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## Evaluation of Inhaler Use Techniques among Asthmatic Patients in King Faisal Medical Complex, Taif, Saudi Arabia

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### ABSTRACT

**Background:** bronchial asthma is a prevalent health problem globally. Inhaled route is commonly used over other routes to manage asthmatic patients. Despite the efficacy of inhalers, the poor inhaler technique used by asthmatic patients leads to decrease drug delivery to lungs and poor asthma control. **Objective:** the main objective of this study was to evaluate the proper use of inhaler devices by asthmatic patients according to the standard recommended steps and to identify the factors related to the inaccurate or poor inhaler use among asthmatic patients at King Faisal Hospital in Taif, Saudi Arabia. **Methods and Materials:** this was a cross-sectional observational study conducted among Saudi asthmatic patients using inhaler devices and visiting out-patient's respiratory clinic. Patients were asked to use their inhaler devices and their inhaler technique and using a validated checklist. MDI, TurboHaler and Handihaler were the most commonly used whether alone or in combinations. **Results:** around 74% and 92% responded to receive any education for asthma and asthma devices respectively. Of those who received any education, mostly reported that they received education about asthma and/or devices from their physicians. Breathing out, breath holding pattern and position of head during inhaling condition were three critical steps that led to improper use. **Conclusion recommendation:** inhalation technique in asthma patients was unsatisfactory and was accompanied with errors, especially in patients with low education levels. This study suggested prioritizing and establishing the proper practice of inhaling devices to better manage asthmatic patients and quality of life.

**Keywords:** bronchial asthma, inhaler devices, inhaler technique, compliance, Saudi Arabia.

### INTRODUCTION

Bronchial asthma is a prevalent health problem globally. In the last 20 years global prevalence of asthma has increased to 5-10% and 20-25% among Saudi patients<sup>(1)</sup>. Inhaled route is the most commonly preferred route used in management of asthmatic patients. The main reason being due to its less systemic side effects and rapid onset of action<sup>(2)</sup>. Inhalers are hand-held portable devices that deliver medication to the lungs for the treatment of respiratory diseases such as asthma<sup>(3)</sup>. Despite the efficacy of inhalers, poor inhaler technique used by asthmatic patients leads to decreased drug delivery to lungs and poor asthma control<sup>(4)</sup>. A study conducted in 2015 found that 93% of metered-dose inhaler (MDI) users demonstrated poor inhaler technique, 63% of them committed 3 or more errors, and the remaining 7% showed perfect technique<sup>(4)</sup>. Another study in India showed that 6% of MDI users, 16.12% of dry-powder inhaler (DPI) users and 20.8% of MDI with spacer were using their inhalers correctly. Around 83% and 16% of the patients received training from healthcare workers and general people respectively, showed that training had a very positive effect on decreasing errors even by non-professionals<sup>(5)</sup>. Study in Nigeria in 2014 for MDI and DPI, found that increased age had association with misuse of these inhalers<sup>(6)</sup>. However a study in Riyadh, Saudi Arabia on asthmatic and COPD patients found that 70% of

patients committed at least one critical error while showing inhaler technique<sup>(5)</sup>. A previous study done in Saudi Arabia showed that the common error committed by patients who were using MDI without a spacer was not tilting the head backwards slightly and breathing out residual volume, followed by not breathing in slowly. While the common errors in patients using an MDI with a spacer, were not tilting the head back slightly and breathing out slowly residual volume, and not holding the breath for 10 seconds<sup>(8)</sup>. In another study conducted, 45% of asthmatic patients used the inhaler devices improperly. Common factors affecting the proper use of these devices were: irregular follow ups, lack of asthma medication education, asthma itself as a disease, uncontrolled asthma and three or more ED (Emergency department) visits. Around 40% of them received no proper education by any health care professionals due to a lack of asthma education programs<sup>(1)</sup>. Despite the importance and magnitude, limited studies have explored the issue particularly in Saudi Arabia.

