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Original Research

The medication management review service and its effect on patient's asthma knowledge and adherence to their medications

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Abstract

Background: Asthma continues to be major challenge, detrimental disease and threat to health and economies. Tremendous number of asthmatics suffer from uncontrolled asthma and fatal exacerbations, therefore emergent interventions are needed to identify the roots of this dilemma and increase patient's knowledge of their disease in order to improve their adherence. The medication management Review (MMR) service is an appropriate service that can improve knowledge and adherence of asthma patients. **Aim:** To evaluate the impact of MMR service on the knowledge of asthmatic patients and subsequently their adherence to therapy. **Methods:** This study followed a single-blinded randomized controlled clinical trial design, and was conducted over 15 months in outpatient clinics of public hospitals in Amman, Jordan, involving asthma patients. Patients diagnosed with asthma were recruited and randomized into intervention and control groups. The MMR service was conducted for each patient to assess patients' knowledge and adherence. Socio- demographic characteristics were obtained via prepared questionnaires and patients' medical records. Clinical data were collected by validated questionnaires. Intervention group patients were educated concerning knowledge of asthma and adherence to therapy. Control group patients did not receive the education. Both groups were reassessed at 3 to 4 months after baseline, and their knowledge and adherence were evaluated. R**esults:** Patients with asthma (n = 152) were recruited, intervention (n=76) and control (n =76) groups showed lack in asthma knowledge; score mean at baseline was 5.28±1.654 for intervention, 5.53±1.47 for control, P-value= 0.327. Asthma knowledge at follow up score was 8.87±0.099 and 5.57±1.398 for intervention and control groups respectively, with significant difference between both groups (P-value<0.001). The majority of patients were poor adherent to therapy at baseline, due to various factors such as misperception regarding their disease, absence of asthma action plan, and cognitive and economic issues. Neither at base line nor at follow up patients follow asthma action plan, 100% of intervention and 90.8% of control didn't have asthma action plan, as well as patients' inability to afford medications. on the contrary other adherence parameters were improved significantly for intervention group at follow up, forgetfulness to take medication barrier adherence mean score 3.36±2.284 at baseline and 4.75±1.308 at follow up, P-value< 0.001, patients' perceptions toward their preventative medication score elevated from 3.87±2.282 to 4.83±1.482, P- value < 0.001, poor adherence due to side effects was overcome, adherence score enhanced from 3.68±2.282 to 4.22±1.943, P-value< 0.001. In contrast to intervention group, control group didn't show any improvement at follow up. **Conclusion:** The MMR service, which was employed by pharmacists for the first time in Jordan evidenced successful in identifying and resolving asthma patient's lack of knowledge and adherence. Thus, positive health outcome and better asthma control can result from the service.

Keywords: Jordan, medication management review, adherence to therapy, treatment related problems, asthma knowledge, pharmacist's educational intervention

INTRODUCTION

The Global initiative for asthma (GINA) defines asthma as a heterogeneous disease characterized by chronic airway inflammation (Global Initiative for Asthma - Global Initiative for Asthma - GINA, 2023).Asthma distresses about 250 million people worldwide. Over than 1000 deaths a day are due to asthma, the majority of these deaths are preventable (Levy et al., 2023). This chronic airway inflammation is classically managed by daily inhaled controller medications, the efficacy of these medication depends on patients' adherence (George & Bender, 2019), higher adherence has been linked to positive health outcomes, optimal asthma control and to reduction in fatal exacerbations (George & Bender, 2019).

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According to NICE (2009), the definition of adherence is the extent of matching between patient's behavior and prescriber's recommendation. Aspects of non-adherence fall into 3 main categories; medication factors that are directly linked to the medication itself, intentional factors and unintentional factors (Amin et al., 2020) (George & Bender, 2019). Patient's decision to unfollow their medication plan is considered to be an intentional non-adherence while unintentional non-adherence results from a variety of circumstances such as physical or sensory barriers that suppress patients control even if they hope to adhere to their medication plan, such as not being able to use their inhaler device correctly. Lots of patients do not adhere to their medication in the absence of symptoms and take more than the prescribed dose when symptoms come about (De Smet et al., 2006). In order to achieve optimal adherence, patients' practical issues that are linked to unintentional non-adherence, must be addressed, which include capability and resources (highly cost medication, cognitive issues). Furthermore, patients' perceptual issues that are linked to intentional non-adherence must be addressed, problems such as what patients believe, or what they prefer

and what are the incentives which can be solved by discussing patient's medical condition and it's prognosis, so patients gain better understanding of the treatment options, benefits and side effects (Engelkes et al., 2015).

