Jarab AS, Al-Qerem W, Alzoubi KH, Abu Heshmeh SR, , Al Momany EM, Al Hamarneh YN, Mukattash T, Eberhardt J, Aburuz S, Akour A. . A hospital-based exploration of medication adherence among outpatients with COPD: implications for clinical practice. Pharmacy Practice 2025 Apr-Jun;23(2):3142.

https://doi.org/10.18549/PharmPract.2025.2.3142

Original Research

A hospital-based exploration of medication adherence among outpatients with COPD: implications for clinical practice

Anan S. Jarab, Walid Al-Qerem, Karem H. Alzoubi, Shrouq R. Abu Heshmeh, Enaam M Al Momany, Yazid N Al Hamarneh, Tareq Mukattash, Judith Eberhardt, Salah Aburuz, Amal Akour

Received (first version): 11-Jun-2024 Accepted: 05-Sep-2024 Published online: 09-May-2025

Abstract

Background: The management of COPD typically involves a multifaceted approach and a complex treatment regimen. Poor adherence to prescribed medications can lead to worsened symptoms, increased exacerbations, and reduced quality of life among patients with COPD.

Objective: This study aimed to assess medication adherence and associated factors in outpatients with COPD, which remain insufficiently investigated.

Methods: A cross-sectional study was conducted at outpatient respiratory clinics in two major Jordanian hospitals. Data collection included socio-demographic and medical parameters. Medication adherence was assessed using a validated Arabic 4-item scale.Logistic regression was conducted to identify the variables associated with medication adherence.

Results: Of the 702 participants, 68%reported poor medication adherence. Key determinants of medication adherence included age, inhaler technique, knowledge, comorbidities, concerns about side effects, dosing frequency, disease duration, and depression.

Conclusion: Medication adherence in COPD patients, particularly in the elderly, and those with comorbidities, depression, and longer disease duration, is inadequate. Effective counselling and more convenient medication regimens are essential to improving adherence in this patient population.

Keywords: COPD, adherence, medication, inhaler, patient

Anan S. Jarab. PhD. Department of Clinical Pharmacy, Faculty of Pharmacy, Jordan University of Science and Technology, Irbid, 22110, Jordan. asjarab@just.edu.jo
Walid Al-Qerem. PhD. Department of Pharmacy, Faculty of Pharmacy, Al-Zaytoonah University of Jordan. P.O. Box 130, Amman 11733, Jordan.waleed.qirim@zuj.edu.jo
Karem H. Alzoubi. Department of Pharmacy Practice and Pharmacotherapeutics, College of Pharmacy, University of Sharjah, Sharjah, UAE. Faculty of Pharmacy, Jordan University of Science and Technology, Irbid, Jordan. kelzubi@sharjah.ac.ae
Shrouq R. Abu Heshmeh. MSc. Department of Clinical Pharmacy, Faculty of Pharmacy, Jordan University of Science and Technology. P.O. Box 3030. Irbid 22110, Jordan. srabuheshmeh19@ph.just.edu.jo
Enaam M Al Momany. PhD. Faculty of Pharmaceutical Sciences, Department of Clinical Pharmacy and Pharmacy Practice, The Hashemite University, Jordan. enaam@hu.edu.jo.
Yazid Al-Hamarneh. PhD. Department of Pharmacology, Faculty of Medicine and Dentistry, University of Alberta. Canada. Yazid.alhamarneh@ualberta.ca
Tareq Mukattash. PhD. Department of Clinical Pharmacy, Faculty of Pharmacy, Jordan University of Science and Technology. P.O. Box 3030. Irbid 22110, Jordan. tlmukattash@just.edu.jo
Judith Eberhardt. PhD.Department of Psychology, School of Social Sciences, Humanities and Law, Teesside University, United Kingdom. j.eberhardt@tees.ac.uk
Salah Aburuz. PhD. Department of Pharmacology & Therapeutics, College of Medicine and Health Sciences, United Arab Emirates University, Al Ain P.O. Box 15551, United Arab Emirates. saburuz@uaeu.ac.ae
Amal Akour*. Department of Pharmacology and Therapeutics, College of Medicine and Health Sciences, United Arab Emirates University, Al Ain, United Arab Emirates. Department of Biopharmaceutics and Clinical Pharmacy, The School of Pharmacy, The University of Jordan. Amman, Jordan. E-mail: aakour@uaeu.ac.ae

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is characterized by airway obstruction and dyspnea; it is a heterogeneous disease that can range from asymptomatic disease to a condition with severe reflective systemic manifestations that include skeletal muscle dysfunction, weight loss, and cardiac effects.[1] COPD is mainly caused by tobacco smoking; however, other etiologies are well documented, including vocational exposure to hazardous substances and biomass fuel.[1] The prevalence of various types of tobacco smoking, including cigarettes and water pipes, in Jordan is substantial, reaching up to 55.9% in males and 23.7% in females, and previous studies revealed that 15%–20% of smokers develop COPD.[2–4]

