

Incorrect use for Inhalation Techniques of Inhaled Medication among Children with Asthma in Qassim Region: Prevalence and its Risk

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ABSTRACT

Introduction: Asthma is one of the world's most common chronic respiratory disorders, and inhalers are frequently recommended to help manage allergy symptoms, improve quality of life, and reduce the risk of exacerbations or flare-ups. In Saudi Arabia, the prevalence of asthma is relatively high. Inhaler misuse can result in a variety of problems. This study aims to measure the prevalence of correct use of inhalation techniques of inhaled medication among children with asthma and investigate whether improper inhaler use can lead to uncontrolled bronchial asthma and its problems.

Material and Methods: A cross-sectional study used a validated self-administered Arabic questionnaire given to 180 participants who visit paediatrics pulmonology clinic at Qassim University Medical City and Dr. Sulaiman Alhabib Hospital in Buraydah from June to December 2021. This study used a completed questionnaire consisting of sociodemographic characteristics, questions assess the participants' condition and its severity, and questions to evaluate their inhalation technique of inhaled medication and if they were educated about the correct inhalation technique or not.

Results and Conclusion: Findings demonstrate that number of ED visits is significantly associated with the time of diagnosis and frequency of using an inhaler ($P=0.032$) and ($P=0.010$) respectively. When we looked at the relationship between several characteristics and the timing of diagnosis, we discovered that age and times of using an asthma inhaler (Ventolin) in one week were significantly related ($P=0.000$). Revealing association between variables and frequency of using inhaler; the significant association with the source of advice about on the correct use of inhaler ($P=0.005$), and way of fixing the mask ($P=0.040$). Although our study showed enhanced knowledge and techniques using inhalers, physicians and other health workers should teach children and their caregivers how to use their inhalation devices properly whenever possible, and rectify errors when they occur, to ensure that medication is delivered effectively. As a result, future awareness campaigns should focus more resources on educating families and caregivers of asthmatics on correct medication use to avoid asthma complications and control asthma episodes for children.

INTRODUCTION

Asthma is one of the most common chronic respiratory diseases in the world. A meta-analysis study has been conducted on asthma prevalence from 1990 to 2000 in different regions in Saudi Arabia which showed a rise in the variation of asthma prevalence [1]. The total prevalence of asthma in children from Saudi Arabia has been reported to range from 8% to 25%, based on studies conducted over the past three decades, the increase of prevalence of asthma in the past three decades may be attributed to rapid change in lifestyle related to the modernization of Saudi society, changes in dietary habits, and exposure to environmental factors such as indoor allergens, dust, sand storms, and tobacco [1]. The fundamental causes of asthma are more likely to be a combination of genetics association with a Th-1–Th-2 imbalance that leads to decreased and altered microbial exposure, pollution, epithelial microbiome changes [2]. An external trigger, such as allergies to house dust mites, pollen, animal contact, tobacco smoke, pollution, cold air, chemical irritants in the workplace can lead to asthma [2]. Furthermore, some researchers have found that children's asthma is associated with obesity [3], prenatal maternal smoking, and particulate matter exposure are significant risk factors for the development of childhood asthma [4].

Recurrent asthma symptoms frequently cause sleeplessness, fatigue, decreased activity, and school and work absenteeism [5]. Visits to primary care settings (physician offices and hospital outpatient departments), fatigue, underperformance or absence from school or work, exercise intolerance, frequent visits to the hospital and repeated admissions, psychological problems including stress, anxiety and depression, recurrent chest infections, lung collapse, respiratory failure, status asthmaticus may result from poorly controlled asthma [6]. Among the 25 million people in the United States with asthma, about 7.1 million are children, it is the third cause of hospitalization among children younger than the age of 15, and the most common cause of emergency visits (593,000 ED visits in 2006) [4]. Every day in the United States, 44,000 people have an asthma exacerbation, 36,000 children miss school because of asthma, and 27,000 adults miss work because of asthma [4].

Pharmacological Management includes inhaled corticosteroids used as maintenance and is the most effective monotherapy in childhood asthma, and inhaled short-acting Beta two agonist can be used as a reliever therapy [1]. The use of a valved-holding spacer with mouthpiece, when possible, is recommended when metered-dose inhalers (MDI) are prescribed, Breath-

actuated devices (e.g., dry powder inhalers) represent an effective and simpler option for maintenance therapy in children 5–12 years of age [1]. Another study found that the inhaler technique is generally very poor among the pediatric age group, but it shows better effects when children use their MDIs with spacers [7]. An experimental study was done in PubMed from September to October 2016, twenty-eight researches selected, the outcome was poor and became better with MDI [8].

