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Evaluation of school achievements in adolescents with primary hypertension

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ABSTRACT

OBJECTIVE: Primary hypertension (HT) is a global public health problem with increasing prevalence in recent years. HT may have caused decreased neurocognitive functions and learning difficulties. In this study, clinical characteristics of adolescents with primary HT were examined and the relationship between semester grade point average (GPA) and HT was evaluated.

METHODS: This is an observational, cross-sectional, descriptive study conducted on adolescents with primary HT attending high school. Patient records (number of hospital visits, HT-related complaints, blood pressure measurements, and laboratory tests) were evaluated retrospectively. End-of-semester report card grades of Mathematics, Turkish Language and Literature and English courses were noted, and compared with the clinical characteristics of the patients.

RESULTS: The study included 83 patients with a mean age of 15.6±1.2 years. Patients with higher body mass index had lower grades in Mathematics (p=0.007) and Turkish Language and Literature (p=0.004). Patients with HT-related symptoms such as headache, epistaxis and palpitations had lower GPAs for all courses. Also, patients with hyperuricemia or proteinuria had lower semester GPAs compared to patients with normal serum uric acid levels or without proteinuria (p<0.05). GPAs for Mathematics (p=0.000) and Turkish Language and Literature (p=0.006) decrease as the number of hospital visits increases.

CONCLUSION: HT may cause not only cardiovascular complications but also decreased neurocognitive functions through various mechanisms and may have a negative impact on academic skills. Therefore, HT should be followed up with a multidisciplinary approach and intensive efforts should be made to approach the goal of normotension.

Keywords: Academic skills; children; hypertension; neurocognitive functions; school achievements.

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Primary hypertension (HT) is a global public health problem with an increased prevalence in the recent decades in parallel with the increase in the prevalence of obesity. Pediatric primary HT is underestimated due to the difficulties in blood pressure (BP) measurements and as the normative data are not as easy to evaluate as in adults [1]. The global prevalence of pediatric HT is 9.7%, and this prevalence is even higher in overweight and obese children [2]. Although primary HT can be mostly asymptomatic, different clinical presentations can be observed [3]. Neurological symptoms such as headache, visual disturbances, changes in mental status and cardiovascular symptoms such as chest pain, palpitations and coughing may cause a negative impact on daily life and general health [3].

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Uncontrolled HT can cause damage to many target organs. The main cardiovascular complications include arterial stiffness, increased left ventricular mass index (LVMI), left ventricular hypertrophy (LVH), occurring in 8% of HT patients, or left ventricular dysfunction [4]. Patients may also experience ophthalmologic complications such as hypertensive retinopathy (HTRP) or renal complications such as microalbuminuria/proteinuria with eventual risk of progressing into chronic kidney disease (CKD) [5].

Children with HT may have decreased cerebrovascular reactivity and neurocognitive function, and an increased prevalence of learning disabilities is reported [6]. Children with a systolic BP percentile above 90% have been shown to have lower working memory, attention, and achievement in mathematics. In children with higher BP percentiles, the decline in working memory and attention is even more pronounced [7]. Increased frequency of attention deficit in children with HT may be partly explained by the BP-increasing properties of the medications used for attention deficit as well as the fact that attention deficit may have developed due to HT, causing a neurocognitive disorder [8]. As a result, children with HT are considered as having increased risk of academic difficulties.

In this study, we examined the clinical features associated with HT in adolescents with primary HT and evaluated whether there was a relationship between HT-related parameters and the school achievements of the patients by using semester report grade point averages (GPAs).

Highlight key points

- Patients with higher body mass index had lower grade point average (GPA) in Mathematics and Turkish Language and Literature.
- Patients with HT-related symptoms such as headache, epistaxis and palpitations had lower GPAs for all courses.
- Patients with hyperuricemia or proteinuria had lower GPAs compared to patients with normal serum uric acid levels or without proteinuria.
- GPAs for Mathematics and Turkish Language and Literature decrease as the number of hospital visits increases.
- Hypertension may cause not only cardiovascular complications but also decreased neurocognitive functions through various mechanisms and may have a negative impact on academic skills.

MATERIALS AND METHODS

This is an observational, cross-sectional, descriptive study conducted on adolescent patients who were regularly attending high school in the Turkish Education System and who were regularly followed up in the Department of Pediatric Nephrology. Patient records were evaluated retrospectively and only patients with a confirmed diagnosis of primary HT and who had been followed up for at least one year were included in the study. Participants with a diagnosis of secondary HT, a history of hospital admission or hospitalization for indications other than HT and HT-related causes, arbitrary school absenteeism for other than medical reasons, neurological or other systemic diseases were excluded.

