



Subjective and objective assessment of cognitive function in patients with bronchial asthma, arterial hypertension, and their comorbidity

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Abstract. Bronchial asthma and arterial hypertension are common chronic conditions that have both been associated with impaired cognitive function. The coexistence of these conditions may be associated with greater impairment of memory and attention, highlighting the need to assess both subjective cognitive complaints and objective cognitive performance in this patient population. The aim of this study was to analyze the characteristics of subjective and objective assessment of cognitive function in patients with asthma, arterial hypertension, and their comorbidity. The study included 82 patients stratified into three groups: Group I comprised patients with bronchial asthma ($n=25$), Group II comprised patients with arterial hypertension ($n=20$), and Group III comprised patients with coexisting bronchial asthma and arterial hypertension ($n=37$). The control group (CG) included 21 apparently healthy individuals. Subjective assessment was based on the analysis of cognitive complaints, whereas objective assessment was performed using the Montreal Cognitive Assessment and Schulte tables. Statistical analyses were performed using Statistica 10.0 software, with the Mann – Whitney U test, Pearson's chi-square test, and Spearman's rank correlation coefficient applied as appropriate. Cognitive complaints were most frequently reported by patients with coexisting bronchial asthma and arterial hypertension (59.5 %). This group also had the lowest median Montreal Cognitive Assessment score, 22.00 [20.00; 24.00], and the longest median Schulte table completion time, 54.00 s [47.00; 59.00]. Schulte table completion time was significantly longer among patients reporting cognitive complaints in the asthma group and in patients with coexisting asthma and arterial hypertension, whereas no statistically significant difference was observed in group II. Spearman correlation analysis revealed weak to moderate correlations between the number of cognitive complaints and objective measures of cognitive performance. The number of complaints correlated negatively with the MoCA score and positively with Schulte table completion time. Cognitive complaints were associated with poorer performance on objective cognitive tests; however, weak and moderate correlations suggest that the number of subjective complaints does not always reflect the severity of cognitive impairment. These findings underscore the importance of cognitive assessment in patients with coexisting bronchial asthma and arterial hypertension, based not only on subjective complaints but also on standardized cognitive test results.

Keywords: bronchial asthma; arterial hypertension; cognitive function; complaints; Montreal Cognitive Assessment; Schulte tables.

Introduction

Bronchial asthma (BA) is a common chronic noncommunicable disease with substantial clinical and public health significance. A systematic analysis of the Global Burden

of Disease Study 2021 estimated that approximately 260 million people worldwide had asthma [1].

Arterial hypertension (AH) is a common and clinically relevant comorbidity in patients with asthma. According

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to the BADA study (Blood Pressure Levels, Clinical Features and Markers of Subclinical Cardiovascular Damage of Asthma Patients), the prevalence of hypertension among adults with asthma was 45 % and increased to 75 % when cases identified by 24-h ambulatory blood pressure monitoring were included [2]. According to a review by Cazzola *et al.* [3], coexisting asthma and cardiovascular comorbidities, including hypertension, may complicate disease management and reflect shared pathobiological mechanisms, including chronic systemic inflammation, oxidative stress, and endothelial dysfunction. Visca *et al.* found that neutrophilic airway inflammation may contribute to the association between asthma and hypertension, as a neutrophil percentage of ≥ 61 % in induced sputum was an independent predictor of hypertensive status in patients with asthma [4].

In a systematic review and meta-analysis, Bushi *et al.* reported a pooled prevalence of cognitive impairment of 16.3 % among patients with asthma; this condition was also associated with an increased risk of cognitive decline and dementia [5]. Proposed mechanisms underlying this association include chronic systemic inflammation and hypoxic episodes [6]. Wei *et al.* highlighted the role of hypertension as a major modifiable risk factor for cognitive decline, with its adverse cognitive effects linked to cerebral small vessel disease, neurovascular dysfunction, impaired cerebral perfusion, and white matter lesions [7]. Existing studies on the coexistence of asthma and hypertension have focused primarily on clinical characteristics and the bidirectional clinical burden of these conditions [8], whereas evidence regarding cognitive status in this patient population remains limited.

