

Associations between inhaler technique and asthma control among asthma patients using pressurised MDIs and DPIs

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SUMMARY

OBJECTIVES: To investigate associations between technique with pressurised metered-dose inhalers (pMDIs) and dry powder inhalers (DPIs) used as controller medication and asthma control variables measured using Asthma Control Test (ACT) scores.

DESIGN: In this cross-sectional study, the inhaler technique of asthma patients using pMDIs or DPIs (Turbuhaler® [TH] and Accuhaler Diskus™ [ACC]) were assessed against published inhaler technique checklists. ACT scores (maximum 25, higher score corresponding to better asthma control) were assessed.

RESULTS: Of the 130 subjects enrolled in the study (41 TH, 54 ACC and 35 pMDI), inhaler technique scores (out of nine for all devices) were low for TH (4.4 ± 0.9) and ACC (5.4 ± 1.0) compared with pMDI (8.1 ± 0.9) ($P < 0.001$, one-way analysis of variance). Older age

and use of pMDI were associated with better inhaler technique. ACT scores were low, consistent with very poorly controlled asthma (mean TH $13.1 \pm SD 3.9$, mean ACC $13.3 \pm SD 3.9$ and mean pMDI $12.8 \pm SD 4.2$). No significant association between inhaler technique scores and ACT scores was found. More recent asthma diagnosis and a higher level of education were associated with higher ACT scores (better asthma control).

CONCLUSION: Asthma control was poor in this population. Lack of a significant association between the inhaler technique score and asthma control may reflect the multiple factors contributing to poor asthma control in the Jordanian population.

KEY WORDS: health care professionals; Turbuhaler®; Accuhaler; Asthma Control Test; Jordan; low-resource countries

ASTHMA is a serious global health care problem, affecting people of all ages.¹ Asthma affects an estimated 300 million individuals, with prevalence ranging from 1% to 18% in different countries.¹ In low-resource countries, asthma prevalence has been increasing;² in Jordan, there has been an alarming two-fold increase in the prevalence of asthma over the past 10 years.³

Inhaled medications for asthma are available mainly as pressurised metered-dose inhalers (pMDIs) and dry powder inhalers (DPIs). pMDIs are most commonly used due to their familiarity, low cost and the requirement for only low inspiratory flow rates for adequate drug deposition in the lung.⁴ Both pMDIs and DPIs require training and certain skills to achieve the correct technique and deep deposition of the medication into the lungs.^{5,6}

The Asthma Control Test (ACT)⁷ is a validated questionnaire often used to evaluate asthma control in clinical care settings,⁸ reflecting the patient's status over the previous 4 weeks. ACT was one of the tools

recommended by the American Thoracic Society (ATS)/European Respiratory Society (ERS) Task Force on standardisation of asthma control measures.⁹ No previous study has investigated the relationship between incorrect use of pMDIs and DPIs (Turbuhaler® [TH; AstraZeneca, London, UK] and Accuhaler™ [ACC; GlaxoSmithKline, Brentford, UK]) and asthma control evaluated using ACT scores.

The primary objective of the present study was to investigate the cross-sectional relationship between asthma control, assessed by ACT scores, and inhaler technique. Secondary objectives included assessing the association between inhaler technique and demographic and asthma-related variables.

METHODS

Study design

This was a prospective cross-sectional study, with participants recruited between June and September 2011. Ethics approval was obtained from two public

Table 1 Technique checklists for the DPIs and the pMDI*

Accuhaler™ [Diskus]	
Step	Description/action
1	Open inhaler [†]
2	Push lever back completely [†]
3	Exhale to residual volume
4	Exhale away from mouthpiece
5	Place mouthpiece between teeth and lips
6	Inhale forcefully and deeply [†]
7	Hold breath for 5 sec
8	Exhale away from mouthpiece
9	Close inhaler
Turbuhaler®	
Step	Description/action
1	Remove the cap from the inhaler [†]
2	Keep inhaler upright [†]
3	Rotate grip until a click is heard [†]
4	Exhale to residual volume
5	Exhale away from mouthpiece
6	Place mouthpiece between teeth and lips
7	Inhale forcefully and deeply [†]
8	Hold breath for 5 sec [‡]
9	Exhale away from mouthpiece
pMDI	
Step	Description/action
1	Remove mouthpiece cover and shake [†]
2	Hold inhaler upright
3	Exhale to residual volume
4	Keep head upright or slightly tilted
5	Place mouthpiece between teeth and lips
6	Inhale slowly and press canister [†]
7	Continue slow and deep inhalation [†]
8	Hold breath for 5 sec
9	Close the inhaler

