Correlation of Metered Dose Inhaler Use Technique and Asthma Control Level in Asthma Patients at a Hospital in Bandung, West Java, Indonesia.

(*Hubungan Ketepatan Penggunaan Metered Dose Inhaler dengan Tingkat Kontrol Asma pada Pasien Asma di Salah Satu Rumah Sakit di Bandung, Jawa Barat, Indonesia*)

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ABSTRACT

Background: Asthma is still a major health problem in the global population, including Indonesia. Antiasthma drugs are available in various dosage forms, including an inhaler. However, several problems arose related to the inhalation route due to its unique dosage form and specific use technique. One of the major problems is the inappropriate use technique of inhaler devices, which could lead to treatment failure. To evaluate the therapy outcome, Asthma Control Test (ACT) is widely used in clinical settings. **Objectives:** The purpose of this study was to evaluate the correlation between metered-dose inhaler (MDI) use technique and asthma control level in patients. **Methods:** A cross-sectional analytic study was conducted in May-June 2021. Thirty patients who met inclusion criteria were enrolled in this study. The patient's MDI use technique and asthma control level was evaluated using a valid and standardized questionnaire. Statistics analysis using Pearson correlation was performed to determine the correlation between MDI use technique and asthma control level. **Results:** This study showed that most of the asthma patients were women of older age with mild asthma severity for more than 10 years. The most prevalent medication used was Fenoterol HBr, followed by salbutamol, and salmeterol/fluticasone combination. Inappropriate MDI use was found in 70.0% of patients, and most of the patients experienced problems with breathing techniques before and during MDI use. An asthma control test showed that 90,0% of asthma patients involved in this study had uncontrolled asthma. The mean ACT score in patients with proper use of MDI was 18.22±1.958. In contrast, patients with improper use of MDI had a lower ACT score of 14.80±1.653. Pearson correlation test showed a positive correlation between proper use of MDI and asthma control level (r=0.425, p<0.05). **Conclusions:** Patients with proper use of MDI have a higher score in the asthma control test, thus have better control of asthma. This study emphasized the pharmacist's role as a patient educator in ensuring appropriate inhaler use to achieve therapeutic goals.

ABSTRAK

Latar Belakang: Penyakit asma masih menjadi masalah kesehatan di hampir semua negara termasuk di Indonesia. Antiasma tersedia dalam berbagai bentuk sediaan, termasuk salah satunya adalah inhaler. Namun demikian, beberapa masalah ditemukan dalam penggunaan inhaler, karena bentuk sediaan yang unik dan cara penggunaan yang spesifik. Salah satu masalah yang terkait dengan rute ini adalah kesalahan penggunaan inhaler. Hal ini dapat menyebabkan kegagalan terapi, yang dapat diukur melalui *Asthma Control Test* (ACT). **Tujuan:** Penelitian bertujuan untuk mengevaluasi hubungan antara penggunaan *Metered Dose Inhaler* (MDI) dengan tingkat kontrol asma pasien. **Metode:** Penelitian analitik dengan pendekatan potong lintang telah dilakukan selama Bulan Mei-Juni 2021. Sebanyak 30 pasien yang memenuhi kriteria inklusi diikutsertakan dalam penelitian. Ketepatan penggunaan MDI dan status kontrol asma diukur menggunakan kuisioner baku dan terstandar. Analisis statistik dengan uji korelasi Pearson dilakukan untuk mengetahui hubungan antara kedua variabel. **Hasil:** Penelitian ini menunjukkan bahwa sebagian besar pasien asma merupakan wanita berusia lansia dengan tingkat keparahan asma ringan selama lebih dari 10 tahun. Obat yang paling banyak digunakan adalah fenoterol HBr, diikuti dengan salbutamol dan kombinasi salmeterol/flutikason. Ketidaktepatan penggunaan inhaler ditemukan pada 70,0% pasien dengan masalah utama pada Teknik bernapas sebelum dan selama penggunaan alat. Sebanyak 90,0% pasien memiliki tingkat kontrol asma yang tidak terkontrol. Nilai rata-rata skor ACT pada kelompok pasien yang menggunakan MDI secara tepat sebesar 18.22±1.958. Sementara, pada kelompok yang tidak tepat menggunakan MDI sebesar 14.81 ± 1.653. Uji korelasi Pearson menunjukkan korelasi positif yang signifikan antara ketepatan penggunaan inhaler dan tingkat kontrol asma pada pasien asma dengan tingkat korelasi sedang (r=0,425, p<0,05). **Kesimpulan:** Pasien yang menggunakan MDI secara tepat memiliki nilai skor ACT yang lebih tinggi, sehingga memiliki tingkat kontrol asma lebih baik. Penelitian ini menekankan peran tenaga kefarmasian sebagai edukator pasien dalam menjamin ketepatan penggunaan inhaler untuk mencapai tujuan terapi.