Customarily pharmacists play a significant role in overcome many problems that lead to lack of adherence (Chandrasekhar et al., 2019). One strategy that can be followed by health care professionals is to shift patients' beliefs about the necessity of their medications is via their asthma perceptions. Particularly the relation between necessity beliefs and timeline illness perceptions, that suggest that asthmatics should be encouraged to perceive their illness as a continuous underlying condition which should be treated even if it is asymptomatic (Horne & Weinman, 2002). Non- adherence to therapy is a serious problem because patients often are not suffering despite their poor lung function and discontinue their medication even without seeking their physician's approval, as soon as they experience a quick response Global Initiative for Asthma (GINA) - Global strategy for asthma management and prevention report 2023). Generally, adherence to therapy is low among asthmatics, some studies show that adherence in adults is as low as 30% (Jeminiwa et al., 2019).

Asthma knowledge is important in improving adherence to therapy. The ability of patients to manage their chronic diseases has been a crucial concept for improving health outcomes over a decade. Asthma is an illness in which awareness of the chronic inflammation, the episodic patterns symptoms, the triggering or exacerbating factors, along with the beneficial or harmful aspects of medications would enhance self-care, adhering to therapy and eventually controlling the disease (Saini et al., 2011). Thus, educating and counseling are important components of asthma management guidelines (Saini et al., 2011). As a result of low asthma knowledge, asthmatic patients would be unable to differentiate between controller and reliever therapy, have improper inhaler technique, and have doubts about the efficacy of their treatment and concerns about potential side effects (Amin et al., 2020). No previous study has looked into the effect of the MMR service on improving patient's asthma knowledge and adherence to their treatment.

Aim of this study is to evaluate the impact of MMR service on the knowledge of asthmatic patients and subsequently their adherence to therapy.

METHODS

Data collection tools

In order to collect and evaluate data the following questionnaires were used in this study:

Demographic and asthma characteristics data Sheet

The demographic questionnaire consisted of two parts and was filled for all patients. The first part included demographic variables including age, income, marital status, education, employment status, residential status, and smoking. The second part included questions related to patient's asthma features, complications, triggering factors, and life style modification that might be done by patients in order to decrease their asthma exacerbation episodes.

Patient's asthma knowledge questionnaire

An assessment of asthmatics patients' awareness in regards to their disease features, severity, triggering factors and proper management options was achieved by utilizing the asthma knowledge questionnaire (Kritikos et al., 2005). Patients were asked 10 questions about factors that cause asthma exacerbations, such as medications, weather changes and respiratory infections, moreover, how often they dealt with these situations. Patients answered these questions by 'true' or 'false' answers. The score was calculated by number of correct answers, giving a mean out of 10.

Adult asthma adherence questionnaire

Patient adherence to therapy for one month earlier was assessed by questionnaire completion, using a questionnaire that was developed and used previously in similar studies (Schatz et al., 2013). It identified five questions linked to adherence measurements and to asthma control in order to use it clinically to identify patients who are at risk of non-adherence, and to explore specific adherence barriers that could be involved. Responses were documented as a six-point Likert scale as follows: I agree completely, I agree mostly, I agree somewhat, I disagree somewhat, I disagree mostly, I disagree completely (Schatz et al., 2013).

Sample size

For this parallel pre-post interventional study, the sample size was based on a distribution-based difference in ACT score of 2.21 points, SD 4.42. For 80% power and a two-sided significance level of $p < 0.05$, 63 patients per group were needed, giving a total of 126 patients; with an expected drop-out rate of 20%, a total sample size of 152 patients were recruited

Data Analysis

The Statistical Package for the Social Science (SPSS) software version 24.0 was used to analyze the study data (IBM Corp, 2016). The level of significance was set at 0.05, consistent with educational intervention literature. Descriptive statistical analysis, including means and standard deviation was used to describe sample characteristics and TRPs. Outliers, skewness and missing data were checked and handled before analyzing the study data. All assumptions for each proposed statistical test were tested before preceding the implementation of the assigned statistical tests.

An independent sample t-test was utilized in order to evaluate differences between groups for continuous variables and normally distributed data, while Mann-Whitney U tests was used if the data was not normally distributed.

