

RESEARCH ARTICLE

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## Characteristics of Patients with Asthma Attack Followed in the Intensive Care Unit

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### Abstract

**Objective:** Asthma attack is a critical reason for morbidity and mortality if not treated effectively at the right time. Data about the efficiency of noninvasive and invasive mechanical ventilation (NIV, IMV) in respiratory failure due to asthma attacks are scant. The aim of this study was to investigate the relationship between asthma-related factors, medical and NIV/IMV treatments received in the Intensive Care Unit (ICU), and the mortality rates and length of hospital stay, in asthma attacks.

**Methods:** The characteristics of patients with severe asthma treated in Hacettepe University Medical ICU for a ten-year period were analyzed from patient records retrospectively. The association between age, sex, comorbidities, asthma duration, treatment, adherence to the treatment, the effectiveness of NIV/IMV treatment if performed, and asthma attack severity, length of hospital stay, and mortality were investigated.

**Results:** A total of 22 patients were included in this study. In addition to medical treatment, eight (36.6%) patients received NIV, five (22.7%) received invasive mechanical ventilation (IMV), and five (22.7%) patients had both. Four (18.1%) patients died in the ICU. There was no significant relationship between these parameters and length of hospital stay and mortality. The relationship between baseline PaCO<sub>2</sub>, pH, and HCO<sub>3</sub><sup>-</sup> and the difference of PaCO<sub>2</sub>, pH, and HCO<sub>3</sub><sup>-</sup> changes were significant, indicating the correct and effective use of NIV/IMV.

**Conclusion:** NIV applications, which have been proven to be effective in hypercapnic respiratory failure, were also found to be effective in hypoxemic respiratory failure due to asthma attacks. The absence of a relationship between the investigated parameters and mortality revealed that the reasons for the mortality might be infections or comorbidities, not the respiratory tract.

**Keywords:** Asthma, severe asthma, asthma attack, intensive care unit

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## INTRODUCTION

Asthma is a chronic inflammatory disease associated with airway inflammation and bronchial hyperreactivity, characterized by occasional dyspnea, cough, and wheezing, mostly increasing after exposure to triggers such as allergens, exercise, or viral infections (1). Asthma affects 1-20% of the population in different countries and an estimated 300 million people worldwide. Also asthma cause 455.000 deaths, with a prevalence ranging between 2-12 % in adults (2). The prevalence of asthma in adults in Turkey was reported to be 1.2-9.4%, while the prevalence of asthma-like symptoms was reported 9.8-27.3% (3). The emergence or increase of symptoms such as cough, dyspnea, chest tightness, and wheezing and the deterioration of respiratory functions in parallel with the symptoms in an asthmatic patient are defined as "asthma attacks". The severity of an asthma attack may vary from mild increases in symptoms to respiratory failure resulting in death (4).

The most important point in the treatment of an attack is the early recognition of the onset of the attack by the patient and immediate start to the appropriate treatment at home, or in hospital if necessary. Severe attacks in which emergency treatments fail should be followed up in intensive care units (ICU) and evaluated in the need for non-invasive ventilation (NIV) and/or invasive mechanic ventilation (IMV) (5). The severity of the attacks and the

treatment responses of patients may be different. Therefore, it is essential to investigate which patients respond better to particular treatments.

The efficacy of non-invasive ventilation (NIV) has been proven especially in diseases such as chronic obstructive pulmonary disease (COPD) with hypercapnic respiratory failure, but its use in hypoxemic respiratory failure and asthma attacks is still controversial (6-8). However, recent studies have shown that NIV applications in hypoxemic respiratory failure reduce intubation and mortality rates, and also the time of hospitalization (7, 9-11).

The aim of this study is to investigate patients followed up in a tertiary ICU due to asthma attacks by means of the relationship between age, gender, comorbidities, asthma duration, and medications, causes of attacks, medical and NIV/IMV treatments, if any, received in ICU, and their mortality rates and length of hospital stay.

## METHODS

The present retrospective study included adult patients with asthma attacks admitted to Hacettepe University Hospital, Internal Medicine ICU for a ten-year period. Due to the retrospective design of the study, the characteristics of patients admitted to the intensive care unit with asthma attack were searched from their files and hospital data system. All patients who met the inclusion criteria within the specified date range without

randomization were enrolled. Masking method was not used and the files of all patients diagnosed with asthma attack in the last ten years were meticulously examined. Patients with physician-diagnosed asthma who had symptoms such as progressive dyspnea, cough, wheezing, and chest tightness at admission and determined with an ICD-10 code for asthma were included in the study. Since this study is retrospective, every patient who met the inclusion criteria was included in the study without going through sample size. Despite an asthma diagnosis code, patients whose clinical symptoms were not compatible with an asthma attack as mentioned above were not included in the study. Patients' age, gender, age at the onset of asthma, time until the first hospitalization in the ICU, medications used at admission with asthma attack, conditions that may cause an asthma attack, accompanying comorbidities, APACHE II scores, length of stay in ICU, treatments received in the ICU, discharge status, chest X-ray and/or thoracic computed tomography (CT) findings, echocardiography, Brain-Natriuretic Peptide (BNP), D-dimer values if performed, were collected.