During 2000–2003 study was done and targeted children aged six and seven years who had asthma and they gave them at least two β agonists and the inhalation technique was assessed by standardized checklist from 131 (24%) of them was made ≥ 1 error especially in children who had asthma and more mistakes with the use of MDI compared with others because the patients and their parents said no one told them the proper technique [9]. Another study recruited hundred and seventy-one patients and/or their families were evaluated by a questionnaire for the proper use of the inhaler and compliance to the therapy, the main age was 8.29 ± 4.65 years (1–19), 119 (68.1%) of them use MDI and 52 (34.6%) of them use DPI, Patients who use correctly 68.1% of the MDI and 34.6% of the DPI [10]. Inhaler use for a longer duration, follow-up regularly, mother educational level, and receiving education from a professional trainer were significantly associated with a correct instructional technique. The most common incorrect step was shaking the inhaler in asthmatic children using MDI with spacer, coordinating the actuation-slow deep inhalation was noticed in children using MDI without a spacer and instructional interventional training associated with significant improvement of correct inhalation technique steps and thus asthma control and outcome [11]. Educational videos and daily feedback were effective and improved inhaler technique to 83.33% and 96.67% respectively from an at-home baseline of 72.83% [12]. Another study reported 200 patients, some of them received the instructions of the correct inhalation technique, and 47 referred patients received the same instructions and then followed up all patients after being told the correct way again and again in multiple sessions and the result was 78% of them did the correct technique and patients who received multiple sessions were more likely than others [13]. Inhalation technique influences asthma prognosis since incorrect users significantly have more uncontrolled asthma compared with patients using correct inhalation technique [14]. Educational instructional interventions, which are the most beneficially, improving long-term outcomes in the asthmatic pediatric patient that aim for optimizing asthma control and inhaler technique, and breathing exercises [15].

Few published studies address incorrect use of inhalation technique of inhaled medication among children; however, this issue is not fully reported in the region of Qassim. From this point of view, we planned to investigate that issue in a population in this region; measure the prevalence of correct use for inhalation technique of inhaled medication in children with asthma, and investigate whether improper inhaler use can lead to uncontrolled bronchial asthma and its problems.

MATERIALS AND METHODS

Ethics statements: We obtained approval from Qassim Regional Ethics Committee (NCBE, No. H-04-Q-001) for the application and publication of the study (approval number 19-14-07). Before conducting the questionnaire, consent from the participants was obtained after a brief introduction about the study.

Study design and population: This cross-sectional study was conducted among children with asthma aged from one to fourteen in Qassim region, Saudi Arabia.

Questionnaires: A validated self-administered Arabic questionnaire was given to participants who visit paediatrics pulmonology clinic at Qassim University Medical City and Dr. Sulaiman Alhabib Hospital from June to December 2021. This study used a completed questionnaire consisting of sociodemographic characteristics, questions assess the participants' condition and its severity and questions evaluate their inhalation technique of inhaled medication and know if someone educates them about correct inhalation technique or not.

Statistical analysis: All data analyses were performed using Statistical Package for Social Sciences, version 26 (IBM Corp., Armonk, NY, USA). We categorized, coded, and analyzed the data using the password-protected laptop to ensure data safety. Categorical variables were presented as numbers and percentages. A chi-squared test was used to compare responses. A p-value < 0.05 was used as the cut-off value for statistical significance.

RESULTS

A total of 180 participants were in this study. The results of the survey in table 1, revealed that 18 (10%) participants were less than two years, 101 (56.1%) from 2 to 10 years, 61 (33.9%) were from 10 to 14 years. 168 (93.3%) were Saudis and 12 (6.7%) were non-Saudis. According to educational level, 29 (16.1%) were in kindergarten, 76 (42.2%) were in elementary school, 35 (19.4%) were in preparatory school, and 40 (22.2%) were not applicable. The time of diagnosis of 30 (16.7%) was from less than three months, 32 (17.8%) from 3-6 months, 33 (18.3%) from six to twelve months, and 85 (47.2%) from more than a year. For using the inhaler regularly, 124 (68.9%) of the participants used the asthma inhaler regularly, while 56 (31.1%) did not use it regularly. 127 (70.6%) of the participants used the asthma inhaler (Ventolin) when needed, 46 (25.6%) used it 2-4 times per week, 5 (2.8%) used it 5-7 times per week, and only 2 (1.1%) used it more than seven times per week. 76 (42.2%) of the participants visited the ED once because of asthma during the previous year, 37 (20.6%) visited the ED twice because of asthma during the last year, and 34 (18.9%) visited the ED 3 times because of asthma during the last year. 30 (16.7%) of the participants had been admitted to the ICU once to twice due to an asthma exacerbation in the past year while only 1 (0.6%) participant was admitted 2-3 times. 10 (5.6%) of the participants had asthma attacks weekly in the last year, 56 (31.1%) had asthma attacks monthly in the last year, and 62 (34.4%) had asthma attacks annually in the last year. 150 (83.3%) of the participants had received advice on the correct use of a child's inhaler mainly 139 (77.2%) from their primary doctor, while 57 (31.7%) had stopped using the nebulizer under the supervision of a specialist doctor.

