unikatowy Identyfikator Czasopisma: 201159. Przynależność dyscypliny naukowej: Nauki o kulturze fizycznej (Dziedzina nauk medycznych i nauk o zdrowiu); Nauki o zdrowiu (Dziedzina nauk medycznych i nauk o zdrowiu).
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The authors declare that there is no conflict of interests regarding the publication of this paper.
Received: 24.01.2023. Revised: 20.02.2023. Accepted: 16.02.2023.

Adherence to treatment recommendations of patients with chronic non-communicable respiratory diseases – a narrative review: Adherence in asthma and COPD

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Abstract

Despite modern therapeutic solutions, patients with chronic obstructive pulmonary disease (COPD) and bronchial asthma do not achieve therapeutic benefits due to emerging obstacles to compliance. This review aimed to present and analyze the results of available studies evaluating the influence of sociodemographic, clinical, and psychosocial factors on the level of adherence of patients with COPD and asthma. This narrative review was based on papers indexed in the following databases: PubMed, MEDLINE, CINAHL, Web of Science, and Scopus. The analyzed studies showed that the adherence level of patients with COPD and asthma is unsatisfactory, ranging from 23.6 to 80%. The main factors increasing the level of adherence of COPD patients mentioned in the analyzed studies were: unemployment, taking LAMA, not smoking cigarettes, belief that medication is necessary, higher education, use of multi-dose DPI and MDI inhalers, a greater sense of self-efficacy, and longer duration of disease. Independent determinants of good adherence of patients with asthma were better quality of life, high level of disease control, treatment with ICS + LABA or FF/UMEC/VI, good knowledge about asthma, and positive attitude towards the disease. According to available studies, determinants lowering adherence among patients with COPD were overweight or obesity, depression, poor quality of life, belief that treatment is harmful, frequent hospitalizations, lack of knowledge about the disease and treatment, sleep disorders, and use of ICS, LABA/ICS. Patients with asthma who received infrequent functional support consumed alcohol and were convinced of the harm and lack of need for treatment were non-adherent. In addition, an association was shown between high levels of adherence and a reduction in ED visits and hospitalizations in asthma and COPD patients.

Keywords: chronic obstructive pulmonary disease, bronchial asthma, adherence, compliance, knowledge summary, narrative review

Introduction

Chronic non-communicable respiratory diseases are among the leading causes of death worldwide and in EU countries. Among the diseases that lead to acute or exacerbation of chronic respiratory failure are chronic obstructive pulmonary disease (COPD) and bronchial asthma, which are among the most common chronic non-communicable respiratory diseases. According to statistics from the World Health Organization (WHO), currently, COPD is the third most common cause of death worldwide [1]. The Global Burden of Disease (GBD)

organization estimates that more than 328 million people worldwide have COPD [2]. In Poland, more than 2.5 million patients, of whom only 20% have COPD diagnosed and treated [2]. An estimated 235 million people worldwide have asthma [3]. In Europe in 2017, the highest prevalence rate for asthma, at 8,371 per 100,000 population, was observed in the United Kingdom [2]. According to GBD estimates, in Poland, 4,917 people per 100,000 population, or 1.9 million people, had asthma in 2017, and the mortality rate was 12 people per 1 million population [2]. A study conducted as part of the Epidemiology of Allergic Diseases program in Poland (pol. *Epidemiologia Chorób Alergicznych*, ECAP) showed that of all eligible patients diagnosed with asthma by doctors in the ECAP program, only 30% of patients had it previously diagnosed. This means that the scale of non-diagnosis can be as high as 70% [3].