The number of visits during the last year were recorded. Presence or types of complaints of the patients including headache, dizziness, blurred vision, etc. were noted at their latest visits. In addition to the anthropometric measurements such as body weight and height, BP measurements and laboratory tests (fasting serum glucose, creatinine, creatinine, uric acid, alanine aminotransferase (ALT), total cholesterol, protein and microalbumin levels in 24-hour urine) were recorded at their last visits.

Height and weight standard deviation scores (SDS) were calculated automatically via internet access [9]. Body mass index (BMI) was calculated using the formula weight/height^2 (kg/m^2) and patients were grouped according to weight using BMI percentiles [10]. BP was measured using a manual auscultation device. Hypertension was diagnosed and classified based on the 'Clinical Practice Guideline for Screening and Management of High BP in Children and Adolescents, 2017' [11]. Estimated glomerular filtration rate (eGFR) was calculated using the modified Schwartz formula and defined as glomerular hyperfiltration >120 ml/min/1.73 m^2 [12]. Hyperuricemia was defined as a uric acid level >5.7 and >7.7 mg/dL for boys and girls, respectively [13]. Fasting plasma glucose level <100 mg/dL was considered normal, values between 100–126 mg/dL were defined as impaired fasting glucose and >126 mg/dL as hyperglycemia [14]. Hypercholesterolemia is defined as a total cholesterol level at or above the 90th percentile for age and gender, and borderline elevation is defined as a level between the 75th and 90th percentile [15]. 24-hour urinary protein and microalbumin excretion >4 mg/m^2/hour and >30 mg/day have been defined as proteinuria and microalbuminuria, respectively [16]. The presence of hypertensive retinopathy (HTRP) was determined by fundoscopic examination by an ophthalmologist and, hypertensive cardiomyopathy was evaluated by a pediatric cardiologist by echocardiography.

According to the Turkish Education System, in high schools and equivalent schools, two or three written exams were held for each course within the scope of the curriculum during the semester, and the GPAs were shown on the report cards as the final grades [17]. The end-of-semester report card grades of Mathematics, Turkish Language and Literature, and English courses taken in common by all our patients who continue their education at high schools were examined and the results were noted. The end-of-semester grades of the related courses were compared with the clinical characteristics of the patients.

The study protocol was established in accordance with the Declaration of Helsinki and approved by the Ethics Committee of Gazi University University on 12.03.2024 with decision number 05.

Statistical Analysis

In the presentation of descriptive statistics, measured data were expressed as mean±standard deviation (SD) and categorical data as number (percentage). Cross-tabular analyses and Fisher's exact Chi-square tests were used to compare the qualitative characteristics of the groups. Shapiro Wilks test was used to determine the normal distribution of numerical measurements in the groups. Two groups were compared using independent samples t-test and Mann-Whitney U test for those not normally distributed. IBM SPSS Statistics version 22 package program (Chicago, IL, USA) was used for all statistical analyses. The significance level was taken as $p<0.05$.

RESULTS

Demographics and Clinical Characteristics of the Patients

A total of 83 patients were included in the study. The male/female ratio was 1.67. The mean age was 15.6±1.2 (13–17.8) years. The mean height and weight SDS were -0.11±1.73 (-2.07–2.77) and 0.81±2.23 (-1.66–5.42), respectively. The mean BMI was 27.3±7.8 kg/m^2 (16.7–45.9). A total of 41 (49.4%) patients had BP in the normal range at the time of the study, while stage 1 HT and stage 2 HT were observed in 21 (25.3%) and 12 (14.5%) patients, respectively. While 42.5% (n=17) of patients with normal BMI were hypertensive, 58.1% (n=25) of patients with high BMI had HT (p=0.154).

A total of 14 (16.9%) patients had impaired fasting glucose and 2 (2.4%) patients had hyperglycemia. Mean serum creatinine was 0.76±0.81 mg/dL (0.24–1.18) and mean eGFR was 111.2±39.6 (94.1–252.7). Hyperfiltration was present in 2 (2.4%) patients. Hyperuricemia was present in 9 (10.8%) of the patients. The mean total cholesterol level was 166.5±66.1 (89–600) with borderline elevation in 4 (4.8%) patients and hypercholesterolemia in 3 (3.6%) patients.