The global prevalence of COPD is 10.3%, while in Jordan, its prevalence among the elderly population reached up to 37.5%,[5] and it is the fourth leading cause of morbidity and mortality worldwide. Severe forms of COPD are associated with impaired quality of life, anxiety, and depression.[6] Although pharmaceutical intervention has proven to be highly effective in controlling COPD, uncontrolled symptoms of COPD remain a prominent challenge for health care providers. The clinical trials, which have demonstrated the effectiveness of the

pharmaceutical management of COPD, were conducted in a controlled environment with high levels of patient adherence, which is distant from the real world situation.[7]

Medical adherence is defined as "the extent to which the person's behavior (including medication-taking) corresponds with agreed-upon recommendations from a healthcare provider".[8] Non-adherence remains an obstacle for achieving treatment goals, particularly among patients with chronic diseases,[9] including COPD, as reported by numerous studies that have shown that around 60% of COPD patients are non-adherent to their medication.[10,11]

Several variables have previously been associated with low adherence among COPD patients, including high anxiety and depression levels, advanced age, frequency of taking COPD medications, and the presence of other comorbid diseases. [12–14]The diversity of the factors associated with medication non-adherence necessitates conducting further research to determine the predictors of medication non-adherence among patients with COPD. Therefore, the current study aimed to evaluate the prevalence of medication non-adherence among COPD patients and the factors associated with it.

MATERIALS AND METHODS

Study design and subjects

A cross-sectional study was conducted among patients with COPD attending the outpatients' respiratory clinics at King Abdullah University Hospital (KAUH) and Royal Medical Services (RMS) in the period from September to December 2022. Patients were eligible to participate if they had a consultant-verified diagnosis of COPD for at least 6 months, had no change in therapy within the previous six weeks before registration, and were physically and cognitively able to complete the questionnaire. Patients were excluded from the study if they had congestive heart failure, learning difficulties, disorientation, or other pulmonary problems. During the outpatient clinic visit, the research pharmacist verbally explained the study purpose to eligible patients and gave them an information sheet describing the study objectives and procedure. Patients were informed that their participation in the study was voluntary and that they could opt out at any time. Patients were also informed that their medical care at KAUH or RMS would not be affected by their participation. The researcher emphasized that the collected data would only be used for research purposes and would be stored securely in the principal investigator's office to ensure data confidentiality.

Study instruments

A custom-designed questionnaire was used to collect information about age, gender, education degree, smoking status, marital status, living conditions, area of residence, and pet ownership. Patient interviews and hospital data were used to collect information on disease and medication characteristics, including the duration of COPD, perceived disease severity, the presence of comorbid diseases, the number and types of comorbid diseases and COPD medications, the total number of prescribed medications, patients' own ratings of medication effectiveness, and their concerns about these side effects.

Hospital Anxiety and Depression Scale (HADS)

The Hospital Anxiety and Depression Scale (HADS) is a reliable and valid instrument developed to detect depression and anxiety in a hospital outpatient setting.[15] The 14-item questionnaire yields two scores, one for anxiety and one for depression. Each question is scored from 0 (no impairment) to 3, with a maximum score of 21 for anxiety or depression. Patients who scored 11 or higher on either scale were classified as having anxiety, depression, or both.[16]

Modified Medical Research Council (mMRC) Dyspnea Scale

The Modified Medical Research Council (mMRC) Dyspnea Scale is the most widely used validated scale for assessing the degree of functional impairment caused by dyspnea in chronic respiratory diseases, particularly COPD. The scale runs from 0 to 4, with 0 indicating no dyspnea except during strenuous exercise, 1 indicating shortness of breath when hurrying or walking up a slight hill, 2 indicating that the patient walks slower than people of the same age due to breathlessness or has to stop to catch their breath when walking on level ground, 3 indicating that the patient stops for breath after walking 100 yards (91 m) or after a few minutes of walking, and 4 indicating that the patient is too breathless to leave the house or is too dyspneic to dress.[17] In addition to the subjective assessment of disease severity, we utilized the GOLD classification criteria, where the modified British Medical Research Council (mMRC) questionnaire and the history of hospitalization classified COPD severity into four groups: Group A (low risk/low symptoms), Group B (low risk/high symptoms), Group C (high risk/low symptoms), and Group D (high risk/high symptoms).[18]

A forward translation was used to convert the original English versions of the HADS and mMRC to Arabic, followed by a backward translation from Arabic to English. Finally, both translations were compared to the original English version of the questionnaire.

Appropriate technique for using inhaler devices

Patients were asked to explain how they use their inhaler device, and their responses were evaluated using a validated checklist adapted from the German Respiratory League's recommendations [19]to determine whether or not patients' use of their own inhalers was appropriate.