Of the participants, 114 (63.3%) used the preventive inhaler containing cortisone once daily, 59 (32.8%) used it twice daily, and 7 (3.9%) used it for three or more than three times daily.

123 (68.3%) of the participants sprayed one spray before use when using a new inhaler, and 167 (92.8%) shake the spray can before connecting it to the spacer. After completing the first spray, 95 (52.8%) of the participants give the second spray right after the 1st spray, 64 (35.6%) shake the inhaler between the two sprays, and 21 (11.7%) wait 5 minutes between the two sprays. 97 (53.9%) of the participants wash their mouth or use the toothbrush and paste after using the preventive asthma

inhaler containing cortisone. 112 (62.2%) use for their child spacer, while 40 (22.2%) sometimes use it, 17 (9.4%) rarely use it, and 11 (6.1%) never used it. 150 (83.3%) of the participants who use spacer put the mask on the mouth and nose, 11 (6.1%) on the mouth, and 8 (4.4%) on the nose. Of the participants using masks, 9 (5%) fix the mask loosely, 99 (55%) fix the mask tightly, and 61 (33.9%) fix the mask completely tight. 81 (45%) of the participants' families change the spacer (mask), 172 (95.6%) does not share their mask with anyone else, and 129 (71.7%) of the families wash the mask after finishing, 74 (41.1%) of them wash the mask daily.

Table 1: Demographic characters and techniques of inhaler use

Parameter		Frequency (%)
Age	Less than 2 years	18 (10%)
	2-10 years	101 (56.1%)
	10-14 years	61 (33.9%)
Nationality	Saudi	168 (93.3%)
	Non-Saudi	12 (6.7%)
Educational level	Kindergarten	29 (16.1%)
	Elementary	76 (42.2%)
	Preparatory	35 (19.4%)
	N/A	40 (22.2%)
Time of diagnosis	From less than 3 months	30 (16.7%)
	From 3-6 months	32 (17.8%)
	From 6-12 months	33 (18.3%)
	More than a year	85 (47.2%)
Regular use of inhaler	Yes	124 (68.9%)
	No	56 (31.1%)
Frequency of use per week	When needed.	127 (70.6%)
	2-4 times	46 (25.6%)
	5-7 times	5 (2.8%)
	More than 7 times	2 (1.1%)
How many visits to ED because of asthma during the last year?	Once	76 (42.2%)
	Twice	37 (20.6%)
	Three times	34 (18.9%)
	More than 3 times	33 (18.3%)
How many times has your child been hospitalized due to an asthma exacerbation in the past year?	Never	91 (50.6%)
	Once to twice	74 (41.1%)
	2-3 times	11 (6.1%)
	More than 4 times	4 (2.2%)
How many times has your child been admitted to the ICU due to an asthma exacerbation in the past year?	Never	149 (82.8%)
	Once to twice	30 (16.7%)
	2-3 times	1 (0.6%)
How many asthma attacks has your child had in the last year	Weekly	10 (5.6%)
	Monthly	56 (31.1%)
	Annually	62 (34.4%)
	Never	52 (28.9%)
Do you use Ventolin inhaler for your child during asthma attacks	Yes	161 (89.4%)
	No	19 (10.6%)
Have you ever received advice on the correct use of your child's inhaler?	Yes	150 (83.3%)
	No	30 (16.7%)
If the answer was yes, from where you get the advice?	From my primary doctor	139 (77.2%)
	Asthma educators	8 (4.4%)
	Youtube	6 (3.3%)
	Others	27 (15%)
Have you stopped using the nebulizer for your child under the supervision of a specialist doctor?	Yes	57 (31.7%)
	No	123 (68.3%)
How many times a day do you use the preventive inhaler containing cortisone for your child?	Once daily	114 (63.3%)
	Twice daily	59 (32.8%)
	3 or more than 3 times a day	7 (3.9%)
Do you shake the spray can before connecting it to the spacer?	Yes	167 (92.8%)
	No	13 (7.2%)
When using a new inhaler, do you spray one spray before use?	Yes	123 (68.3%)
	No	57 (31.7%)
Usually how long do you wait after each dose?	I don't wait	37 (20.6%)
	10 seconds	99 (55%)
	15-20 seconds	36 (20%)
	More than that	8 (4.4%)