### Objective

The paper aimed to evaluate the proper use of inhaler devices by asthmatic patients according to the standard recommended steps and to identify the factors related to the inaccurate or poor inhaler use among asthmatic patients at King Faisal Hospital in Taif, Saudi Arabia.

**Methodology**

This was a cross-sectional observational study conducted among Saudi asthmatic patients using inhaler devices and visiting out-patients respiratory clinic at King Faisal Hospital, Taif, Saudi Arabia during a nine months period from August 2016 until April 2017. Following ethical approval of King Faisal Hospital Research and Ethics Committee, written informed consent was obtained from the respondents. They were informed about the nature of the study and the confidentiality of their responses. Patients were asked to use their inhaler devices and their inhaler

technique was observed and assessed using a validated checklist as shown in **figure 1**<sup>(7)</sup>.

Factors related to proper or improper inhaler use were evaluated via a questionnaire. The questionnaire explored information related to: gender, age, marital status, follow up with doctor, education level, education about asthma, education about medication, emergency department visits, duration of asthma, received asthma health education and devices used. IBM SPSS statistical package (v. 21) was utilized to enter and analyze the data.

**Table 1: checklist for the correct technique for inhaler devices**<sup>(7)</sup>.

<b>MDI</b>
1. *Remove cap
2. *Shake well
3. Breath out normally
4. Keep head upright or slightly tilted
5. Seal lips around mouthpiece
6. *Inhale slowly, actuating once during first half of inhalation
7. *Continue slow and deep inhalation
8. Hold breath for 5 or more seconds
<b>MDI with spacer</b>
1. *Remove caps
2. *Shake MDI well
3. Insert MDI into spacer
4. Breath out normally
5. Seal lips around mouthpiece
6. *Actuate MDI
7. *Inhale slowly and deeply
8. Hold breath for 5 or more seconds
<b>Diskus</b>
1. *Open to expose mouthpiece
2. *Slide lever until click heard
3. *Keep level throughout
4. Breath out normally and away from inhaler
5. Seal lips around mouthpiece
6. *Inhale forcefully and deeply
7. Hold breath for 5 or more seconds
8. Exhale but not through inhaler
<b>Turbuhaler</b>
1. *Hold upright without occluding air vents
2. *Turn colored wheel one way, then back
3. Breathe out normally and away from mouthpiece
4. Seal lips around mouthpiece without occluding air vents
5. *Inhale forcefully and deeply
6. Hold breath for at least 5 seconds
7. *Exhale but not through inhaler
<b>HandiHaler</b>
1. *Open lid and mouthpiece
2. *Place capsule in chamber
3. Close mouthpiece, ensuring click is heard
4. *Holding inhaler upright, press blue button fully
5. Breath out normally and away from inhaler
6. Seal lips around the mouthpiece
7. Inhale forcefully and deeply so that capsule vibrates
8. Hold breath for 5 or more seconds
9. *Repeat steps 6-8

## RESULTS

The total number of Saudi asthmatic patients who followed-up at outpatients departments during the study period from August 2016 to April 2017 was 1310. The sample size was calculated using Raosoft sample size calculator software, taking into consideration confidence level 95% and the acceptable margin of error was 5%, we had to recruit 298 patients. The response rate was 86%, as 256 patients gave their consent to participate in this study. The mean age was  $50.8 \pm 1.2$  years old with

43% of them between 40 to 60 years old. Females represented 58.6% of study participants, most of them being housewives. More than 63% were married and around 15% were employed. Approximately half of the respondents did not have any formal education and 16.8% had college level education.

In terms of history of asthma, only 8% had it for less than a year, while 48% and 44% had it for 1 to 10 years and more than 10 years respectively. Fifteen percent(15%) stated to have regular follow up for asthma in pulmonary clinics.

