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Exploring inhaler technique misuse and socio-demographic influences on asthma severity

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ABSTRACT

Background: Improper use of asthma inhalers is one of the potential factors of poor asthma control. Inhaled medications are widely prescribed for patients with asthma and chronic obstructive pulmonary disease (COPD); these allow therapeutic agents to be delivered directly to the lungs and provide more rapid onset, greater efficacy, and fewer side effects; proper inhaler technique is essential to maximize the benefit of medications and improve asthma outcomes. *Aim:* This study aimed to evaluate the proportion of errors committed while demonstrating the inhaler technique in patients with asthma and to evaluate the effect of gender, smoking, residence, severity of asthma and marital status on asthmatic patients. *Methodology*: The study enrolled 410 asthmatic patients on inhaled cortisone therapy for at least three months of both sexes. Subjects enrolled in the study are ≥12 years. Women who were pregnant or nursing were excluded from the study. *Results*: Asthma was more prevalent in females than males, with more than 65.85% of females and only 34.14% of males. Urban residence affects asthma state, which is more prevalent in people living in urban areas than in rural areas. *Conclusion*: Incorrect use of inhalers affects the severity of asthma; this requires educating the patient's medical staff on how to use inhalers correctly.

KEYWORDS

asthma, inhalers, technique misuse, pulmonary constriction, bronchodilator, nebulizer

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1. INTRODUCTION

The pulmonary route of administration has been chosen as an efficient method for treating both pulmonary and non-pulmonary disorders. Pulmonary delivery can be used to provide medications, proteins, peptides, and biotechnology products for the treatment of different ailments, both locally and across the body [1,2]. The lungs provide a vast surface area with ample blood vessels and a thin barrier between the air and blood. Pulmonary administration is very advantageous for the quick absorption of drugs while also circumventing first-pass metabolism [3]. The injection of medications directly into the lungs has several benefits for patients with pulmonary infections, asthma, and lung cancer [4,5].

The distribution pattern and effectiveness of the inhaled substance rely on the accurate alloca-

tion of the formulation components and the design of the delivery device's effectiveness. Hence, the efficacy and triumph of inhalation therapy are heavily contingent upon factors such as the composition of the medication, the construction of the inhaler apparatus, the patient's health status, and the accessibility of the drug at the targeted deposition site [5].

Administration by inhalation allows for targeted delivery of the effective dose directly to the affected area, as opposed to providing significantly greater doses across the entire body. [6] Therapeutic localization facilitates the efficient use of drugs at lower dosages, resulting in a decrease in overall adverse effects while increasing drug concentration at the targeted site of action. This also leads to a reduction in the frequency of drug administration [7].

Inhalation as a method of drug administration to the lungs has several benefits. One major advantage is the capacity to obtain high bioavailability of medications in the lungs due to the low presence of intracellular and extracellular drug-metabolizing enzymes. Inhalation treatment has a quick beginning of effect as a result of the vast lung surface area and abundant vasculature that are accessible. [8,9] Targeted treatment decreases the likelihood of irreversible tissue damage resulting from the drug's cytotoxic effects. The process of localizing the medicine helps to decrease the dosage required and minimize the likelihood of drug deterioration. Inhalation treatment promotes self-administration, leading to enhanced patient adherence. The solute permeability is enhanced by the harmonic interplay of formulation parameters and the design of the device, which is achieved by reducing the particle size and utilizing innovative technologies [10,11].

Mucus, a gel with viscoelastic properties, is released under normal physiological conditions to safeguard cellular surfaces and regulate water equilibrium. The mucus layers function as a barrier to eliminate germs. Hence, the secretion of mucus by epithelial cells serves as a physical obstacle and a step that restricts the pace of medication delivery. Adhesion interactions commonly arise between mucus and medication particles via electrostatic, hydrophobic, and hydrogen bonding [12].

A nebulizer is an apparatus used to provide medicine to the lungs by converting it into a fine mist and delivering it through the nose. A nebulizer facilitates the conversion of medicine from a liquid state to a mist, allowing for convenient inhalation of the drug into the lungs. No need for synchronized synchronization between breath and actuation. Nebulizers produce droplets ranging from 1 to 5 μm, depending on the specific type and make [13,14].