After completing the first spray, how is the second spray given to your child?	Right after the 1 st spray	95 (52.8%)
	The inhaler should be shaken between the two sprays	64 (35.6%)
	Wait 5 minutes between the 2 sprays	21 (11.7%)
Gargling or brushing after inhaler	Yes	97 (53.9%)
	No	83 (46.1%)
Use of spacer	Always	112 (62.2%)
	Sometimes	40 (22.2%)
	Rarely	17 (9.4%)
	Never	11 (6.1%)
If you use a spacer for asthma, where do you put the mask on your child?	not use it	11 (6.1%)
	On mouth and nose	150 (83.3%)
	On mouth	11 (6.1%)
	On nose	8 (4.4%)
If you use the mask, how do you fix the mask on your child?	not use it	11 (6.1%)
	Loosely	9 (5%)
	Tightly	99 (55%)
	Completely tight	61 (33.9%)
Does the family change the spacer (the mask)?	Yes	81 (45%)
	No	99 (55%)
Do you share the mask with someone else	Yes	8 (4.4%)
	No	172 (95.6%)
Does the family wash the mask after finishing?	Yes	129 (71.7%)
	No	51 (28.3%)
If yes, how often do you wash?	Daily	74 (41.1%)
	Weekly	53 (29.4%)
	Never	43 (23.9%)
	Monthly	10 (5.6%)

Table 2: Association between variables and time of diagnosis

Parameter		Diagnosed since				P-value
		Less than three months	3 - 6 months	6 - 12 months	More than 12 months	
Age	Less than 2 years	11 (61.1%)	4 (22.2%)	0 (0%)	3 (16.7%)	0.000
	2-10 years	11 (10.9%)	20 (19.8%)	23 (22.8%)	47 (46.5%)	
	10-14 years	8 (13.1%)	8 (13.1%)	10 (16.4%)	35 (57.4%)	
Nationality	Saudi	29 (17.3%)	25 (14.9%)	31 (18.5%)	83 (49.4%)	0.002
	Non-Saudi	1 (8.3%)	7 (58.3%)	2 (16.7%)	2 (16.7%)	
Educational level	Kindergarten	2 (6.9%)	5 (17.2%)	3 (10.3%)	19 (65.5%)	0.000
	Elementary	8 (10.5%)	12 (15.8%)	21 (27.6%)	35 (46.1%)	
	Primary	4 (11.4%)	5 (14.3%)	6 (17.1%)	20 (57.1%)	
	N/A	16 (40%)	10 (25%)	3 (7.5%)	11 (27.5%)	
Frequency of inhaler use	When needed	20 (15.7%)	19 (15%)	20 (15.7%)	68 (53.5%)	0.000
	2-4 times	4 (8.7%)	13 (28.3%)	13 (28.3%)	16 (34.8%)	
	5-7 times	4 (80%)	0 (0%)	0 (0%)	1 (20%)	
	More than 7 times	2 (100%)	0 (0%)	0 (0%)	0 (0%)	
How many emergency visits for asthma were last year?	Once	12 (15.8%)	15 (19.7%)	18 (23.7%)	31 (40.8%)	0.032
	Twice	4 (10.8%)	4 (10.8%)	8 (21.6%)	21 (56.8%)	
	3 times	8 (23.5%)	6 (17.6%)	3 (8.8%)	17 (50%)	
	More than 3 times	6 (18.2%)	7 (21.2%)	4 (12.1%)	16 (48.5%)	
How many asthma attacks has your child had in the last year?	Weekly	4 (40%)	1 (10%)	0 (0%)	5 (50%)	0.189
	Monthly	10 (17.9%)	6 (10.7%)	9 (16.1%)	31 (55.4%)	
	Annually	7 (11.3%)	12 (19.4%)	13 (21%)	30 (48.4%)	
	Never	9 (17.3%)	13 (25%)	11 (21.2%)	19 (36.5%)	
How many times a day do you use the preventive inhaler containing cortisone for your child?	Once	21 (18.4%)	15 (13.2%)	24 (21.1%)	54 (47.4%)	0.263
	Twice	8 (13.6%)	14 (23.7%)	9 (15.3%)	28 (47.5%)	
	3 or more than 3 times	1 (14.3%)	3 (42.9%)	0 (0%)	3 (42.9%)	
Do you shake the spray can before connecting it to the spacer?	Yes	28 (16.8%)	28 (16.8%)	30 (18%)	81 (48.5%)	0.509
	No	2 (15.4%)	4 (30.8%)	3 (23.1%)	4 (30.8%)	
When using a new inhaler, do you spray one spray before use?	Yes	19 (15.4%)	27 (22%)	16 (13%)	61 (49.6%)	0.014
	No	11 (19.3%)	5 (8.8%)	17 (29.8%)	24 (42.1%)	
Does the child wash the mouth (gargling) or use the toothbrush and paste after using the preventive asthma inhaler containing cortisone?	Yes	10 (10.3%)	16 (16.5%)	20 (20.6%)	51 (52.6%)	0.067
	No	20 (24.1%)	16 (19.3%)	13 (15.7%)	34 (41%)	
If you use the mask, how do you fix the mask on your child?	not use it	3 (27.3%)	1 (9.1%)	2 (18.2%)	5 (45.5%)	0.919
	Loosely	3 (33.3%)	1 (11.1%)	1 (11.1%)	4 (44.4%)	
	Tightly	16 (16.2%)	18 (18.2%)	18 (18.2%)	47 (47.5%)	
	Completely tight	8 (13.1%)	12 (19.7%)	12 (19.7%)	29 (47.5%)	
Does the family change the mask	Yes	6 (7.4%)	18 (22.2%)	21 (25.9%)	36 (44.4%)	0.003
	No	24 (24.2%)	14 (14.1%)	12 (12.1%)	49 (49.5%)	