* These checklists and essential steps are in accordance with the literature.^{5,6,10}

[†] Essential step: if not performed correctly, little/no medication will reach the lung.¹¹

[‡] This step is not included in the product insert but appears in the Turbuhaler instructions on the Global Initiative for Asthma Web site,¹ and in the checklist from van der Palen et al.⁶

DPI = dry powder inhaler; pMDI = pressurised metered-dose inhaler.

hospitals, Jordan University Hospital (Amman) and Albasheer Hospital (Amman, Jordan). The main study was preceded by a pilot study to assess its feasibility, identify barriers that could hinder the conduct of the research, and to assess clarity and readability of the developed questionnaires. This pilot study was run over 1 month at the aforementioned hospitals.

Subjects with physician-diagnosed asthma who were visiting the respiratory clinics at these hospitals were approached by the researcher for participation. Subjects were patients who presented at the respiratory clinic for planned or unplanned, but not emergency, visits. All subjects who agreed to participate provided written informed consent. For children aged <18 years, a parent provided signed parental informed consent.

Inclusion criteria were age ≥ 14 years, physician-diagnosed asthma, currently using a controller

medication (inhaled corticosteroid [ICS] with or without long-acting β_2 -agonist [LABA]) via DPI (TH or ACC) or pMDI, and having been on the same medication and dose for a minimum of 1 month before study enrolment. Subjects were excluded from the study if they did not self-administer their medication, were involved in another clinical study or did not speak or understand Arabic (Arabic is the official language for medical care in Jordan).

Inhaler technique assessment

The assessment of the inhaler technique in all subjects was completed by the same researcher, who was experienced in inhaler technique education. The controller inhaler technique (TH, ACC and pMDI) used by patients was assessed by the researcher using validated inhaler technique checklists (Table 1),^{5,10} with placebo inhalers provided by AstraZeneca (AstraZeneca Pharmaceuticals, Wilmington, DE, USA; Amman, Jordan) and Glaxo-SmithKline (GSK) (Philadelphia, PA, USA; Amman, Jordan). The checklists for each device consist of 9 steps, with 4 'essential' steps (steps without which little or no medication would reach the airway) for the TH and 3 essential steps for the ACC and pMDI (Table 1).¹⁰ All subjects received education about the correct inhaler technique once the trial assessments were completed.

Subjects completed a questionnaire under the supervision of the researcher on demographic data, the asthma medications used, duration of inhaler use, previous education received on asthma inhaler use, peak flow meter use, complementary asthma treatment use, an asthma knowledge questionnaire for consumers (CQ)¹² and the ACT questionnaire (using the published Arabic translation).¹³ The CQ, as published by Kritikos et al., comprises 12 true/false questions about asthma and its treatment.¹² The questionnaire was translated into Arabic, and was tested for clarity, accuracy and repeatability by the researchers following translation. As the researcher was allowed access to the patient file, the medications used by the patient were documented by the patient and verified from the patient file.

The ACT questionnaire is a five-item questionnaire developed for assessing asthma control in clinical practice and clinical research, based on symptom frequency, night waking, use of rescue medications, impact on activities and patient-assessed asthma control.⁷ Each question is graded from one to five. The score range is 5 to 25. Well-controlled asthma is defined as an ACT score above 19. The ACT has been translated into different languages. The Arabic version has been professionally translated and distributed by the pharmaceutical company, GSK.^{13,14} Verbal approval to use the Arabic version of the ACT was obtained from GSK Jordan.