**Table 1: types of devices used for asthma with proper or improper technique**

Devices		n	%
<b>Devices used for asthma therapy</b>	TurbuHaler +Handihaler	5	2.0%
	MDI	95	37.1%
	MDI with spacer	2	0.8%
	TurbuHaler	16	6.3%
	MDI + Diskus	4	1.6%
	Handihaler	0	0.0%
	MDI + TurbuHaler	88	34.4%
	MDI + TurbuHaler +Handihaler	22	8.6%
	MDI + Handihaler	22	8.6%
	MDI + Diskus +Handihaler	2	0.8%
<b>MDI</b>	Proper	74	31.5%
	Improper	161	68.5%
<b>MDI with spacer</b>	Proper	0	0.0%
	Improper	2	100.0%
<b>TurbuHaler</b>	Proper	65	49.6%
	Improper	66	50.4%
<b>Diskus</b>	Proper	3	50.0%
	Improper	3	50.0%
<b>Handihaler</b>	Proper	31	60.8%
	Improper	20	39.2%

**Table 1** described the types of devices used for asthma with proper or improper technique and shows that MDI, TurboHaler and Handihaler were the most commonly used, whether alone or in combinations. Approximately more than half of the users showed improper techniques for all devices with exception of Handihaler that showed less than 40% respondents used improper technique.

Around 74% and 92% responded positively to have received any education for asthma and asthma devices respectively. Of those who received any education, most respondents reported that they received education about asthma and/or devices from their physicians. Self-learning was also reported as a source of education for asthma and asthma devices by around 14% and 12% respectively.

**Table 2** showed the results of recommended procedures that were followed for the three commonly used devices (MDI, TurboHaler and Handihaler).

**Table 2: procedures followed while using asthma medication devices**

Device	Procedure	No		Yes	
		N	%	n	%
MDI	1. Remove cap	3	1.3%	230	98.7%
	2. Shake well	149	63.9%	84	36.1%
	<b>3. Breathe out normally</b>	<b>210</b>	<b>90.1%</b>	23	9.9%
	<b>4. Keep head upright or slightly tilted</b>	<b>149</b>	<b>63.9%</b>	84	36.1%
	5. Seal lips around mouthpiece	49	21.0%	184	79.0%
	6. Inhale slowly, actuating once during first half of inhalation	17	7.3%	216	92.7%
	7. Continue slow and deep inhalation	23	9.9%	210	90.1%
	8. Hold breath for 5 or more seconds	99	42.5%	134	57.5%
TurbuHaler	1. Hold upright without occluding air vents	9	6.8%	123	93.2%
	2. Turn colored wheel one way, then back	53	40.2%	79	59.8%
	<b>3. Breathe out normally and away from mouthpiece</b>	<b>117</b>	<b>88.6%</b>	15	11.4%
	4. Seal lips around mouthpiece without occluding air vents	7	5.3%	125	94.7%
	5. Inhale forcefully and deeply	18	13.6%	114	86.4%
	6. Hold breath for at least 5 seconds	48	36.4%	84	63.6%
	7. Exhale but not through inhaler	21	15.9%	111	84.1%
Handihaler	1. Open lid and mouthpiece	2	4.0%	48	96.0%
	2. Place capsule in chamber	2	4.0%	48	96.0%
	3. Close mouthpiece, ensuring click is heard	2	4.0%	48	96.0%
	4. Holding inhaler upright, press blue button fully	20	40.0%	30	60.0%
	<b>5. Breathe out normally and away from inhaler</b>	<b>44</b>	<b>88.0%</b>	6	12.0%
	6. Seal lips around the mouthpiece	3	6.0%	47	94.0%
	7. Inhale forcefully and deeply so that capsule vibrates	5	10.0%	45	90.0%
	8. Hold breath for 5 or more seconds	18	36.0%	32	64.0%
	9. Repeat steps 6-8	7	14.0%	43	86.0%

**Table 3** showed findings when explored for proper and improper use of asthma devices with background information. The following were found to be significantly associated with each other: age for TurboHaler and Handihaler, education for MDI and TurboHaler while regular follow up for Handihaler. No significant difference was observed for gender, marital or employment status and disease duration.