Kata kunci: *Metered Dose Inhaler* (MDI), teknik penggunaan inhaler, *Asthma Control Test* (ACT), tingkat kontrol asma.

INTRODUCTION

Asthma is still a major health problem in the global population, including Indonesia. It is estimated that global asthma prevalence is around 262 million cases and caused about 461,000 deaths (WHO, 2021). In Indonesia, national rate of asthma is estimated around 2.4% of the total population in Indonesia (Indonesian Ministry of Health, 2018). Antiasthma medication can be administered through various route, such as parenteral, oral, or inhalation route. Inhalation is the most common route of antiasthma medication due to its direct effect to respiratory tract and reduced systemic side effect (Anggraini, *et al*., 2018). Types of inhalation therapy can be administered independently by patients including Metered Dose Inhaler (MDI), Dry Powder Inhaler (DPI), and nebulizer. However, several problems related to inhalation route were found due to its unique device form and specific use technique. One of the major problems related to inhalation route is inappropriate use technique of inhaler device, which could lead to treatment failure (Prastikaningrum, *et al*., 2016).

One of asthma therapy outcomes is improving patients' quality of life, allowing patient to perform daily activities without hindrance. Asthma therapy outcomes can be measured using the Asthma Control Test (ACT) score (Haryanti, 2016). ACT is a simple instrument deleveloped by Nathan, *et al* (2004) for measuring asthma control level which can be used in limited resources and does not require pulmonary function testing. ACT has been widely used in various region such as America, Europe, and Asia. ACT consists of five questions to detect a worsening of the disease based on asthma symptoms (daytime and

nocturnal), use of emergency medications, asthma effect on daily activity restrictions, and patients' subjective assessment about their illness. Qualitative assessment has shown that ACT is an appropriate instrument to measure overall asthma impact in clinical settings. (van Dijk, *et al.*, 2020).

Several studies showed the high prevalence of inappropriate use of inhaler medication (Anggraini, 2018; Onyendum, *et al.*, 2014; Jahedi, *et al.*, 2017). Inappropriate use of antiasthma inhaler could lead to subtherapeutic dose of drugs, asthma exacerbation, and uncontrolled asthma level (GINA, 2015; Lorensia, *et al.*, 2018). This study was aimed to assess the propriety of inhaler use technique, determine asthma control level, and analyze the correlation between inhaler use technique and asthma control level among asthma patients in a hospital in Bandung, West Java, Indonesia.

METHODS

This study was designed as analytic observational study with cross sectional approach. The research protocol had been approved by hospital ethical committee (No. Etik.RSD/035/IX/2021). The study was conducted at the pulmonary clinic of a hospital in Bandung. Data was collected concurrently using primary data obtained through questionnaire-guided interview. The inclusion criteria were asthmatic patients who visited the pulmonary clinic during June 2021, received metered dose inhaler (MDI) therapy, aged >18 years, communicate well, and were willing to participate in this study. Exclusion criteria were asthmatic patients who did not fill out the questionnaire completely. The number of samples set was 30 patients in accordance with the minimum number of representative research samples.

The research instrument is a valid questionnaire to measure the proper use of MDI developed by Ramadan, *et al.* (2020) and the Asthma Control Test (ACT) questionnaire, a standard questionnaire to measure the level of asthma control (Nathan, *et al.*, 2004). Univariate analysis was performed to describe patients' characteristics such as age, gender, smoking habits, asthma severity, and medications used. Bivariate analysis was performed using Pearson product moment correlation to analyze the correlation between the use technique of MDI and the level of asthma control. Univariate and bivariate analysis was performed using SPSS software.