Viewing the relationship between some variables and time of diagnosis as seen in table 2, we found that age, educational level, and times of using asthma inhaler (Ventolin) in one week was significantly related (P=0.000). Significance of nationality is P= 0.002, where the number of emergency visits for asthma last year's significance is P= 0.032. Spraying one spray before using a new inhaler is

significant P=0.014, and changing the mask was significant also P= 0.003.

In table 3, we demonstrated the association between variables and frequency of using inhaler; the significant association was with nationality (P= 0.002), the number of ED visits (P= 0.010), source of advice about the correct use of inhaler (P=0.005), and way of fixing the mask (P=0.040).

Table 3: Association between variables and frequency of using inhaler

Parameter	Frequency of using inhaler			P-value	
	Once daily	Twice daily	Trice or more		
Age:	Less than 2 years	7 (38.9%)	10 (55.6%)	1 (5.6%)	0.101
	2-10 years	62 (61.4%)	35 (34.7%)	4 (4%)	
	10-14 years	45 (73.8%)	14 (23%)	2 (3.3%)	
Nationality:	Saudi	112 (66.7%)	51 (30.4%)	5 (3%)	0.002
	Non-Saudi	2 (16.7%)	8 (66.7%)	2 (16.7%)	
Educational level	kindergarten	15 (51.7%)	13 (44.8%)	1 (3.4%)	0.051
	Elementary	51 (67.1%)	24 (31.6%)	1 (1.3%)	
	Preparatory	28 (80%)	5 (14.3%)	2 (5.7%)	
	N/A	20 (50%)	17 (42.5%)	3 (7.5%)	
Since when was the child diagnosed with asthma?	Less than 3 months	21 (70%)	8 (26.7%)	1 (3.3%)	0.263
	From 3-6 months	15 (46.9%)	14 (43.8%)	3 (9.4%)	
	From 6-12 months	24 (72.7%)	9 (27.3%)	0 (0%)	
	More than a year	54 (63.5%)	28 (32.9%)	3 (3.5%)	
Do you use your child's asthma inhaler regularly?	Yes	73 (58.9%)	46 (37.1%)	5 (4%)	0.17
	No	41 (73.2%)	13 (23.2%)	2 (3.6%)	
How many times do you give your child asthma inhaler (Ventolin) per week	When needed	80 (63%)	41 (32.3%)	6 (4.7%)	0.951
	2-4 times	29 (63%)	16 (34.8%)	1 (2.2%)	
	5-7 times	4 (80%)	1 (20%)	0 (0%)	
	More than 7 times	1 (50%)	1 (50%)	0 (0%)	
How many ED visits because of asthma were last year?	Once	57 (75%)	16 (21.1%)	3 (3.9%)	0.01
	Twice	23 (62.2%)	12 (32.4%)	2 (5.4%)	
	3 times	18 (52.9%)	15 (44.1%)	1 (2.9%)	
	More than 3 times	16 (48.5%)	16 (48.5%)	1 (3%)	
How many times has your child been admitted to the ICU due to an asthma exacerbation in the past year	Never	98 (65.8%)	46 (30.9%)	5 (3.4%)	0.486
	Once or twice	15 (50%)	13 (43.3%)	2 (6.7%)	
	2-3 times	1 (100%)	0 (0%)	0 (0%)	
How many asthma attacks has your child had in the last year	weekly	10 (100%)	0 (0%)	0 (0%)	0.072
	Monthly	29 (51.8%)	25 (44.6%)	2 (3.6%)	
	Annually	39 (62.9%)	19 (30.6%)	4 (6.5%)	