**Table 3: proper and improper use of asthma devices with background information**

		MDI					TurbuHaler					Handihaler				
		Proper		Improper		P-Value	Proper		Improper		P-Value	Proper		Improper		P-Value
		n	(%)	n	(%)		n	(%)	n	(%)		n	(%)	n	(%)	
Age in Years	<20	9	-37.5	15	-62.5	0.718 <sup>a</sup>	10	-83.3	2	-16.7	0.025 <sup>*a</sup>	1	-100	0	0	0.018 <sup>*b</sup>
	20-40	15	-35.7	27	-64.3		16	-55.2	13	-44.8		4	-66.7	2	33.3	
	40-60	33	-31.1	73	-68.9		28	-49.1	29	-50.9		15	-83.3	3	16.7	
	>60	17	-27	46	-73		11	-33.3	22	-66.7		11	-42.3	15	57.7	
Gender	Male	29	-30.2	67	-69.8	0.725 <sup>a</sup>	28	-45.9	33	-54.1	0.427 <sup>a</sup>	10	-50	10	50	0.249 <sup>a</sup>
	Female	45	-32.4	94	-67.6		37	-52.9	33	-47.1		21	-67.7	10	32.3	
Education Level	No education	24	-20.3	94	-79.7	0.003 <sup>*a</sup>	20	-32.8	41	-67.2	0.007 <sup>*b</sup>	16	-50	16	50	0.146 <sup>b</sup>
	Primary	9	-36	16	-64		10	-66.7	5	-33.3		4	-57.1	3	42.9	
	Elementary	6	-37.5	10	-62.5		4	-57.1	3	-42.9		1	-100	0	0	
	High School	15	-40.5	22	-59.5		14	-70	6	-30		5	-100	0	0	
	College/Univ.	20	-51.3	19	-48.7		17	-60.7	11	-39.3		5	-83.3	1	16.7	
Employment	Employed	15	-41.7	21	-58.3	0.116 <sup>a</sup>	11	-52.4	10	-47.6	0.166 <sup>a</sup>	5	-83.3	1	16.7	0.171 <sup>b</sup>
	Unemployed	13	-25.5	38	-74.5		12	-36.4	21	-63.6		6	-40	9	60	
	Housewife	34	-27.9	88	-72.1		32	-50.8	31	-49.2		18	-64.3	10	35.7	
Marital Status	Single	17	-37	29	-63	0.273 <sup>a</sup>	16	-57.1	12	-42.9	0.504 <sup>b</sup>	5	-83.3	1	16.7	0.637 <sup>b</sup>
	Married	49	-32.5	10 2	-67.5		37	-44.6	46	-55.4		20	-55.6	16	44.4	
	Divorced	3	-37.5	5	-62.5		3	-60	2	-40		1	-100	0	0	
	Widowed	5	-16.7	25	-83.3		9	-60	6	-40		5	-62.5	3	37.5	
No. of years with bronchial asthma	<1year	8	-40	12	-60	0.220 <sup>a</sup>	6	-75	2	-25	0.084 <sup>b</sup>	4	-100	0	0	0.120 <sup>b</sup>
	(1-10) years	28	-25.9	80	-74.1		26	-40.6	38	-59.4		10	-47.6	11	52.4	
	>10years	38	-35.5	69	-64.5		33	-55.9	26	-44.1		17	-65.4	9	34.6	
Regular follow up for bronchial asthma	Yes	65	-32.2	13 7	-67.8	0.574 <sup>a</sup>	56	-50.5	55	-49.5	0.654 <sup>a</sup>	31	-66	16	34	0.019 <sup>*b</sup>
	No	9	-27.3	24	-72.7		9	-45	11	-55		0	0	4	100	

\*. Association is significant at the 0.05 level

a. Chi-Square test is used

b. Expected cell counts less than 5. Fisher's Exact test is used

## DISCUSSION

The poor level of understanding and practices of inhaling asthmatic drug delivery devices have been widely established among asthmatic patients<sup>(9-11)</sup>. This study described the common inhaling errors among asthmatic patients of KFH, Taif (Saudi Arabia). The proper use of inhaling devices was assessed. The most used devices during this observational study were: meter dose inhalers (MDI), TurbuHalers and Handihalers. The user practice was evaluated by validated inhaling instructions (Figure 1) among the study population of both males and females. The level of asthma awareness among patients was around 74% and even better for asthma medication devices,

around 92%. Most reported physicians as source of education.