Table 2 Baseline demographics and asthma management characteristics

Variable	Turbuhaler (<i>n</i> = 41) <i>n</i> (%)	Accuhaler (<i>n</i> = 54) <i>n</i> (%)	pMDI (<i>n</i> = 35) <i>n</i> (%)	<i>P</i> value
Age, mean $\pm$ SD	41.8 $\pm$ 14.3	47.2 $\pm$ 16.1	47.5 $\pm$ 16.5	0.90
Female sex	29 (71)	36 (67)	23 (66)	0.90
Amman location, east:west:outside Amman*	16:14:11 (39:34:27)	19:20:15 (35:37:28)	7:11:17 (20:31:49)	0.20
Marital status, married:widowed:single	27:5:9 (66:12:22)	35:6:13 (65:11:24)	23:5:7 (66:14:20)	1.00
Onset of asthma, infancy: 2–12 years: >12 years	2:5:35 (5:12:83)	0:6:48 (0:11:89)	0:6:29 (0:17:83)	0.30
Duration of controller use, years, mean $\pm$ SD	8.8 (11.4)	9.1 (8.2)	11.7 (11.5)	0.40
Reliever use, puffs/day, mean $\pm$ SD	6.5 (2.5)	5.1 (3.6)	4.8 (2.3)	0.04
Antihistamine use	19 (46)	29 (54)	9 (26)	0.03
Use of complementary treatment	39 (72)	22 (54)	23 (66)	0.17
Smoking status, smoker: ex-smoker: non-smoker	1:4:36 (2:10:88)	8:4:42 (15:7:78)	3:4:28 (9:11:80)	0.20
Oral cortisone use (any use in the last 12 months)	5 (12.2)	11 (20.4)	3 (8.6)	0.30
ACT scores (out of 25), mean $\pm$ SD	13.2 (3.9)	13.3 (3.9)	13.1 (3.9)	0.80
Asthma control, well-controlled: not well-controlled: very poorly controlled [†]	2:11:28 (5:27:68)	3:14:37 (6:26:68)	2:6:27 (6:17:77)	0.90
CQ score (out of 12), mean $\pm$ SD	5.4 (1.7)	5.7 (1.8)	5.6 (2.2)	0.70
Inhaler technique score, mean $\pm$ SD	4.4 (0.9)	5.4 (1.0)	8.1 (0.9)	<0.001
Correct inhaler technique [‡]	0	1 (2)	11 (31)	<0.001
Correct essential technique [‡]	0	41 (76)	29 (83)	<0.001
Occupation				0.617
Housewife	21 (51)	24 (44)	20 (57)	
Employee	7 (17)	10 (19)	4 (11)	
Student	5 (12)	6 (11)	4 (11)	
Other	8 (20)	14 (26)	7 (20)	
Education level				0.218
Elementary	3 (7)	8 (15)	5 (14)	
High school	17 (42)	17 (32)	16 (46)	
College	8 (20)	10 (19)	2 (6)	
University	13 (32)	13 (24)	8 (23)	
Not educated	0	6 (11)	4 (11)	

* East Amman = low SES areas; west Amman = high SES areas; outside Amman = mixed SES areas.

[†] ACT score out of 25: ≥ 20 = well controlled; 16–19 not well controlled; ≤ 15 = very poorly controlled asthma.¹⁵

[‡] See Table 1.

pMDI = pressurised metered-dose inhalers; SD = standard deviation; ACT = Asthma Control Test; CQ = asthma knowledge questionnaire for consumers; SES = socio-economic status.¹²

Data analysis

Data were analysed using the statistical software package Statistical Package for the Social Sciences, v 20 (IBM Corp, Armonk, NY, USA). The proportions of subjects with the correct technique (all steps correct) and the correct essential technique (essential steps correct) were compared using the Pearson's χ^2 test. Differences with $P < 0.05$ were considered statistically significant. For continuous variables (inhaler technique mean scores [out of 9], ACT mean scores and CQ mean scores), comparisons between groups were performed using the independent sample *t*-test, Wilcoxon signed-rank test and Mann-Whitney *U*-test.

To determine predictors of the correct inhaler technique score, a multiple linear regression analysis was performed using the inhaler technique score as the dependent variable. Independent variables included inhaler type (TH, ACC or pMDI), age, sex (male or female), working status (employed or unemployed), socio-economic status (SES; East Amman, lower SES areas vs. areas outside Amman, mixed SES areas vs. West Amman, higher SES areas), marital status, educational level (not educated, elementary school, high school, college, university), age at onset

of asthma, smoking status (smoker, non-smoker, ex-smoker), CQ score. Predictors of ACT scores were similarly identified using the same independent variables, together with inhaler technique scores.