Effective treatment of obstructive diseases should be multidirectional and include both pharmacological management and non-pharmacological interventions. Due to the chronic nature of these diseases, in both cases, the goal of treatment is to slow the progression of the disease, reduce symptoms that affect the patient's quality of life, prevent and treat exacerbations and complications of the disease, which in extreme cases can lead to disability or death [4,5]. When the disease is inadequately controlled, both asthma and COPD patients can experience significant reductions in physical, social, and occupational functioning, with high indirect costs [6,7]. Both asthma and COPD therapy require daily, long-term medication. The preferred form of therapy for both diseases is inhaled therapy. However, due to difficulties arising from the handling of inhalers, there is a low rate of compliance with therapeutic recommendations. A report by the National Health Fund (pol. *Narodowy Fundusz Zdrowia*, NFZ) on the fulfillment of prescriptions for asthma control drugs showed that almost 89.7% of patients under the age of 18 filled prescriptions for reimbursable drugs with the active ingredient budesonide for less than 90 defined daily doses, which was less than 17% of the theoretical need for this substance considering the length of the observation period [2]. In the group of patients aged 18-40, only 14.7% of patients filled prescriptions for the reimbursed, while in the 41-55 and 56-70 age groups, this was 30.7% and 42% of patients, respectively [2]. In contrast, for COPD, only 21% of patients continue treatment with inhaled medications [8].

WHO stresses that non-adherence to therapeutic recommendations is one of the most severe health problems. Lack of adherence to therapeutic recommendations is a fundamental barrier to patients achieving therapy benefits based on current medical knowledge. Studies show that in patients with asthma, a 25% increase in compliance contributes to a reduction in the risk of disease exacerbation by about 10% [9]. In addition, maintaining compliance at no less than 80% contributes to a 52% reduction in the chance of an asthma exacerbation compared to poor compliance. In comparison, persistence is associated with a 58% reduction in asthma exacerbations compared to no persistence [10]. In addition, regular use of inhaled corticosteroids in patients with asthma contributes to a 31% reduction in the risk of hospitalization and a 39% reduction in repeat hospitalizations. Similarly, a 44% reduction in the risk of severe exacerbation is observed in patients with COPD when compliance is maintained at a minimum of 80% [11]. The Vestbo 2009 study showed that patients who took >80% of prescribed doses of medication had a 60% lower risk of death at 3-year follow-up compared to patients with lower compliance [11].

So far, several hundred factors affecting adherence to treatment recommendations have been described. According to the scheme proposed by the WHO, they can be divided into five main groups: 1. social and economic factors, 2. factors related to the health care system, 3. factors related to the condition, 4. factors related to therapy, and 5. factors related to the patient [12]. However, available studies present contradictory positions on the influence of sociodemographic and clinical factors on the level of adherence and compliance of patients with COPD and asthma. Therefore, an attempt was made to present and analyze the results of available studies on evaluating the influence of sociodemographic, clinical, and psychosocial factors on the level of adherence and compliance of patients with COPD and asthma.

Literature search

This review was prepared in accordance with the SANRA (Scale for the Assessment of Narrative Review Articles) guidelines [13]. In terms of the proper preparation of both the article section and the content, the Narrative Review Checklist was followed. In addition, the PICO strategy of Patient (COPD, asthma), Intervention, Control (not applicable), and Outcomes (adherence) was used to develop the guiding question and search the paper. Keywords were established according to MeSH headings [14], and medical databases were searched using the terms adherence, compliance, COPD, and asthma. Inclusion criteria included: (1) studies indexed in medical databases PubMed, MEDLINE, CINAHL, Web of Science, and Scopus, (2) full-text articles available in English, (3) papers published between 2017 and 2023, and (4) addressing the topic of assessing adherence levels in COPD and asthma. Editorial letters, commentaries, research protocols, conference abstracts, review articles, and duplicates were excluded from the review. In addition, due to the narrative nature of this review, the quality of methodological evidence of the studies and the strength of the recommendations using the GRADE (Grading of Recommendations, Assessment, Development, and Evaluation) method were not included [15].

Enrolled studies

The present review enrolled 44 studies [16-59] covering 70,206 patients with COPD [16-38,55] and 90,530 with asthma [20,39-59]. Of the included articles, 13 were conducted in America, 13 in Europe, five in Asia, and one in Africa. The remaining 12 studies were all multicenter studies. Of the papers selected for review, 26 were observational studies, 8 RCTs, 5 retrospective studies, 3 clinical trials, and 2 prospective studies.