RESULTS

Following the initial evaluation, 152 asthmatic patients were found eligible for study entry. Asthmatic patients who agreed to be enrolled in the study signed a consent form, and their

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participation was voluntary. The privacy of patients was protected by giving a number for each patient during data collection and analysis, upon signing the consent form by all patients, they were randomized into intervention (n=76) and control (n=76) groups. Pharmacist-patient face-to-face interviews were done in order to collect data

Socio-demographic characteristic of the sample

The mean age of the study participants was 46.98±12.75, and 118 (77.6%) were females while 34 (22.4%) were males. In addition, 78.9% of patients were married, 96.1% were living with their families and 15.8% of patients were smokers Smoking cessation was a big challenge, more education is required, secondhand smoking is a massive problem, since asthmatic patient suffer at home, at work and at public places, in order to avoid this problem, smoking ban must come into force and deterrent penalties must be enforced.

Regarding their occupational status, the majority of patients were without jobs, 108 (71.1%) of the total study participants. Mean income was 423.29 ±210.38 JD a month. Only 10.5% of the study sample have received previously health education. There were no statistically significant differences between intervention and control groups regarding baseline demographic characteristics (Table 1).

Baseline asthma knowledge

Lack of disease knowledge is one of the reasons for uncontrolled asthma (Nguyen et al., 2018). Assessing patients' knowledge prior to educational interventions is essential. A questionnaire that are consisting of 10 parameters was completed by all of the study participants, the collected data is shown in Table 2A. A high percent of patients were lacking proper asthma knowledge, their score mean at baseline was 5.28±1.654 for intervention and 5.53±1.47 for control, with no significance difference since the *P-value*= 0.327.

Asthma knowledge after 3 months, at follow up

Table 2B showed changes in the mean of asthma knowledge scores as a result of pharmacist intervention, significant difference between intervention and control group, *P*-value<0.001. Asthma knowledge score was 8.87±0.099 and 5.57±1.398 for intervention and control groups respectively, concerning patients' asthma knowledge after 3-months follow up, the majority of intervention group responded correctly. Higher percent of intervention group patients who answered correctly at follow-up, particularly questions about medication addiction, medication use if there is a potential exposure to triggering factors, and side effects.

Table 1. Demographic characteristics of the study subjects (n=152).

Parameters	Intervention	Control	Total	*P-value*
	n= 76 (50%)	n=76 (50%)	n= 152 (100%)	
Age mean ±SD	46.29±12.488	47.67±13.058	46.98±12.753	0.506**
Gender n (%)				
Male	18(23.7)	16(21.1)	34 (22.4)	0.697*
Female	58(76.3)	60(78.9)	118 (77.6)	
Marital Status n (%)				
Single	12(15.8)	9(11.8)	2 (13.8)	
Married	59(77.6)	61(80.3)	120 (78.9)	0.432*
Divorced	3(3.9)	1(1.3)	4 (2.6)	
Widow	2(2.6)	5(6.6)	7 (4.6)	
Residence status n (%)				
Alone	1(1.3)	1(1.3)	2 (1.3)	0.598*
Living with family	74(97.4)	72(94.7)	146 (96.1)	
Living with family in law	1(1.3)	3(3.9)	4 (2.6)	
Education level n (%)				
Elementary	11(14.5)	13 (17.1)	24 (15.8)	
Preparatory	21(27.6)	21 (27.6)	40 (26.3)	
Secondary	30(39.5)	19(25.0)	51 (33.6)	
Diploma	11(14.5)	10(13.2)	21 (13.8)	0.199*
bachelor	2(2.6)	10(13.2)	12 (7.9)	
masters	1(1.3)	1(1.3)	1 (.7)	
PhD	0 (0)	2(2.6)	3 (2)	