Complaints involving memory, attention, and other cognitive functions are an important component of the initial cognitive assessment, as they may reflect subjective cognitive decline [9] and may also be associated with objective evidence of cognitive impairment [10]. In their meta-analysis, Van Patten *et al.* reported an inconsistent relationship between subjective and objective cognitive functioning, with effect sizes often ranging from null to weak across different clinical conditions [11]. Therefore, studies of cognitive changes should include subjective cognitive complaints and standardized objective cognitive test results [12]. Early identification of cognitive impairment in patients with chronic diseases is clinically important, as it may affect treatment adherence and patients' ability to self-manage their disease [13]. Therefore, assessing both subjective cognitive complaints and objective cognitive test performance in patients with asthma, hypertension and coexisting bronchial asthma and arterial hypertension may be clinically useful for optimizing patient management. The aim of this study was to evaluate subjective cognitive complaints

and objective cognitive performance in patients with asthma, hypertension and their coexistence.

Materials and Methods

The study included 82 patients stratified into three groups: Group I comprised patients with bronchial asthma ($n=25$), Group II comprised patients with arterial hypertension ($n=20$), and Group III comprised patients with coexisting bronchial asthma and arterial hypertension ($n=37$). The control group (CG) comprised 21 apparently healthy individuals aged 45–70 years who had no history or clinical evidence of asthma, hypertension, or any of the other conditions listed in the exclusion criteria.

Patients aged 45–70 years with moderate persistent asthma, stage II, grade 2 hypertension, or both were eligible for inclusion. Patients with asthma were required to have had no exacerbations during the 4 weeks before enrollment, whereas patients with hypertension were required to have had no hypertensive crisis during the same period.

Arterial hypertension was diagnosed in accordance with the Unified Clinical Protocol for Primary and Specialized Medical Care "Hypertensive Disease (Arterial Hypertension)", approved by Order of the Ministry of Health of Ukraine No. 1581 dated September 12, 2024. Asthma was diagnosed in accordance with the Unified Clinical Protocol for Primary and Secondary (Specialized) Medical Care "Bronchial Asthma", approved by Order of the Ministry of Health of Ukraine No. 868 dated October 8, 2013, and the 2026 Global Initiative for Asthma (GINA) recommendations.

Exclusion criteria included secondary hypertension; other chronic respiratory diseases; obstructive sleep apnea; a history of stroke or myocardial infarction; angina pectoris; severe cardiovascular, neurological, renal, or hepatic disease; diabetes mellitus; dementia; diagnosed anxiety, depressive, or other psychiatric disorders; severe visual or hearing impairment; alcohol or drug dependence; the use of medications with marked sedative effects that could influence cognitive test performance.

At enrollment, patients with asthma were receiving maintenance therapy with a fixed-dose combination of an inhaled corticosteroid and a long-acting β_2 -agonist, as recommended by GINA. Patients with hypertension were receiving free- or fixed-dose combinations of antihypertensive agents in accordance with the current national clinical protocol.

The study was approved by the Bioethics Committee of I. Horbachevsky Ternopil National Medical University, Ministry of Health of Ukraine (Protocol No. 85 dated April 1, 2026). All participants provided written informed consent, and the study was conducted in accordance with the principles of the Declaration of Helsinki.

Subjective cognitive complaints were assessed using a structured interview. All participants were asked the same nine questions about common difficulties with memory, attention, executive functioning, language, and processing speed. Participants who answered “yes” to at least one question were classified as having subjective cognitive complaints. The frequency of each complaint and the total number reported by each participant were also analyzed.

Objective cognitive performance was evaluated using the Montreal Cognitive Assessment (MoCA), with scores ranging from 0 to 30; a score below 26 was considered indicative of cognitive impairment. Sustained attention was assessed using the Schulte Table test, in which participants were instructed to identify the numbers from 1 to 25 in ascending order as quickly as possible; completion time was recorded, with longer times indicating poorer performance.

