Influence of medication related burden on asthma control and medication adherence among Iraqi asthmatic patients

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Abstract:

Background: Medication-related burden (MRB) reflects negative patient experiences with treatment, including adverse effects, concerns about dependency, and the complexity of different regimens. Asthmatic patients are subjected to multiple inhalers and oral drugs that can heighten the MRB, reduce life quality, and worsen health outcomes when medication adherence or technique becomes poor.
MRB was measured by The Living with Medication Questionnaire (LMQ), and medication adherence is measured by Morisky's adherence test, while asthma control is measured using the Asthma Control Test (ACT), which are validated tools.

Methods: This study is cross-sectional conducted in two teaching hospitals in Baghdad from October 2024 till September 2025, enrolling 200 Patients. Data collection included sociodemographic characteristics, adherence, asthma control, and MRB assessment

Results: Results showed that 65.5% of patients reported minimum MRB, 30% moderate MRB, 2.5% high MRB, and only 2% no burden. Adherence levels were low overall: 41.5% had poor adherence, 42.5% intermediate, and just 16% high adherence. MRB was significantly associated with social status and body mass index (BMI), and strongly correlated with asthma control, being higher among patients with uncontrolled asthma. However, there was no significant association between MRB and adherence levels.

Conclusion: Most Iraqi asthmatic patients experienced minimum to moderate MRB, with higher burden among divorced individuals, those with BMI > 30, and those with uncontrolled asthma.

Key words: Adherence, Asthma, Living with medication, Medication related burden, Polypharmacy.

تأثير العبء المرتبط بالأدوية على السيطرة على الربو والالتزام بالعلاج لدى المرضى العراقيين المصابين بالربو

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الخلاصة:

مقدمة: تبحث هذه الدراسة في العبء المرتبط بالأدوية (MRB)، والالتزام بالعلاج، والسيطرة على الربو بين المرضى العراقيين المصابين بالربو المستمر. يعكس العبء المرتبط بالأدوية التجارب السلبية للمرضى مع العلاج، بما في ذلك الآثار الجانبية، المخاوف من الاعتماد، والأنظمة العلاجية المعقدة. في حالة الربو، يؤدي الاستخدام المتكرر لعدة بخاخات وأدوية فموية إلى زيادة العبء، تقليل جودة الحياة، وتدهور النتائج عند ضعف الالتزام أو سوء التقنية. استُخدم استبيان "العيش مع الدواء" (LMQ) لقياس العبء، إلى جانب اختبار موريسكي للالتزام واختبار السيطرة على الربو.

منهجية البحث:أُجريت دراسة مقطعية في مستشفيين تعليميين في بغداد بين أكتوبر 2024 وسبتمبر 2025، شملت 200 مريض. شملت البيانات الخصائص الاجتماعية والديموغرافية، الالتزام، السيطرة على الربو، وتقييم العبء المرتبط بالأدوية.

النتائج: أظهرت النتائج أن 65.5% من المرضى لديهم عبء أدنى، 30% عبء متوسط، 2.5% عبء مرتفع، و2% بلا عبء. مستويات الالتزام كانت منخفضة إجمالاً: 41.5% لديهم التزام ضعيف، 42.5% متوسط، و16% فقط التزام مرتفع. كان العبء مرتبطاً بشكل ملحوظ بالحالة الاجتماعية ومؤشر كتلة الجسم (BMI)، وارتبط بقوة مع مستوى السيطرة على الربو، حيث كان أعلى بين المرضى غير المسيطرين على الربو. ومع ذلك، لم يظهر ارتباط ذو دلالة إحصائية بين العبء ومستويات الالتزام.

الاستنتاج: معظم مرضى الربو العراقيين يعانون من عبء أدنى إلى متوسط، مع عبء أعلى بين المطلقين، من لديهم مؤشر كتلة جسم أكبر من 30، والمرضى غير المسيطرين على الربو.

الكلمات المفتاحية: الالتزام بالعلاج، الربو، التعايش مع الدواء، العبئ المرتبط بالأدوية، تعدد الادوية.