The definition of an asthma exacerbations (asthma attack or acute asthma) was based on the presence of episodes accompanied by the coexistence of one or more of the complaints including progressive dyspnea, cough, wheezing, and chest tightness according to Global Initiative for Asthma (GINA) and

Asthma Diagnosis and Treatment Guide, Chronic Asthma Treatment, Step Treatment 2022 Update Guideline (3, 12). Body temperature values  $\geq 38.3$  °C at least twice were defined as fever and leucocytosis was defined as  $>10000$   $\mu$ /L for white blood cell (WBC) count. The diagnosis of pneumonia was made with the presence of fever or leukocytosis in addition to infiltration on chest X-ray or findings compatible with an infection on thoracic CT, if available. For BNP, values above 100 pg/ml were considered significant in terms of chronic heart failure. Chest radiographs were evaluated by intensive care physicians and thorax CT was reported by the radiology department. Echocardiography evaluations were performed and reported by experienced cardiology physicians.

Chest X-rays were performed on all patients to investigate the cause of the aggravation of the attacks, and thoracic CT was performed when there are abnormalities on chest X-rays. Patients with a history of cardiac disease or suspected cardiac morbidity during follow-up were also evaluated by echocardiography. For the medical treatments in the ICU, salbutamol, and ipratropium were administered by inhalation every four hours, and continuous oxygen therapy was given to keep oxygen saturation at 90% and above. NIV was applied when the desired oxygen saturation targets could not be achieved with a nasal or face mask or when the patient had tachypnea and use of

accessory respiratory muscles. And intubation was performed by physicians within appropriate indications.

The ethical approval of the Hacettepe University Scientific Research Evaluation Commission has been obtained (Approval date and number: 10.04.2013; GO 13/207-10).

### ***Statistical Analysis***

SPSS 18.0 was used for statistical analysis (IBM, Armonk, NY, USA). Descriptive statistics were reported as numbers and percentages (%) for categorical variables and mean  $\pm$  standard deviation, and median and interquartile ranges for continuous variables. In comparisons for mortality and treatment groups, Chi-square test was used for categorical variables, and Mann-Whitney U test was used for continuous variables. Fisher's exact test was used for comparisons of categorical variables when the expected number was below 5 in 25% of the cells. The relationship between blood gas changes and initial measurements was evaluated by a non-parametric (Spearman) correlation coefficient and correlation graphs were determined. In all comparisons,  $p < 0.05$  was accepted for statistical significance in bilateral tests.

### **RESULTS**

Twenty-two patients hospitalized in Hacettepe University Internal Medicine Intensive Care Unit due to an asthma attack were included in the current retrospective study. Eighteen (81.8%) of the patients were

female and the mean age of the study group was  $71 \pm 14$  years. The most common symptom of admission to the emergency department was dyspnea, which was observed in all patients, and hypertension (11 (50%)) was the most common accompanying chronic disease. Rhinitis, which may frequently accompany asthma, was present in only two (9.1%) patients (Table 1). The median time from the diagnosis to ICU admission with an asthma attack was  $17 \pm 18.8$  years. Considering the season of hospitalization in the ICU, 6 (27.2%) patients were hospitalized in winter, 6 (27.2%) in autumn, 5 (22.7%) in summer, and 5 (22.7%) in spring. Except for two patients, all other patients (20 (90.9%)) were on asthma medications at the time of admission. The medications used by the patients were summarised in Table 1. Pneumonia (20 (90.9%)) was the most common cause of the attacks while pulmonary thromboembolism and acetylsalicylic acid intake were observed in only one (4.5%) patient each (Table 1).

The most common causes of admission to the emergency department were dyspnea and sleep disturbance due to dyspnea. The most common clinical finding in all patients at the time of initial examination was rhonchi. APACHE II scores calculated at ICU admission were available in 20 patients and the median score was found 13.6 (IQR: 8-34).

Chest X-rays were performed on 20 (90.9%) patients and 10 (50%) were evaluated

normal. Thoracic CT was performed on 11 (50%) patients. The findings included embolism, bronchiectasis, right heart dilatation, atelectasis, pleural effusion, and findings consistent with pneumonia. BNP levels were measured in eight (36.3%) patients and four

(50%) were above the reference value. Fourteen (63.6%) patients were evaluated by echocardiography and five (35.7%) had heart failure when four (28.5%) had pulmonary hypertension (PHT).

**Table 1.** Patient characteristics of the study population

Variables	n ( % )
Age, mean±SD, years	71±14
Female	18 (81.8%)
<b>Asthma treatment before ICU admission</b>	
No medication	2 (9)
SABA as-needed	1 (4,5)
ICS alone	4 (18,1)
ICS +LABA	8 (36,3)
Tiotropium alone	0 (0)
ICS +LABA+Tiotropium	6 (27,2)
ICS with nebuliser	1 (4,5)
<b>Comorbidities</b>	
Hypertension	11 (50)
Diabetes Mellitus	6 (27,2)
CAD	4 (18,1)
CHF	4 (18,1)
Rhinitis	2 (9)
Other*	12 (54)
<b>Reasons for ICU admission</b>	
Pneumonia	20 (90,9)
Pulmonary thromboembolism	1 (4,5)
NSAID-exacerbated bronchospasm	1 (4,5)