The majority of liposomal formulations designed for inhalation have been specifically formulated for use in nebulizers. Both jet and mesh nebulization methods subject liposomal formulation to shear forces at the air-liquid interface, causing the disruption of liposomal bilayers. This disruption leads to either the fusion of vehicles, resulting in an increase in size, or the fragmentation of vesicles, leading to a decrease in size [15,16].

Compressed oxygen or air, which is propelled by a compressor or electrically powered apparatus, is utilized by the SVN to aerosolize liquid drug suspensions or solutions. Three distinct variations of SVN are now accessible. The AeroEclipse® II nebulizer converts the medication solution into aerosol form in response to the patient's inhalation attempt. It has been scientifically demonstrated that it can effectively transport a substantial amount of breathable medication in the ideal size of particles to the specific parts of the lungs that are afflicted. In this technique, the medicine can be administered both during inhalation and exhalation, and its timing is determined by the inhalation-to-exhalation (I:E) ratio. This characteristic reduces both medication wastage and economic inefficiency in drug consumption. The one-way valve system offers a defense against detrimental viruses [17,18].

The aim of this study was to evaluate the proportion of errors committed while demonstrating the inhaler technique in patients with asthma and to evaluate the effect of gender, smoking, residence, severity of asthma and marital status on asthmatic patients.

2. METHODOLOGY

2.1. Study design and participants

The study was conducted at Al-Kadhimiya Teaching Hospital, Baghdad, Iraq, and designed as a cross-sectional study. The study enrolled 410 asthmatic patients on inhaled cortisone therapy for at least three months of both sexes. Subjects enrolled in the study are ≥12 years. Women who were pregnant or nursing were excluded from the study.

Data collection based on demographic factors including age, gender, smoking status, place of residence, occupation, marital status, educational level, co-morbidities and asthma severity, disease duration, and source of instruction of inhaler use were gathered through direct interviews. The participant's height (m) and body weight (kg) were measured while they were unclothed and without shoes. BMI was calculated by dividing weight in kg by the square of height in meters.

2.2. Statistical analysis

The results of the current study were displayed as means ± slandered deviations. The statistical tool used to explore the differences between studied groups was the One-way analysis of variance (ANOVA) followed by the Tukey test comparison. The statistical analysis was carried out by using SSPS 16.0; the level of significance was set at $P<0.05$.

2.3. Ethical approval and consent of the study participants

A consent form was taken from the respondent before answering the questions as participants needed to read the instructions and give agreement to participate before the questionnaire window opened to them, those who refused to tick on consent approval were shown and thanks message and not allowed to proceed. Al-Bayan University's College of Pharmacy provided ethics approval.

3. RESULTS

The average age of the subjects included was (48±13) years, with a range of (21-67) years. (34.14%) of the individuals were male, while (65.85%) were female. The prevalence of smoking and married status among the individuals was (65.85%) and (83%), respectively. The prevalence of asthma severity among urban residents was (68.29%), while the prevalence of asthma severity itself was (46.3%). The prevalence of co-morbidities was (43.9%) for Type 2 Diabetes Mellitus (T2DM) and (19.5%) for other co-morbidities. The inappropriate utilization accounts for (65.85%). The average BMI was (27.92±3.4) kg/m^2 as shown in (Table 1).

Table 1: Baseline characteristics of the patients (N=410).

Demographic factors		Value
Age (years)	Mean ±SD	48±13
	Range	21-67
Gender	Male	140 (34.14 %)
	Female	270 (65.85%)
Smoking	Never	140 (34.14%)
	Ex/current	270 (65.85%)
Marital status	Married	340 (83%)
	Single	70 (17%)
Residence	Urban	280 (68.29%)
	Rural	130 (31.7%)
Asthma severity	Mild	80 (19.5%)
	Moderate	140 (34.1%)
	Severe	190 (46.3%)
Co-morbidities	No comorbidities	150 (36.58%)
	T2DM	180 (43.9%)
	Other	80 (19.5%)
Errors	Correct use	140 (34.14%)
	Incorrect use	270 (65.85%)
BMI, kg/m^2	Mean ±SD	27.92±3.4
	Range	24.44-41.62

The proportion of females with asthma was 65.85%, whereas for males it was (34.14%). Smoking is found to be a significant factor in this study, with (65.85%) of those who used to or now smoke, and (34.14%) for those who do not smoke. Moreover, there was a substantial disparity in the prevalence of asthma between patients residing in urban areas, with a rate of (68.29%), compared to those living in rural regions, who only accounted for (31.7%). Approximately (83%) of the cases were in a state of matrimony, whereas a mere (17%) were not married.