Introduction:

A chronic illness that affects lungs' airways is asthma. The most frequent symptoms of asthma are inflammation, and bronchospasm (1, 2). Asthma is classified by severity, causes, and phenotypes shaped by genetic and environmental factors (3, 4, 5).

Asthma prevalence has risen globally, increasing from 34.7 to 49.4 per thousand, with Iraq showing high rates that strain healthcare and reduce quality of life; childhood asthma is most common in Baghdad (22.7%) and lowest in Erbil (7%) (6). In Saudi Arabia, asthma prevalence ranges from 9–33.7% in children and 10.5–18.3% in adults (7,8), while the UAE reports 13% in children linked to urbanization and pollution (9), and Kuwait shows 11.9% in both children and adults (10). Asthma prevalence is more common among boys until 20 years old age, after this age become equal among both sexes (11). Worldwide, the strongest and the most frequent risk facor for asthma is family history (12). Other factors include age where school-aged is the most are the most affected group (13), home conditions (12), sex (14), Obesity, and lower socioeconomic levels (15, 16). These factors show the complexity of interaction between environment, genetic, lifestyle effect on asthma development.

Asthma control and adherence to medication have a crucial role in decreasing MRB among asthmatic patients in Iraq. Recently, several studies conducted in Iraq showed that low

patient educational level, poor inhaler technique, and lower medication adherence were a significant contributing factor for poor asthma control and high MRB (17,18, and 19). Measuring medication-related burden from patients perspective is very important to better outcomes, though research remains limited for this topic (20). The living with medication questionnaire (LMQ) is a valid tool to measure MRB (21, 22)

Adherence is defined as initiation, implementation, and discontinuation of prescribed medication, while compliance and concordance reflect different aspects of patient–provider cooperation (23–25). Non-adherence is influenced by beliefs, polypharmacy, demographics, and health system factors, and is linked to poor outcomes and higher costs (26, 27). In asthma, non-adherence worsens clinical results and increases hospital use (28). Medication adherence can be measured using the Arabic version (29) of 4 item Morisky adherence scale. Score 1 point for every "Yes" answered (0 points = high adherence, 1-2 points = intermediate, 3-4 points = low adherence).

The purposes of this study are to evaluate MRB level, Adherence scale and asthma control level among the patients, another purpose is to determine any possible association between MRB and adherence, asthma control level as well as some sociodemographic characteristics.

Methods:

Study design and setting

This current cross-sectional study conducted at two hospitals in Baghdad the capital of Iraq (Al-Yarmouk teaching hospital and Al-Imamein Al-Kadhemein medical city) from October 2024 to September 2025

Study population

The study included conveniently selected already diagnosed asthmatic patients.

Inclusion criteria: Adult patients with chronic bronchial asthma, both genders aged 18-70 years, and patients who are on regular medication of chronic asthma.

Exclusion criteria; Patients who refused to participate, patient who had social habit or chronic lung disease other than asthma that may affect this study measurement like other chronic obstructive lung diseases, interstitial lung disease, asthmatic patient on chronic oral steroid therapy and on other drugs that affect the inflammatory process, current smoker or history of smoking within five years. , asthmatic patients with other comorbid inflammatory disorder or on medication that may affect inflammatory process, pregnant women or nursing mother, and finally patient who had mental disability that impair their understanding.

Sample size measured by G power software version 3.1.9.7 using the following parameter: t-test for independent means, two tailed, effective size(d) = 0.5, alpha error 0.05, power= 0.91, where the sample size after calculation was 172.

Ethical Approval

Approval For this study was obtained from the “Scientific and Ethical Committee” in the College of Pharmacy, Mustansiriyah university (Approval No. 78-91/2024). In addition, approval from the Ministry of Health was also obtained (Approval No. 178 16/7/2024). While patients' consent was obtained after a full explanation by researcher.

Data Collection

Data collected by using a data sheet, which consists of the following parts:

Socio-demographic characteristics: including age, gender, social status, education level, residence, smoking status, drinking alcohol, body mass index (BMI), and monthly income.