CAD: Coronary artery disease, CHF: Congestive heart failure, AAA: Abdominal aortic aneurysm, AF: atrial fibrillation, BPH: Benign prostate hypertrophy, CKD: Chronic kidney disease, SABA: Short-acting  $\beta$ -agonist, ICS: Inhaled corticosteroid, LABA: Long-Acting  $\beta$ -Agonists, NSAID: Nonsteroidal anti-inflammatory drug. \*Other comorbidities: AAA, bronchiectasis, hypothyroidism, AF, BPH, endometrium cancer, CKD

In the evaluation of the characteristics of the four female patients who died in the ICU, it was observed that the median age was 80 years and the reason for hospitalization was pneumonia in all four. In the follow-up, all had fever, and the

respiratory examinations revealed rhonchi. Two (50%) had leucocytosis and the other two had normal white blood cell counts. In the arterial blood gas (ABG) at admission, one (25%) of them had combined metabolic

acidosis and respiratory acidosis, and the others had compensated respiratory acidosis. One was not receiving treatment for asthma at the time of the attack, while the others were receiving inhaled corticosteroid and long-acting beta2 agonist (ICS+LABA) combination treatment. When the accompanying pulmonary diseases that may aggravate the asthma attack were analyzed, it was observed that one had cystic bronchiectasis and the others did not have any other underlying lung disease. Echocardiography was performed in two of them, one had an ejection fraction (EF) of 39%, 3rd-degree tricuspid regurgitation, and the other had an EF of 55%. Two patients had newly diagnosed asthma, while the other two patients had asthma duration of 10 and 30 years. One of the patients with newly diagnosed asthma did not respond to NIV treatment in the ICU, was intubated and remained intubated for 28 days, and died. The other patients were treated with NIV for a median of seven days and then intubated. The median length of ICU stay of these four patients was 16 days. All four patients were non-smokers, one had no comorbidities, and the others had one or more comorbidities.

In addition to medical treatment, eight (36.3%) patients received only NIV, five (22.7%) patients received IMV, five (22.7%) patients received NIV and then IMV support, and four (18.1%) patients received no mechanical ventilation support. All NIVs were

performed with a mouth-nose mask and no other complications such as barotrauma were observed except for mild facial injuries due to local compression.

NIV was administered to a total of 13 (59.1%) patients who could not achieve the desired oxygen saturation targets with a nasal or face mask or who had tachypnea and the use of auxiliary respiratory muscles. Since 5 (38.4%) of these patients did not respond to NIV, they were intubated and switched to IMV. Five (22.7%) patients were immediately intubated due to severe asthma attacks that did not respond to medical treatment. NIV/IMV was not applied in four (18.1%) patients.

ABG results were available in 20 (90.9%) patients. The mean PaO<sub>2</sub> was 71.9 ± 28.2 mmHg and PaCO<sub>2</sub> was 55.6 ± 21.5 mmHg at the time of admission. Table 2 shows the comparison of the difference between admission and final ABG values of the patients. When the ABG results at ICU admission and the changes between the admission and final values were analyzed, no significant difference was observed in terms of PaO<sub>2</sub>, but a significant relationship was found between the baseline values of pH, PaCO<sub>2</sub>, and HCO<sub>3</sub><sup>-</sup> and their changes (Table 3).

The relationship between patients' admission HCO<sub>3</sub><sup>-</sup> and HCO<sub>3</sub><sup>-</sup> changes was

presented in Figure 2. It was observed that there was a similar relationship between the change in  $\text{HCO}_3^-$  and  $\text{PaCO}_2$  in alive patients. Hospitalization  $\text{HCO}_3^-$  values were decreased with the treatment in the alive group but there

was no similar relation in the patients who died. In the analysis of the pH values of the patients at the time of admission and pH changes, an inverse trend was observed.

