Journal of Clinical and Nursing Research, 2025, Volume 9, Issue 6
http://ojs.bbwpublisher.com/index.php/JCNR
Online ISSN: 2208-3693
Print ISSN: 2208-3685

Clinical Study on the Effect of Elderly Hypertension in Yunnan on Glomerular Filtration Rate

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Abstract: *Objective*: As the prevalence of chronic diseases among the elderly increases year by year, chronic renal insufficiency caused by hypertension has become a hot issue of concern to society and even the world. *Methods*: This article conducted a retrospective analysis of 1856 elderly people over 65 years old, with a follow-up time of 6 years. The aim is to compare the decline in estimated glomerular filtration rate (EGFR) between hypertensive and non-hypertensive populations under non-intervention conditions, and to explore the impact of blood pressure on EGFR in the elderly. *Results*: The incidence of hypertension among the elderly in this region is significantly higher than the national level. The EGFR value of hypertensive patients is significantly lower than that of non-hypertensive people. There is a difference in the percentage decline in EGFR between hypertensive and non-hypertensive populations under non-intervention conditions, with hypertensive patients experiencing a higher rate of EGFR decline. When blood pressure is lower than 120/80 mmHg, the EGFR decline ratio is lower compared to when blood pressure is higher than 120/80 mmHg. *Conclusion*: Lowering blood pressure can effectively slow down the decline of EGFR, and the prevalence of hypertension should be reduced.

Keywords: Elderly; Hypertension; EGFR decline ratio; Non-intervention

Online publication: July 8, 2025

1. Introduction

Population aging is a common problem faced by countries around the world. As aging intensifies, the number of elderly people with hypertension increases accordingly. Currently, there are 245 million hypertensive patients, and this number is increasing year by year. The overall blood pressure control in elderly hypertensive patients is not ideal, and there are many complications [1]. It is common for elderly hypertensive patients to experience a decline in renal function. For hypertensive patients, the assessment of target organ damage is more significant than the mere value of hypertension, especially for the elderly. Therefore, it is particularly important to correctly

identify the risk factors of major target organs [2]. The estimated glomerular filtration rate (EGFR) can reflect the degree of renal function damage more sensitively and early than creatinine and urinary microalbumin [3]. However, there is currently relatively little research on the progression of kidney disease in elderly hypertensive patients, especially in comparison to changes in renal function in non-hypertensive elderly patients [4]. This study aims to track data from 1856 elderly people over 65 years old in Guandu District, Kunming City, who underwent physical examinations in 2017 and 2023. The goal is to compare whether there is a significant difference in the rate of EGFR decline over six years between hypertensive patients and non-hypertensive individuals under non-intervention conditions. Additionally, the study explores whether controlling blood pressure can affect the rate of EGFR decline and effectively protect renal function. Through this research, it is hoped to provide a deeper understanding and guidance for hypertension management and renal function protection in the elderly population.

2. Subjects and methods

2.1. Subjects

This study employs a cross-sectional analysis method and is retrospective. It focuses on 1,856 elderly individuals who participated in free health screenings for those over 65 years old in Guandu District, Kunming, both in 2017 and 2023.

Inclusion criteria are:

(1) Voluntary participation in the health screening by elderly individuals aged 65–80 in 2017.

(2) Participation in the screening program in both 2017 and 2023.

Exclusion criteria are:

(1) Patients who were on dialysis during the 2017 screening.

(2) Individuals over 80 years old during the 2017 screening. This study does not involve ethical issues; thus, no informed consent form was signed.

2.2. Methods

2.2.1. Data source

This study retrospectively analyzed 1,856 elderly individuals aged 65–86, including 678 males (36.53%) and 1,178 females (63.47%). The average age is 71.88 years (median 72.5) in 2017 and 77.88 years (median 78.5) in 2023. These 1,856 elderly individuals underwent health screenings in 2017 and 2023, including liver and kidney function tests, blood glucose, blood lipids, and ultrasound examinations. The research team compared and analyzed changes in EGFR, hypertension incidence, and blood pressure control compliance rates over six years without any intervention.