The age categorized into groups below or equal to 50 years old and above 50 years old, social status categorized into single, married, divorced and widows. The monthly income categorized into below 500000 Iraqi Dinar (ID), between 500000 and 1000000 ID, and more than 1000000 ID. Educational level categorized into Illiterate, primary school, secondary school, bachelor's degree and higher education. Residency classified into urban and rural areas. Finally. the Body mass index (BMI) classified into 18.9-24-9 BMI, 25-29.9 BMI, and above 30 BMI.

Asthma control test (ACT): A numerical score to test the level of asthma control (30) to evaluate asthma control. It consists of five questions about patient-relevant aspects of asthma control. Breathlessness frequency, nighttime/early awakenings, use of rescue medication, overall asthma control, and productivity loss are all evaluated by the ACT. Higher scores imply better asthma control. Each item is scored on a 5-point scale, with a total score ranging from 5 to 25. A score of 20 or more denotes "well-controlled" asthma, whereas a score of less than 20 means not well controlled asthma (31).

Medication adherence: Level of adherence measured using the Arabic version of 4-item Morisky adherence scale. Score 1 point for every "Yes" answer (0 points = high adherence, 1-2 points = intermediate, 3-4 points = low adherence) (29).

Medication-Related Burden: MRB measurement was by the LMQ "Arabic version. " Utilizing a 5-point Likert-type scale ranging from strongly disagree to strongly agree, participants indicated their level of agreement or disagreement with 41 statements in the LMQ. Furthermore, an open-ended question, or free text, that allows the patient to discuss any other concerns not covered in the LMQ (21).

The LMQ contains eight domains: the first domain: contains questions about the relationships with healthcare professionals (questions seven , 14, 20, 24, and 34), the second domain consist of questions about the practical difficulties in using medicines (questions one, two, four, ten , 23, 27, and 29), while the third domain concerned about the cost-related burden (Questions five, 31, and 33), the fourth domain about the side effects of medicines (questions 21, 22, 30, and 38), the fifthe one were asking about the effectiveness of prescribed medications (questions three, 15, 25, 32, 39, and 40), while the sixth domain asks about the concerns about medicines use (questions six, eight, nine, 12, 16, 17, and 18), the seventh one about the impact of using medicines on daily life (questions 19, 28, 35, 36, 37, and 41), and final the eighth domain asking about the autonomy to vary regimen (questions 11, 13, and 26). A patient with a high LMQ score means has higher burden. The results scored as follows: strongly agree takes five points, agree four points, neutral three points, disagree only two points, and strongly disagree only one point; or, using reverse scoring (strongly agree one point, agree two points, neutral three points, disagree four points, and strongly disagree five points) as appropriate (Questions 3, 4, 7, 11, 13, 14, 15, 20, 24, 25, 26, 27, 32, 34, 39, and 40) (21), the total LMQ score, which ranged from 41 to 205, was the product of the scores for each of the 41 questionnaire items. Higher scores indicated higher MRB (32).

Questionnaire Validity:

Validity: is the ability of an instrument to measure the data accurately (33) The questionnaire was designed and translated to Arabic, then presented to five experts to investigate the clarity, relevancy, related with subject, adequacy of the questionnaire and

lectures of the program to achieve the study objectives.

Pilot Study

A pilot study was performed to test the tools for the data collection Purposive sample of (30) patient's chosen from Al-Imamian Al-khademainn medical city and Al-Yarmouk teaching hospital (15 from each one) , and those patients did not enroll in the original study

Reliability can be equated with a measuring stability, consistency, or dependability also concerns accuracy (33).

The aim of testing is to determine the reliability and the stability of the assessment tools. The researchers used the alpha Cronbach equation to measure the stability of the scale items and as shown in table (1):

Table (1): Stability test

Place of Application	Scale Name	Number of questions	The Number of the Sample	Cronbach's Alpha Coefficient
AL-Imamain Al-khademain medical city And Al-Yarmouk teaching hospital	Living with medication questionnaire	**41**	**30**	**0.710**
	Morisky adherence scale	**4**	**30**	**0.872**
	asthma control test	**5**	**30**	**0.721**

Statistical Analysis

The data will be analyzed using "Statistical Package for the Social Sciences (SPSS) software version 22 where the results represented by table, graphs, and diagram after analysis of the significancy of differences between this study variables using the independent t-test and One -Way ANOVA tests. A P-value ≤ 0.05 considered statistically significant.