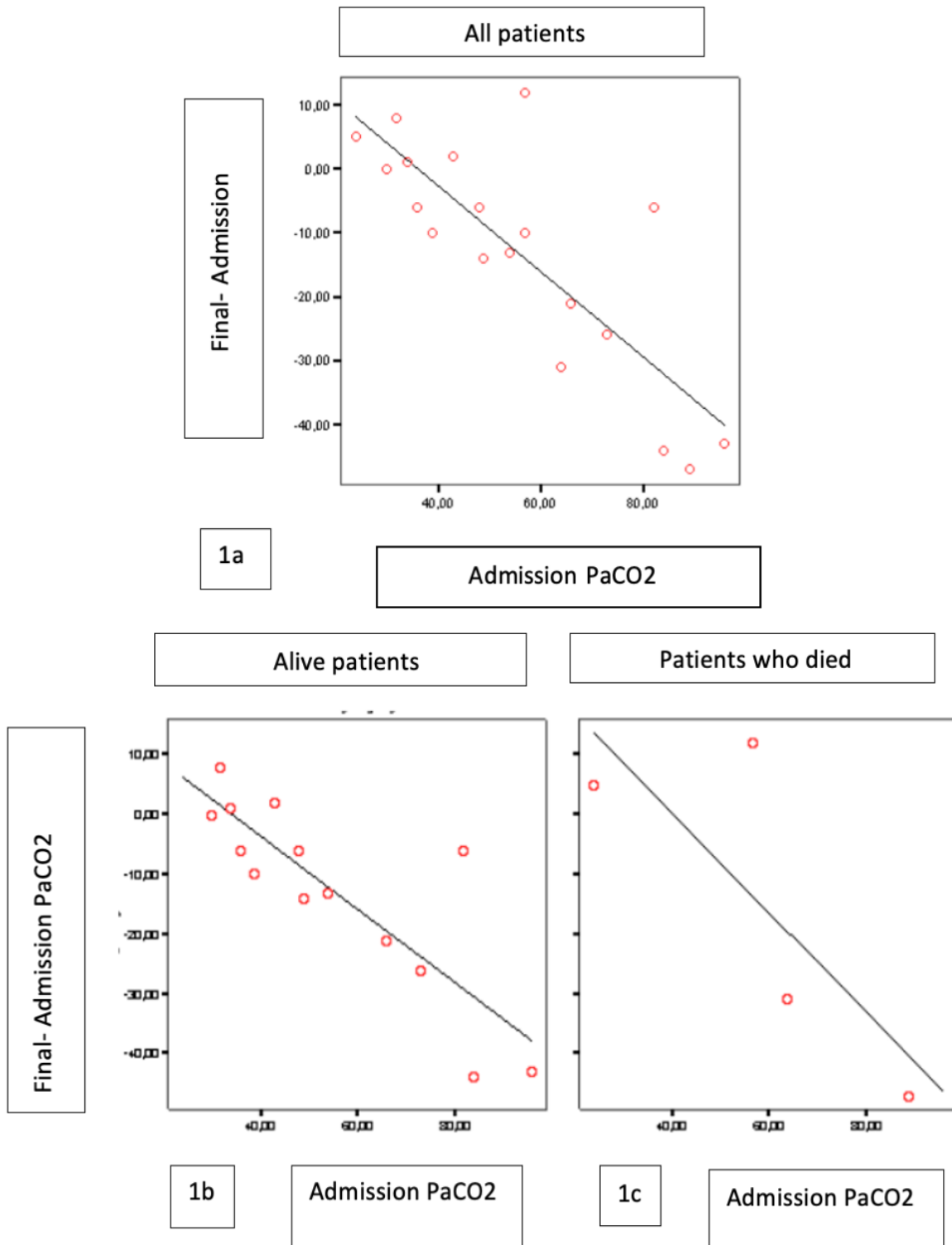
**Table 2.** Evaluation of ABG values at ICU admission and discharge

	Alive (n=15)		Dead (n=4)		p-value
	Median	IQR (25%, 75%)	Median	IQR (25%, 75%)	
<b>Admission Values</b>					
pH	7.37	(7.27, 7.4)	7.37	(7.29, 7.39)	0,74
PaO <sub>2</sub> (mmHg)	60	(54, 85)	62.5	(55.25, 102)	0,89
PaCO <sub>2</sub> (mmHg)	49	(36, 73)	60.5	(32.25, 82.75)	0,74
SaO <sub>2</sub> (%)	92	(82, 96)	94	(91.25, 96.75)	0,47
HCO <sub>3</sub> <sup>-</sup> (mmol/L)	25	(21.7, 31)	29	(14.5, 33)	0,96
<b>Final Values</b>					
pH	7.40	(7.37, 7.45)	7.43	(7.02, 7.48)	0,81
PaO <sub>2</sub> (mmHg)	72	(56, 80)	140	(54.25, 156.75)	0,15
PaCO <sub>2</sub> (mmHg)	41	(35,47)	37.5	(30, 62.25)	0,74
SaO <sub>2</sub> (%)	95	(91, 96)	98	(67.75, 99)	0,15
HCO <sub>3</sub> <sup>-</sup> (mmol/L)	26	(23, 29)	28	(12, 33.5)	0, 67
<b>Differences</b>					
pH	0.04	(0.00, 0.10)	0.06	(-0.27, 0.10)	0,74
PaCO <sub>2</sub> (mmHg)	-10	(-21, 0)	-13	(-43, 10.25)	0,96
HCO <sub>3</sub> <sup>-</sup> (mmol/L)	-1	(-6, 3)	-2	(-6, 5)	0,96

**Table 3.** The relationship between variations of PaCO<sub>2</sub>, HCO<sub>3</sub><sup>-</sup>, pH values, and values at admission