The 4-item Medication Adherence Scale

The 4-item Medication Adherence Scale is a commonly used instrument for assessing medication adherence in chronic disease patients. The validated Arabic version of this questionnaire was used to assess medication adherence in the present study. The questionnaire consists of four items with 'yes' or 'no' dichotomous response categories assessing patient non-adherence in a variety of ways, including forgetting to take one's medication, being careless about taking medication, stopping medication when feeling better, and stopping medication when feeling worse. Each 'yes' response is worth

one point. A score of zero denotes high adherence, a score of 1 or 2 denotes intermediate adherence, and a score of 3 or 4 denotes low adherence. [20] For analysis purposes, patients were divided into two groups, with those who scored zero being considered adherent and those scoring 1-4 being considered non-adherent in this study.

Statistical analysis

Data analysis was conducted using the Statistical Package for the Social Sciences (SPSS) version 26 from IBM (Illinois, New York, USA).[21]The Q-Q plots indicated that the data was not normally distributed, therefore, the continuous data was represented as the median/interquartile range (IQR). Categorical variables were presented as frequencies and percentages. Univariate analysis was conducted using Chi-square and Mann-Whitney tests to determine variables significantly associated with medication adherence, while multivariate analysis using binary logistic regression was conducted to build a model with variables that were significantly and independently associated with medication adherence. A p-value of <0.05 was considered statistically significant.

Ethics approval statement

The study received ethical approval from the Institutional Review Board of KAUH at Jordan University of Science and Technology (Ref # 29/139/2021). Patients who agreed to participate in the study were asked to sign an informed consent form.

RESULTS

The median age of the participants (n=702) was 68 years (58-77). Most of the participants were males (78.6%), married (91.5%), smokers (58%), not living alone (93%), and living in urban areas (86.9%), while nearly half had a low income (47%). Details of the socio-demographic characteristics of the sample are presented in Table 1.

As shown in Table 2, the median of the severity of breathlessness estimated by mMRC was 2 (2-3), reflecting that COPD patients walk slower than people of the same age when walking on level ground, or they need to stop for breath when walking at their own pace on the level. The majority of participants reported experiencing a moderate level of disease severity (55.6%), hypertension (72.6%), diabetes (50.4%), were receiving inhaled corticosteroids (68.4%), and believed that the medication effectiveness was good (59%). Although most participants were not suffering from anxiety (59%), 54.7% were depressed. The median of the inhaler score was estimated at 91.4% (74.4-100), indicating good knowledge about the appropriate use of inhalers among study participants. Based on the GOLD disease severity, the majority of participants (40.2%) belonged to the B group, while 28.2% belonged to the D group.

According to the 4-item medication adherence scale, most participants were not adherent to their medications (68%). The most common form of non-adherence was stopping medication when feeling better (44.5%). Other forms of non-adherence included stopping taking medication when feeling worse (41.3%), forgetfulness (39.4%), and being careless about the time at which to take the medication (35.6%).

Univariate analysis showed that age (p<0.001), the presence of chronic disease (p<0.001), depression (p<0.001), anxiety (p=0.008), inhaler score (p<0.001), frequency of taking COPD medications (p<0.001), and disease duration (p<0.001) were significantly associated with medication adherence.

As shown in Table 3, multivariate analysis showed that as age increased, the odds of being non-adherent significantly increased (OR: 1.047, 95%CI: 1.031-1.063, p<0.001). Patients who obtained higher inhaler scores (OR: 0.978, 95%CI: 0.967-0.989, p<0.001), had no other chronic diseases (OR: 0.534, 95%CI: 0.303-0.942, p=0.030), and had no concerns about COPD medication side effects (OR: 0.395, 95%CI: 0.226-0.691, p=0.001) had significantly lower odds of being non-adherent. Patients who were receiving COPD medication more frequently (OR: 1.929, 95%CI: 1.371-2.716, p<0.001) and had longer disease duration (OR: 1.086, 95%CI: 1.014-1.163, p=0.018) were found to have higher odds of being non-adherent. Furthermore, patients who were not suffering from depression had significantly lower odds of exhibiting medication non-adherence (OR: 0.586, 95%CI: 0.373-0.920, p=0.02).

DISCUSSION

Poor medication adherence in COPD is associated with greater healthcare expenses, increased hospitalizations, and worse disease control,[22] demanding examination of the underlying variables that hamper medication adherence in these patients, which was the primary goal of our study. The current study findings should serve as a foundation for future healthcare strategies aimed at improving medication adherence and health-related outcomes among patients with COPD.

The majority of the current study participants were non-adherent to their medication. Age, knowledge about the proper inhaler technique, the presence of diseases other than COPD, concerns about medication side effects, frequency of taking COPD medications, disease duration, and depression were all predictors of medication adherence.

Medication adherence in the present study was far below expectations, with the majority of participants showing non-adherence to their medications (68%). An earlier study that used the same adherence assessment instrument showed that only 39.3% of COPD patients reported high medication adherence in Italy.[23] Another study reported that around three-quarters of COPD patients had low to medium medication adherence in Nepal.[24] A non-adherence rate as high as 93% was also found among COPD patients in Egypt.[25] On the other hand, studies conducted in Hungary,[13] the Netherlands,[26] and China[27] reported higher rates of medication adherence in patients with COPD. The variation in medication adherence rates between studies shows that exploring the factors associated with medication adherence is an essential preliminary step for the development of interventions aiming to enhance medication adherence in patients with COPD.