Statistical analyses were performed using Statistica version 10.0. Quantitative variables with non-normal distributions are presented as the median and first and third quartiles (Me [Q1; Q3]), and categorical variables as n (%). The Kruskal – Wallis test was used to compare quantitative variables across the four groups, followed by pairwise comparisons using the Mann – Whitney U test. Categorical variables were compared using Pearson's χ^2 test. The Bonferroni correction was applied to multiple pairwise between-group comparisons. Associations were assessed using Spearman's rank correlation coefficient (r_s).

Results

The clinical and demographic characteristics of the study groups are summarized in Table 1. No statistically

significant between-group differences were found in age ($p=0.968$), sex ($p=0.433$), place of residence ($p=0.914$), educational level ($p=0.429$), employment status ($p=0.600$), or smoking status ($p=0.760$). The duration of asthma did not differ significantly between patients with asthma alone and those with coexisting asthma and hypertension ($p=0.83$). Similarly, the duration of hypertension did not differ significantly between patients with hypertension alone and those with coexisting asthma and hypertension ($p=0.215$).

The analysis then focused on subjective cognitive complaints. Participants were classified as having such complaints if they reported at least one difficulty involving memory, attention, executive functioning, or language. The prevalence of subjective cognitive complaints differed significantly across the study groups ($\chi^2=11.95$, $p=0.008$). The highest prevalence was observed in Group III, where 59.5% of patients with coexisting asthma and hypertension reported at least one complaint of memory impairment, difficulty concentrating, or language problems (Table 2). Pairwise comparisons showed that the prevalence was significantly higher in this group than in the CG ($p=0.00084$). Group I also had a higher prevalence of cognitive complaints than the control group ($p=0.015$); however, this difference did not meet the Bonferroni-adjusted significance threshold ($p<0.0083$). No other pairwise between-group differences were statistically significant.

The profile of the most frequent cognitive complaints was further analyzed in the overall sample. Complaints were categorized according to the main cognitive domains: memory, attention, executive function, language, and processing speed (Table 3).

Table 1. Clinical and demographic characteristics of the study groups

Characteristic	Group I, n=25	Group II, n=20	Group III, n=37	CG, n=21
Age, years	55 [48,00; 60,00]	53,5 [51,00; 60,50]	52 [48,50; 59,50]	55 [51,50; 61,50]
Sex				
Male	12 (48,0 %)	14 (70,0 %)	23 (62,2 %)	11 (52,4 %)
Female	13 (52,0 %)	6 (30,0 %)	14 (37,8 %)	10 (47,6 %)
Place of residence				
Urban	16 (64,0 %)	13 (65 %)	23 (62,2 %)	15 (71,5 %)
Rural	9 (36,0 %)	7 (35 %)	14 (37,8 %)	6 (28,5 %)
Educational level				
Higher education	14 (56,0 %)	7 (35,0 %)	15 (37,0 %)	11 (52,3 %)
Secondary vocational education	11 (44,0 %)	13 (65 %)	22 (63 %)	10 (47,3 %)
Employment status				
Employed	15 (60 %)	13 (65 %)	22 (59,5 %)	16 (76,2 %)
Not employed	10 (40 %)	7 (35 %)	15 (40,5 %)	5 (23,8 %)
Duration of asthma, years	20,00 [12,00; 29,00]	–	17,5 [10,00; 30,50]	–
Duration of hypertension, years	–	8,50 [7,00; 10,50]	7,00 [3,50; 11,00]	–
Smoking status				
Never smoker	19 (76 %)	11 (55 %)	25 (67,6 %)	13 (62,0 %)
Former smoker	5 (20 %)	6 (30 %)	10 (27 %)	6 (28,5 %)
Current smoker	1 (4 %)	3 (15 %)	2 (5,4 %)	2 (9,5 %)

Table 2. Prevalence of cognitive complaints among patients with BA alone, AH alone, and both conditions

Group	Complaints present		Complaints absent	
	n	%	n	%
Group I, n=25	12	48,0	13	52,0
Group II, n=20	7	35,0	13	65,0
Group III, n=37	22	59,5*	15	40,5
CG, n=21	3	14,3	18	85,7

Note: * Statistically significant compared with the control group after Bonferroni correction ($p < 0.0083$).