RESULTS

One hundred and thirty subjects were enrolled into the study: 54 ACC, 41 TH and 35 pMDI. Average age was 45.6 years (standard deviation [SD] 15.8), and 67% were females. No significant difference in demographic features was found between the groups (Table 2). The majority of the participants (82%) were non-smokers.

For all participants, inhaled controller treatment had been initiated by a specialist, i.e., a physician specialising in respiratory diseases. However, 83% of the participants reported never being asked for a prescription when they sought inhaler refills. The majority of the subjects (ACC 70%, TH 71%, pMDI 63%) accepted the need to use their inhalers to manage their asthma symptoms, with no significant differences between inhaler groups ($P = 0.3$). Significantly more pMDI users (57%) believed that their

Table 3 Summary of the regression model for the dependent variable, inhaler technique score, with its associated predictors, size and direction of the association ($n = 130$)*

Variables	β	t	P value
Types of inhaler (TH, ACC, MDI)	0.587	7.919	<0.001
Age	0.353	3.493	0.001
Sex	0.050	0.607	0.545
Work status (employed or unemployed)	0.071	0.825	0.411
East Amman vs. west Amman vs. outside Amman [†]	0.021	0.277	0.782
Marital status	0.076	0.816	0.416
Educational status	0.018	0.234	0.815
Smoking status	-0.122	-1.631	0.106
Age at onset of asthma	-0.061	-0.637	0.525
Asthma knowledge test score	0.125	1.595	0.113

* This table shows the output from a regression analysis ($R^2 = 0.374$, $P < 0.001$) in which inhaler technique score was the dependent variable. β is the standardised regression coefficient; values with their P values show whether or not each variable is making a statistically significantly unique contribution to the model ($P < 0.05$). The t -test value gives the significance of each coefficient, and can determine the relative importance of each variable in the model (useful predictors usually have t values >2 or <-2). A higher inhaler technique score represents better inhaler technique.

[†] East Amman = low SES areas; west Amman = high SES areas; outside Amman = mixed SES areas.

TH = Turbuhaler®; ACC = Accuhaler™; MDI = metered dose inhaler; SES = socio-economic status.

inhalers were effective than TH (39%) and ACC (35%) users ($P = 0.048$).

Participants reported obtaining information on inhaler techniques from various sources, most commonly their specialist (69%), followed by the hospital clinic (49%) and their general physician (GP) (40%), with no significant difference between groups ($P > 0.05$, χ^2 test). The majority of the subjects reported receiving advice on inhaler technique in the form of a physical demonstration (45%), verbal recommendations (20%) or both (26%) when they first started using their inhalers (90%), and only 14% of subjects had received inhaler advice at any other time. Most subjects (82%) had not received any advice regarding correct inhaler use in the previous 12 months. A high proportion of subjects (92%) reported that no health care professional had ever assessed the way they were using their inhalers, and 93% believed that they were not using their inhalers correctly.

When participants were asked which health care professional should provide assessment and education about the correct use of inhalers, some chose their GP (9%), specialist (9%) or pharmacist (5%), but the majority (78%) chose a combination of the different health care professionals (specialist, GP, pharmacist and nurse). Only 19% of the participants reported having an asthma action plan. Only one patient (<1%) reported using a peak flow meter at home.

Alternative treatments in asthma

A significantly higher proportion of subjects in the ACC and TH groups were using antihistamines than those in the pMDI group (Table 2). A high proportion

of subjects reported using complementary or alternative treatment, including infusions of chamomile, ginger, anise, thyme and black seed. More than half of the subjects (55%) believed that the complementary treatment they were using was effective in managing their asthma symptoms. There was no significant difference in ACT scores between subjects who were and those who were not using complementary therapy (12.7 ± 4.0 vs. 13.9 ± 3.8 , $P = 0.09$).