Table 1: Socio-demographic characteristics of the study participants (n=702)			
Variable		**Median (IQR)**	**Frequency (%)**
Age (years)		68 (58-77)	
Gender	Male		552 (78.6)
	Female		150 (21.4)
Educational level	Low		252 (35.9)
	Moderate		228 (32.5)
	High		222 (31.6)
Average income	less than 600 JD		330 (47.0)
	600-1000 JD		290 (41.3)
	more than 1000 JD		82 (11.7)
Material status	Not married		0 (0)
	Married		642 (91.5)
	Other		60 (8.5)
Smoking	Former smoker		295 (42.0)
	Smoker		407 (58.0)
Living conditions	Alone		49 (7.0)
	Not alone		653 (93.0)
Living area	Rural area		92 (13.1)
	Urban area		610 (86.9)
Having pets	No		636 (90.6)
	Yes		66 (9.4)

IQR: interquartile range, JD: Jordanian dinar.

Table 2: Medical characteristics of the study participants (n=702)				
Variable			**Median (IQR)**	**Frequency (%)**
The severity of breathlessness in patients with COPD (mMRC)			2.0 (2-3)	
Disease duration			4 (2-5)	
Perceived disease severity Moderate Severe		Minor		114 (16.2)
			390 (55.6)	
			198 (28.2)	
Comorbidities	Hypertension	No		192 (27.4)
		Yes		510 (72.6)
	Heart diseases	No		366 (52.1)
		Yes		336 (47.9)
	Diabetes	No		348 (49.6)
		Yes		354 (50.4)
Number of COPD medications			2 (2-2)	
Total number of prescribed medications			5 (3-6)	
Receiving Inhaled corticosteroids Yes		No		222 (31.6)
			480 (68.4)	
Receiving Oral steroids Yes		No		678 (96.6)
			24 (3.4)	
Receiving LABA Yes		No		272 (38.7)
			430 (61.3)	

Receiving LAMA Yes	No		396 (56.4)
		306 (43.6)	
Receiving SABA Yes	No		564 (80.3)
		138 (19.7)	
Frequency of taking COPD medications		2 (2-2)	
Do you have concerns about the side effects of COPD medication? Yes	No		594 (84.6)
		108 (15.4)	
Inhaler score		91.4 (74.4-100)	
Your evaluation for the drug effectiveness? Good Excellent	Not good		54 (7.7)
		414 (59.0)	
		234 (33.3)	
Anxiety level abnormal	normal		414 (59.0)
		288 (41.0)	
Depression level abnormal	normal		318 (45.3)
		384 (54.7)	
GOLD disease severity group B (low risk/high symptoms) C (high risk/low symptoms) D (high risk/high symptoms)	A (low risk/low symptoms)		114 (16.2)
		282 (40.2)	
		108 (15.4)	
		198 (28.2)	

IQR: interquartile range, COPD: chronic obstructive pulmonary disease, LABA: long-acting B_2 agonist, LAMA: long-acting muscarinic antagonist, SABA: short-acting B_2 agonist.

Table 3: Multivariate analysis of the factors associated with medication adherence

Variable		**P-value**	**OR**	**95% CI**	
			Lower	**Upper**	
Age		<0.001 *	1.047	1.031	1.063
Inhaler score		<0.001 *	0.978	0.967	0.989
Having other chronic disease(s)	No	0.030 †	0.534	0.303	0.942
	Yes	Reference			
Having concerns about the side effects of COPD medication	No	0.001 ‡	0.395	0.226	0.691
	Yes	Reference			
Frequency of taking COPD medications		<0.001 *	1.929	1.371	2.716
Disease duration		0.018 †	1.086	1.014	1.163
Depression level	Normal	0.020 †	0.586	0.373	0.92
	Abnormal	Reference			
Anxiety level	Normal	0.096	1.487	0.932	2.373
	Abnormal	Reference			

COPD: chronic obstructive pulmonary disease.
*Significant at p<0.001, † significant at p<0.05, ‡ significant at p<0.01.