Results:

The total participants engaged in this study were two hundred participants, 113 (56.5%) of them females and 87 (43.5%) males. The married participants were 140 (70%) while the single, widowed, and divorced were 41 (20.5%), 14(7%) and 5(2.5%) respectively. Regarding educational level, 12.5 %, 31%, 37% and 19% were with illiterate, primary, secondary, and bachelor education respectively. 48% of the participants were with income less than 500000 Iraqi Dinar (ID) while 39% of them were with income between 500000 ID and 1000000 ID, and 13% of them were with income more than 1000000 ID. 93% of them were from urban area and 7% from rural area. 20%, 32.5% and 47.5 % of them were with 18.9-24.9, 25-29.9, and > 30 BMI respectively.

MRB level according to the LMQ was as follows: 2% of the participants were with no burden, while 65.5 % of them were with minimum burden, and 30% were with moderate burden and finally 2.5% were with high burden as illustrated in table (2).

Table 2: level of the medication burden according to the Living with Medications quastionnaire (LMQ)

Burden degree	Category ranges	Patients' number	%
No burden	41-73	4	2
Minimum burden	74-106	131	65.5
Moderate burden	107-139	60	30
High burden	140-172	5	2.5
Extremely high burden"	173–205	0	0

%= Percentage

Regarding LMQ domains; domain one, domain two, domain five, and domain seven had lowest mean of burden score according to LMQ, while domain four and domain six had slightly lower mean than theoretical average, and lastly domain three and domain eight had slightly higher mean than theoretical average as shown in table (3)

Table (3): Descriptive statistics of LMQ domains

LMQ domain	Theoretical average of the domains *	Mean	SD
Domain one	15.00	8.655	3.713
Domain two	21.00	16.73	8.754
Domain three	9.00	9.870	4.008
Domain four	12.00	11.100	4.760
Domain five	18.00	12.440	5.390
Domain six	21.00	20.020	8.415
Domain seven	18.00	13.410	6.847
Domain eight	9.00	9.640	3.935

LMQ: Living with Medicines Questionnaire; SD: Standard deviation * Theoretical average of the domains: calculated if the answers to all questions were Neutral

Regarding Medication adherence, the results were that only 16% of participants with high adherence, 42.5% of them with intermediate adherence, and 41.5 % of them with low adherence as illustrated in figure 1

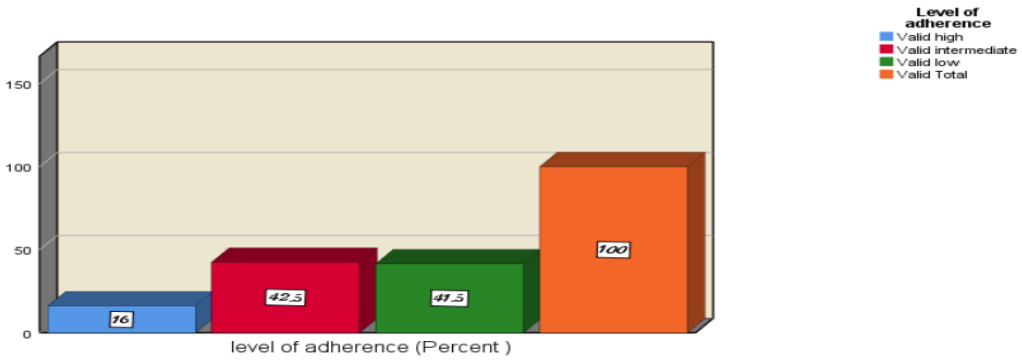

Figure 1: levels of medication adherence

The association of medication burden according to LMQ score and sociodemographic factors was significant with social state where higher burden was among divorced participants and lower burden was among married participants. It also was significant regarding BMI of the participant where higher burden was among those with BMI > 30 and lower among those with BMI between 18.9 and 24.9. Other sociodemographic factors weren't significantly associated with LMQ score. As shown in table (4)

Table (4): Association of patients' socio-demographics characteristics and medication burden according to LMQ score