RESULTS AND DISCUSSION

The purpose of this study was to evaluate the propriety of MDI use technique in asthmatic patients, evaluate the outcome of therapy through asthma control level, and analyze the correlation between the use of MDI and asthma control level of patients in a hospital in Bandung, West Java, Indonesia. The study was conducted in June 2021, involving total 30 subjects. Sociodemographic and clinical characteristics are shown in table 1. Most of the patients in this study were elderly (73.3%), female (60.0%), and 86.7% of patients did not have a smoking habit. Based on occupation, most of the patients were not actively working (56.7%). Most of the asthma patients suffered from mild asthma (56.7%) with duration of illness is more than 10 years (60%).

Table 1. Sociodemographic and clinical characteristic of asthma patients

Sociodemographic and Clinical Characteristic		Number of Patient (n=30)	%
Age group (y.o)	17-25	3	10,0
	26-45	5	16,7
	>46	22	73,3
Sex	Male	12	40,0
	Female	18	60,0
Educational	Elementary School	5	16,7
Background	Junior High School	4	13,3
	Senior high School	10	33,3
	College	11	36,7
Occupation	No	17	56,7
	Yes	13	43,3
Smoking habit	No	26	86,7
	Yes	4	13,3
Asthma severity	Mild	17	56,7
	Moderate	9	30,0
	Severe	4	13,3
Duration of Ilness	< 5 years	9	30,0
	5-10 years	3	10,0
	>10 years	18	60,0

Table 2 showed the frequency of MDI used in asthmatic patients involved in this study. Most of the drugs used by patients were fenoterol HBr (86.7%). Another small proportion of patients received salbutamol (10.0%) and a combination of salmeterol with fluticasone (3.3%). Most of the patients had used MDI for more than 1 year (66.7%), while 33.3% others had only used the drug for less than 1 year. Fenoterol HBr belongs to the class of immediate-acting β2 agonists and is the treatment of choice for acute asthma attack. Although fenoterol HBr is less selective, but it causes a significantly greater peak effect and longer duration compared to salbutamol (Galanter and Boushey, 2018). The combination of salmeterol and fluticasone is used as maintenance therapy for asthma and is not intended to relieve acute asthma attacks. Study found that the combination of salmeterol and fluticasone provided a significant improvement in lung mechanics in COPD patients (Chen, et al., 2016).

Table 2. Metered dose inhaler used in asthma patients

Medication Characteristic		n	%
Medication	Fenoterol HBr	26	86,7
	Salbutamol	3	10,0
	Salmeterol+Fluticason	1	3,3
Duration of inhaler use	≤ 1 year	10	33,3
	> 1 years	20	66,7

Propriety use of MDI in asthma patients is assessed using a validated questionnaire developed by Ramadan, *et al* (2020). The questionnaire consists of 2 subscales with 11 questions in total. Subscale 1 consists of 6 questions to evaluate the device preparation, and subscale 2 consists of 5 questions to

evaluate the process of device use. The two subscales are interelated, thus the overall use of MDI inhaler is concluded as appropriate when the patients correctly answer at least 9 out of 11 questions (Ramadan, *et al.*, 2020). Figure 1 showed the results of the assessment of the propriety use of MDI in asthmatic patients. The results showed that 21 from 30 asthma patients (70.0%) did not use MDI correctly. Most of the inaccuracies in inhaler use occurred at the process of device use (90.0%). While in the preparation stage, inaccuracy only occurred in 3.3% of patients. Similar research results were obtained by Anggraini, *et al.* (2018), Al-jahdali, *et al.* (2013), and Giraud and Roche (2002) which concluded that 45%-71% of patients did not use inhalers correctly.

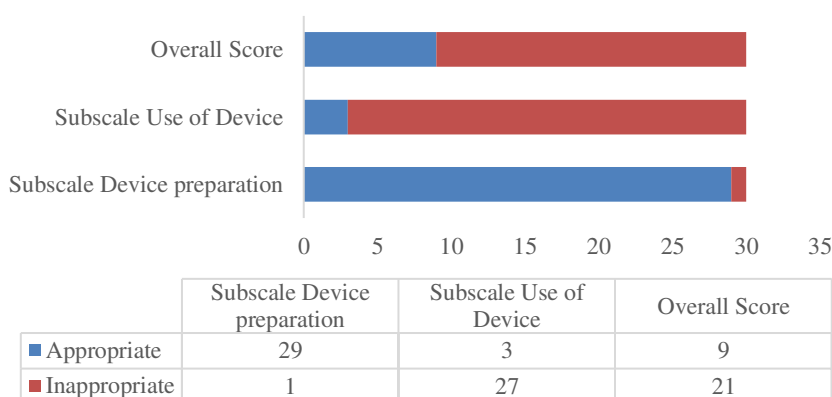|	Subscale Device preparation	Subscale Use of Device	Overall Score
■ Appropriate	29	3	9
■ Inappropriate	1	27	21