Consistent with previous findings,[28] older patients demonstrated significantly poorer medication adherence than younger ones. On the other hand, contradictory findings have been reported in the literature regarding this relationship, where higher medication adherence was found among older COPD patients.[13,29–33] This association may be explained by the fact that our study population was of advanced age, with a median age of 68 (58-77) years, because older age coupled with comorbidities, polypharmacy, memory loss, and impaired cognitive levels could impair medication compliance.[34] The inconsistent findings on the association between age and medication adherence necessitate conducting further research, as aging itself may have a different effect on adherence during adulthood (i.e., improving it) when compared to geriatric age

(i.e., decreasing it).[33]

COPD patients who showed greater proficiency in utilizing inhaler devices correctly were less likely to be non-adherent in the current study; this calls for customized instructional inhaler technique interventions that should be put into place in actual clinical practice settings in order toincrease adherence to COPD inhaled drugs. [35] According to a randomized controlled trial, a multifactorial intervention that focuses on knowledge, motivation, and skilled inhalation techniques (COPD information, dose reminders, audio-visual material, motivational aspects, and training in inhalation techniques) improved therapeutic adherence in COPD patients who were receiving scheduled inhalation therapy.[36]

Patients who were suffering from comorbidities other than COPD were significantly more likely to be non-adherent in the present study. Similar findings have been reported in earlier studies.[11,28,30,33,37–40] A study conducted in Egypt showed that patients with COPD had higher non-adherence rates than those with asthma because a higher percentage of the COPD patients included in the study had comorbid conditions and were on complicated therapeutic regimens, both of which could have increased the level of non-adherence.[25] Other studies have reported that depression, one of the most prevalent comorbidities in COPD, was associated with higher rates of medication non-adherence in COPD patients,[29,39–43] which was also confirmed by the current study findings. The tendency of depressed patients to neglect their own needs and medical treatment might increase respiratory symptoms and set off a depressive state. Depression and respiratory impairment may then interact and intensify one another, increasing patient suffering and diminishing treatment adherence. Therefore, healthcare providers should take into account comorbid conditions and psychological symptoms when treating COPD patients in order to effectively manage these comorbidities and reduce their burden on affected patients, thereby improving medication adherence.

In the present study, medication adherence was influenced by medication-related issues, including patients' concerns about the side-effects of COPD medication and dosing frequency. These findings are in line with those of previous studies, which observed a strong relationship between fear of medications' side effects and medication non-adherence.[11,13,25,40,44–47]On the other hand, an earlier study discovered that less frequent use of inhalers (once daily as opposed to twice daily) was linked to better treatment compliance in patients with severe asthma.[48] According to a large retrospective cohort study involving more than 55,000 COPD patients in the USA, patients who started their therapy with once-daily dosing showed much higher adherence than those who started with different daily dosing frequencies.[49] Similar results were found in other studies.[50,51] These findings highlight the significance of reducing COPD patients' concerns about treatment side effects by enhancing their views on their medication through effective counseling. Moreover, selecting a long-acting, once-daily medicine or simplifying dosing regimens by lowering dose frequency may also increase medication adherence.

Patients who lived with COPD for longer periods had significantly poorer medication adherence than those with shorter COPD duration in the present study. This finding is in line with those from a study conducted in Bangladesh, which found a significant relationship between prolonged duration of inhaler intake and medication non-adherence in patients with asthma.[52] Conversely, a systematic review found no association between disease duration and medication adherence.[53] These conflicting findings might be attributed to the heterogeneity of patient-related characteristics, as well as diverse adherence measurement tools, as this systematic review's conclusion was based on the analysis of studies involving patients with cancer, rheumatoid arthritis, and chronic non-malignant pain, calling for further investigation to be conducted in this area, especially in patients with COPD.

Several limitations of the current study need to be acknowledged. The cross-sectional study design cannot confirm a cause-and-effect relationship. Further research using a longitudinal design would help determine causal links between medication non-adherence and the variables identified as predictors. Furthermore, the use of self-report through the survey may have exposed the results to social desirability bias. However, given the very high rates of medication non-adherence self-reported by patients in this study, it is likely that social desirability bias was low.Moreover, the relatively higher proportion of males to females in this study suggests a non-homogeneous sample, potentially impacting the generalizability of the results. While no association was discovered between smoking and medication non-adherence, it is noteworthy that pack-year, representing the number of cigarettes smoked over a patient's lifetime,[54] was not calculated in this study. Future research incorporating this variable may provide a more accurate understanding of the association between smoking and medication non-adherence. It is also deemed necessary to use the Charles Comorbidity Index to assess the mortality risk among this group of patients in future studies.

CONCLUSION

Poor medication adherence was clearly demonstrated among the current study participants. Effective counseling interventions involving patient education on inhaler techniques and COPD medications' safety profile, and selecting medications with more convenient dosage regimens are essential to improving medication adherence in COPD patients, particularly in older patients, patients with comorbid diseases, depressed patients, and those with longer disease duration.

AUTHORS' CONTRIBUTION

ASJ conceived and designed the study, supervised the project, conducted research, provided research materials, and wrote initial and final draft of article. WA designed the study, validated instruments, organized, analysed and interpreted data and reviewed the manuscript. KHA designed the study, organized, analysed and interpreted data, and wrote initial and final draft of article. SRA designed the study, collected, organized, analyzed and interpreted data, and wrote initial

and final draft of article. EMA designed the study, collected, organized, analyzed and interpreted data, and wrote initial and final draft of article. YNA conceived the study co-supervised the study and reviewed the final draft of the manuscript. TM conceived and designed the study, wrote initial and final draft of article, and provided logistic support. JE conceived the study co-supervised the study, reviewed the final draft of the manuscript and provided logistic support. SA conceived the study and research methods, co- reviewed the final draft of article, and co-supervised the project. AA conceived the study co-supervised the study, reviewed the final draft of the manuscript and provided logistic support. All authors have critically reviewed and approved the final draft of the study and agreed to be accountable for all aspects of the work.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest to declare.