Inhaler technique scores

Inhaler technique scores (of a total of 9 for all devices) were low for TH (4.4) and ACC (5.4) compared to the pMDI (8.1) (Table 2). A significant difference was found between the different inhaler groups ($P < 0.001$). Multiple regression modelling showed that older age was significantly associated with higher inhaler technique scores (Table 3). The type of inhaler device also showed a significant association: subjects using the two DPIs for their controller therapy had a significantly lower score than subjects using a pMDI. These two factors explained 37% of the variance in inhaler technique scores ($P < 0.001$).

Correct inhaler technique and correct essential technique

More subjects using pMDI had the correct inhaler technique (31%) than those using ACC (2%) and TH (0%); the difference between the groups was statistically significant ($P < 0.001$, Table 2). As regards the correct 'essential technique', a statistically significant difference was also detected between the groups ($P < 0.001$). A significantly higher proportion of pMDI (83%) and ACC (76%) users demonstrated correct essential technique than TH users (0%). The Figure (A, B and C) provides a clear picture as to which steps were more problematic to the users of the three devices.

Asthma knowledge scores

All three groups performed poorly with regard to their responses to the CQ questions, with scores not exceeding 6 out of 12 (Table 2). No significant difference between the groups was observed ($P = 0.7$, one-way analysis of variance).

ACT scores

Overall, 71% of subjects were classified as having very poorly controlled asthma (ACT score ≤ 15). ACT scores showed no significant difference between the three device groups, with mean scores ($\pm$ SD) of 13.3 ± 3.9 , 13.1 ± 3.9 and 12.8 ± 4.2 for ACC, TH and pMDI, respectively (Table 2).

In univariate analysis, inhaler technique score was not significantly associated with the ACT score (Spearman's $\rho -0.89$, $P = 0.3$). Multiple regression modelling showed that having a higher level of education and being diagnosed with asthma at an