Medication adherence in COPD

Currently, available pharmacotherapy allows most patients to relieve COPD symptoms and reduce the risk of exacerbations significantly. However, pharmacologic management should be supported by non-pharmacologic methods, which include combating smoking habits, improving physical fitness, and preventing infections. Pierobon et al. [16] showed an association between the level of compliance with non-pharmacological treatment recommendations and the 6-minute walk test, body mass index (BMI), and the GOLD disease severity scale. In multivariate logistic regression analysis, higher BMI, depression, and low anxiety were associated with non-adherence to physical activity. In contrast, Kjærgaard et al. [17] found in their study that there was an association between the number of rehabilitation sessions attended by patients with COPD and a 7% reduction in hospital admissions at 1-year follow-up (incidence rate ratio 0.93 (95% CI 0.88 to 0.99), $p=0.02$). Similarly, at the 2-month follow-up, physical fitness was positively associated with attendance at rehabilitation sessions. Thus, increased frequency of early pulmonary rehabilitation after COPD exacerbation was associated with reduced risk of hospital readmission and improved physical state.

The factors affecting adherence are quality of life, medication beliefs, and depression. Kokturk et al. [18] examined the adherence levels of 199 COPD patients in Turkey and 206 in Saudi Arabia. Low adherence to treatment recommendations was presented by 49.2% of the subjects. Patients with a low level of adherence also presented a high impact of the disease on daily functioning, low quality of life, and a high level of depression as measured by the HADS scale. In addition, age ≥ 60 and secondary/higher education were independent determinants of high adherence. Albrecht et al. [19] conducted a retrospective cohort study using a 5% random sample of Medicare participants from 2006-2012 who were co-diagnosed with COPD and depression. Patients were followed-up for 12 months, and adherence was measured by the proportion of days covered in a 30-day period. Of the 16,075 patients studied, 21% achieved a high level of adherence ($\geq 80\%$) to COPD maintenance medications and 55% to antidepressants. Higher ($\geq 80\%$) adherence to both antidepressants and COPD maintenance medications was associated with a reduced risk of ED visits and hospitalizations. The study by Homętowska et al. [24] included 325 patients, aged 63.04 ± 11.29 , with COPD or asthma. Respondents presented a moderate level of adherence, with 74% of patients showing occasional non-compliance. Factors significantly influencing pharmacological adherence were unemployment, non-smoking, and the belief that medication was necessary. In contrast, the number of hospital stays due to exacerbations of the disease in the past year, and the belief that medications are harmful were independent determinants of lower levels of medication adherence.

One way to support patients in maintaining the regularity of therapy is to provide tools that make it easier for them to take prescribed medications regularly in their daily lives. Kaye et al. [20] evaluated the relationship between objective engagement of smartphone apps and the use of control medications in adults with asthma and COPD. Eligible adults in the study had a smartphone and a paired electronic medication monitor (EMM). A group of 2309 participants (71% asthma; 29% COPD) were analyzed. Opening the app (vs. not opening the app) was associated with a significantly higher likelihood of using control medications in asthma (OR= 2.08 (1.98, 2.19)) and COPD (OR= 1.61 (1.49, 1.75)). Longer session duration was also associated with higher odds of using control medications for asthma and COPD. However, after a certain amount of time was reached, the odds decreased for COPD. Similarly, Criner et al. [21], in their 6-month RCT evaluated the association of BreatheMate reminders sent via the device and app to COPD patients regarding medication intake with adherence to inhaled therapy recommendations. Patients were divided into two groups: in the intervention group ($n = 68$) and the control group ($n = 70$), they received the BreatheMate device, a smartphone app, and coupons to exchange their pressurized metered-dose inhalers (pMDIs) for the prescribed 2 puffs of budesonide/formoterol 160/4.5 μg twice daily. The intervention group also received twice-daily electronic reminders to take budesonide/formoterol. The IG compared with the CG had a higher mean percentage of days of adherence (77.6% vs. 60.2%; $P < 0.001$) and puff/day adjusted sets (1.61 vs. 1.33; $P < 0.001$). At each 60-day interval, IG adherence was higher compared to CG ($P < 0.001$). In addition, IG patients were 3.07 (95% confidence interval: 1.49-6.52) times more likely to adhere to pharmacological recommendations for $\geq 80\%$ of study days compared to CG. Overuse (> 2 sets of 2 puffs/day), underuse (< 2 sets of 2 puffs/day), and days without use were lower in IG compared to CG ($P < 0.05$). Patients aged ≥ 65 had higher adherence levels ($P < 0.001$). In their study, Farias et al. [22] observed 40 patients with COPD via a tele-system that recorded detailed data on patient behavior during exacerbations of the disease. Eighty-one exacerbations were recorded during the one-year follow-up. Patients with a high degree of adherence recovered significantly faster than those with non-