Characteristics		N	Mean of medication burden score	Standard Deviation	P-value
Gender	Male	87	100.528	19.031	0.48
	Female	113	98.7168	17.604	
Age	≤ 50 years	127	101.204	19.876	0.82
	> 50years	73	96.547	14.546	
Social status	Single	41	103.682	19.574	**0.021***
	Married	140	97.657	17.232	
	Divorced	5	119.400	35.620	
	Widowed	14	98.642	9.443	
Income	< 0.5 million ID	96	101.958	17.900	0.23
	0.5-1.0 million ID	78	99.333	18.322	
	>1.0 million ID		90.961	17.035	
Education	Illiterate	25	104.360	21.175	0.409
	Primary school	62	99.709	15.809	
	Secondary school	74	97.324	18.646	
	Bachelor	39	100.205	18.965	
Residency	Urban	186	99.731	18.174	0.523
	Rural	14	96.500	19.178	
BMI	18.9-24.9	40	94.750	20.017	**0.030***
	25-29.9	65	97.415	19.045	
	>30	95	102.936	16.266	

N: Number; ID; Iraqi dinar; BMI: Body mass index. *Significancy by one-way ANOVA test.

The association between medication burden according to LMQ score and Asthma control test (ACT) revealed a highly significant difference, where medication burden was much higher among those with uncontrolled asthma than those with controlled asthma as shown in table (5)

Table (5): The association between medication burden according to LMQ score and Asthma control test (ACT)

ACT	Mean of medication burden score	SD	P value
Uncontrolled	101.619	18.012	**<0.001***
Good controlled	84.000	10.802	

ACT: Asthma control test; SD: Standard deviation. *Significancy by independent t- test.

In respect to the effect of medication burden according to LMQ score on patients' adherence, the results showed that there was no significant association between medication burden according to LMQ score with the level of participants' adherence to medications as shown in table (6)

Table (6): Effect of medication burden according to LMQ score on patients' adherence

Patients' adherence	N	Mean of medication burden score	SD	P-value
Low	83	98.734	20.579	0.483
Intermediate	85	101.188	15.261	
High	32	97.031	19.044	

N: Number; SD: standard deviation. Note: [0 points = high adherence, 1-2 points = intermediate, 3-4 points = low adherence]. Significancy using one-way Anova test.

Discussion:

There is no Study tested the MRB in asthmatic patients till the time when this study conducted. Therefore, the results of current study compared with other studies dealt with MRB in other chronic diseases. In this study the LMQ assessment showed that most of the participants were with minimal to moderate medication burden. Compared with Bahrain's study of 500 older adults on multiple prescriptions, only 0.4% had no/minimal burden. In Bahrain, 27.4% reported moderate burden, while 72.2% experienced a high burden (34). In a 2022 cross-sectional study of 405 elderly TB patients in Guizhou, China, the LMQ3 revealed that nearly half (49.4%) experienced a moderate medication related burden, while 42.7% reported a high burden across its eight domains. (35). Nigerian cross-sectional study of 417 HIV positive adults on antiretroviral therapy found that most participants (67.6%) experienced a moderate medicine burden. About 29.5% reported a minimal burden, while only 2.9% faced a high burden, showing the overall burden was mainly minimal to moderate (36). Similarly, a cross-sectional study conducted in northwest Ethiopia on 423 systematically selected diabetic patients attending the DM clinic at Felege Hiwot Comprehensive Specialized Hospital (FHCSH) between June and August 2020 reported that the majority of participants experienced moderate (58.9%, 95% CI: 53.9–63.7) to high (26.2%, 95% CI: 22.5–30.0) levels of medication burden (37).

The Living with Medication Questionnaire showed a significant association between burden, marital state, and body mass index. Divorce participants were with higher MRB, while married ones were with lower MRB. This can be explained by the spouse's help and support to decrease MRB as found in a previous study (38). In addition to that, high BMI is linked to more morbidity, like diabetes and hypertension, which leads to more medication regimens and high MRB (39). No

significant association between MRB and age, sex, or education, which is consistent with many other studies (40).

This study showed a strong association between MRB and asthma control, with more burden among those with poor asthma control due to difficult regimens and multiple interventions. This increases psychological stress, cost, and treatment complexity (41). GINA highlights that lower asthma control led to more healthcare needs and frequent drug changes. A low ACT score is associated with worse asthma morbidity and higher stress (42). These findings reinforce this strong association between asthma control and MRB (43).