The prevalence of severe, moderate, and mild asthma among patients was 46.3%, 34.1%, and 19.5%, respectively.

The percentage of patients with both T2DM and asthma was (43.9%), while the percentage of patients without any other medical conditions was (36.58%). The study also revealed that (65.85%) of asthmatic patients who use inhalers incorrectly,

compared to (34.14%) of those who use them correctly.

4. DISCUSSION

The overall prevalence of asthma varies significantly among nations, ranging from 1% to 18%, resulting in a global population of about 339 million individuals affected by this condition. This study revealed a distinct gender imbalance in the prevalence of asthma. Although asthma is more prevalent among boys under the age of 13, with a prevalence rate of 65%, adult women have greater rates of asthma compared to males, also with a prevalence rate of 65%, as shown in (figure 1) [19].

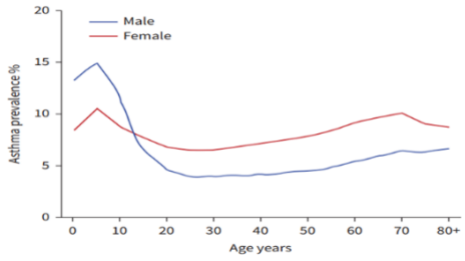

Figure 1: Relationship of age and gender in asthmatic patients.

The observed change in the incidence of asthma among males and females over time indicates that sex hormones and many socioeconomic factors, such as disparities in access to resources like diet and air quality, as well as differences in comorbidities and healthcare systems between developing and industrialized nations, play a significant part in this complicated phenomenon. Genetic variances, such as differences in gene expression and epigenetic changes, play a fundamental role in distinguishing males and females with asthma [20].

Females have more chances to acquire asthma than males during the course of their entire lives [21]. The findings of the present study suggest that marriage is linked to a higher severity of asthma, maybe attributable to increased social stress experienced by married individuals. However, these findings further elucidated that those who were not in a relationship were more likely to be linked with mild asthma. This might be attributed to the phenomenon of singularity, which diminishes both social and financial assistance. Consistent with this study, a group of researchers from India documented that individuals who are not in a romantic relationship have fewer negative health consequences in cases of chronic illnesses [22].

This study presents empirical support for the existence of a gradient in asthma prevalence between urban and rural areas. It demonstrates that the likelihood of asthma is greater in urban regions than in rural regions. These findings hold true regardless of the specific definition of asthma utilized. This technique has been beneficial in distinguishing between environmental and social factors that may account for the urban-rural disparity in asthma prevalence [23]. Their usefulness in comprehending the multifaceted character of urbanization is restricted. Factors include various facets of urban settings, disparities in lifestyle among populations, varying degrees of urbanization among metropolitan centers, and temporal transformations.

The data provided highlights many distinctions between individuals with severe asthma who have never smoked and those who are former or current smokers. These findings are unexpectedly significant since they indicate a lesser-than-anticipated influence of smoking on asthma management and history, especially among those with severe asthma. The Belgian Severe Asthma Registry reports a much greater percentage of current smokers (12%) compared to the SANI database (3.5%). Asthma may elevate the likelihood of certain comorbidities [24], which can exacerbate asthma symptoms and trigger severe flare-ups, particularly if left untreated [25,26].

5. CONCLUSION

Asthma is more prevalent in females (65.85%) compared to males (34.14%) and is more common in urban areas. Incorrect inhaler use, co-morbidities such as T2DM, and BMI (over 26) can worsen asthma severity. Additionally, married patients may experience more severe attacks, possibly due to financial stress.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

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