adherence. Telesystem patients recovered more quickly from exacerbations and saw further reductions in COPD-related outpatient visits and hospitalizations. In a study by Montes de Oca et al. [23], of 795 patients with COPD, 54.1% of patients had good, 26.5% had medium, and 19.4% had poor compliance with inhaled pharmacotherapy recommendations. In contrast, 51% had high, 29.1% medium, and 19.9% low adherence regarding oral therapy. Low adherence was associated with poorer health status and more exacerbations.

The drug dosing regimen was found to be a significant factor affecting adherence levels in the study by López-Pintor et al. [25] 318 inhaler-treated COPD patients were followed for 3 months. Persistence was achieved by 78.6% of patients, and 58.5% had a good level of adherence. Patients with multi-dose dry powder inhalers (DPIs) and patients with metered dose inhalers (MDIs) showed a 2.8-fold and 4.1-fold increase in the association with poor adherence, respectively, compared to those with single-dose DPIs. Patients who had no knowledge of COPD (aOR 2.106, $p = 0.006$) and those who thought the inhaler's effectiveness was poor (aOR 2.361, $p = 0.006$) were more likely to have low adherence.

In pharmaceutical care, one of the primary activities undertaken by the pharmacist is to conduct in-depth patient education. Education includes disease-related areas - its causes, consequences, and treatment options - and general education, which aims to make the patient aware of how their lifestyle and habits (such as nutrition) can affect their health. When providing pharmaceutical care, through an in-depth relationship with the patient, the pharmacist also has the opportunity to influence patients' health attitudes and health beliefs. In an RCT, Abdulsalim et al. [26] showed that pharmacist-led education on medication adherence, among other topics, was associated with an increase in COPD patients' adherence (from 49% to 80% after 24 months, $p < 0.001$). Similarly, Nguyen et al. [27] evaluated the impact of a pharmacist-led pharmaceutical care program on improving medication adherence and quality of life in 211 COPD patients in Vietnam. During the 12-month follow-up period, the mean medication adherence score improved from 6.7 to 7.4 ($p < 0.001$). In addition, EQ-5D-5L index values (0.47 to 0.59; $p < 0.001$) and the percentage of patients with good adherence increased (37.4% to 53.2%; $p < 0.001$) after the program ended.

Adherence to treatment recommendations largely depends on the severity of disease symptoms. A high degree of disease symptom severity and associated difficulties in daily functioning may result in better patient adherence to treatment recommendations. Jouleh et al. [28] analyzed the adherence of 90 COPD outpatients and 245 COPD inpatients. The group of patients hospitalized for COPD and with lower symptom severity had significantly lower adherence levels than those in the outpatient group and those with higher disease severity. Similarly, in the study by Scalone et al. [29], patients in the GOLD D group were most adherent (81.2%) to treatment recommendations, while patients in the A group were least adherent (30.3%) at baseline, which was mainly attributed to overuse of inhaled corticosteroids in the less severe GOLD groups. On the other hand, Polanski et al. [30] observed that low adherence to pharmacotherapy was determined by sociodemographic factors such as older age, female gender, loneliness, inactivity, and clinical factors - more frequent hospitalizations, sleep, and daily functioning disorders, higher severity of GOLD.