Who is taking care of you? n (%)				
Wife	13(17.1)	12(15.8)	25 (16.4)	0.320*
Husband	43(56.6)	37(48.7)	80 (52.6)	
Children	5(6.6)	11(14.5)	16 (10.5)	
Relatives	14(18.4)	12(15.8)	26 (17.1)	
No one	1(1.3)	4(5.3)	5 (3.3)	
Do you work? n (%)				
Yes	19(25)	14(18.4)	33 (21.7)	0.220*
No	54(71.1)	54(71.1)	108 (71.1)	
Retired	3(3.9)	8(10.5)	11 (7.2)	
Income JD (mean ±SD)	410.26±178.116	436.32±238.841	423.29±210.385	0.687***
Smoking n (%)				
Yes	12(15.8)	12(15.8)	24 (15.8)	0.951*
No	59(77.6)	58(76.3)	117 (77.0)	
Former smoker	5(6.6)	6(7.9)	11 (7.2)	
Type of smoking n (%)				
Cigarette	7(9.2)	5(6.6)	12 (50.0)	0.012*
Shisha	1(1.3)	6(7.9)	7 (29.2)	
Both	5(6.6)	0 (0)	5(20.8)	
Frequency of Shisha n (%)				
Daily	2(33.3)	3(50.0)	5(41.7)	0.819*
Weekly	1(16.7)	1(16.7)	2(16.7)	
Rarely	3(50.0)	2(33.3)	5(41.7)	
Smoker since when (mean ±SD)	20.71±14.682	22.40±12.759	21.42±13.324	0.841**
Number of cigarettes				0.372**
(mean ±SD)	8.33±5.015	11.40±8.820	9.24±6.230	
Health education? n (%)				
Yes	6(7.9)	10(13.2)	16(10.5)	0.214*
No	70(92.1)	66(86.8)	136(89.5)	
Onset of asthma				
Infancy	5 (6.6)	3 (3.9)	8 (5.3)	0.734*
2-12 years old	4 (5.3)	5 (6.6)	9 (5.9)	
Older than 12	67 (88.2)	68 (89.5)	135 (88.8)	
*Chi-square test / ** t-test Independent sample /***Mann-Whitney Test				

Asthma medications adherence at baseline

Table 3A showed specific parameters that were assessed to detect the level of adherence and the barriers that would restrain patients from getting the optimal benefits of their medications. The majority of patients were poorly adherent to therapy of intervention group, 98.7% of patients disagreed completely to follow medications action plan vs. 88.2% of control group. Percent of intervention group patients whom agreed completely that they forget to take at least one dose of their inhaled steroid each day is 39.5% vs. 32.9% of control group with no significant difference between both groups (*P-value*=0.524). Many patients in the intervention group disagreed completely, (n= 37,48.7%) that their asthma is mild and does not require regular preventative treatment, however 52 (68.4%) of control group disagreed completely. Many intervention group patients (35.5%) agreed completely that inhaled steroid causes side effects vs. 38.2% of control group, with no significant difference between both groups *P-value*=0.105. Of intervention group, 67.1% stated that they can't afford inhaled steroid and 76.3% of control group (*P-value*=0.295).

Table 4A recognizes barriers of asthma adherence at baseline and compares intervention with control groups, as 76 patients of intervention and 69 of control groups scored >1 in statement 1 ("**I follow my asthma medication plan),** which suggest possible adherence problem. For question 2 (**"I Forget to take**

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Table 3: Baseline and three months follow up asthma medication adherence assessment score (Schatz et al., 2013) comparing intervention n= 76 and control n= 76 groups.