References

1. Barnes PJ, Celli BR. Systemic manifestations and comorbidities of COPD. Eur Respir J. 2009 May;33(5):1165–85. https://doi.org/10.1183/09031936.00128008
2. Hawash M, Mosleh R, Jarrar Y, et al. The Prevalence of Water Pipe Smoking and Perceptions on its Addiction among University Students in Palestine, Jordan, and Turkey. Asian Pac J Cancer Prev. 2022;23(4):1247–56. https://doi.org/10.31557/APJCP.2022.23.4.1247
3. Vestbo J, Hurd SS, Agustí AG, et al. Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease: GOLD executive summary. Am J Respir Crit Care Med. 2013 Feb 15;187(4):347–65. https://doi.org/10.1164/RCCM.201204-0596PP
4. Sweis NJ. Smoking Behavior among Jordanians: Physical, Psychological, Social, and Economic Reasons. Value Heal Reg issues. 2018 Sep 1;16:5–8. https://doi.org/10.1016/J.VHRI.2017.09.003
5. Adeloye D, Song P, Zhu Y, et al. Global, regional, and national prevalence of, and risk factors for, chronic obstructive pulmonary disease (COPD) in 2019: a systematic review and modelling analysis. Lancet Respir Med. 2022 May 1;10(5):447–58. https://doi.org/10.1016/S2213-2600(21)00511-7
6. Koskela J, Kilpeläinen M, Kupiainen H, et al. Co-morbidities are the key nominators of the health related quality of life in mild and moderate COPD. BMC Pulm Med. 2014 Jun 19;14(1):102. https://doi.org/10.1186/1471-2466-14-102/TABLES/4
7. López-Campos JL, Gallego EQ, Hernández LC. Status of and strategies for improving adherence to COPD treatment. Int J Chron Obstruct Pulmon Dis. 2019;14:1503–15. https://doi.org/10.2147/COPD.S170848
8. World Health Organization. Adherence to long-term therapies: evidence for action. Geneva: World Health Organization; 2003.
9. Al Bawab AQ, Al-Qerem W, Abusara O, et al. What Are the Factors Associated with Nonadherence to Medications in Patients with Chronic Diseases? Healthcare. 2021 Sep 20;9(9):1237. https://doi.org/10.3390/HEALTHCARE9091237
10. Restrepo RD, Alvarez MT, Wittnebel LD, et al. Medication adherence issues in patients treated for COPD. Int J Chron Obstruct Pulmon Dis. 2008;3(3):371–84. https://doi.org/10.2147/COPD.S3036
11. Jarab AS, Mukattash TL. Exploring variables associated with medication non-adherence in patients with COPD. Int J Clin Pharm. 2019 Aug 30;41(5):1202–9. https://doi.org/10.1007/S11096-019-00895-3
12. Volpato E, Toniolo S, Pagnini F, et al. The Relationship Between Anxiety, Depression and Treatment Adherence in Chronic Obstructive Pulmonary Disease: A Systematic Review. Int J Chron Obstruct Pulmon Dis. 2021;16:2001–21. https://doi.org/10.2147/COPD.S313841
13. Agh T, Inotai A, Meszaros A. Factors associated with medication adherence in patients with chronic obstructive pulmonary disease. Respiration. 2011;82(4):328–34. https://doi.org/10.1159/000324453
14. Ierodiakonou D, Sifaki-Pistolla D, Kampouraki M, et al. Adherence to inhalers and comorbidities in COPD patients. A cross-sectional primary care study from Greece. BMC Pulm Med. 2020;20:253. https://doi.org/10.1186/S12890-020-01296-3
15. Zigmond AS, Snaith RP. The Hospital Anxiety and Depression Scale. Acta Psychiatr Scand. 1983 Jun 1;67(6):361–70. https://doi.org/10.1111/J.1600-0447.1983.TB09716.X
16. Lichtenberg PA. Handbook of Assessment in Clinical Gerontology. 2nd Ed. Academic Press; 2010.
17. Mahler DA. mMRC (Modified Medical Research Council) Dyspnea Scale [Internet]. MDCalc. [cited 2022 Apr 27]. Available from: https://www.mdcalc.com/mmrc-modified-medical-research-council-dyspnea-scale#use-cases
18. Laisure M, Covill N, Ostroff ML, et al. Summarizing the 2021 Updated GOLD Guidelines for COPD [Internet]. 2022 [cited 2023 May 29]. Available from: https://www.medscape.com/viewarticle/955946_2
19. The Deutsche Atemwegsliga e.V. (German Airway League) Correct Inhalation Technique [Internet]. 2019 [cited 2022 Apr 28]. Available from: https://www.atemwegsliga.de/correct-inhalation.html
20. Awwad O, AlMuhaissen S, Al-Nashwan A, et al. Translation and validation of the Arabic version of the Morisky, Green and Levine (MGL) adherence scale. PLoS One. 2022;17(10):e0275778. https://doi.org/10.1371/journal.pone.0275778
21. Karamurugan S, Govindarajan B. Statistical Package for the Social Science. Int J Bus Econ Res. 2023 Jan;8(4):616–8.
22. Davis JR, Wu B, Kern DM, et al. Impact of nonadherence to inhaled corticosteroid/LABA therapy on COPD exacerbation rates