The level of adherence largely depends on the treatment used. In their study, Palmiotti et al. [31] showed that 30% of all patients evaluated used inadequate therapy. Moy et al. [32] showed that participant readiness and confidence at the onset of oxygen therapy were associated with high short- and medium-term adherence levels. An RCT by Qin et al. [33] examined the adherence of patients with COPD taking varenicline and bupropion for smoking cessation. Factors such as older age, higher level of education, the greater number of previous quit attempts, greater self-efficacy, preparation for smoking cessation, perceived risks of smoking, and longer duration of COPD were determinants of higher adherence to treatment recommendations ($P < 0.05$). Similarly, a study by Park et al. [34] conducted in South Korea showed that the rate of discontinuation of roflumilast due to side effects was 46.4% in the conventional dose group and 59.3% in the dose escalation group. In multivariate analysis, older age was a significant risk factor for drug discontinuation. Frequent treatment discontinuation suggests that a dose escalation strategy may not be useful in Asian patients. In contrast, Federman et al. [35] observed a significant relationship between the number of medications taken, the incidence of dyspnea, and the severity of COPD. In contrast, Chan et al. [36] found that COPD patients with low adherence overused inhaled corticosteroids (ICS) and underused long-acting bronchodilators. A retrospective cohort analysis by Mueller et al. [37] found that compared with LABA therapy, LAMA therapy was less associated with early non-persistence. In contrast, patients who started ICS therapy or LABA/ICS combination therapy with a single device had a higher risk of non-persistence. In a cross-sectional study by Bollmeier et al. [38], of 682 patients, only 28.7% of participants had high adherence ($PDC \geq 80\%$) to at least 1 COPD maintenance medication.

Medication adherence in asthma

Adherence to treatment recommendations of patients with bronchial asthma remains unsatisfactory. Alahmadi et al. [39], in their study analyzing the adherence levels of 166 patients with severe asthma participating in the U-BIOPRED (Unbiased Biomarkers for the Prediction of Respiratory Disease Outcomes) trial, determined adherence to ICS to be suboptimal in 37% of subjects. Bassam et al. [40] assessed the adherence of 7203 patients treated for asthma at 577 centers. High adherence was observed in 23.6% ($p < 0.001$).

Older age, a better quality of life in the mental domain of the SF-36 questionnaire, and a high level of disease control were associated with good adherence ($p < 0.001$). The level of adherence depended significantly on treatment modality; patients treated with a fixed combination (ICS + LABA) had better adherence than those treated with short-acting beta-agonists alone.

Different inhalation systems require different techniques for their use. Using more than one type of inhalation device increases the risk of making a significant error, and this consequently affects the clinical effectiveness of therapy. If it is necessary to use different inhalation systems, inhalers with similar handling techniques should be selected. In their retrospective cohort study, Busse et al. [41] compared the adherence level of 1396 patients with asthma treated with FF/UMEC/VI as a single inhaler and 5115 patients treated with triple therapy using multiple inhalers (MITT). Asthma patients initiating triple therapy with FF/UMEC/VI had significantly better adherence and persistence compared to MITT initiators. In contrast, a study conducted in six government hospitals in eastern Ethiopia involving 320 asthmatic patients showed low adherence to anti-asthma medications [42]. Patients on treatment for 2-3 years and those on medication for ≥ 4 years were 70.5% and 77.1% times less likely to adhere to anti-asthmatic medications, respectively. In contrast, high adherence was presented by only 34.1% of patients and depended on being a housewife, having good knowledge about asthma, having a positive attitude toward asthma, and using oral corticosteroid medications.