Table 3. Distribution of cognitive complaints among patients with BA alone, AH alone, and both conditions, n (%)

Cognitive domain	Complaints	Group I, n=25		Group II, n=20		Group III, n=37		CG, n=21	
		n	%	n	%	n	%	n	%
Memory	«trouble remembering new information»	7	28,8	4	20,0	15	40,5	1	4,8
	«forgetting where I put things»	5	20,0	2	10,0	13	35,1	1	4,8
	«feeling that my memory had become worse»	7	28,0	4	20,0	16	43,2	–	–
Attention	«trouble concentrating»	4	16,0	6	30,0	16	43,2	1	4,8
	«losing my train of thought during conversation»	3	12,0	3	15,0	8	21,6	–	–
Executive function	«forgetting to complete planned tasks»	4	16,0	2	10,0	7	18,9	1	4,8
	«making mistakes when doing tasks»	3	12,0	2	10,0	8	21,6	–	–
Language	«trouble finding the right word»	8	32,0	4	20,0	14	37,8	1	4,8
Processing speed	«feeling mentally foggy»	4	16,0	3	15,0	10	27,0	2	9,5

In Group I, language- and memory-related complaints were the most common: trouble finding words was reported by 32.0 % of participants, while trouble remembering new information and feeling that memory had become worse were each reported by 28.0 %. In Group II, trouble concentrating was reported by 30.0 % of patients, and memory- and language-related complaints were also frequently noted. In the group with coexisting asthma and arterial hypertension, the most common complaints were feeling that memory had become worse and trouble concentrating, each reported by 43.2 % of participants, followed by trouble remembering new information (40.5 %) and trouble finding words (37.8 %). Overall, these findings suggest that patients with coexisting asthma and arterial hypertension present with a broader spectrum of subjective cognitive complaints.

Objective cognitive functioning in the study groups was assessed using the MoCA and Schulte table tests (Table 4).

Cognitive performance differed significantly across the groups in terms of both MoCA scores ($p < 0.001$) and Schulte Table completion time ($p < 0.001$).

The lowest cognitive performance on both tests was observed in patients with combined asthma and arterial hypertension. Group III showed significantly poorer results than Groups I and II and the control group. The median MoCA score in Group III was 22.00 [20.00; 24.00], which was 12.0 % lower than in Group I, 10.2 % lower than in Group II, and 20.0% lower than in the control group (Fig. 1). The median Schulte table completion time in Group III was 54.00 [47.00; 59.00] s, exceeding the values observed in Group I by 9.00 s (20.0 %), in Group II by 10.50 s (24.1 %), and in the control group by 20.00 s (58.8 %) (Fig. 2).

Moreover, participants in Groups I and II had significantly lower MoCA scores than the control group, whereas no significant difference was observed between Groups I and II. The time required to complete the Schulte tables was also significantly longer in both groups than in the control group.

Table 4. Cognitive performance assessed using the MoCA and Schulte table test in the study groups, median [Q1; Q3]