In terms of end organ damage, 10 (12%) patients had microalbuminuria and 8 (9.6%) had proteinuria. Mean LVMI was 0.4255±0.5982 g/m^2 (0.2864–0.8970) and 12 (14.5%) patients had LVH. HTRP was detected in 4 (4.8%) patients.

Although regular exercise and salt-free diet were recommended to all patients, 51.8% of the patients stated that they did not exercise regularly and 39.8% stated that they did not practice adequate salt restriction. A total of 38 (45.8%) patients did not use any antihypertensive medications, while 20 (24.1%) and 7 (8.4%) patients used dual and triple antihypertensives, respectively. The most commonly used antihypertensive drug was losartan (n=22, 26.5%), followed by amlodipine (n=16, 19.3%), diuretics (n=16, 19.3%) and enalapril (n=15, 18.1%).

Demographic and clinical characteristics of the overall study population are shown in Table 1.

Assessments of School Performance

The number of patients in the freshman year of high school (grade 9) was 20 (24%) and the number of senior patients (grade 12) was 18 (21.6%) in our study. When the end-of-semester grades of the patients were examined, the average grade for Mathematics was 74.2±11.4 (45–92), for Turkish Language and Literature 81.9±8.4 (60–100), and for Foreign Language (English) 76.4±16.4 (40–100).

There was no relationship between the classes of the patients and their final GPAs. When final grade points were compared according to gender, although not statistically significant, girls had higher end-of-semester GPAs than boys in all courses (p=0.127). The patients with higher BMI scores had lower mean end-of-semester grades in Mathematics (p=0.007) and Turkish Language and Literature (p=0.004). In the evaluation conducted for HT stages, patients diagnosed with stage 2 HT had lowest end-of-semester GPAs in all courses, although not statistically significant (p>0.05 for all courses). As the number of antihypertensive drugs used increased, students' end-of-semester GPAs in Mathematics, Turkish Language and Literature and English decreased significantly (p=0.000, p=0.011 and p=0.001, respectively).

TABLE 1. Demographic and clinical characteristics of the study population

	n=83 (%)	Mean±SD	Min–Max
Sex			
Males, (%)	62.7		
Females, (%)	37.3		
Age		15.6±1.2	13–17.8
Males (years)		15.95±1.11	13–17.8
Females (years)		15.07±1.15	13.2–17.2
Anthropometric measurements			
Height SDS		-0.11±1.73	-2.07–2.77
Weight SDS		0.81±2.23	-1.66–5.42
BMI average (kg/m^2)		27.3±7.8	16.7–45.9
Overweight	20.5		
Obese	26.5		
Morbidly obese	4.8		
Blood pressure			
Systolic BP (%)		73.3±25.5	7–>99
Diastolic BP (%)		79.8±21.9	20–>99
Normal	49.4		
Elevated BP	10.8		
Stage 1 HT	25.3		
Stage 2 HT	14.5		
Blood biochemistry			
Plasma glucose (mg/dL)		92.2±11.7	67–143
Impaired fasting glucose	16.9		
Hyperglycemia	2.4		
eGFR (ml/min/1.73 m^2)		0.76±0.81	0.24–1.18
Hyperfiltration	2.4		
Uric acid (mg/dL)		5.3±1.3	3.4–10.2
Hyperuricemia	10.8		
Total cholestrerol (mg/dl)		166.5±66.1	89–600
Borderline elevation	4.8		
Hypercholesterolemia	3.6		
End-organ damage			
Protein excretion (mg/m^2/hour)		3.27±27.9	0.24–42.7
Proteinuria	9.6		
Microalbumin excretion (mg/day)		16.4±31.6	0.30–189.6
Microalbuminuria	12		
LVMI		0.4255±0.5982	0.2864–0.8970
LVH	14.5		
HTRP	4.8		
Treatments			
No drug	45.8		
One antihypertensive	21.6		
Two antihypertensives	24.1		
Three antihypertensives	8.4		
Losartan	26.5		
Amlodipine	19.3		
Diuretics	19.3		
Enalapril	18.1		
Propranolol	2.4		
Metoprolol	6		

BMI: Body mass index; BP: Blood pressure; HT: Hypertension; eGFR: Estimated glomerular filtration rate; LVMI: Left ventricular mass index; LVH: Left ventricular hypertrophy; HTRP: Hypertensive retinopathy.