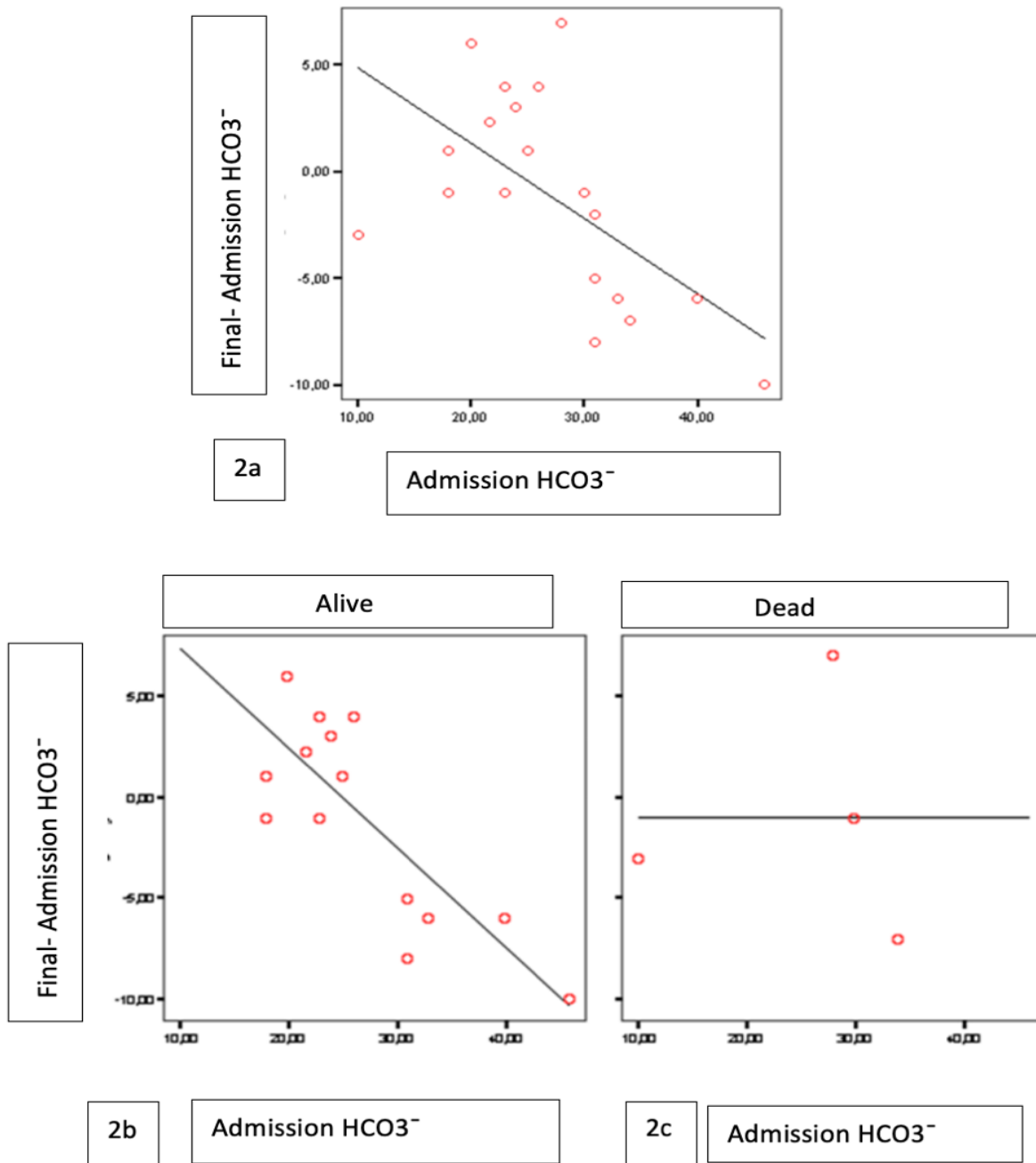
Parameter	All patients Correlation coefficient (p value)	Dead patients Correlation coefficient (p value)	Alive patients Correlation coefficient (p value)
PaCO <sub>2</sub> *	-0,76 (<0,001)	-0,80 (0,2)	-0,80 (<0,001)
HCO <sub>3</sub> <sup>-</sup> **	-0,61 (0,005)	-0,4 (0,6)	-0,70 (0,003)
pH	0,58 (0,009)	0,94 (0,051)	-0,84 (<0,001)

\*PaCo2: Partial arterial carbondioxide pressure, \*\*HCO3<sup>-</sup>: Plasma bicarbonate level



**Figure 1.** Graph of the relationship between admission PaCO2 and PaCO2 change  
a: In all patients; b: In alive patients; c: In dead patients