Figure 1. Assessment of Metered Dose Inhaler Use

Table 3 showed the distribution of patient answers on each item in the MDI use questionnaire. Most of the inaccuracies of MDI use occurred in breathing technique, both at the preparation stage and at the stage of using MDI (question number 3 and 7). In the preparation stage, 86.7% of patients did not perform proper breathing techniques (patients did not exhale before using the inhaler). At the stage of device use, 66.7% of patients did not breathe properly when pressing the MDI. Most patients also did not adjust the MDI use interval when 2 doses were needed.

Table 3. Questionnaire Items by Subscale and Patient Answers Distribution.

No	Question Item	Correct		Incorrect		Total
		n	%	n	%	%
	Subscale I : MDI Preparation					
1	Priming the new inhaler	30	100.0	0	0.0	100.0
2	Shaking inhaler before using	23	76.7	9	23.3	100.0
3	Exhaling lung air just before using inhaler	4	13.3	26	86.7	100.0
4	Titling head before and during using inhaler	22	73.3	8	26.7	100.0
5	Holding inhaler canister down	27	90.0	3	10.0	100.0
6	Positioning the mouthpiece in mouth enclosed by lips	23	76.7	7	23.3	100.0

	Subscale 2 : MDI use					
7	Taking breath when pushing the canister down for a dose	10	33.3	20	66.7	100.0
8	Inhale slowly and deeply while taking the dose	24	80.0	6	20.0	100.0
9	Holding breath 5-10 seconds before exhaling	28	93.3	2	6.7	100.0
10	Exhaling slowly after taking the dose	26	86.7	3	13.3	100.0
11	Waiting a minute before taking the second dose, if needed	10	33.3	20	66.7	100.0

Inappropriate use of MDI can be caused by poor coordination in entire stages of MDI use. In this study, most of the inappropriate of MDI use occurred in breathing technique, both at the preparation and during the device use. Inappropriate breathing technique could lead to inadequate inhalation and drug delivery to the lungs. Patients also did not shake the MDI before using it. This step is important to homogenize the suspension, thus allowing dose uniformity before it is delivered. Patient also generally did not provide sufficient time interval between two puffs. This step emphasizes the timing interval before the second dose. Errors in this process could lead to a dose decrease of medication released by the inhaler, because the metering chamber had not been fully refilled before second dose. Correct technique and proper use of inhalers ensures effective drug delivery to the lungs and thus affect asthma control (Hashmi, *et al.*, 2012; Jolly, *et al.*, 2015; Lorensia, *et al.*, 2017; Lorensia, *et al.*, 2018).

Patients' asthma control level was assessed using Asthma Control Test (ACT) questionnaire. This instrument consists of 5 questions regarding the symptoms experienced during the last 4 weeks. Maximum score of each question is 5 points, thus the total score is 25 points. Higher score of ACT indicates a better asthma control level. Patient with ACT score >19 is considered to have their asthma under control, while score below 19 indicates an uncontrolled asthma. Figure 2 showed the distribution of the number of patients by level of asthma control, and the result showed that 90% of patients have an uncontrolled asthma.
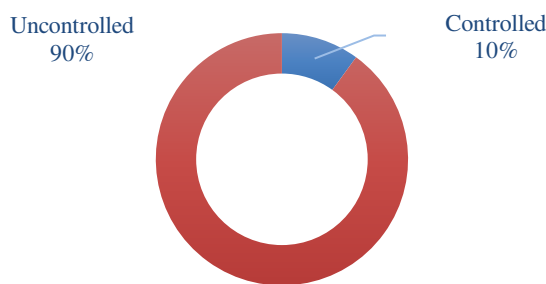