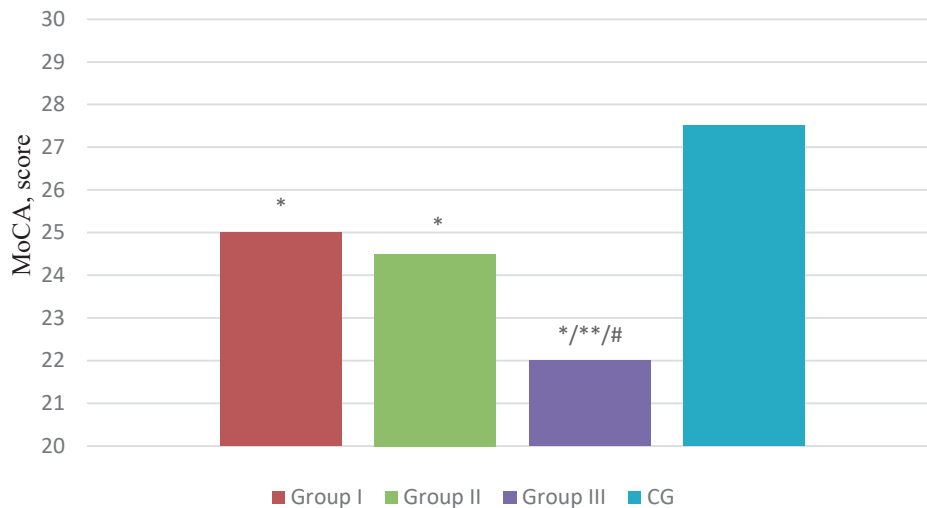
Parameter	Group I, n=25	Group II, n=20	Group III, n=37	CG, n=21
MoCA, score	25,00 [23,00; 26,00]*	24,50 [22,50; 26,00]*	22,00 [20,00; 24,00]*/**/#	27,50 [25,75; 28,00]
Schulte table completion time, s	45,0 [39,00; 49,00]*	43,50 [40,00; 51,00]*	54,0 [47,00; 59,00]*/**/#	34,00 [30,50; 39,00]

Notes: The Bonferroni-adjusted significance threshold for pairwise Group comparisons was $p < 0.0083$.

1. * Statistically significant compared with the control Group;

2. ** Statistically significant compared with Group I;

3. # Statistically significant compared with Group II.

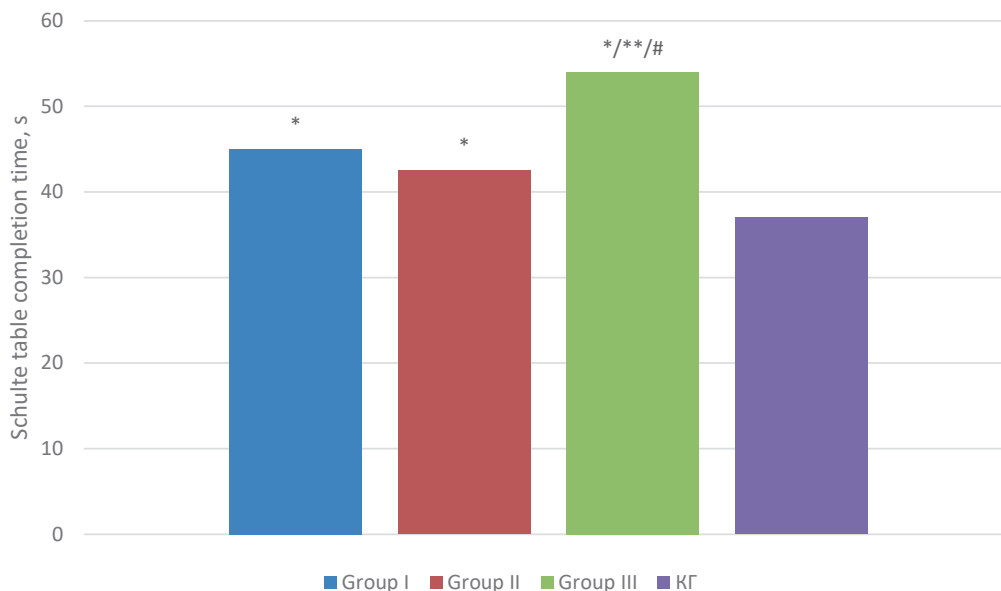
**Fig. 1.** MoCA scores in patients with BA alone, AH alone, and both conditions.

Notes: The Bonferroni-adjusted significance threshold for pairwise group comparisons was $p < 0.0083$.

1. * Statistically significant compared with the control group;

2. ** Statistically significant compared with Group I;

3. # Statistically significant compared with Group II.

**Fig. 2.** Schulte table completion time in patients with BA alone, AH alone, and both conditions/

Notes: The Bonferroni-adjusted significance threshold for pairwise Group comparisons was $p < 0.0083$.