Data collection for the 2017 screening is done manually. Team members accessed the medical system and manually extracted and organized participant data. For the 2023 screening, some data are collected manually, while other parts are matched by medical staff. Through phone number matching, 2,000 elderly individuals who participated in both screenings are identified. After excluding those over 80 in 2017, those on dialysis for End-Stage Renal Disease (ESRD), and those with incomplete data, 1,856 elderly individuals were matched for analysis. These 1,856 participants came from nine community centers in the Guandu District. The participation rate and gender composition of each community center are shown in **Table 1**. The table indicates that the

female population is larger than the male population, possibly due to women valuing the free screening more. It also suggests that women have a longer average lifespan than men. Since the same group of people participated in both screenings, there are no comparative differences.

Table 1. Proportion of health screening participants from each community and gender

Area	Total examined	Proportion	Male	Proportion	Female	Proportion
Jinma	338	18.20%	114	33.80%	224	66.20%
Xiaobanqiao	170	9.00%	66	38.82%	104	61.18%
Guandu	249	13.30%	76	30.52%	173	69.48%
Liujia	144	7.70%	60	42.67%	84	57.33%
Yiliu	64	3.50%	20	31.25%	44	68.75%
Dabanqiao	238	12.50%	89	37.39%	149	62.61%
Taihe	159	8.50%	53	33.33%	106	66.67%
Wujing	151	8.10%	62	41.06%	89	58.94%
Guanshang	343	18.40%	138	40.23%	205	59.77%
Total	1856	100%	678	36.53%	1178	63.47%

2.2.2. Methods

All elderly participants are informed the day before to attend a health check-up the next day. On the day of the check-up, they arrived at the community center on an empty stomach for blood draws. The biochemical testing equipment used at all nine community centers was the Dirui CS-600B biochemical analyzer. The reference range for creatinine in the test results (for both 2017 and 2023) is 31.8–93.7 umol/L. Blood pressure is measured twice in the right upper limb using a mercury blood pressure monitor in a resting state, and the average value is taken. Past medical histories are collected and gathered by community doctors during the check-up. EGFR is calculated using the formula: EGFR = 186 * Scr^(-1.154) * Age^(-0.203) * 1 (for females: 0.742). Blood creatinine value, age, and gender are input into the glomerular filtration rate formula to obtain the EGFR [5]. All statistical data are double-checked.

2.2.3. Statistical analysis

SPSS 21.0 software is used for the analysis of the health check-up data. Comparisons between the two groups were made using t-test and chi-square test ($\chi 2$). Count data are expressed as the number of cases and percentages. A *P*-value of less than 0.05 is considered statistically significant.

3. Results

3.1. Comparison of blood pressure control rates and EGFR decline between blood pressure-controlled and uncontrolled groups in two health check-ups

Based on past medical histories, there were 858 hypertensive patients in 2017 (334 males and 524 females) and 915 hypertensive patients in 2023 (354 males and 561 females). Over six years, there was an increase of 57 hypertensive patients among the 1856 elderly individuals. The incidence rate of hypertension among those aged

65 and above was 46.23% in 2017 and 49.30% in 2023. According to the China Hypertension Prevention and Treatment Guidelines (2024 Revised Edition) released by the Beijing Hypertension Prevention and Treatment Association, the weighted prevalence rate of hypertension among adults aged 18 and above in China was 27.5% in 2018 [6]. The comparison shows that the incidence rate of hypertension among the elderly in this region is significantly higher than the national average, and it increases with age. Additionally, a significant differences in EGFR values between hypertensive and non-hypertensive patients, both in 2017 and 2023, was observed. Over six years, excluding the influence of time, the EGFR decline in the two groups was 9.59 ml/min and 7.2 ml/min, respectively. The percentage decline was 13.28% and 8.32% ($P < 0.05$), indicating a statistically significant difference (**Figure 1** and **Figure 2**).