	Never	36 (69.2%)	15 (28.8%)	1 (1.9%)	
Do you use Ventolin inhaler for your child during an asthma attack?	Yes	100 (62.1%)	54 (33.5%)	7 (4.3%)	0.483
	No	14 (73.7%)	5 (26.3%)	0 (0%)	
Have you ever received advice on the correct use of your child's inhaler?	Yes	92 (61.3%)	52 (34.7%)	6 (4%)	0.455
	No	22 (73.3%)	7 (23.3%)	1 (3.3%)	
If the answer is yes, from where did you get it?	From my primary doctor	86 (61.9%)	48 (34.5%)	5 (3.6%)	0.005
	Asthma educators	4 (50%)	4 (50%)	0 (0%)	
	Youtube	3 (50%)	1 (16.7%)	2 (33.3%)	
	Others	21 (77.8%)	6 (22.2%)	0 (0%)	
Have you stopped using the nebulizer for your child under the supervision of a specialist doctor?	Yes	34 (59.6%)	19 (33.3%)	4 (7%)	0.319
	No	80 (65%)	40 (32.5%)	3 (2.4%)	
When using a new inhaler, do you spray one spray before use	Yes	75 (61%)	43 (35%)	5 (4.1%)	0.075
	No	39 (68.4%)	16 (28.1%)	2 (3.5%)	
Usually how long do you wait after each dose?	I don't wait	26 (70.3%)	10 (27%)	1 (2.7%)	0.626
	10 seconds	61 (61.6%)	34 (34.3%)	4 (4%)	
	15-30 seconds	23 (63.9%)	13 (36.1%)	0 (0%)	
	More than that	4 (50%)	2 (25%)	2 (25%)	
After completing the first spray, how is the second spray given to your child?	Right after the 1 st spray	59 (62.1%)	32 (33.7%)	4 (4.2%)	0.085
	The inhaler should be shaken between the two sprays	36 (56.3%)	25 (39.1%)	3 (4.7%)	
	Wait 5 minutes between the 2 sprays	19 (90.5%)	2 (9.5%)	0 (0%)	
Does the child wash the mouth (gargling) or use the toothbrush and paste after using the preventive asthma	Yes	64 (66%)	29 (29.9%)	4 (4.1%)	0.672
	No	50 (60.2%)	30 (36.1%)	3 (3.6%)	

inhaler containing cortisone?					
Do you use spacer for your child	Always	64 (57.1%)	42 (37.5%)	6 (5.4%)	0.636
	Sometimes	30 (75%)	10 (25%)	0 (0%)	
	Rarely	14 (82.4%)	2 (11.8%)	1 (5.9%)	
	Never	6 (54.5%)	5 (45.5%)	0 (0%)	
If you use a spacer for asthma, where do you hold the end of the spacer (the mask) on your child?	not use it	6 (54.5%)	5 (45.5%)	0 (0%)	0.136
	On mouth and nose	89 (59.3%)	54 (36%)	7 (4.7%)	
	On mouth	11 (100%)	0 (0%)	0 (0%)	
	On nose	8 (100%)	0 (0%)	0 (0%)	
If you use the mask, how do you fix the mask on your child?	not use it	6 (54.5%)	5 (45.5%)	0 (0%)	0.04
	Loosely	6 (66.7%)	2 (22.2%)	1 (11.1%)	
	Tightly	60 (60.6%)	34 (34.3%)	5 (5.1%)	
	Completely tight	42 (68.9%)	18 (29.5%)	1 (1.6%)	
Does the family change the mask?	Yes	54 (66.7%)	23 (28.4%)	4 (4.9%)	0.463
	No	60 (60.6%)	36 (36.4%)	3 (3%)	
Do you share your mask with someone else?	Yes	4 (50%)	3 (37.5%)	1 (12.5%)	0.389
	No	110 (64%)	56 (32.6%)	6 (3.5%)	
Does the family wash the mask after finishing	Yes	78 (60.5%)	45 (34.9%)	6 (4.7%)	0.389
	No	36 (70.6%)	14 (27.5%)	1 (2%)	