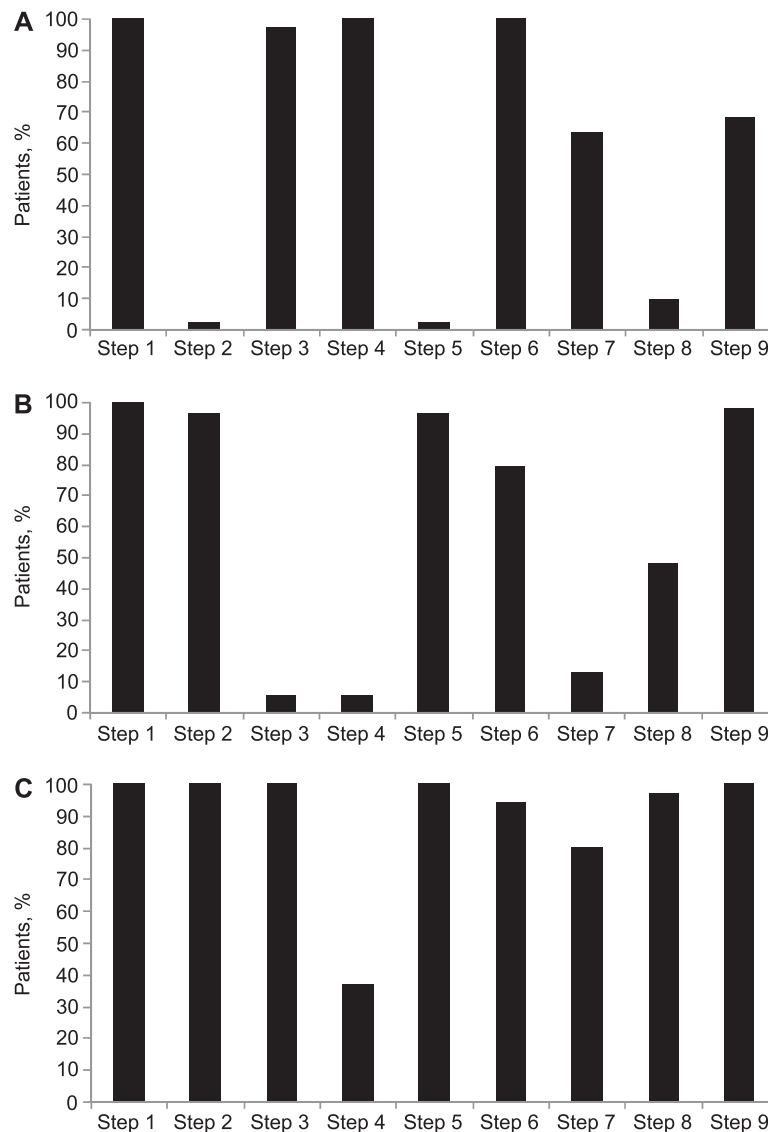


Figure 3 **A)** Proportion of subjects who correctly demonstrated each step in the TH ($n = 54$) technique checklist (Table 1). **B)** Proportion of subjects who correctly demonstrated each step in the ACC ($n = 41$) technique checklist (Table 1). **C)** Proportion of subjects who correctly demonstrated each step in the MDI ($n = 35$) technique checklist (Table 1). TH = Turbuhaler®; ACC = Accuhaler™; MDI = metered dose inhaler.

older age were significantly associated with having higher ACT scores (better asthma control); however, the association was weak, as these two variables explained only 18% of the observed variance in ACT score ($R^2 = 0.18$, $P < 0.011$, Table 4).

DISCUSSION

This is the first study to examine correlations between inhaler technique scores, asthma control and other patient factors for adult asthma patients living in a low-resource country. Among subjects using a controller inhaler, better inhaler technique was significantly associated with older age and with the use of pMDIs vs. the newer DPIs (TH and ACC). This could be due to the fact that patients had had more

opportunities to learn the correct technique with the older pMDIs. Overall, asthma control was very poor; however, better inhaler technique was not significantly associated with better asthma control, with older age at asthma diagnosis (more recent onset of asthma) and a higher level of education the only significant predictors of ACT score in this analysis.

The importance of inhaler technique and its association with asthma control has recently been emphasised in the 2014 Global Initiative for Asthma strategy report,¹ with studies in the United Kingdom,¹⁶ Italy¹⁷ and Brazil¹¹ all showing that patients with an incorrect inhaler technique were more likely to have poor asthma control. This is in contrast with the present study findings, which showed no significant association between better inhaler techniques

Table 4 Summary of the regression model for the dependent variable, ACT score, with its associated predictors, size and direction of the association ($n = 130$)*

Variables	β	t	P value
Types of inhaler (TH, ACC, MDI)	0.073	0.670	0.504
Sex	-0.015	-0.166	0.868
East Amman vs. west Amman			
vs. outside Amman [†]	-0.089	-1.000	0.319
Inhaler technique score	-0.083	-0.745	0.458
Asthma knowledge test score	0.156	1.681	0.095
Marital status	0.126	1.164	0.247
Educational status	0.293	3.461	0.001
Work status (employed or unemployed)	0.150	1.526	0.130
Age	0.109	0.684	0.495
Smoking status	0.012	0.131	0.896
Age at onset of asthma	0.277	3.269	0.001

* This table shows the output from a regression analysis ($R^2 = 0.18$, $P < 0.011$) in which ACT score was the dependent variable. β values with their P values show whether or not each variable is making a statistically significant unique contribution to the model ($P < 0.05$). The t-test value gives the significance of each coefficient, and can determine the relative importance of each variable in the model (useful predictors usually have t values > 2 or < -2). ACT score: higher values represent better asthma control; inhaler technique score: higher values represent better technique.

[†] East Amman = low SES areas; west Amman = high SES areas; outside Amman = mixed SES areas.

ACT = Asthma Control Test; TH = Turbuhaler®; ACC = Accuhaler™; MDI = metered dose inhaler; SES = socio-economic status.

and higher ACT scores. This may have been due to the fact that the majority of the study participants, regardless of the type of inhaler device they were using, were categorised in the 'very poorly controlled' category. A similar proportion of patients with 'very poorly controlled' asthma was seen in a recent study in tertiary clinics in Nigeria.¹⁸ In our patients, having a higher level of education and older age at asthma onset were the only independent predictors of better asthma control, as indicated by higher ACT scores. The association between lower education level and poor inhaler technique is consistent with other studies.¹⁷ Melani et al. reported that older age significantly predicted *worse* inhaler techniques,¹⁷ but the present study population was younger, with an average age of 45.6 years.