It was found that education level of patients significantly affected the standard user practice of MDI and TurboHaler users and interestingly, the improper use of inhaling devices was most prevalent among uneducated patients. Another study from Saudi Arabia, reported that improper use of inhaling devices was more prevalent among uneducated patients<sup>(1)</sup>. Our findings are consistent with studies outside the region<sup>(12-14)</sup>. A study conducted in Riyadh region of Saudi Arabia also reported similar results of education level as one of the responsible factors for improper use of inhalers<sup>(15)</sup>.

However, that study also reported that the employment status affects the patient's behavior towards inhaling devices and that has not been reported in our study. Furthermore, the other factors such as employment level, marital status and number of years having bronchial asthma did not show any significant impact on proper and improper use of devices. These study findings also indicated that irregular follow-up promoted suboptimal inhaling practices among patients, particularly in Handihaler users. The most deviated step during MDI use was the breathing out pattern, where less than 10% of patients were able to follow the correct pattern for breathing. (Table 2). The head position, shake the devices and holding breath for 5 or more seconds were the next steps that were incorrectly followed. The head position and holding breath for 5 or more seconds were the next factors that were correctly followed. Various other studies also reported similar factors associated with incorrect inhaling pattern among patients<sup>(9,16-18)</sup>. One such study conducted to assess the most common errors during use of MDI at King Abdul-Aziz University Hospital (KAUH), Jeddah, Saudi Arabia and found that 65% of patients used the MDI incorrectly and the major steps for failure were the incorrect breath holding (52.2%) and inhaling pattern (46.4%) during inhalation<sup>(19)</sup>.

Similar to MDI inhalation, breathing out procedure was also incorrectly followed by 88.6% and 88.0% patients who were using TurbuHaler and Handihaler, respectively. This similar pattern was also reported in a study carried out at KAUH, Jeddah (Saudi Arabia) among patients using TurbuHaler<sup>(19)</sup>.

Additionally, the improper breath holding and failure to twist the grip were the major factors responsible for improper use of above-mentioned devices. Study findings are aligned with findings of literature reports suggesting incorrect use of inhalers and importantly, this situation has not improved over the past 40 years<sup>(9,20)</sup>. Thus, the breathing out, breath holding pattern and position of head during inhaling condition were three critical steps which led to improper use of inhaling devices among asthmatic patients at KFH, Taif (Saudi Arabia). These errors might be reduced by educating and training patients<sup>(21-23)</sup>.

A systematic review found some commonly recommended strategies to overcome the issue of above errors. These included careful instruction, observation of inhalation technique and individual matching of inhaler and patient<sup>(9)</sup>. Training has also been facilitated by demonstration<sup>(24)</sup> and repeated tuition<sup>(25)</sup> as well as by video instructions, computer assistance, and written material

<sup>(9)</sup>. Considering adherence to recommended inhalation therapy and its appropriate use as one of the key factors for effective asthma treatment, relevant stakeholders and in particular physicians need to identify and focus on needs to improve inhalation technique with different devices used by patients. Reassessing and educating patients on a regular basis might be helpful in this context. Major limitations of this study included limited number of patients from a single health facility as a source of patients. In addition, limited exploration of type and quality of prior patient education or training was done that could have affected the device use. However, considering similar verdicts from other regions in literature, study findings can be considered as the tip of an iceberg that requires urgent consideration and further exploration.

## CONCLUSION

Inhalation technique in asthma patients was unsatisfactory and errors in inhaler technique persist in patients, more so in patients with a lower education level. This study suggested prioritizing and establishing the proper practice of inhaling devices to better manage asthmatic patients and quality of life.

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