DISCUSSION

Previous research has demonstrated that inappropriate inhaler device use reduces drug delivery, patient adherence, and treatment outcomes, which leads to uncontrolled asthma and numerous emergency visits [16-19]. Conducting this study, we tried to measure the prevalence of correct use of inhalation technique of inhaled medication in children with asthma and investigate whether improper inhaler use can lead to uncontrolled bronchial asthma and its problems. When compared to previous studies we found that the knowledge about using inhaler technique has risen in our study compared with other studies [7, 20]. Also the information public about from where to get information has increased, in the study conducted in Jeddah, Riyadh, and Dammam, during the National Asthma Awareness Campaign in April 2019 [21], only 22% of the participants get their information from their doctor wherein our study 139 (77.2%) of the participants tend to get their information from their primary doctor, and this indicates a better awareness and better treatment outcomes, as well as this, will assure that the patients will comply to medication and deliver the drug in the most effective way and technique.

Moreover, comparing our results with a study conducted at the King Abdulaziz Medical City between 2010 and 2011 [22], we found that receiving health education about asthma disease from a physician, education about asthma was of significance $P=0.0001$, and the number of ED visits significance was $P=0.0497$. As in this study the ED visits significance is $P=0.032$, and demonstrated that children diagnosed over a year ago had the most ED visits during the last year, 31 (40.8%) of them visited the ED once, 21 (56.8%) visited the ED twice, 17 (50%) visited the ED three times, and 16 (48.5%) more than three times.

A study in the United States discovered that considerable resources were wasted on unjustified preventive measures due to a lack of parental understanding about environmental asthma causes [23]. Understanding causes, triggers of asthma, and techniques using inhalers improve the health care system concerning treatment outcomes. Importantly, knowledge of asthma techniques using the inhalers such as washing masks,

using spacers, spraying one spray before the first use, fixing the mask, not sharing the mask with someone else is significant about our study and demonstrating the improvement.

The current study's limitations include a smaller number of patients, the inclusion of only children up to the age of 14, and children who visit paediatrics pulmonology clinic.

CONCLUSION

Asthma is one of the most common chronic respiratory diseases in the world. Most asthmatic patients considered asthma as disabling, which negatively affected their quality of life. Successful bronchial asthma management requires a multidisciplinary strategy that can't be achieved without a well-informed community. Although this study showed enhanced knowledge and techniques using inhalers, physicians and other health workers should teach children and their caregivers how to use their inhalation devices properly whenever possible, and rectify errors when they occur, to ensure that medication is delivered effectively. As a result, future awareness campaigns should focus more resources on educating families and caregivers of asthmatics on correct medication use to avoid asthma complications and control asthma episodes for children.

REFERENCES

1. Al-Moamary MS, Alhaider SA, Alangari AA, et al. The Saudi Initiative for Asthma - 2019 Update: Guidelines for the diagnosis and management of asthma in adults and children. *Ann Thorac Med.* 2019;14(1):3-48. doi:10.4103/atm.ATM_327_18
2. Toskala E, Kennedy DW. Asthma risk factors: Asthma risk factors. *Int Forum Allergy Rhinol.* 2015;5 Suppl 1(S1):S11-6. doi:10.1002/alr.21557
3. Lai L, Zhang T, Zeng X, Tan W, Cai L, Chen Y. Association between physician-diagnosed asthma and weight status among Chinese children: The roles of lifestyle factors. *Int J Environ Res Public Health.* 2020;17(5):1599. doi:10.3390/ijerph17051599
4. Mcinerny TK, Campbell DE, Dewitt TG, Foy JM, Kamat DM. Asthma. *American Academy of Pediatrics Textbook of Pediatric Care.* Published online 2017.
5. Chronic respiratory diseases: asthma. *Who.int.* Accessed February 12, 2022. <https://www.who.int/news->