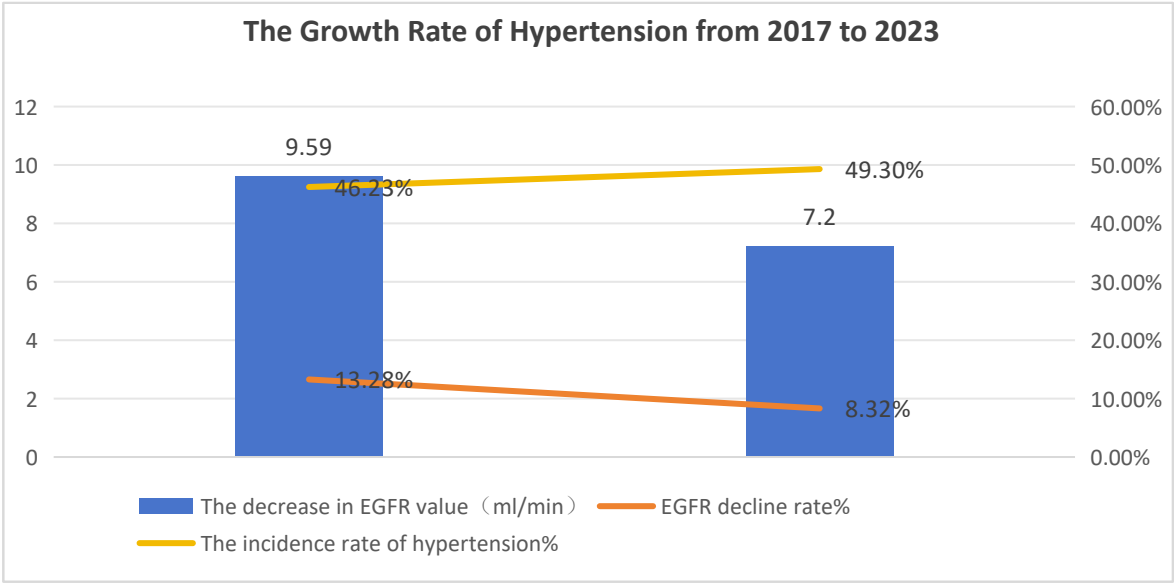

Figure 1. Comparison of EGFR decline rates and hypertension incidence between hypertensive and non-hypertensive populations in two health check-ups.

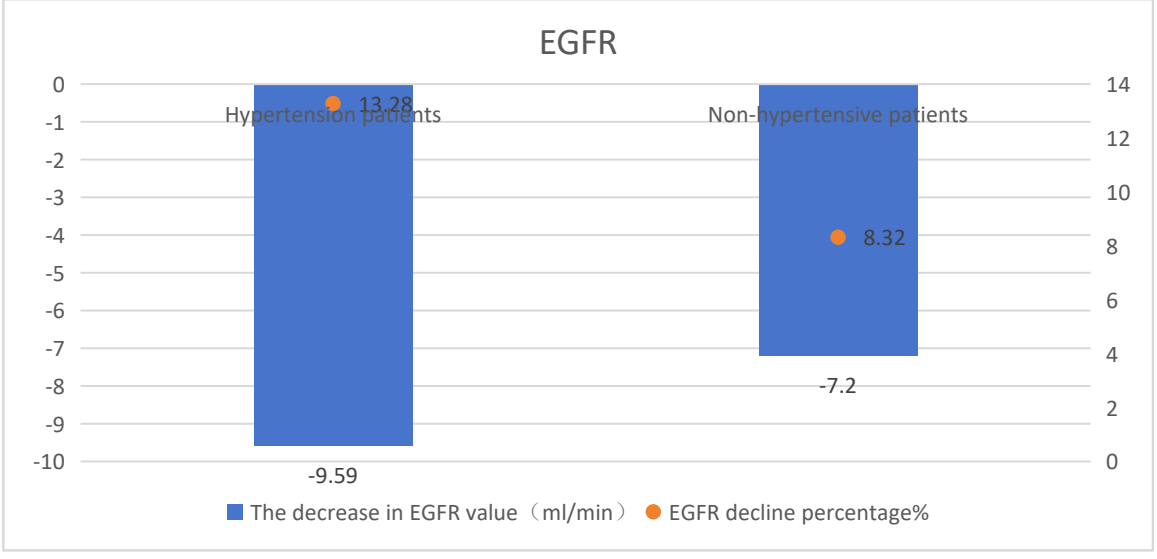

Figure 2. Comparison of EGFR decline between hypertensive and non-hypertensive populations in two physical examinations