Patients with asthma often remain under primary care (pol. *podstawowa opieka zdrowotna*, POZ) physicians. In many cases, these physicians are able to recognize inadequately controlled asthma and modify treatment accordingly. In a significant proportion of patients, however, asthma is inadequately controlled. In a prospective, observational, multicenter study, Mohd Isa et al. [43] showed low adherence rates among patients with asthma treated at POZ in Malaysia. In addition, less than 50% of patients had well-controlled asthma, and 56% needed to remember to take subsequent doses of medication. In contrast, a study by Baldacci et al. [44] showed that overtreatment of intermittent/mild persistent asthma is common in GP settings. At the same time, therapeutic regimens are more appropriately used for moderate/severe asthma. In addition, GPs had low adherence to GINA GL recommendations for treatment. In contrast, Takala et al. [45] conducted a 12-year follow-up of 203 asthma patients in the real Seinäjoki Adult Asthma Study (SAAS) asthma cohort. The study showed that patients under the care of primary care physicians had a higher level of adherence regarding taking a group of inhaled corticosteroids (ICS) throughout the 12-year follow-up period compared to patients under secondary medical care.

Memory aids, which include reminder notes hung in the kitchen or bathroom, placed by the bedside, or displayed, for example, on the phone, or diaries, especially electronic ones, can be helpful in meeting recommendations. Also useful are electronic dosage recorders available in some countries that are worn on inhalers, which display the number of doses remaining in the inhaler and record drug consumption over a specified time period. In addition to simply reminding patients to take their medication, they are a good tool for informing patients and physicians about their therapy and an outlet for taking action to improve patient compliance with therapeutic recommendations. Jácome et al. [46] evaluated the feasibility and acceptability of the InspirerMundi app for monitoring medication adherence in 107 patients with asthma. The study found that only 34% of patients recorded a complete asthma treatment plan. The app was installed by 92.5% of patients, and the average period of use was 9 days. Median adherence to medication was 75% for inhalers and 82% for other preparations. Patients were generally satisfied with the app and said the app motivated them to better adhere to inhaled medications, and 77% would recommend it to other patients. Patients who maintain high ICS adherence during treatment have better asthma control [47]. The study by Raebel et al. [48], conducted as part of a randomized multi-intervention trial was conducted at Kaiser Permanente Colorado examined asthma patients' preferences for text message, phone, or email reminders to renew ICS prescriptions. 52.7% chose text message reminders. Patients who expressed a preference had a higher baseline level of adherence. The study was followed up in the same cohort and found that in a population of patients already receiving medication reminders, offering a choice about the type of asthma medication reminder technology patients wanted did not improve outcomes but did enable a subgroup to maintain adherence to pharmacological recommendations better [49].

Another important factor affecting the effectiveness of pharmacotherapy in COPD patients is the proper technique of inhaling aerosolized drugs. Aerosol therapy is the cornerstone of treatment for both diseases. Unfortunately, the clinical effectiveness of inhaled drugs is limited by technical errors made by patients during inhalation. Those also present a better level of adherence with a higher level of knowledge about taking inhaled medications [50]. A study by Sulaiman et al. [51] assessed whether an intervention with feedback on inhaler use characteristics would identify refractory asthma and improve inhaler technique and adherence. Eligible patients were divided into two groups. The intensive education group ($n=107$) received repeated training in inhaler use, adherence, and disease management. The intervention group ($n=111$) received the same intervention, enhanced with (bio)feedback-based training. The mean adherence rate at month three in the group receiving (bio)feedback was higher than in the enhanced education group (73% vs. 63%; 95% CI 2.8%-17.6%; $p=0.02$). At the end of the study, asthma was stable or improved in 38% of subjects, uncontrolled but poorly adhered to in 35%, and uncontrolled but adhered to in 27%. Repeated feedback significantly improved adherence to inhaled medications.