* Statistically significant compared with the control Group;

** Statistically significant compared with Group I;

Statistically significant compared with Group II.

In addition, participants in Groups I and II had significantly lower MoCA scores than those in the CG, whereas no significant between-group difference was observed between Groups I and II. Schulte table completion time was significantly longer in Groups I and II than in the CG.

To assess the association between subjective cognitive complaints and objective measures of cognitive performance, MoCA scores and Schulte table completion time were compared between participants with and without complaints within each study group (Table 4).

Across all clinical groups, patients reporting cognitive complaints had significantly lower MoCA scores than those without complaints. Schulte table completion time was significantly longer among patients with complaints in Groups I and III, whereas no statistically significant difference was found for this parameter in Group II.

To evaluate the relationship between subjective cognitive complaints and objective cognitive performance, correlation analysis was performed between the number of different cognitive complaints, MoCA score, and Schulte table completion time (Table 5).

In Groups I and II, the number of cognitive complaints showed moderate negative correlations with MoCA scores. In patients with coexisting asthma and hypertension, this correlation was also statistically significant, although weak ($r_s = -0.376$; $p < 0.05$). This finding may suggest a weaker relationship between subjective cognitive complaints and objective cognitive

test performance in patients with comorbid asthma and hypertension.

Moderate positive correlations were observed between the number of complaints and Schulte table completion time in Groups I and III, whereas no statistically significant association was found in Group II.

Discussion

One of the key findings of this study was that patients with coexisting asthma and hypertension had the highest prevalence of cognitive complaints and the poorest performance on objective cognitive tests. These findings are consistent with those of Hu et al. [14], who reported an association between asthma and poorer attention and processing speed, and Muela et al. [15], who found lower MoCA scores in patients with hypertension than in individuals without hypertension.

Across all clinical groups, patients who reported cognitive complaints had significantly lower MoCA scores than those who did not. This result is consistent with Vintimilla et al. [16], who found that subjective cognitive difficulties in patients with hypertension were associated with poorer performance on objective cognitive tests. The presence of cognitive complaints should therefore be considered during clinical assessment and may indicate the need for further evaluation using standardized cognitive tests.

The findings indicate that the associations between the number of cognitive complaints and objective cognitive measures were predominantly weak to moderate, with no strong correlations identified.

Table 4. MoCA scores and Schulte table completion time according to the presence of cognitive complaints in the study groups

Group	Cognitive complaints	MoCA, score median [Q1;Q3]	p	Schulte table completion time, s median [Q1;Q3]	p
Group I, n=25	Present, n=12	22,50 [21,50; 25,00]	0,027*	48,50 [44,00; 54,00]	0,016*
	Absent, n=13	26,00 [24,00; 26,00]		41,00 [38,00; 45,00]	
Group II, n=20	Present, n=7	24,00 [22,00; 24,00]	0,032*	46,00 [42,00; 58,00]	0,152
	Absent, n=13	25,00 [24,00; 26,00]		42,00 [33,00; 50,00]	
Group III, n=37	Present, n=22	21,00 [20,00; 22,00]	0,017*	57,50 [52,00; 64,00]	0,005*
	Absent, n=15	23,00 [21,00; 24,00]		49,00 [43,00; 55,00]	
CG, n=21	Present, n=3	25,00 [25,00; 28,00]	0,058	36,00 [32,00; 40,00]	0,075
	Absent, n=18	27,00 [26,00; 28,00]		32,00 [29,50; 36,00]	

Notes: * $p < 0.05$ for the comparison between participants with and without complaints; comparisons were performed using the Mann – Whitney U test.

Table 5. Associations between the number of cognitive complaints and objective measures of cognitive performance in the study groups

Group	Number of complaints and MoCA score, r_s	Number of complaints and Schulte table completion time, r_s
Group I, n=25	-0,460*	0,521*
Group II, n=20	-0,517*	0,341
Group III, n= 37	-0,376*	0,454*
CG, n=21	-0,160	-0,078

Notes: r_s , Spearman's rank correlation coefficient; * $p < 0.05$ indicates a statistically significant correlation.