3.2. Analysis of two physical examination results across different age groups

Excluding 57 hypertensive patients added in 2023, the 1799 cases were divided into 858 hypertensive patients and 941 non-hypertensive patients. A comparative analysis was conducted by grouping them according to their age during the 2017 physical examination, with 5-year intervals. It was observed that the percentage decrease in EGFR among hypertensive patients was greater than that of non-hypertensive patients in all age groups. Notably, in the 70–74 age group, the EGFR decline among hypertensive patients was significantly steeper than that of non-hypertensive patients. Upon analysis, it was found that the blood pressure control rate among hypertensive patients in this age group was relatively low. Therefore, it can be inferred that there are significant differences in the impact on EGFR values across different age stages (see **Table 2**).

Table 2. Comparison of EGFR decline percentage between hypertensive and non-hypertensive patients in different age groups

Age group	2017 EGFR value		2023 EGFR value	
	Non- hypertensive	Hypertensive	Non- hypertensive	Hypertensive
65–69 years	89.84	84.40	83.67	75.68
70–74 years	86.38	80.68	81.43	73.05
75–79 years	81.78	77.28	76.25	70.51
Age group	**EGFR decline rate**		**P- value**	
	Non- hypertensive	**Hypertensive**		
65–69 years	6.87%	10.33%	0.008	
70–74 years	5.73%	9.46%	0.004	
75–79 years	6.76%	8.76%	0.010	

3.3. Impact of blood pressure on EGFR

The EGFR values of 858 hypertensive patients among 1856 individuals who underwent physical examinations in 2023 were analyzed. The patients are categorized based on their SBP (greater than 140mmHg, 120–140 mmHg, less than 120 mmHg) and DBP (greater than 90mmHg, 80–90 mmHg, less than 80 mmHg). It was observed that higher blood pressure corresponded to lower EGFR values. Notably, when blood pressure was below 120/80 mmHg, the EGFR value was 82.39. Patients with either SBP below 120 mmHg or DBP below 80 mmHg had the best EGFR values ($P < 0.05$). Therefore, actions should be taken to lower patients' blood pressure below 120/80 mmHg whenever possible. Controlling blood pressure can delay the progression of chronic kidney disease or the occurrence of complications [6].