We used the ACT score in this study to assess asthma control, as this is recommended in the GINA guidelines.¹ This 5-item questionnaire assesses asthma control over the previous 4 weeks, a period recommended by the ATS/ERS Task Force on asthma control for assessment of the patient's recent status.⁹ The ACT has shown a strong correlation with physician-assessed asthma control,^{7,15} forced expiratory volume in 1 s and asthma-specific health-related quality of life, and was shown to correctly predict uncontrolled asthma as defined by GINA in 81% of adult patients.⁸ We recommend the routine use of the ACT for clinical assessment of asthma control, especially by community pharmacists, as ACT is feasible for use in primary care and spirometry services are not readily available in community pharmacies.¹⁹

Antihistamine use was reported by the majority of the study subjects. Anecdotal comments showed that both subjects and pharmacists in Jordan believe that antihistamines play a role in the treatment of asthma. Histamine is an important chemical mediator in asthma, but traditional antihistamines that target the histamine H(1) receptor have failed to demonstrate a significant clinical effect in asthma, in contrast with their clinical utility in allergic rhinitis.²⁰ Antihistamine use is not recommended in guidelines as a treatment for asthma, but further research may be warranted to investigate reasons for their use by patients.

Although the use of complementary treatments is prevalent among asthma patients, their use does not necessarily indicate that it is 'competing' with conventional asthma therapies. As in previous research, patients in Jordan appear to incorporate different health belief systems simultaneously into their asthma management.²¹

Strengths of the study include the systematic recording of inhaler technique, use of standardised questionnaires, use of a standardised tool for the assessment of asthma control (ACT) and the fact that all steps were carried out by the same researcher. Limitations include the lack of an objective measure of adherence and lack of evaluation of outcomes with regard to the daily dose of ICS or use/non-use of LABAs by patients. The latter factors were not included in the regression analysis because of the complex relationship between asthma severity, asthma control and prescribed medication steps.²²

CONCLUSION

Subjects using MDIs in Jordan, a low-resource country, are more likely to use their controllers inhalers correctly than subjects using the newer DPIs. Older age was also associated with better inhaler technique. No significant association was found between ACT scores and inhaler technique scores, although this may have been due to the generally very poor level of asthma control in the present population. This should not be taken to suggest that, at policy and practice level, implementation of a brief intervention to correct inhaler technique, which we have shown is feasible, effective and sustainable in community pharmacies in Australia,^{23–25} should be any less important in low-resource countries than in other countries, but that the approach to asthma management should take into account all factors that may be contributing to poor asthma control. Having a higher level of education and an older age at asthma diagnosis (more recent onset of asthma) were associated significantly with higher ACT scores (better asthma control), suggesting that educational interventions for asthma should take into account health literacy and recency of diagnosis. Finally, this

paper highlights the importance of routinely assessing asthma control in clinical practice, and the complexity in determining relationships between inhaler technique and asthma control. Future studies investigating ACT scores in populations with a broad range of asthma control (including more patients with well-controlled and partly controlled asthma) need to be conducted to further explore the associations revealed in this study, and their implications for global policy and practice.

Acknowledgements

The authors are grateful to the Applied Science Private University, Amman, Jordan, for the full financial support granted to this research project (Grant number DRGS-2013-2014-13).

Clinical Trial Registration: This study has been registered with the Australian New Zealand Clinical Trials Registry in 18 February 2010. Registration number is ACTRN12610000159055.

Conflicts of interest: HKR has been a member of the Advisory Boards for AstraZeneca (London, UK), GlaxoSmithKline (Brentford, UK), Novartis (Basel, Switzerland) and Boehringer Ingelheim (Ingelheim, Germany); been Chair of the Data Safety Monitoring Board for AstraZeneca, GlaxoSmithKline, Merck (Whitehouse Station, NJ) and Novartis; provided consulting for AstraZeneca and GlaxoSmithKline; prepared and delivered independent medical presentations for AstraZeneca, GlaxoSmithKline, Mundipharma (Cambridge, UK), Novartis and Teva (Petah Tikva, Israel); and has received unrestricted research grants from AstraZeneca and GlaxoSmithKline for investigator-sponsored research.

No financial or other potential conflicts of interest exist for the other authors.