and healthcare costs in a commercially insured US population. Am Heal Drug Benefits. 2017;10(2):92–100.
23. Napolitano F, Napolitano P, Angelillo IF. Medication adherence among patients with chronic conditions in Italy. Eur J Public Health. 2016;26(1):48–52. https://doi.org/10.1093/eurpub/ckv147
24. Acharya S, Sharma K. Factors affecting medication adherence among chronic obstructive pulmonary disease patients attending at teaching Hospital, Chitwan. Int J Med Sci Public Heal. 2019;8(7):498–503. https://doi.org/10.5455/ijmsph.2019.0409905052019
25. Galal IH, Mohammad YM, Nada AA, et al. Medication adherence and treatment satisfaction in some Egyptian patients with chronic obstructive pulmonary disease and bronchial asthma. Egypt J Bronchol. 2018;12(1):33–40. https://doi.org/10.4103/ejb.ejb
26. Koehorst-Ter Huurne K, Kort S, Van Der Palen J, et al. Quality of life and adherence to inhaled corticosteroids and tiotropium in COPD are related. Int J COPD. 2016;11(1):1679–88. https://doi.org/10.2147/COPD.S107303
27. Peng Y, Duan J, Li X, et al. Adherence to inhaled therapy in patients with COPD associated to pneumoconiosis. Int J COPD. 2021;16:2697–706. https://doi.org/10.2147/COPD.S327686
28. Vetrano DL, Bianchini E, Onder G, et al. Poor adherence to chronic obstructive pulmonary disease medications in primary care: Role of age, disease burden and polypharmacy. Geriatr Gerontol Int. 2017 Dec 1;17(12):2500–6. https://doi.org/10.1111/GGI.13115
29. Kokturk N, Polatli M, Oguzulgen IK, et al. Adherence to COPD treatment in turkey and Saudi Arabia: Results of the ADCARE study. Int J COPD. 2018;13:1377–88. https://doi.org/10.2147/COPD.S150411
30. Mueller S, Wilke T, Bechtel B, et al. Non-persistence and non-adherence to long-acting COPD medication therapy: A retrospective cohort study based on a large German claims dataset. Respir Med. 2017;122:1–11. https://doi.org/10.1016/j.rmed.2016.11.008
31. Arfè A, Nicotra F, Cerveri I, et al. Incidence, Predictors, and Clinical Implications of Discontinuing Therapy with Inhaled Long-Acting Bronchodilators among Patients with Chronic Obstructive Pulmonary Disease. COPD J Chronic Obstr Pulm Dis. 2016;13(5):540–6. https://doi.org/10.3109/15412555.2016.1141877
32. Humenberger M, Kaiser B, Labek A, et al. Adherence to inhaled therapy and its impact on chronic obstructive pulmonary disease (COPD). BMC Pulm Med. 2018;18:163–8. https://doi.org/10.1183/13993003.congress-2016.pa3684
33. Monteiro C, Maricoto T, Prazeres F, et al. Determining factors associated with inhaled therapy adherence on asthma and COPD: A systematic review and meta-analysis of the global literature. Respir Med. 2022;191:106724. https://doi.org/10.1016/j.rmed.2021.106724
34. Hanania NA, Sharma G, Sharafkhaneh A. COPD in the elderly patient. Semin Respir Crit Care Med. 2010;31(5):596–606. https://doi.org/10.1055/S-0030-1265900
35. Sánchez-Nieto JM, Bernabeu-Mora R, Fernández-Muñoz I, et al. Effectiveness of individualized inhaler technique training on low adherence (LowAd) in ambulatory patients with COPD and asthma. npj Prim Care Respir Med 2022 321. 2022 Jan 10;32(1):1–9. https://doi.org/10.1038/s41533-021-00262-8
36. Leiva-Fernández J, Leiva-Fernández F, García-Ruiz A, et al. Efficacy of a multifactorial intervention on therapeutic adherence in patients with chronic obstructive pulmonary disease (COPD): a randomized controlled trial. BMC Pulm Med. 2014 Apr 25;14(1):70. https://doi.org/10.1186/1471-2466-14-70
37. Van Boven JFM, Chavannes NH, Van Der Molen T, et al. Clinical and economic impact of non-adherence in COPD: A systematic review. Respir Med. 2014;108(1):103–13. https://doi.org/10.1016/j.rmed.2013.08.044
38. Vestbo J, Anderson JA, Calverley PMA, et al. Adherence to inhaled therapy, mortality and hospital admission in COPD. Thorax. 2009;64(11):939–43. https://doi.org/10.1136/thx.2009.113662
39. Khdour MR, Hawwa AF, Kidney JC, et al. Potential risk factors for medication non-adherence in patients with chronic obstructive pulmonary disease (COPD). Eur J Clin Pharmacol. 2012;68(10):1365–73. https://doi.org/10.1007/s00228-012-1279-5
40. Bhattarai B, Walpola R, Mey A, et al. Barriers and strategies for improving medication adherence among people living with COPD: A systematic review. Respir Care. 2020;65(11):1738–50. https://doi.org/10.4187/respcare.07355
41. Qian J, Simoni-Wastila L, Rattinger GB, et al. Association between depression and maintenance medication adherence among Medicare beneficiaries with chronic obstructive pulmonary disease. Int J Geriatr Psychiatry. 2014 Jan;29(1):49–57. https://doi.org/10.1002/GPS.3968
42. Turan O, Yemez B, Itil O. The effects of anxiety and depression symptoms on treatment adherence in COPD patients. Prim Health Care Res Dev. 2014 Jul 1;15(3):244–51. https://doi.org/10.1017/S1463423613000169
43. Albrecht JS, Park Y, Hur P, et al. Adherence to maintenance medications among older adults with chronic obstructive pulmonary disease the role of depression. Ann Am Thorac Soc. 2016 Sep 1;13(9):1497–504. https://doi.org/10.1513/ANNALSATS.201602-136OC
44. Fischer W, Brandstetter S, Brandl M, et al. Specific, but not general beliefs about medicines are associated with medication adherence in patients with COPD, but not asthma: Cohort study in a population of people with chronic pulmonary disease. J Psychosom Res. 2018 Apr 1;107:46–52. https://doi.org/10.1016/J.JPSYCHORES.2018.02.004
45. Krauskopf K, Federman AD, Kale MS, et al. Chronic Obstructive Pulmonary Disease Illness and Medication Beliefs are Associated with Medication Adherence. COPD J Chronic Obstr Pulm Dis. 2015 Apr 14;12(2):151–64. https://doi.org/10.3109/15412555.