Parameter	3A (Baseline)				3B (Follow up)			
	Intervention	Control	Total	*P-Value*	Intervention	Control	Total	*P-Value*
	n= 76(50%)	n=76(50%)	n=150 -100%		n=76(50%)	n=76(50%)	n= 152 -100%	
1.I follow my asthma medication plan. n(%)								
a. I agree completely			7 7(4.6)					
b. I agree mostly	0 (0.0)	(9·2)7	0 0 (0.0)	0.015*	1 (1.3)	7 (9.2)	7 (4.6)	0.015*
c. I agree somewhat	0 (0.0)	(0.0)0	2 (1.3)2		0 (0.0)	0 (0.0)	0 (0.0)	
d. I disagree somewhat	0 (0.0)	(2·6)2	(0.0)0		0 (0.0)	2 (2.6)	2 (1.3)	
e. I disagree mostly	0 (0.0)	(0.0)0	1 (0.7)		0 (0.0)	0 (0.0)	0 (0.0)	
f .I disagree completely	1 (1.3)	(0.0)0	(93.4) 142		0 (0.0)	0 (0.0)	1 (0.7)	
	75 (98.7)	(88·2)67			75 (98.7)	67 (8.2)	142 (93.4)	
2.I forget to take at least one dose of my inhaled steroid each day. n(%)								
a. I agree completely								
b. I agree mostly	30 (39.5)	25 (32.9)	55 (36.2)	0.524*	2 (2.6)	23 (30.3)	25 (16.4)	< 0.001*
c. I agree somewhat	4 (5.3)	4 (5.3)	8 (5.3)		3 (3.9)	5 (6.6)	8 (5.3)	
d. I disagree somewhat	9 (11.8)	10 (13.2)	19 (12.5)		5 (6.6)	11 (14.5)	16 (10.5)	
e. I disagree mostly	0 (0.0)	2 (2.6)	2 (1.3)		23 (30.3)	2 (2.6)	25 (16.4)	
f. I disagree completely	3 (3.9)	7 (9.2)	10 (6.6)		12 (15.8)	7 (9.2)	19 (12.5)	
	30 (39.5)	28 (36.8)	58 (38.2)		31 (40.8)	28 (36.8)	59 (38.8)	
3.My asthma is mild and does not require regular preventative treatment. n(%)								
a. I agree completely								
b. I agree mostly				0.007*				0.016*
c .I agree somewhat	(31·6)24	(18·4)14	38(25)		3 (3.9)	9 (11.8)	12 (7.9)	
d. I disagree somewhat	(7·9)6	(1·3)1	(4·6)7		4 (5.3)	6 (7.9)	10 (6.6)	
e .I disagree mostly	(2·6)2	(7·9)6	(5·3)8		8 (10.5)	6 (7.9)	14 (9.2)	
f .I disagree completely	(6.6)5	(0.0)0	(3.3)5		12 (15.8)	3 (3.9)	15 (9.9)	
	(2·6)2	(3·9)3	(3·3)5		10 (13.2)	3 (3.9)	13 (8.6)	
	37 (48.7)	52 (68.4)	89(58.6)		39 (51.3)	49 (64.5)	88 (57.9)	
4. My inhaled steroid causes side effects. n(%)								
a. I agree completely								
b. I agree mostly	27 (35.5)	29 (38.2)	56 (36.8)	0.105*	12 (15.8)	21 (27.6)	33 (21.7)	0.021*
c .I agree somewhat	5 (6.6)	6 (7.9)	11 (7.2)		5 (6.6)	13 (17.1)	18 (11.8)	
d. I disagree somewhat	2 (2.6)	8 (10.5)	10 (6.6)		13 (17.1)	9 (11.8)	22 (14.5)	
e .I disagree mostly	5 (6.6)	1 (1.3)	6 (3.9)		5 (6.6)	1 (1.3)	6 (3.9)	
f .I disagree completely	5 (6.6)	1 (1.3)	6 (3.9)		6 (7.9)	1 (1.3)	7 (4.6)	
	32 (42.1)	31 (40.8)	63 (41.4)		35 (46.1)	31(40.8)	66 (43.4)	
5. I can't afford my inhaled steroid. medication. n(%)								
a. I agree completely								
b. I agree mostly	(67·1)51	(76·3)58	109(71.7)		51 (67.1)	58 (76.3)	109 (71.7)	

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c .I agree somewhat	(1.3)1	(1.3)1	(1.3)2	0.295*	1 (1.3)	1 (1.3)	2 (1.3)	0.295*
d. I disagree somewhat	(1.3)1	(2.6)2	(1.3)2		0 (0.0)	2 (2.6)	2 (1.3)	
e .I disagree mostly	(3.9)3	(2.6)2	(2.0)3		1 (1.3)	2 (2.6)	3 (1.3)	
f .I disagree completely	(0.0)0	(3.9)3	(3.9)6		3 (3.9)	3 (3.9)	6 (3.9)	
	20 (26.3)	10 (13.2)	30 (19.7)		20 (26.3)	10 (13.2)	30 (19.7)	
*Chi-square test								

Table 4: Baseline and follow up asthma adherence barriers identification, comparison between intervention and control groups.

Questions	**4A (Baseline)**			**4B (Follow up)**		
	Intervention	**Control**	***P*-value**	**Intervention**	**Control**	***P*-value**
	n= 76	**n=76**		**n=76**	**n=76**	
I follow my asthma medication plan. n(%)						
=1; Follow their action plan			0.007*	0 (0.0)	7 (9.2)	
	0 (0.00)	7 (9.2)				0.007*
>1 suggest possible adherence problem.				75 (100.0)	69 (90.8)	
	76 (100)	69 (90.8)				
"I Forget to take at least one dose of my inhaled steroids each day". n(%)						
≤3; probable specific barrier	43 (56.6)	39 (51.3)	0.515*	11 (14.5)	39 (51.3)	< 0.001*
				65 (85.5)	37 (48.7)	
>3	33 (43.4)	37 (48.7)				
"My asthma is mild and does not require regular preventative treatment". n(%)						
≤4; probable specific barrier				28 (36.8)	24 (31.6)	
	36 (47.4)	20 (26.3)	0.007*	48 (63.2)	52 (68.4)	0.494*
>4						
	40 (52.6)	56 (73.7)				
"My inhaled steroid causes side effect". n(%)						
≤3; probable specific barrier	35 (46.1)	43 (56.6)		33 (43.4)	43 (56.6)	
			0.194*	43 (56.6)	33 (43.4)	0.105*
>3	41 (53.9)	33 (43.4)				
I can't afford my inhaled steroid medication" n(%)						
	52 (68.4)	61 (80.3)		52 (68.4)	61(80.3)	
≤3; probable specific barrier			0.095*	24 (31.6)	15 (19.7)	0.095*
	24 (31.6)	15 (19.7)				
>3						
*Chi-square test						