The mean end-of-semester grades of patients with symptoms that may be related to HT such as headache, epistaxis and palpitations were lower than those of patients without complaints for all courses. This difference in GPAs reached statistically significant levels for the headache symptom in Mathematics and English courses (p=0.032 and p=0.028, respectively), for epistaxis in Mathematics, Turkish Language and Literature and English courses (p=0.015, p=0.038 and p=0.028, respectively), and for palpitation symptom in Mathematics and Turkish Language and Literature courses (p=0.006 and p=0.030, respectively).

No statistically significant correlation was found between fasting blood glucose, eGFR and total cholesterol level and end-of-semester course GPAs. However, patients with hyperuricemia had statistically significantly lower end-of-semester GPAs in all courses compared to patients with normal serum uric acid levels (p<0.05 for all).

In the comparisons made in terms of end organ damage, no statistically significant relationship was found between microalbuminuria and end-of-semester GPAs. In the presence of proteinuria, the mean end-of-semester GPAs were lower in all courses compared to patients without proteinuria (p<0.05, for all). There was also no correlation between HTRP and final GPAs. In those with LVH, the final GPAs were lower in all courses, but not statistically significant.

When the number of visits to various departments of our hospital in the last year and the final GPAs of the patients were evaluated, the GPAs were found to be lower with a strong level of significance as the number of visits increased for Mathematics and Turkish Language and Literature courses (p=0.000 and p=0.006, respectively).

The relationships between the end-of-semester GPAs of the patients and HT-related clinical conditions are shown in Appendix 1.

DISCUSSION

Hypertension is associated with poor cognitive functions, especially in the middle-aged population. In a large adult study on patients with a mean age of 58.9 years, patients with HT and elevated BP showed a global decline in cognitive functions. HT was associated with a decreased memory test and elevated BP was associated with a decreased fluency test. Interestingly, cognitive function and memory test scores improved in treated patients with normal BP measurements [18]. In another adult study conducted according to HT stages, cognitive performances were worse in patients with stage 2 HT than those with stage 1 HT or normotensive patients. In neuropsychological tests, patients with HT performed worse in terms of language, processing speed, visuospatial abilities and memory [19].

Hypertension is associated with poor cognitive functions not only in adults, but also in children. In a study by Lande et al. [20] in which participants were matched for gender, age, race, obesity, family income, maternal education and intelligence quotient (IQ), it was shown that executive functions were reduced in children with HT. In another study conducted with a total of 201 children aged 10–18 years with elevated BP and HT, there was a 4-fold increased risk of having learning disability in patients with HT. Besides, attention deficit was more common in hypertensive patients. That study showed that hypertensive children were at higher risk for academic difficulties [21]. Similarly, in our study, the mean end-of-semester GPAs seemed to be lower as the HT stage increased. Besides, we detected significantly lower GPAs in patients with more antihypertensive need, which indicate presence of a more severe underlying HT status.

Hypertension causes cerebral small vessel disease leading to neurocognitive impairment. Endothelial activation is suggested to underlie in the pathogenesis [22]. In a study by Uiterwijk et al. [23], it was shown that soluble vascular cellular adhesion molecule-1, soluble intercellular adhesion molecule-1, P-selectin, and E-selectin, which are markers of endothelial activation, were higher in HT patients. In multiple linear regression analyses, increased endothelial activation was associated with worse cognitive performance independent of other factors [23].

Arterial stiffness is a parameter associated with target organ damage and is known to be higher in patients with stage 2 HT [24]. In a recent study by Kavgaci et al. [25] it was shown that arterial stiffness was higher in overweight and obese children than in normal weight children. Besides, systolic and diastolic BP measurements were correlated with pulse wave velocity in that study [25]. Arterial stiffness adversely affects cerebral microcirculation by increasing microvascular resistance, leading to cerebral hypoperfusion, white matter damage and even serious cerebrovascular events such as stroke. Therefore, patients with arterial stiffness can be considered to be prone to decreased neurocognitive functions [26]. Similarly, in a previous study, increased augmentation index and pulse wave velocity, which are indicators of arterial stiffness, were shown to be associated with lower cognitive function [24]. Lamballais et al. [27], also reported that arterial stiffness and decline in cognitive functions may be detected not only in adults but also in children. A limitation of our study is that arterial stiffness was not specifically evaluated. However, considering the presence of high BP in the study population with accompanying obesity in a significant proportion of the cases, we believe that arterial stiffness might have developed. In addition, we observed a slight decrease in the end-of-semester GPAs as the HT stage increased. Therefore, we think that arterial stiffness itself might possibly contributed to the low end-of-semester GPAs in our obese and/or hypertensive patients.