The current study showed no significant association between MRB and medication adherence, while many other previous studies showed the reverse. Recently, some studies highlighted medication adherence as multifactorial. Perception and acceptance may decrease the adherence effect on burden (44). Stewart et al in 2023, stated that the adherence can be affected by motivation and capabilities, where the therapy beliefs and practical barriers can predict medication adherence more than MRB (45). Zewdu et al in 2025 showed patient's attitude, social stigma, and social support were strong predictors for poor adherence more than MRB (46). LMQ is a validated tool, but it may not capture the full financial, emotional, or interpersonal variations which may affect medication adherence.

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Conclusion: most of asthmatic patients in Iraq have minimum to moderate MRB, with higher medication-related burden among divorced, those with BMI more than 30, and those with poor asthma control.

References:

1- Bereda G. Bronchial asthma: etiology, pathophysiology, diagnosis and management. Austin J Pulm Respir Med. 2022;9(1):1085.
2- Toumpanakis D, Usmani OS. Small airways in asthma: Pathophysiology, identification and management. Chinese Medical Journal Pulmonary and Critical Care Medicine. 2023 Sep 30;1(03):171-80.
3- Oppenheimer J, Hoyte FC, Phipatanakul W, Silver J, Howarth P, Lugogo NL. Allergic and eosinophilic asthma in the era of biomarkers and biologics: similarities, differences and misconceptions. Annals of Allergy, Asthma & Immunology. 2022 Aug 1;129(2):169-80.
4- Miethe S, Karsonova A, Karaulov A, Renz H. Obesity and asthma. Journal of Allergy and Clinical Immunology. 2020 Oct 1;146(4):685-93.
5- Padem N, Saltoun C. Classification of asthma. InAllergy & Asthma Proceedings 2019 Nov 1 (Vol. 40, No. 6).
6- Alsajri AH, Al-Qerem W, Noor DAM. Asthma prevalence among Iraqi children. Al-Salam J Med Sci. 2024;3(1):17–21.
7- Almutairi A, Alolayan AM, Alazmi AH, Alghurayr RY, Alrashidi RA, Alsaud JS. Incorrect use for inhalation techniques of inhaled medication among children with asthma in Qassim Region: prevalence and its risk. Pak J Med Health Sci. 2022;16(2):896. https://doi.org/10.53350/pjmhs22162896