at least one dose of my inhaled steroids each day"), 56.6% of intervention group scored ≤ 3 which suggest a probable specific barrier, with no significant differences between the groups (P-value= 0.515); for the statement (**"My asthma is mild and does not require regular preventative treatment"), 47.4% and 26.3% intervention and control groups respectively scored** ≤ 4; which suggests probable specific barriers, while for the statement ("**My inhaled steroid causes side effect"),** 46.1% and 56.6% of the intervention and control groups respectively scored ≤3; which suggest probable specific barrier, with no significant difference between the groups (*P*-value=0.194). The statement (**"I can't afford my inhaled steroid medication"**), 68.4% of intervention and 80.3% of control patients scored ≤ 3, which suggest probable specific barrier with no significant difference between groups (*P-value*=0.194).

Asthma medication adherence after 3- months follow up

Improved medication adherence (Table 3.B.) was noticed for the intervention group at follow up, particularly for the following statements : " **I forget to take at least one dose of my**

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inhaled steroid each day"; the number of intervention group patients who agreed completely declined from 30 patients to 2 patients; for the statement '**My asthma is mild and does not require regular preventative treatment',** the number of intervention group patients who agreed completely with this statement dropped from 24 to 3. The percent of intervention group patients who agreed completely **that their inhaled steroid causes side effects dropped to 15.8% from 39.5%.** No changes on patient's ability to **afford their inhaled steroid was shown.**

With regards to control group no difference between baseline and follow up data.

Concerning barriers that were indicated at baseline, Table 4.B data reveals that the MMR service was successful in overcoming some of these barriers, such as (**"I Forget to take at least one dose of my inhaled steroids each day**"), as only 14.5% of the intervention group scored ≤ 3, which suggest a probable specific barrier, with significant difference between control and intervention groups (*P-value*< 0.001). Moreover, significant difference within intervention baseline vs. follow-up (*P- value* < 0.001), Table 5) was seen, as responses to the statement (**"My asthma is mild and does not require regular preventative treatment")** revealed improvement in adherence among intervention group patients, with significance difference within intervention group baseline vs. follow-up (P-value< 0.001, Table 5). Furthermore, with regards to the statement ("**My inhaled steroid causes side effect")**, an improvement in the intervention group was noticed (43.4% and 56.6% of intervention and control group respectively scored ≤ 3); which suggests probable specific barrier; significant difference within intervention group baseline vs. follow-up *P-value*< 0.001 (Table 5).

DISCUSSION

Health literacy is an essential part of pharmacists' consultations, and even though patients' lack of knowledge is one of the causes of uncontrolled asthma, pharmacists often underestimate the necessities of health literacy for asthmatic patients (Nguyen et al., 2018). The educational intervention delivered in this study resulted in a significant improvement in asthma knowledge for the intervention group particularly; patients' recognition of the fundamental goals of asthma management and the differentiation between preventers and relivers, moreover, the patients' awareness of triggering factors which could lead to asthma exacerbations

Various types of questionnaires have been employed to assess patients' knowledge towards asthma, such as Patient Asthma Knowledge Questionnaire (PAKQ) validated by Beaurivage (Beaurivage et al., 2018), The Knowledge, Attitude, and Self-Efficacy Asthma Questionnaire (KASE-AQ) which assesses (knowledge, attitude, and self-efficacy about asthma) by Wigal (Wigal et al., 1993), and Asthma General Knowledge Questionnaire for Adults (AGKQA) which was acceptably valid and reliable measure for the knowledge assessment by Allen & Jones (Allen , R. M., & Jones, M. P. (1998)).