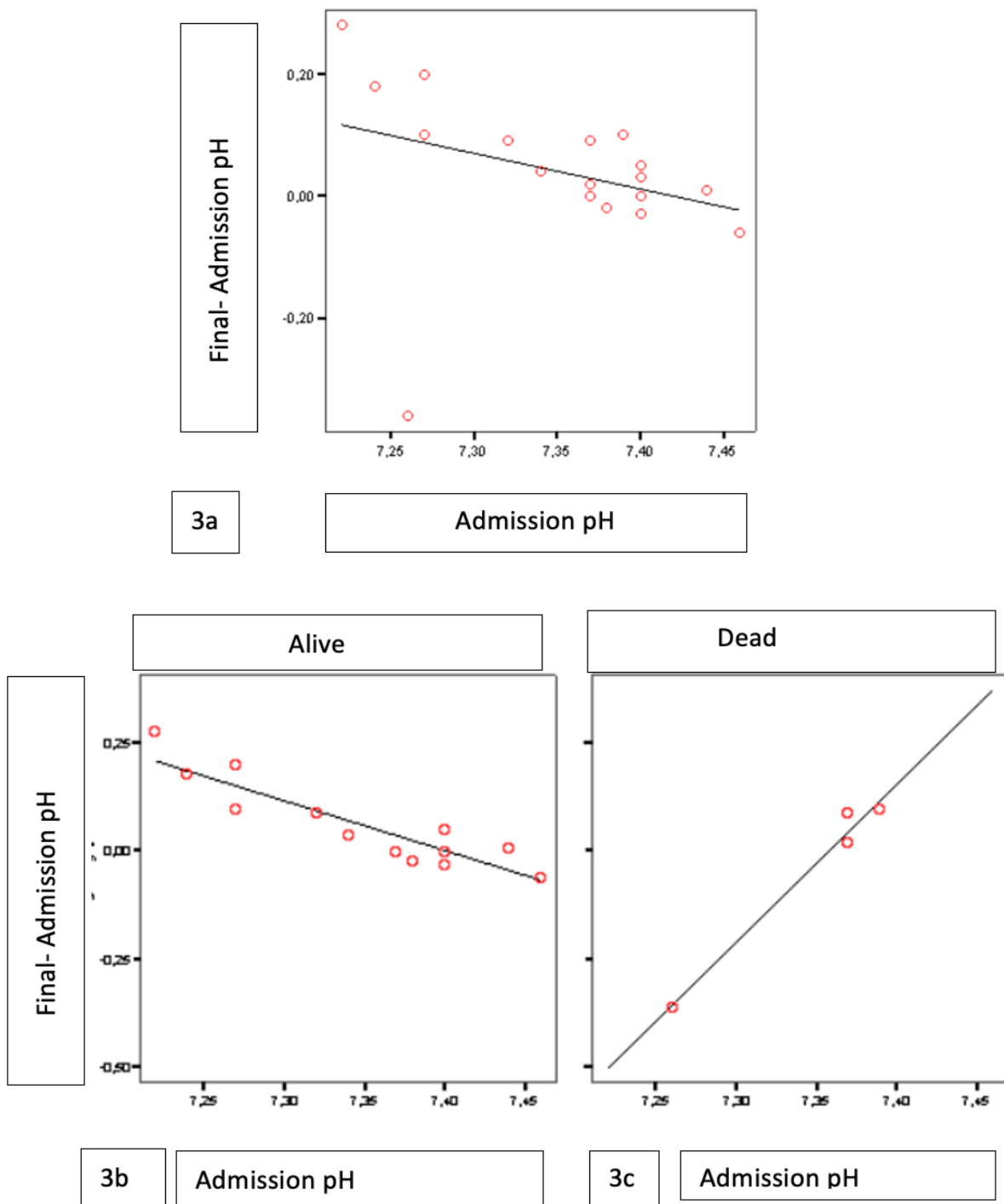




**Figure 2.** Graph of the relationship between admission  $\text{HCO}_3^-$  and  $\text{HCO}_3^-$  change a: In all patients; b: In alive patients; c: In dead patients

The higher the  $\text{PaCO}_2$  value at hospitalization time, the greater the decrease in  $\text{PaCO}_2$  with treatment was observed; however, this improvement was not associated with mortality (Figure 1).

The initial pH values of alive patients were higher and these values tended to normalize with treatment. The pH values of dead patients increased during hospitalization compared to the admission values (Figure 3).



**Figure 3.** Graph of the relationship between hospitalization pH and pH change a: In all patients; b: In alive patients; c: In dead patients

## DISCUSSION

In this study; the way of providing antibiotics, reason and frequency of use, and antibiotic use information (habit of reading the

prospectus, taking an antibiotic when hungry or full, the duration to continue the antibiotic, and storage conditions) were investigated. The findings suggest gender, place of residence, and having healthcare personnel in the family

affected participants' knowledge, attributes, and behaviors about the usage of antibiotics. The most intensive participation in the study, based on volunteering, was provided by first and emergency aid (42.9%) and anesthesia technician department (10.8%) students. Moreover, it was determined that the highest knowledge score about numeracy in health literacy belonged to the students of these two departments. The reason why students studying in these departments both have higher participation and knowledge scores can be attributed to the fact that they received more training on drugs in accordance with the education curriculum in order to be authorized to use drugs, and thus their awareness increased.

In a study conducted among students studying in health sciences and non-health fields, it was determined that 36.1% of students studying in health sciences used self-medication in case of illness (27). According to the results we obtained, 77.4% of the students consult a doctor in the presence of a health problem, while 18.4% try to overcome their health problem without using medication. Our results, as found in the literature, determined that the ratio of self-medication was lower than expected and in line with the education received by our participant group. Our results, in a way, emphasize that the general health status of the individual is an important issue for the participants in the study.

The sources from which individuals obtain information about the antibiotics they use differ from country to country. One out of every three Europeans gets the information from their doctor, and 10% get it from their pharmacist. In Sweden, 98% of respondents to the questionnaire said that they took antibiotics with their doctor's prescription, while in Greece this rate was only 79% (28). Other studies emphasize that most people use drugs without consulting a doctor, and the most commonly used drugs are painkillers and antibiotics (29, 30). In our results, it was determined that the rate of using prescription antibiotics under the supervision of a doctor (85.4%) was higher than the rate of self-use of antibiotics. The fact that students participating in the study stated that they do not need antibiotics at a ratio of 79.2% when they encounter any health problem. The results can be considered evidence that the awareness of inappropriate antibiotic use has increased due to their education and that the expectation of the doctor to prescribe antibiotics has decreased. Below this positive result; public service announcements made by health authorities and restrictions on the over-the-counter sale of antibiotics (31).

A study reported that 35.6% of university students expected antibiotics to be prescribed for viral upper respiratory tract infections such as colds and flu. In the same study, they emphasized that 77.8% of the students knew the role of antibiotics in the treatment of bacterial

infections, but only 27.4% knew that antibiotics were not for viral infections (32). In our study, bacterial infections were determined as the type of disease requiring antibiotics at a ratio of 63.2%. In the definition of disease requiring antibiotic use, the ratio of students reporting viral infections was 33.5%. Considering the increase in the frequency of bacterial infections in parallel with the weakening of the immune system due to viral infections, our results were compatible with the literature. In our study, it was determined that the most common reason for antibiotic use was 'fever' with 49.5%. In the results of the research conducted with families, it was determined that the primary reason for starting antibiotics for the children of parents was fever (33). In similar studies, it has been found that the ratio of those who use antibiotics without the need for doctor control in viral infections such as the flu and cold was quite high (34).