8- Al Ghobain M, Ahmed A, Abdrabalnabi Z, Mutairi W, Al Khathaami A. Prevalence of and attitudes to waterpipe smoking among Saudi Arabian physicians. East Mediterr Health J. 2018;24(3):277–282. doi:10.26719/2018.24.3.277.55145/ajbms .2024.03.01.004.
9- Dalibalta S, Samara F, Qadri H, Adouchana H. Potential causes of asthma in the United Arab Emirates: drawing insights from the Arabian Gulf. Revi environ health. 2018;33(2):205–212. doi:10.1515/reveh-2017-0030
10- Ziyab AH. Prevalence and risk factors of asthma, rhinitis, and eczema and their multimorbidity among young adults in Kuwait: a cross-sectional study. Biomed Res Int. 2017;2017(1):2184193. doi:10.1155/2017/2184193
11- Sinyor B, Perez LC. Pathophysiology of asthma. InStatPearls [Internet] 2023 Jun 24. StatPearls Publishing.
12- Sio Y, Chew F. Risk factors of asthma in the Asian population: a systematic review and meta-analysis. Journal of Physiological Anthropology. 2021 Dec 9;40(1):22.
13- Pate S, Zahran H. The status of asthma in the United States. *Preventing Chronic Disease*, 2024, 21: E53.
14- Marinelli A, Dragonieri S, Portacci A, Quaranta VN, Carpagnano GE. Reconsidering gender in asthma: Is it all about sex? A perspective review. Journal of Clinical Medicine. 2025 Apr 7;14(7):2506.
15- World Health Organization. Tobacco and asthma. July 2024. Available from: https://iris.who.int/bitstream/handle/10665/378266/9789240097537-eng.pdf
16- Hou W, Guan F, Chen W, Qi J, Huang S, Zeng P. Breastfeeding, genetic susceptibility, and the risk of asthma and allergic diseases in children and adolescents: a retrospective national population-based cohort study. *BMC Public Health*. 2024;24:3056.
17- Alsadah A, van Merode T, Alshammari R, Kleijnen J. A systematic literature review looking for the definition of treatment burden. Heliyon (2020) 6(4):e03641.doi: 10.1016/j.heliyon.2020.e03641
18- Awad A, Alhadab A, Albassam A. Medication-related burden and medication adherence among geriatric patients in Kuwait: a cross-sectional study. Frontiers in pharmacology. 2020 Aug 21;11:1296.
19- Alsajri AH, Al-Qerem W, Hammad AM, Alasmari F, Eberhardt J, Mohamed Noor DA. Prevalence and risk factors of asthma among Iraqi adults: a cross-sectional study. *J Asthma Allergy*. 2025;18:983–991.
20- Zhao J, Ding Y, Wang Z, Kou G, Xu S, Tai J, Zhang C, Guo Y, Yang J. A bibliometric analysis of medication compliance in children with asthma. *J Asthma Allergy*. 2025;18:954–972.
21- Zidan A. Medication-related burden among patients with chronic disease conditions: perspectives of patients attending non-communicable disease clinics in a primary healthcare setting in Qatar. [master's thesis] [Qatar university. College of pharmacy]; 2017.
22- Katusiime B, Corlett S, Krska J. Development and validation of a revised instrument to measure burden of long-term medicines use: the Living with Medicines Questionnaire version 3. Patient Related Outcome Measures. 2018;9:155–68.
23- Peh KQ, Kwan YH, Goh H, Ramchandani H, Phang JK, Lim ZY, Loh DH, Østbye T, Blalock DV, Yoon S, Bosworth HB. An adaptable framework for factors contributing to medication adherence: results from a systematic review of 102

conceptual frameworks. Journal of general internal medicine. 2021 Sep; 36:2784-95.
24- Jankowska-Polańska B, Świątoniowska-Lonc N, Sławuta A, Krówczyńska D, Dudek K, Mazur G. Patient-Reported Compliance in older age patients with chronic heart failure. PloS one. 2020 Apr 16;15(4):e0231076.
25- Trimarco V, Manzi MV, Izzo R, Mone P, Lembo M, Pacella D, Esposito G, Falco A, Morisco C, Gallo P, Santulli G. The therapeutic concordance approach reduces adverse drug reactions in patients with resistant hypertension. Frontiers in Cardiovascular Medicine. 2023 May 5;10:1137706.
26- Shahin W, Kennedy GA, Stupans I. The consequences of general medication beliefs measured by the beliefs about medicine questionnaire on medication adherence: a systematic review. Pharmacy. 2020 Aug 17;8(3):147.
27- Jachimowicz JM, Gladstone JJ, Berry DA, Kirkdale CL, Thornley T, Galinsky AD. Making medications stick: improving medication adherence by highlighting the personal health costs of non-compliance. Behavioural Public Policy. 2021 Jul;5(3):396-416.
28- Jansen EM, van de Hei SJ, Dierick BJ, Kerstjens HA, Kocks JW, van Boven JF. Global burden of medication non-adherence in chronic obstructive pulmonary disease (COPD) and asthma: a narrative review of the clinical and economic case for smart inhalers. Journal of thoracic disease. 2021 Jun;13(6):3846.
29- Reyadh JA. Comparative study between ferric citrate and calcium carbonate as phosphate binders in terms of effectiveness, side effects and adherence in a sample of Iraqi patients on hemodialysis. [Ph.D. thesis] [University of Baghdad. College of pharmacy]; 2022.
30- US Department of Health and Human Services, National Institutes of Health, National Heart, Lung, and Blood Institute. Expert Panel Report 3: Guidelines for the Diagnosis and Management of Asthma (EPR-3 2007). NIH Item 08-4051. http://www.nhlbi.nih.gov/guidelines/asthma/asthgdln.htm. Accessed September 10, 2007.
31- Van Dijk BC, Svedsater H, Heddini A, Nelsen L, Balradj JS, Alleman C. Relationship between the Asthma Control Test (ACT) and other outcomes: a targeted literature review. BMC pulmonary medicine. 2020 Dec;20:1-9.
32- Zidan A, Awaisu A, El-hajj MS, et al. Medication-Related Burden among Patients with Chronic Disease Conditions : Perspectives of Patients Attending Non-Communicable Disease Clinics in a Primary Healthcare Setting in Qatar. pharmacy. 2018; 6(3):1-10.
33- Ahmed I, Ishtiaq S. Reliability and validity: importance in medical research. methods. 2021;12(1):2401-6.
34- Alqallaf SM, Matar L, Ghuloom K, Alabbad K, Alshaikh F, Alhaddad M. Medication-related burden from the perspective of the elderly. Medicine and Pharmacy Reports. 2022 Jul 26;95(3):320.
35- Wang Y, Jian S, Huang Z, Chen H, Hu Y, Fang S. Medication-related burden and its association with medication adherence among elderly tuberculosis patients in Guizhou, China: a cross-sectional study. Frontiers in Pharmacology. 2024 Aug 29;15:1416005.
36- Hedima, E.W., Ohieku, J.D., David, E.A., Ikunaiye, N.Y., Nasir, A., Alfa, M.A., Abubakar, S., Bwiyam, I.K. and Bitrus, T.A.Z., 2024. Evaluation of viral suppression and medication-related burden among HIV-infected adults in a secondary care facility. *Exploratory*