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RESUME

OBJECTIF : Etudier les associations entre la technique des aérosols doseurs pressurisés (pMDI) et les inhalateurs à poudre sèche (DPI) utilisés dans le contrôle de l'asthme et les variables de contrôle de l'asthme (score du test de contrôle de l'asthme [ACT]).

SCHEMA : Dans cette étude transversale, la technique d'inhalation des asthmatiques, utilisant les pMDIs or DPIs (Turbuhaler® [TH] et Accuhaler Diskus™ [ACC]), a été évaluée par rapport aux checklists publiées des techniques d'aérosol. Les scores ACT (maximum 25, le score le plus élevé correspondant à un meilleur contrôle de l'asthme) ont été évalués.

RÉSULTATS : Ont été enrôlés 130 sujets dans l'étude (41 TH, 54 ACC et 35 pMDI). Les scores des techniques d'aérosol (sur 9 pour tous les aérosols) ont été faibles pour TH ($4,4 \pm 0,9$) et ACC ($5,4 \pm 1,0$) par comparaison à pMDI ($8,1 \pm 0,9$) ($P < 0,001$, analyse

de variance unidirectionnelle). Un âge plus avancé et l'utilisation de pMDI ont été associés à une meilleure technique d'aérosol. Les scores ACT ont été faibles, en accord avec un asthme très mal contrôlé (TH moyenne $13,1 \pm$ déviation standard [SD] $3,9$; ACC $13,3 \pm 3,9$ et pMDI $12,8 \pm 4,2$). Aucune association significative entre les scores des techniques d'aérosol et les scores ACT n'a été constatée. Un diagnostic d'asthme plus récent et un niveau d'instruction plus élevé ont été associés avec des scores ACT plus élevés (meilleur contrôle de l'asthme).

CONCLUSION : Le contrôle de l'asthme s'est avéré médiocre dans cette population. L'absence d'association significative entre les scores des techniques d'aérosol et le contrôle de l'asthme pourrait refléter les multiples facteurs contribuant à un contrôle médiocre de l'asthme dans la population jordanienne.

RESUMEN

OBJETIVOS: Investigar la correlación entre la técnica de utilización de los inhaladores presurizados de dosis medida (pMDI) y los inhaladores de polvo seco (DPI), cuando se emplean como medicamentos de control y como método de evaluación de las variables de regulación del asma (puntuación en la prueba de control del asma [ACT])

MÉTODO: En el presente estudio transversal se evaluó la técnica inhalatoria de los pacientes que utilizaban pMDI o DPI como Turbuhaler® (TH) o Accuhaler Diskus™ (ACC), mediante la aplicación de las listas de verificación publicadas sobre la técnica de inhalación. Se examinaron además las puntuaciones de la ACT (máximo 25, una puntuación más alta corresponde a un mejor tratamiento de la enfermedad).

RESULTADOS: Participaron en el estudio 130 personas (41 usaban TH, 54 ACC y 35 pMDI). Las puntuaciones de la técnica de inhalación (sobre nueve, con todos los dispositivos) fueron bajas con el TH ($4,4 \pm 0,9$) y el

ACC ($5,4 \pm 1,0$), en comparación con la calificación del uso de pMDI ($8,1 \pm 0,9$) ($P < 0,001$ en el análisis de variancia unidireccional). Una mayor edad y el uso de pMDI se asociaron con una mejor técnica de inhalación. Las puntuaciones en la ACT fueron bajas e indicativas de una regulación muy deficiente de la enfermedad (TH promedio $13,1 \pm$ desviación estándar [SD] $3,9$; ACC $13,3 \pm$ SD $3,9$ e pMDI $12,8 \pm$ SD $4,2$). No se detectó ninguna correlación significativa entre la puntuación de la técnica de inhalación y la ACT. En los pacientes con un diagnóstico más reciente y que contaban con un mayor grado de instrucción se observaron puntuaciones más altas en la ACT (mejor control).

CONCLUSIÓN: La estabilización del asma fue deficiente en esta población. La falta de correlación significativa entre las puntuaciones de la técnica de utilización del inhalador y de control del asma podría guardar relación con los múltiples factores que contribuyen al tratamiento deficiente del asma en la población jordana.