- room/questions-and-answers/item/chronic-respiratory-diseases-asthma
6. Hoch HE, Houin PR, Stillwell PC. Asthma in children: A brief review for primary care providers. *Pediatr Ann.* 2019;48(3):e103-e109. doi:10.3928/19382359-20190219-01
 7. Normansell R, Kew KM, Mathioudakis AG. Interventions to improve inhaler technique for people with asthma. *Cochrane Database Syst Rev.* 2017;3(3):CD012286. doi:10.1002/14651858.CD012286.pub2
 8. Gillette C, Rockich-Winston N, Kuhn JA, Flesher S, Shepherd M. Inhaler technique in children with asthma: A systematic review. *Acad Pediatr.* 2016;16(7):605-615. doi:10.1016/j.acap.2016.04.006
 9. Hagmolen of ten Have W, van de Berg NJ, Bindels PJE, van Aalderen WMC, van der Palen J. Assessment of inhalation technique in children in general practice: increased risk of incorrect performance with new device. *J Asthma.* 2008;45(1):67-71. doi:10.1080/02770900701815834
 10. Capanoglu M, Dibek Misirlioglu E, Toyran M, Civelek E, Kocabas CN. Evaluation of inhaler technique, adherence to therapy and their effect on disease control among children with asthma using metered dose or dry powder inhalers. *J Asthma.* 2015;52(8):838-845. doi:10.3109/02770903.2015.1028075
 11. El Rifai N, Rizk H. Effect of health education about proper inhaler technique among asthmatic children/caregivers. *Alex J Pediatr.* 2019;32(1):6. doi:10.4103/ajop.ajop_9_19
 12. Southey C, Innes S, Achakulwisut V, et al. G39(P) Using mobile direct observation therapy to improve asthma inhaler technique. In: *QUALITY IMPROVEMENT; EMBEDDING A CULTURE OF QUALITY IMPROVEMENT.* Vol 104. BMJ Publishing Group Ltd and Royal College of Paediatrics and Child Health; 2019:A16-A17. https://adc.bmj.com/content/104/Suppl_2/A16.2
 13. Kamps AWA, Brand PLP, Roorda RJ. Determinants of correct inhalation technique in children attending a hospital-based asthma clinic. *Acta Paediatr.* 2002;91(2):159-163. doi:10.1080/080352502317285144
 14. Bsheti IA, Obeidat NM, Reddel HK. Inhaler technique education and asthma control among patients hospitalized for asthma in Jordan. *Saudi Pharm J.* 2018;26(8):1127-1136. doi:10.1016/j.jsps.2018.06.002
 15. Lee C, Alexander E, Lee R, Okorochoa N, Manikam L, Lakhanpaul M. Behavioral interventions for asthma self-management in South Asian populations: a systematic review. *J Asthma.* 2021;58(1):112-120. doi:10.1080/02770903.2019.1658209
 16. Giraud V, Roche N. Misuse of corticosteroid metered-dose inhaler is associated with decreased asthma stability. *Eur Respir J.* 2002;19(2):246-251. doi:10.1183/09031936.02.00218402
 17. Melani AS, Bonavia M, Cilenti V, et al. Inhaler mishandling remains common in real life and is associated with reduced disease control. *Respir Med.* 2011;105(6):930-938. doi:10.1016/j.rmed.2011.01.005
 18. Dolovich MB, Ahrens RC, Hess DR, et al. Device selection and outcomes of aerosol therapy: Evidence-based guidelines. *Chest.* 2005;127(1):335-371. doi:10.1378/chest.127.1.335
 19. Molimard M, Le Gros V. Impact of patient-related factors on asthma control. *J Asthma.* 2008;45(2):109-113. doi:10.1080/02770900701815727
 20. Al-Muhsen S, Horanieh N, Dulgom S, et al. Poor asthma education and medication compliance are associated with increased emergency department visits by asthmatic children. *Ann Thorac Med.* 2015;10(2):123-131. doi:10.4103/1817-1737.150735
 21. Alharbi SA, Kobeisy SAN, AlKhater SA, et al. Childhood asthma awareness in Saudi Arabia: Five-year follow-up study. *J Asthma Allergy.* 2020;13:399-407. doi:10.2147/JAA.S272850
 22. Al-Jahdali H, Ahmed A, Al-Harbi A, et al. Improper inhaler technique is associated with poor asthma control and frequent emergency department visits. *Allergy Asthma Clin Immunol.* 2013;9(1):8. doi:10.1186/1710-1492-9-8
 23. Cabana MD, Slish KK, Lewis TC, et al. Parental management of asthma triggers within a child's environment. *J Allergy Clin Immunol.* 2004;114(2):352-357. doi:10.1016/j.jaci.2004.04.047