Research in Clinical and Social Pharmacy, *15*, p.100473.

37- Bekalu AF, Yenit MK, Tekile MT, Birarra MK. Medication-related burden and associated factors among diabetes mellitus patients at Felege Hiwot Comprehensive Specialized Hospital in northwest Ethiopia. Frontiers in Clinical Diabetes and Healthcare. 2022 Sep 9;3:977216.

38- Yang C, Zhu S, Hui Z, Mo Y. Psychosocial factors associated with medication burden among community-dwelling older people with multimorbidity. *BMC Geriatr*. 2023;23:741.

39- Bekalu AF, Yenit MK, Tekile MT, Birarra MK. Medication-related burden and associated factors among diabetes mellitus patients. *Front Clin Diabetes Healthc*. 2022;3:977216. [8]

40- Liu D, Qiu L, Han L, et al. Prevalence and influencing factors of medication-related burden among patients with late-life depression. BMC Public Health. 2024;24:3521. [6]

41- Koh YLE, Chua KYK, Ng DX, Aau WK, Tan NC. Assessing medication adherence in adults with asthma and its effect on rescue therapy for exacerbations. *Front Pharmacol*. 2025;16:1516062.

42- Global Initiative for Asthma. Global Strategy for Asthma Management and Prevention. 2024 GINA Main Report.

43- Schatz M, Sorkness CA, Li JT, et al. Relationship between the Asthma Control Test (ACT) and other outcomes. *BMC Pulm Med*. 2020;20:1090.

44- Dugunchi F, Mudgal SK, Hosseini Marznaki Z, Shirafkan H, Abrotan S, Jafarian F, Pourkia R. Levels of adherence to treatment, illness perception and acceptance of illness in patients with coronary artery disease: a descriptive and correlational study. *BMC Cardiovasc Disord*. 2024;24(171). Available from: https://bmccardiovascdisord.biomedcentral.com/articles/10.1186/s12872-024-03827-w

45- Stewart SF, Moon Z, Horne R. Medication nonadherence: health impact, prevalence, correlates and interventions. Psychol Health. 2023;38(6):726–765. Available from: https://www.tandfonline.com/doi/pdf/10.1080/08870446.2022.2144923

46- Zewdu WS, Dagnew SB, Tarekegn GY, Yazie TS, Ayicheh MA, Dagnew FN, Moges TA. Non-adherence level of pharmacotherapy and its predictors among mental disorders in a resource-limited life trajectories: a systematic review and meta-analysis. BMC Psychiatry. 2025;25:6838. Available from: https://bmcpsychiatry.biomedcentral.com/counter/pdf/10.1186/s12888-025-06838-9.pdf