The fact that the universe chosen for our research consisted of students and that 41.5% of the students stayed in dormitories can be explained as the reason for going to the doctor once last year. 47.2% of the students who went to the doctor in the previous year were not prescribed antibiotics, and 31.2% of the students have prescribed antibiotics once. In the study conducted in the TRNC, it was determined that pharmacists sell antibiotics without a prescription at a ratio of 41.5%.<sup>20</sup> According to the data in our study, the low

frequency of prescribing antibiotics confirms that antibiotics have ceased to be miracle drugs and that the attitudes and behaviors of all stakeholders on this subject have changed rationally.

Thanks to the developing technology, in our age where the speed of access to information is very high but information pollution on every subject is quite intense, patients can easily access information about the drugs they use. A study reported that as age increases, the frequency of obtaining information from physicians and pharmacists about drug use increases, but the frequency of reading/learning instructions for drug use decreases. As a result of the same research, it was determined that there was not a significant difference between the age groups of individuals and the status of regular drug prospectus reading depending on the presence of chronic disease (30). The fact that the rate of reading the prospectus of the students participating in the research is high (78.8%) suggests that this may be due to the fact that they are healthcare professionals despite their young average age. The information on whether to take antibiotics on an empty stomach or on a full stomach is not fully settled among the public. In this regard, the responsibility of all health professionals, especially physicians, and pharmacists, comes to the fore. It is of great importance to convey the usage information or the points that need attention according to the drug properties to the

patients, especially during the delivery of the drug to the patient. 84.9% of the students stated that they had a habit of eating before using antibiotics. With such a habit, the risk of drug-food interactions and/or delay in emptying stomach contents due to antibiotic use can be avoided.

The statement given by 45.3% of the participants regarding the duration of antibiotic use, which will contribute to the formation of antibiotic resistance, is that "they use the antibiotic given to them until the symptoms disappear". Among the different answers, the ratio of participants stating that "it continues during the prescription", which is the ideal usage period, was 39.1%. Although these two ratios obtained from our results were close to each other, they were lower than the ratio (70%) of students who stated that they were "continuing during the prescription" as a result of the study conducted by Mete et al., (35). Kaya et al. found that 62.2% of the participants stopped using the drug when the symptoms of the disease disappeared, 25.7% changed the drug dose and 18.2% did not use the drug on time (36). While the results of the study conducted on the duration of antibiotic use emphasize the lack of general knowledge in this regard, the results of the current studies in the literature differ considerably from each other. When the responses given to the suggestions about the treatment were evaluated, it was determined that 10.4% of the patients used the

antibiotic when they remembered, and 76.9% used it at the same time every day. RAU is an important point in the development of positive behaviors regarding antibiotic use. With the ratio of 76.9% obtained from our research, it is possible to say that the students received the necessary information from the doctor about the use of antibiotics after the examination and that they followed the antibiotic usage instructions given to them by the pharmacists while supplying their medicines.

Attention to the storage conditions of the drugs after opening the lid during use; in some cases, is important for drugs that lose their properties even in a short time such as the duration of treatment. Another responsibility of the health personnel is to warn the patients about the subject during drug supply and to provide the necessary information. In the study of Güngör et al., parents stated that they kept the antibiotics prescribed to their children in the refrigerator at a ratio of 59.5% (37). In our study results, it was stated that our students had stored antibiotics at room temperature with a ratio of 47.6%. In the study carried out by Sorensen et al., in Belgium, it was found that 1/3 of the participants hid the drugs under inappropriate conditions (38). It can be assumed that our students don't yet know enough about this topic because our findings don't entirely overlap with the literature.

In terms of antibiotic use of knowledge, attitudes, and behaviors of the participants;

there was a statistically significant difference in the presence of gender, residence, and family health personnel. The effect of gender differences on the results is thought to be that the social responsibilities of females cause them to be more careful and detailed. The effect of students whose residence place is a dormitory on the results; in order to continue their education without interruption by taking their own responsibilities, they are more attentive to their general health status than other students. The fact that the presence of health personnel in the family has a meaningful effect on the results is thought to be an indication that the transfer of some known errors on the subject from parents to children is still continuing. Our results were consistent with the results of the study by Çelik et al. (39). It was determined that the level of knowledge of our students studying in the field of health, such as diseases that require antibiotic use, discrimination of symptoms, compliance with antibiotic treatment, and storage conditions, is not lower than the current literature data.