Figure 2. Assessment of Asthma Control in Asthma Patients

The level of asthma control indicates the extent to which asthma manifestations can be observed in the patient, or have been reduced by treatment. The observed level of asthma control was determined by the

interaction between the patient's genetic background, underlying disease, medication used, environment, and psychosocial factors. The effectiveness of the ACT questionnaire in detecting changes in asthma control levels was 78.1% (Murphy, 2018; Sabri and Chan, 2014). The results showed that most of patients have a poor level of asthma control. The results of this study are similar to other studies which also showed that 59.4% to 66.9% of asthma patients had uncontrolled asthma (Bachtiar, *et al*., 2011; Prisllia, *et al*., 2016).

Controlled asthma is indicated by the absence of activity barriers due to asthma, and minimal frequency of asthma symptoms (daytime and nocturnal), and minimal use of asthma reliever drugs. Uncontrolled asthma is characterized by an increase in the frequency of nocturnal asthma, acute asthma attacks, and an increased need for asthma relievers. Poor asthma control can be caused by various factors, such as comorbid factors, resistance to therapy, precipitating factors, inadequate assessment and treatment, ineffective drug use, low adherence to therapy, psychological problems, use of alternative therapies, lack of medical consultation, and lack of patient awareness of poor control indication symptomps. Patients' awareness of poor asthma control symptomps are important to prevent asthma exacerbation, it is reccommended for patients to make regular visits to healthcare facilities at intervals of 1-6 months depending on their asthma condition (Anggraini, *et al*., 2018; PDPI, 2003; GINA, 2016).

Table 4 showed the crosstabulation between the propriety use of MDI and the mean of ACT score. In the group of patients who used the MDI properly, the mean ACT score was 18.22 ±1.958. Meanwhile, patients who used the MDI improperly had a lower number of ACT scores (14.81±1.653). The correlation between the proper use of inhalers and ACT scores was statistically analyzed using the Pearson product-moment correlation test. The result of statistical analysis showed a positive correlation between the proper use of inhalers and the level of asthma control ($p < 0.05$) with correlation coefficient of 0.425, regarded as moderate correlation strength. It can be concluded patients with higher accuracy score of MDI use positively correlate with a better asthma control level.

Table 4. Correlation of inhaler device use technique and mean ACT scores.

		Mean of ACT Score	Pearson Corr.	p-value
Inhaler Device Use Technique	Appropriate (n=9)	18.22±1.958	0.425	0.019*
	Inappropriate (n=21)	14.80±1.653		

*Correlation is significant at the 0.05 level (2-tailed).

The results of this study were supported by the result of research conducted by Al-Jahdali, *et al.* (2013) which concluded that inappropriate use of an asthma inhaler was associated with poor asthma control and increasing the frequency of ER visits. Improper use of inhaaler devices can reduce drug distribution by 50-66% into the lungs, thereby decreasing drug dosage and loss of drug effectiveness. Furthermore,

it will lead to a poor asthma control levels as therapeutic outcomes (Coelho and Carvalho, 2011; Lavorini, *et al.*, 2008; Giraud and Roche, 2002). In addition to the inappropriate use of inhalers, several other factors that can affect therapeutic outcomes are exacerbations of asthma and patient compliance in using asthma medications (Kebede, *et al.*, 2019).

Pharmacists have an important role to ensure the correct use of inhalers in asthma patients to achieve optimal therapeutic outcomes. Efforts to increase patient knowledge, compliance, and skills in using inhalers can have a positive impact on patients' asthma control level. Patient knowledge and adherence can be increased with counseling, optimalize drug information services, and education either directly or indirectly. Propriety of inhaler use technique also needs to be evaluated regularly by pharmacists, probably during patient's visit. Individualized counselling and intervention need to be delivered when inappropriate use of inhalers is detected during visit which potentially reduce therapeutic outcomes. Thus, this study emphasized pharmacists' role as an integral part to achieve therapeutic goals for patients.

CONCLUSION

There is a positive correlation between the appropriate use of inhalers and the level of asthma control in asthmatic patients in the pulmonary clinic at a hospital in Bandung with a moderate correlation (r=0.425, P<0.05). Proper use of inhaler may improve patient's asthma control level.

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CONFLICT OF INTEREST

Authors have no conflict of interest to declare.

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