A study by Cottrell et al. [28] reported that BMI may decrease cognitive functions through a mechanism different from arterial stiffness. In their study, independent of BP values they found a decrease in children's reading/language arts and Mathematic scores as BMI increased [28]. The association between obesity and low neurocognitive status may also be due to obstructive sleep apnea, a condition associated with poor performance on neurocognitive tests and academic difficulties in obese children [29]. In our study, it was shown that children with higher BMI had lower end-of-semester GPAs in Mathematics. The fact that sleep apnea was not evaluated in our study can also be considered as another limitation. We suggest that children with obesity and low school achievements should be evaluated in detail in terms of obstructive sleep apnea.

Hyperuricemia impairs vascular function by disrupting the renin angiotensin aldosterone system and by causing inflammation and oxidative stress. Enzymatic degradation of xanthine, a precursor for uric acid production, leads to the production of superoxide anions, causing endothelial injury [30]. Studies in elderly patients have shown that uric acid may exert neuroprotective effects in Alzheimer's disease and Parkinson's dementia, with hypouricemia being a possible marker of malnutrition and a risk factor for faster disease progression. However, high serum uric acid levels can also cause tissue hypoxia and adversely affect disease progression in vascular dementia [31]. Pediatric studies in this field are quite limited. In a study conducted in patients treated for leukemia, adolescents with hyperuricemia had poorer attention, visual processing speed and cognitive flexibility [32]. In our study, end-of-semester GPAs were significantly lower in adolescents with hyperuricemia. The presence of factors that may cause endothelial damage such as obesity and HT together with hyperuricemia in our patients may suggest that hyperuricemia causes cerebral vascular damage rather than its antioxidant properties and thus affects school performance poorly.

In a study in which the relationship between hypertensive organ damage and cognitive functions was evaluated, 78 children were followed up for 9 years and it was shown that increased LVMI was associated with lower cognitive functions independent of age, gender, premorbid status and brain damage, while eGFR and albuminuria alone did not impair cognitive functions. However, it has been reported that the coexistence of at least two target organ damage, which is an indicator of more severe hypertensive disease burden, may adversely affect cognitive functions in the future [33]. In our study, end-of-semester GPAs were lower in patients with high LVMI and LVH. Although we did not have any patients with low eGFR, no significant correlation was found between eGFR and microalbuminuria and GPAs. However, GPAs were lower in all courses in the presence of proteinuria, which is an indicator of more severe renal impairment compared to microalbuminuria. The decrease in GPAs in the presence of target organ damage may be explained by the fact that patients have more symptoms due to these organ damages or partly due to the need for referral to various departments such as cardiology and ophthalmology and the increase in the number of days away from formal education due to the increased number of hospital visits.

Conclusion

Attention should be drawn to the fact that HT is not only a disease that is associated with physical problems, cardiovascular complications and CKD development, but it may also cause neurocognitive disorders through various pathophysiologic mechanisms and may have an adverse effect on academic skills. Therefore, it is important that HT should be followed up with a multidisciplinary approach, and all efforts should be made in order to be closer to the goal of normotension.

Ethics Committee Approval: The Gazi University Clinical Research Ethics Committee granted approval for this study (date: 12.03.2024, number: 05).

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Appendix 1. The relationships between the end-of-semester GPAs of the patients and HT-related clinical conditions