Studies on the level of numeracy knowledge in health literacy have generally been conducted on chronic diseases, and the number of studies evaluating the use of antibiotics and numeracy knowledge levels in health literacy in acute diseases is very limited. Our findings showed that the numeracy knowledge level of health services school students was good but not excellent. This negative result, which we

encounter even in health students with middle and high education levels, can be considered a reflection of the fact that the situation can be worrying in individuals with standard education. As a result of a study, it was emphasized that the ratio of parents who believe that antibiotics will cure all kinds of viral, bacterial, and fungal infections is almost half of the individuals included in the study (40). Parents especially have problems giving the appropriate dose of liquid medicines to their children (41). Hasan et al. stated that there is a relationship between numeracy knowledge in health literacy and antibiotic resistance and side effects (24). It is also suggested that numeracy skills show parallelism with the patient's age, education level, and socioeconomic characteristics (42). Although the sample of our study consisted of second-year students studying in the field of health, no perfect positive relationship was found between education level and health literacy numerical knowledge level. However, 14.7% of the students scored above 9 points. This result highlights the fact that it is not easy to manipulate the numeracy level of health literacy knowledge of patients with adequate health literacy and education.

## CONCLUSION

In conclusion, the present study revealed that severe respiratory symptoms improved when respiratory support with NIV/IMV was given

without delay, within the correct indications, to patients who were admitted to the ICU due to severe asthma attacks and did not respond to medical treatment.

**Ethics Committee Approval:** Ethics committee approval was received for this study from the Clinical Research Ethics Committee of Hacettepe University (Approval date and number: 10.04.2013; GO 13/207-10).

**Peer-review:** Externally peer-reviewed.

**Author Contributions:** Concept: SK, GK; Design: SK, GK, Data Collection and Processing: SK, SÖ, EOE; Analysis and Interpretation: AUD, SK; Writing: SK, OCB

**Conflict of Interest:** The author declared no conflict of interest.

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## REFERENCES

1. Cevhertas L, Ogulur I, Maurer DJ, Burla D, Ding M, Jansen K, et al. Advances and recent developments in asthma in 2020. *Allergy* 2020;75(12):3124-3146.
2. Busse WW, Fang J, Marvel J, Tian H, Altman P, Cao H. Uncontrolled asthma across GINA treatment steps 2 - 5 in a large US patient cohort. *J Asthma* 2022;59(5):1051-1062.
3. Çelik G, Aydın Ö, Türk Toraks Derneği Astım ve Alerji Çalışma Grubu. Astım Tanı ve Tedavi Rehberi, Astımın Kronik Tedavisi Basamak Tedavisi 2022 Güncellemesi
4. Kostakou E, Kaniaris E, Filiou E, Vasileiadis I, Katsaounou P, Tzortzaki E, et al. Acute Severe Asthma in Adolescent and Adult Patients: Current Perspectives on Assessment and Management. *J Clin Med* 2019;8(9):1283.
5. Agnihotri NT, Saltoun C. Acute severe asthma (status asthmaticus). *Allergy Asthma Proc* 2019;40(6):406-409.
6. Pallin M, Hew M, Naughton MT. Is non-invasive ventilation safe in acute severe asthma? *Respirology* 2015;20(2):251-7.
7. Pallin M, Naughton MT. Noninvasive ventilation in acute asthma. *J Crit Care* 2014;29(4):586-93.
8. Davidson AC, Banham S, Elliott M, Kennedy D, Gelder C, Glossop A, et al. BTS/ICS guideline for the ventilatory management of acute hypercapnic respiratory failure in adults. *Thorax* 2016;71 Suppl 2:ii1-35.
9. Sheikh M, Tiruvoipati R, Hurley JC. Non-invasive ventilation of patients with acute asthma. *Intern Med J* 2019;49(2):262-264.
10. Binachon A, Gateau A, Allou N, Ferdynus C, Allyn J, Dangers L, et al. Acute severe asthma requiring invasive mechanical ventilation in the era of modern resuscitation techniques: A 10-year bicentric retrospective study. *PLoS One* 2020;15(10):e0240063.

11. Althoff MD, Holguin F, Yang F, Grunwald GK, Moss M, Vandivier RW, et al. Noninvasive Ventilation Use in Critically Ill Patients with Acute Asthma Exacerbations. *Am J Respir Crit Care Med* 2020;202(11):1520-1530.
12. Global Initiative for Asthma. *Global Strategy for Asthma Management and Prevention, 2022 (GINA, 2022)*.
13. El Shinnawy OM, Metwally M, Abdel Aleem NA, Eid WM. Assessment of noninvasive ventilation in patients with acute severe asthma. *Egypt J Chest Dis Tuberc* 2022;71:67-73.
14. Shigemura M, Homma T, Sznajder JJ. Hypercapnia: An Aggravating Factor in Asthma. *J Clin Med* 2020;9(10):3207.
15. Vasileiadis I, Alevrakis E, Ampelioti S, Vagionas D, Rovina N, Koutsoukou A. Acid-Base Disturbances in Patients with Asthma: A Literature Review and Comments on Their Pathophysiology. *J Clin Med* 2019;8(4):563.
16. Senna G, Latorre M, Bugiani M, Caminati M, Heffler E, Morrone D, et al. Sex Differences in Severe Asthma: Results From Severe Asthma Network in Italy-SANI. *Allergy Asthma Immunol Res* 2021;13(2):219-228.
17. Chowdhury NU, Guntur VP, Newcomb DC, Wechsler ME. Sex and gender in asthma. *Eur Respir Rev* 2021;30(162):210067.
18. Mikhail I, Grayson MH. Asthma and viral infections: An intricate relationship. *Ann Allergy Asthma Immunol* 2019;123(4):352-358.
19. Martin MJ, Beasley R, Harrison TW. Towards a personalised treatment approach for asthma attacks. *Thorax* 2020;75(12):1119-1129.