This suggests that, in patients with bronchial asthma, arterial hypertension, and both conditions, the number of cognitive complaints does not always reflect the severity of objectively confirmed cognitive impairment. Therefore, cognitive complaints in these patients, regardless of their number, should be interpreted in conjunction with standardized cognitive test results.

Conclusions

Coexisting asthma and hypertension were associated with more frequent cognitive complaints, significantly lower MoCA scores, and longer Schulte table completion times than asthma or hypertension alone. Complaints related to memory, attention, and thinking were associated with poorer performance on objective cognitive tests. Weak to moderate correlations between the number of complaints and objective

cognitive measures suggest that subjective perception of cognitive impairment does not always correspond to the severity of objectively confirmed cognitive changes. These findings highlight the importance of cognitive assessment in patients with asthma, hypertension and both conditions, based not only on subjective complaints but also on standardized cognitive test results.

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Conflict of interest

None.

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Анотація. Бронхіальна астма та артеріальна гіпертензія є поширеними хронічними захворюваннями, які часто асоціюються з порушенням когнітивних функцій. Їх поєднаний перебіг може мати потенційно більш негативний вплив на пам'ять та увагу, що зумовлює необхідність оцінки як суб'єктивних скарг, так і об'єктивних когнітивних показників у таких хворих. Метою дослідження було проаналізувати особливості суб'єктивної та об'єктивної оцінки когнітивних функцій у пацієнтів з астмою, артеріальною гіпертензією та їх поєднанням. У дослідження включено 82 особи, яких поділили на три групи: I група – пацієнти з бронхіальною астмою (n=25), II – з артеріальною гіпертензією (n=20), III – з поєднаним перебігом бронхіальної астми та артеріальної гіпертензії (n=37). До контрольної групи (КГ) було включено 21 практично здорову особу. Суб'єктивну оцінку здійснювали шляхом аналізу когнітивних скарг, об'єктивну – за допомогою тесту Montreal Cognitive Assessment (MoCA) та таблиць Шульте. Найвищу частоту когнітивних скарг виявлено у хворих із поєднаним перебігом астми та артеріальної гіпертензії – 59,5 %. У цій групі також встановлено найнижчі показники MoCA – 22,00 [20,00; 24,00] бала та найбільший час виконання таблиць Шульте – 54,00 [47,00; 59,00] с. У пацієнтів зі скаргами в усіх клінічних групах спостерігали достовірно нижчі значення MoCA порівняно з особами без скарг. Час виконання таблиць Шульте був значущо більшим в осіб зі скаргами в I та III групах, тоді як у II статистично достовірної різниці не встановлено. У контрольній групі статистично значущих відмінностей за показником MoCA та часом виконання таблиць Шульте, залежно від наявності скарг, не виявлено. У клінічних групах аналіз показав слабкий та помірний кореляційний зв'язок між кількістю скарг і результатами об'єктивного тестування когнітивних функцій: із показником MoCA – зворотний, тоді як із часом виконання таблиць Шульте – прямий. Поєднаний перебіг бронхіальної астми і артеріальної гіпертензії асоціювався з більшою частотою когнітивних скарг, достовірно нижчими показниками MoCA та тривалішим часом виконання таблиць Шульте порівняно з ізольованим перебігом цих захворювань. Наявність скарг асоціювалася з гіршими результатами об'єктивного когнітивного тестування, однак слабка та помірна сила цих кореляційних зв'язків свідчить, що кількість суб'єктивних скарг не завжди відображає ступінь когнітивного зниження. Отримані дані підкреслюють важливість оцінки когнітивного стану хворих на астму, артеріальну гіпертензію, а також їх поєднання, яка має ґрунтуватися не лише на аналізі суб'єктивних скарг, а й на результатах стандартизованих тестів.

Ключові слова: бронхіальна астма; артеріальна гіпертензія; когнітивні функції; скарги; Монреальська шкала оцінки когнітивних функцій; таблиці Шульте.