	Mathematics			Turkish language and literature			Foreign language (English)		
	Mean±SD	Min–Max	p	Mean±SD	Min–Max	p	Mean±SD	Min–Max	p
Sex			0.231			0.131			0.446
Males, n (%)	73±11	45–90		80.9±8.2	60–100		75.4±15.9	45–100	
Females, n (%)	76.1±11.9	45–92		83.8±8.5	60–98		78.2±17.4	45–100	
BMI groups			0.007			0.004			0.083
Normal	77.6±9.4	55–90		83.5±6.6	68–98		79.2±16.3	45–100	
Overweight	75.1±11.6	50–92		85±7.5	65–100		78±17.8	52–100	
Obese	69.5±12.8	45–89		78.6±10.2	60–98		73.5±14.8	45–95	
Morbidly obese	62.5±6.4	55–70		72±6.7	65–80		58.7±11	45–70	
Blood Pressure			0.519			0.505			0.586
Normal	75.2±12.1	45–90		82.9±9.5	60–98		78.1±18.1	45–100	
Elevated BP	69.3±17.8	45–90		79.7±9.9	68–98		73.6±15.2	50–95	
Stage 1 HT	73.4±7.9	65–92		80.2±5.5	65–90		73.4±13.9	52–95	
Stage 2 HT	71.8±7.9	60–85		77.9±7.7	68–100		72.1±16.2	45–95	
Treatments			0.000			0.011			0.001
No drug	77.9±11.3	45–92		83.4±7.9	60–98		83.7±14.4	45–100	
One antihypertensive	76.2±8.4	60–90		84±7.4	68–98		73.6±17.4	45–95	
Two antihypertensives	70.2±10.1	65–100		80.6±8.5	65–100		69.7±15.7	45–95	
Three antihypertensives	60.4±9	60–80		72.8±8	60–80		63.8±9.4	50 –77	
Complaints									
Headache			0.032			0.065			0.028
Yes	69.5±12	45–90		78.9±8.5	60–90		69.5±15.6	50–95	
No	75.4±10.8	45–92		82.9±8.2	60–100		78.7±16.2	45–100	
Epistaxis			0.015			0.038			0.028
Yes	66.1±10.4	45–80		78.6±8.3	60–85		65.8±14.3	45–91	
No	75.3±11.1	45–92		82.6±8.2	60–100		77.9±16.2	45–100	
Palpitation			0.006			0.030			0.100
Yes	62.1±10.1	45–70		74.8±9.8	60–84		65.8±11.4	50–78	
No	75.1±11	45–92		82.5±8.1	60–100		77.3±16.5	45–100	
Blood biochemistry									
Plasma glucose			0.123			0.116			0.108
Normal	75.2±11.6	45–92		82.7±8.1	60–100		78.4±15.4	45–100	
Impaired fasting glucose	68.7±9.3	55–89		77.7±9.3	65–98		64.9±17.4	45–95	
Hyperglycemia	80±1.1	79–81		85±4.9	81–89		91±6.4	85–97	
eGFR			0.304			0.616			0.321
Normal	74.4±11.4	45–92		82±8.4	60–100		76.7±16.4	45–100	
Hyperfiltration	66±11.3	58–74		79±12.7	70–88		65±21.1	50–80	
Uric acid			0.027			0.015			0.049
Normal	75.2±11.3	45–92		82.7±8	60–100		77.7±16	45–100	
Hyperuricemia	66.3±9.3	55–80		75.5±9.1	60–85		66.3±17.4	45–91	
Total cholestrerol			0.148			0.197			0.591
Normal	74.6±10.7	45–90		82.3±8.2	60–100		76.5±16.4	45–100	
Borderline elevation	76±15.6	55–92		82.5±6	74–88		81.2±13.7	65–95	
Hypercholesterolemia	61.6±20.8	45–85		73.3±15.2	60–90		68.3±23.6	50–95	

Appendix 1 (cont). The relationships between the end-of-semester GPAs of the patients and HT-related clinical conditions

	Mathematics			Turkish language and literature			Foreign language (English)		
	Mean±SD	Min–Max	p	Mean±SD	Min–Max	p	Mean±SD	Min–Max	p
End-organ damage									
Microalbumin excretion			0.439			0.276			0.252
Normal	74.5±11.5	45–92		82.3±8.3	60–100		77.1±16.3	45–100	
Microalbuminuria	71.2±10.1	58–88		78.8±9.3	68–90		70.1±17.4	45–97	
Protein excretion			0.021			0.025			0.005
Normal	75.3±11.2	45–92		82.7±8	60–100		78.3±16	45–100	
Proteinuria	66.5±10	45–80		76.4±9.8	60–88		63.1±13.6	45–84	
LVH			0.243			0.802			0.058
No	74.8±11.5	45–92		82±8.5	60–98		77.9±16.2	45–100	
Yes	70.6±10.5	45–85		81.4±8.1	68–100		68.1±16.1	45–95	
HTRP			0.788			0.204			0.600
No	74.1±11.5	45–92		81.7±8.4	60–98		76.7±16.2	45–100	
Yes	75.7±9	68–85		87.2±8.6	82–100		72.2±23.4	52–95	
Hospital visits			0.000			0.006			0.000
1–2 visits	79.5±9.5	55–92		84.7±6.4	70–98		84.8±12.8	45–100	
3–4 visits	70.9±9.2	50–90		80.2±8.5	60–100		68.7±16.2	45–95	
5–6 visits	62.3±15.3	45–89		75.7±12.3	60–98		68.7±14.7	50–100	

BMI: Body mass index; BP: Blood pressure; HT: Hypertension; eGFR: Estimated glomerular filtration rate; LVH: Left ventricular hypertrophy; HTRP: Hypertensive retinopathy.