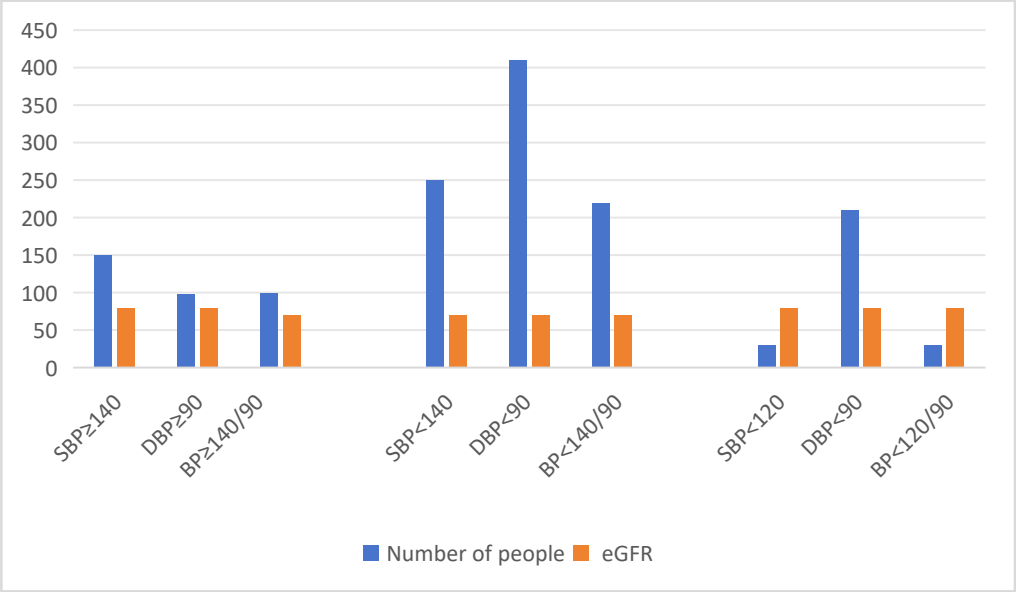

Figure 3. Impact of blood pressure on EGFR

4. Discussion

Essential hypertension (EH) is a polygenic genetic disease influenced by both genetic background and environmental factors. It is a risk factor for the onset and death of cardiovascular and cerebrovascular diseases. The kidney is not only an important organ that causes hypertension but also a target organ damaged by hypertension. Epidemiological data shows that the number of patients progressing to chronic kidney disease (CKD) due to hypertension is increasing year by year. The close relationship between independent factors of hypertensive nephropathy and patient mortality has received increasing attention. Some experimental research conclusions in recent years suggest that EGFR, urinary microalbumin, and insulin resistance are independently associated with renal function impairment in patients with EH and are also independent risk factors for cardiovascular event fatality in hypertensive patients [7]. The "Chinese Guidelines for the Prevention and Treatment of Hypertension" points out that for every 5 mmHg reduction in diastolic blood pressure, the risk of developing end-stage renal disease can be reduced by 1/4 [8]. Good control of hypertension to reduce cardiovascular disease mortality and prevent or delay the occurrence and development of hypertensive nephropathy is an important issue faced by clinicians and patients [9].

Chronic kidney damage caused by long-term hypertension can affect multiple sites such as glomeruli, renal tubules, renal interstitium, and renal blood vessels, which can progress to ESRD. The pathogenesis of CKD is complex and not fully understood, but the following related mechanisms have been proven to be closely related to the onset of CKD: changes in glomerular hemodynamics, overactivity of the renin-angiotensin-aldosterone system, excessive generation of reactive oxygen species and inflammatory factors, genetic and epigenetic disorders, and other factors may be related to CKD [10, 11]. Additionally, elevated systolic blood pressure may damage the glomeruli through endothelial cells and glomerular epithelial cells, leading to glomerulosclerosis, inducing renal lesions, forming renal function decline, and resulting in decreased EGFR [12]. Elevated systolic blood pressure can also cause the deposition of substances such as lipids in the body, forming macrophage infiltration and phagocytosis, which can cause inflammatory damage to the renal parenchyma [13, 14]. Therefore,

early prevention, early diagnosis, and early treatment of CKD are particularly important for delaying the progression of CKD and improving patients' quality of life [15]. EGFR is a specific indicator of hypertensive nephropathy and has important reference significance for judging renal function decline and clinical treatment effects [16].

5. Conclusion

In summary, the incidence of hypertension among elderly people in this region is significantly higher than the national level. The EGFR values of hypertensive patients are significantly lower than those of non-hypertensive people. There are differences in the percentage of EGFR decline between hypertensive and non-hypertensive populations, with a higher rate of EGFR decline in hypertensive patients. Lowering blood pressure in a non-intervention state can alleviate the decline in EGFR and protect renal function. Blood pressure, which should be below 120/80 mmHg without contraindications, needs to be controlled to effectively slow down the declining trend of EGFR. Simultaneously, the management of hypertensive risk factors should be strengthened, to reduce the prevalence of hypertension, and reduce hypertensive kidney damage.

Funding

"Clinical Research on Chronic Disease Screening and Therapeutic Guidance for Elderly People Over 60 Years Old" Kunming Science and Technology Plan Project (Project No.: 2017-1-S-15382)

Disclosure statement

The authors declare no conflict of interest.

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