Among the factors affecting adherence are psychosocial factors, such as beliefs about treatment, quality of life, doctor-patient communication, and feelings of loneliness or support. O'Connor et al. [52] examined the association between structural and functional support and medication adherence in 383 patients >60 years of age. 64% showed poor adherence to taking asthma-controlling medications. Patients who received infrequent functional support in managing their medications were less likely to have poor adherence to dose counts (OR 0.51, 95% CI 0.26 to 0.98) but not when assessed via self-report (OR 0.81, 95% CI 0.44 to 1.48). Structural support was not associated with adherence. In contrast, Norful et al. [53] examined how 80 black adults with uncontrolled asthma and their primary care physicians communicated about non-adherence to ICS and used shared decision-making to identify strategies to increase adherence to ICS. Conversations between physicians and patients addressed ICS overuse and lack of knowledge and beliefs about ICS. Exarchos et al. [54] examined the adherence levels of 716 adult patients diagnosed with asthma receiving budesonide/formoterol fixed-dose combination (FDC) via the Elpenhaler device. The study showed that about 80% of patients presented a moderate to high level of adherence during the study. In addition, after 6 months of budesonide/formoterol FDC treatment, patients with a high level of adherence achieved an increase in quality of life and better spirometry parameters (mean FEV1 2.58 L (0.85) at the end of the study, increased by 220 mL from baseline). Toyama et al. [55] identified barriers to using inhaled and oral medications in patients treated for asthma and COPD regularly attending outpatient clinics. The reported barriers varied by disease. Independent barriers to using inhaled versus oral medications among COPD and asthma patients were related to patients' beliefs about achieving their health goals and not receiving prescriptions on time. Among patients with poor use of inhaled medications only, COPD and asthma patients identified alcohol consumption and forgetting to take medications as independent barriers to inhaled medication use. The number of barriers was higher in asthma patients with low adherence ($p=0.0057$), while it was not significant in COPD patients ($p>0.05$). In contrast, Smits et al. [56] examined the beliefs of asthma patients regarding treatment. Respondents who were convinced that their health depended on asthma treatment were less likely to have poor treatment adherence (OR=0.56: 95%CI: 0.32-0.97). If patients were concerned about the need for ongoing asthma medication or sometimes about the long-term effects of asthma medication, they were 1.96 (95%CI:1.19-3.24) and 2.43 (95%CI:1.45-4.08), respectively, likely to have poor treatment adherence.

Non-adherence to therapy results in increased exacerbations, follow-up visits, and hospitalizations. The study by Averell et al. [57] involving 50,037 patients found a significant association between good treatment adherence and a low risk of asthma-related events (aOR=0.942; 95%CI: 0.890, 0.998; $p=0.041$) and severe exacerbations (aOR=0.778; 95% CI: 0.691, 0.877; $p<0.001$). In addition, compliant patients were less likely to visit the ED during the quarter and were less likely to be hospitalized for every 20% increase in PDC. In contrast, a study by Ramsahai et al. [58] found that serum prednisolone can be used as an objective marker of adherence in patients with severe asthma taking daily oral prednisolone. Combined with sputum eosinophil counts, it can distinguish a steroid-resistant cohort from one in which inflammation persists without adherence. Similarly, in the study by Papi et al. [59], adherence to ICS recommendations was not associated with fewer exacerbations in patients with elevated blood eosinophil levels. Thus, additional therapy should be considered in these patients, such as biologics, which have previously been shown to improve control in severe uncontrolled eosinophilic asthma.

Summary

Despite modern therapeutic solutions, patients with COPD and asthma still need to achieve the benefits of modern therapy due to emerging obstacles to compliance. Many interfering factors depend on the individual characteristics of the patient in question, but also the surrounding environment, the type of therapy, and the degree of cooperation between doctor and patient. The studies analyzed have mainly focused on the role of psychosocial factors related to inhaled therapy and the relationship between adherence to medical events such as hospitalizations and ED visits. Most studies have emphasized the importance of education regarding inhaled medication adherence and the need to adapt treatment regimens to the GINA/GOLD guidelines in order to control the disease better. There are conflicting reports on the effect of age on adherence to therapy for both COPD and asthma patients. In other respects, no inconsistencies were observed in the results of the analyzed studies. Also noteworthy is the fact that the patients studied consumed more adherent medications than disease-controlling medications. Although the number of known factors affecting the level of therapeutic adherence is increasing, research into new risk factors is needed. Regular assessment of the level of therapeutic adherence plays a key role in managing patients with chronic non-communicable respiratory diseases. There are many simple actions that any medical professional can take to improve medication adherence.

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