In this study, asthma knowledge questionnaire (Kritikos et al., 2005) was employed in order to evaluate patient's knowledge. This questionnaire revealed that the majority of patients were lacking in asthma knowledge. The mean of asthma knowledge at baseline was noticeably low (5.40±1.566) but comparable to a Jordanian study (asthma knowledge mean was 6.53±1.68) (Basheti et al., 2018).

Patient education is a fundamental factor of effective self-management programs in adults' asthma self-management. Such programs have concentrated on the medical sides of living with a variable disorder and put emphasis on the significance of recognizing and acting on symptoms and signs of worsening (James et al., 2016). In this study, the intervention group participants were educated and their misperceptions regarding asthma disease process were corrected. Patients' health beliefs concerning asthma control were also explored, in addition to counseling points regarding the triggering factors being either environmental or medicinal triggers, avoidance of triggers was

Table 5. Comparison of medication adherence barrier-score mean (Baseline data vs. Follow up data)

Group	**Barrier 2(question 2)**	**Barrier 2(question 2)**	***P*-value within the same group**
	Baseline adherence score mean ±SD	**Follow up adherence score mean ±SD**	
Intervention(76)	3.36±2.284	4.75±1.308	< 0.001‡
Control (76)	3.64±2.152	3.61±2.185	0.083‡
Group	Barrier 3(question 3)	Barrier 3(question 3)	P-value within the same group
	Baseline adherence score mean ±SD	Follow up adherence score mean ±SD	
Intervention(76)	3.87±2.282	4.83±1.482	< 0.001‡
Control (76)	1.9714.82±	4.74±1.893	0.238‡
Group	Barrier 4(question 4)	Barrier 4(question 4)	P-value within the same group
	Baseline adherence score mean ±SD	Follow up adherence score mean ±SD	
Intervention(76)	3.68±2.282	4.22±1.943	< 0.001‡
Control (76)	2.288 3.42±	3.54±2.187	0.002‡

‡Wilcoxon test

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delivered, and the importance of adherence to medications, be it the controllers or the preventers was explained, in addition to strategies to reduce side effects such as using gargling solution following inhaling a preventer inhaler that has corticosteroids, or using a spacer. Patients were educated about asthma basics and were given a simplified explanation of asthma pathophysiology. Several studies proved the positive impact of educational sessions on patients' level of understanding asthma (HPD & Subasinghe, 2016). In this study, pharmacist who conducted the educational sessions were successful in conveying the management guidance in a simple method, avoiding medical expressions and abbreviations, and ensuring that asthmatic patients completely understood each aspect in their asthma management plan. This study was successful in resolving problems related to inappropriate knowledge; the follow up assessment for intervention group revealed a significant improvement, asthma knowledge test mean intervention elevated from 5.28±1.654 to 8.87±.099, which is comparable to an Australian study conducted by Saini (Saini et al., 2011) previously, which revealed a significant improvement in patients' asthma knowledge owing to the pharmacists' educational intervention (asthma knowledge test mean improved from 7.65±2.36, n=561 to 8.78±2.14, n=393). This improvement was sustained for at least 1 year after patients got the educational intervention. Furthermore, patients stated that they gained a knowledge and skills that changed the way they dealt with their disease.

The vast majority of patients had TRPs related to medication adherence. In order to assess patients' adherence, a questionnaire that was developed and used previously in similar studies (Schatz et al., 2013) was employed in this study. Majority of patients (93.4% of patients) disagreed completely to follow their asthma medication action plan, which is higher than a similar study conducted by Makhinova et al (Makhinova et al., 2021) revealing that 76.6% of asthmatics who reported poor adherence did not have an asthma medication action plan. About 36.2% of patients forgot to take at least one dose of their inhaled steroid each day; this was comparable to a similar study conducted in Turkey where 34.1% of patients forgot to take their medications (Apikoglu-Rabus et al., 2016). Patients' overestimation of the risks linked to ICS could be one of the causes for poor adherence, most of patients preferred to use LABA inhaler since they observed improvements in their asthma symptoms, resulting from broncho-dilation faster than the long-term effect of ICS. Moreover, pharmacists should be aware of the fact that even though forgetfulness is the major reason for poor adherence,(Iuga & McGuire, 2014), (George & Bender, 2019), asthmatics may claim that they are unable to remember to take their medications in order to evade talking about the true reason(s) behind their poor adherence (George & Bender, 2019) such as feeling embarrassed from taking medications in public and misunderstanding of the benefits of controller treatment, therefore positive interpersonal communication and employing empathic response while communicating with patients would assess both patients' preference and concerns with regards to their treatment. About 25% of patients were not aware of their disease pathophysiology and refused regular preventative treatment, 36.8% were facing side effect problems which were linked to ICS, such as mouth candida, comparable to a study conducted by Erdogan et al (Erdoğan et al., 2019) showing that lifelong incidence of oral candidiasis was 19.4% while the incidence of any other fungal infection was 59.7% (n=111).