2014.922067

46. Alefishat E, Jarab AS, Al-Qerem W, et al. Factors associated with medication non-adherence in patients with dyslipidemia. Healthc. 2021 Jul 1;9(7):3–12. https://doi.org/10.3390/healthcare9070813
47. Jarab AS, Abu Heshmeh SR, Al-Qerem WA, et al. Non-adherence to pharmacotherapy and its associated factors in outpatients with rheumatoid arthritis. Pharm Pract (Granada). 2023 Jun 30;21(2):1–8. https://doi.org/10.18549/PharmPract.2023.2.2822
48. Santos PDM, D'Oliveira A, De Araújo Costa Beisl Noblat L, et al. Predictors of treatment adhering in patients with severe asthma treated at a referral center in Bahia. J Bras Pneumol. 2008 Dec;34(12):995–1002. https://doi.org/10.1590/S1806-37132008001200003
49. Toy EL, Beaulieu NU, McHale JM, et al. Treatment of COPD: relationships between daily dosing frequency, adherence, resource use, and costs. Respir Med. 2011 Mar;105(3):435–41. https://doi.org/10.1016/J.RMED.2010.09.006
50. Coleman CI, Limone B, Sobieraj DM, et al. Dosing frequency and medication adherence in chronic disease. J Manag care Pharm. 2012;18(7):527–39. https://doi.org/10.18553/JMCP.2012.18.7.527
51. Weeda ER, Coleman CI, McHorney CA, et al. Impact of once- or twice-daily dosing frequency on adherence to chronic cardiovascular disease medications: A meta-regression analysis. Int J Cardiol. 2016 Aug 1;216:104–9. https://doi.org/10.1016/j.ijcard.2016.04.082
52. Rafi MA, Tahmin CI, Tashrik S, et al. Adherence to inhalers and associated factors among adult asthma patients: an outpatient-based study in a tertiary hospital of Rajshahi, Bangladesh. Asthma Res Pract. 2022 Dec;8(1):1. https://doi.org/10.1186/S40733-022-00083-7
53. Mathes T, Jaschinski T, Pieper D. Adherence influencing factors - a systematic review of systematic reviews. Arch Public Heal. 2014 Oct 27;72(1):1–9. https://doi.org/10.1186/2049-3258-72-37/TABLES/3
54. Eldridge L. Pack Years of Smoking and Health Risks [Internet]. verywellhealth. 2023 [cited 2023 Nov 20]. Available from: https://www.verywellhealth.com/definition-of-pack-years-of-smoking-2249140