Poverty was a serious barrier, since 71.7% of patients stated that they could not afford inhaled steroid medication. Similarly, a Brazilian study evaluated 160 subjects with severe asthma, showed poor adherence to therapy because of poverty. The study investigated the benefits of enrolling those patient in a free program in order to offer medications, education and healthcare; results showed a high rate of adherence to asthma treatment (83.9%) (Souza-Machado et al., 2010).

Significant improvement concerning some parameters was noticed following the intervention in this study, particularly cognitive issues; forgetfulness: the percent of intervention patients who agreed completely to forgetting to take at least one dose of their inhaled steroid each day dropped from 39.5% to 2.6%. Numerous studies concerning the impact of patients education on improving adherence to medications and having an action plan, (Armour, et al., 2007) study revealed that adherence to preventative treatment was enhanced (from 54% to 71%), comparing to this study; patients' perceptions about asthma improved significantly as well, at follow up intervention group patients who agreed completely that their asthma is mild and does not require regular preventative treatment dropped down to 3.9%. Concerning asthma action plan in Armour et al (Armour, et al., 2007) study, 23% of patients were without asthma action plan at baseline, which elevated to be 64% of intervention patients who owned asthma action plan at follow up. Interestingly, in this study, no improvement was noted at follow up for both groups, 93.4% of patients didn't have an asthma action plan at follow up. Previous studies reported that it is not likely to accomplish ownership in 100% of asthmatic patients, despite referrals to their physicians (Armour, et al., 2007), thus more effective interprofessional collaboration between the health care team is needed to be established. Concerning the poverty barrier, unfortunately this barrier could not be overcome, owing to the occupational status since the majority of patients did not have a job (71.1%).

This study has shown that pharmacists efforts in offering care which leads to positive clinical and humanistic outcomes for patients. Pharmacists' educational interventions concerning the pathophysiology of asthma, and the role of controller medications, led to the enhancement of patients' awareness toward their asthma. Pharmacists' role extended from the traditional responsibilities of dispensing and giving simple medical counseling to working either with public or with other health professionals. Various studies have assessed the impact of pharmacist-provided interventions and revealed optimistic results. A study that was held in south Europe by Lithuania et al, has reported positive outcomes with regards to patients' skills in using their inhalers. Furthermore, medication errors have been reduced (Nastaravičius & Ramanauskienė, 2018). Jordanian study by (Basheti et al., 2018) assure the vital

pharmacist's role, the study stated that hospitalized asthmatics have achieved correct inhaler technique following training by a pharmacist and significant improvements in ACT scores. Therefore, the presence of asthma-specialist pharmacists in respiratory outpatient clinics in order to be incorporative into multifaceted medical care providing teams is necessary, particularly in respiratory outpatients' clinics, since poor patient-physician communication due to the large number of patients are attending clinics or inadequate time.

Strengths and limitations of this study

Strengths involve rigorous testing for patients adherence to therapy by using a validated questionnaire that was developed and used previously in similar studies (Schatz et al., 2013). Barriers were identified and somewhat surmounted owing to the pharmacists' simplified educational interventions. The use of a validated measure for asthma knowledge by a researcher blinded to the participants' randomization group, with confirmation of inter-rater reliability prior to study start. Limitations include that; this study was unsuccessful in defeating the poverty barrier, which was identified as a barrier to proper adherence in this study. Absences of asthma action plan shed light on the necessity of coordination and collaboration between the health care givers, but it also affected adherence assessment.

CONCLUSION

This randomized controlled study has shown the benefits of the MMR service delivered by pharmacists to asthmatic patients in Jordan; a significantly positive impact on asthmatic patients' adherence to therapy owing to pharmacist's educational intervention was found. Moreover, pharmacists were evidenced successful in assessing patients' asthma knowledge and resolving their misunderstandings, pharmacists were uniquely situated to ensure achieving optimum clinical outcomes in asthmatics' health care, furthermore, their clinical expertise was beneficial in health literacy enhancement.

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