Original Article

Caspian Journal of Internal Medicine 2025 (Autumn); 16(4): 741-746
DOI: 10.22088/cjim.16.4.741

Association between triglyceride-glucose index and nephrolithiasis among the elderly in Amirkola: A cross-sectional population-based study

Parsa Aghajani [1]
Seyed Reza Hosseini (MD, MPH) [2*]
Ali Bijani (MD, PhD) [2]
Reza Ghadimi (MD, PhD) [2]

1. Student Research Committee, Babol University of Medical Sciences, Babol, Iran
2. Social Determinants of Health Research Center, Health Research Institute, Babol University of Medical Sciences, Babol, Iran

*** Correspondence:**
Seyed Reza Hosseini, Social Determinants of Health Research Center, Health Research Institute, Babol University of Medical Sciences, Babol, Iran

E-mail:
hosseinirezaseyed@gmail.com
Tel: +98 1132199936

Received: 12 Nov 2024
Revised: 23 June 2025
Accepted: 13 July 2025
Published: 18 Oct 2025

Abstract

Background: Kidney stones are a condition that is prevalent in the geriatric group and significantly impairs their quality of life. The formation of stones may be associated with insulin resistance, which can be measured using the triglyceride-glucose (TyG) index.

Methods: This cross-sectional study was part of the second phase of the Amirkola Health and Ageing Project (AHAP) Cohort, which was initiated in 2011 with a focus on individuals aged 60 years and older. The study population included a case group comprising 349 individuals diagnosed with kidney stones and a control group of 349 individuals without kidney stones, matched by age and sex. The data have been analyzed afterwards.

Results: The mean TyG index was 4.77±0.33 in individuals with kidney stones and 4.75±0.34 in the group without kidney stones. The observed difference did not achieve statistical significance. Moreover, after logistic regression analyses, both crude and adjusted logistic regression analyses indicated no statistically significant relationship between the TyG index and the presence of kidney stones in the studied population.

Conclusion: The findings of this study indicate that there is no significant link between the TyG index and the occurrence of kidney stones among older adults.

Keywords: Nephrolithiasis, Elderly, Population, Insulin Resistance, TyG Index.

Citation:
Aghajani P, Hosseini SR, Bijani A, Ghadimi R. Association between triglyceride-glucose index and nephrolithiasis among the elderly in Amirkola: A cross-sectional population-based study. Caspian J Intern Med 2025; 16(4): 741-746.

Kidney stones are a common medical condition, with a dramatic increase in incidence in the past decades. In the USA, the expense of diagnosis of kidney stones has been calculated to be 10 billion dollars annually (1). The prevalence is particularly higher among the elderly. Based on the National Health and Nutrition Examination Survey (NHANES), 1.5% of male subjects aged 20–39 are affected, increasing to 19% in those aged 80 and above. Prevalence of 5.8% and 6.1% occurs in females in these age groups, respectively (2). Insulin resistance has been found to be a significant contributor to increased risk of kidney stone formation (3). The mechanisms linking insulin resistance to a higher occurrence of kidney stones include decreased ammonium production in the nephrons, thus causing acidification of the urine (4), and decreased levels of citrates and increased urinary calcium levels (5, 6). Among the methods through which insulin resistance can be quantified is through the calculation of the triglyceride-glucose index (TyG). This method has been viewed as valid, simple, and reproducible and entails fasting blood triglyceride and glucose measurement (7). Limited studies have been carried out to investigate the relationship between the TyG index and kidney stones, but the results have been inconsistent. Moreover, there is a lack of focused studies on this issue in geriatric groups. As a result, the present study seeks the relationship between TyG index and kidney stones in individuals aged 60 and above residing in Amirkola.

Methods

Study population: This case-control study is part of the second phase of the Amirkola Health and Aging Project (AHAP), registered under number 82917. Initiated in 2011, AHAP is concentrating on people aged 60 and over living in Amirkola, a city in the North of Iran (8). This research was approved by the Ethics Committee of Babol University of Medical Sciences (Ethical code No. IR.MUBABOL.HRI.REC.1401.261) and written consent was obtained from all participants before joining the study. AHAP second phase enrolled the participants between April 2016 and November 2017 (9). Case group consisted of individuals with kidney stones (n = 349) and were matched by age and sex with an equal number of individuals without kidney stones as control group (n = 349). The exclusion criteria were loss of a follow-up or insufficient data.

Data collection and definitions: The history of kidney stones was collected by asking elderly individuals the question, "Has a doctor ever told you that you have kidney stones?" To ensure accuracy, we cross-checked their responses with their companions. For those whose response was positive, we conducted additional verification by reviewing the patient's prescriptions and medications. Pars-Azmoon kits (Tehran, Iran) and the DiaSys Respons 910 auto analyzer (Holzheim, Germany) were used to analyze blood samples in the Caspian Core Research Laboratory located in Amirkola. The TyG index calculation was carried out by using the formula: Ln [fasting triglycerides (mg/dL) × fasting plasma glucose (mg/dL)/2] (7). Moreover, all other specific evaluation methods related to the study were described in the AHAP Phase 1 and 2 studies (8, 9).

Statistical analysis: Descriptive statistics, like the mean and standard deviation, were used for numerical variables, whereas frequency and percentage were utilized for categorical variables. The chi-square test was employed to evaluate categorical variables, and the independent sample t-test for numerical variables. To examine the relationships between different factors, the Pearson correlation coefficient was calculated. A logistic regression analysis was conducted with three models to examine the effect of the main variables on the prevalence of kidney stones, with adjusted odds ratios (aOR) with a 95% confidence interval (CI). The first model focused on kidney stones as the dependent variable and the TyG index as the independent variable. The second model added factors such as blood pressure, BMI, diabetes, PASE score, uric acid, and cholesterol. The third model involved daily intake of fats, proteins, carbohydrates, and energy. SPSS Version 22 was used for all statistical analyses, where a p-value of less than 0.05 was considered a sign of statistical significance.

Results

This study was conducted on 698 elderly individuals aged over 60 years old living in Amirkola and divided into case and control groups, as shown in table 1, age and sex matched. Table 1 displays the baseline characteristics of the participants. The mean age in the kidney stone and non-kidney stone groups was 70.23±7.24 years and 70.27±7.52 years, respectively. Most individuals were in the age range of 65–69 years. Representing 95 participants (27.2%), while the least number of participants were in the age group of 85 years and older, representing 12 participants (4.3%). Each group contained 223 men, which accounted for 63.9% of the total population, and 126 females, representing 36.1%. Hypertension was more prevalent in individuals with kidney stones (79.6% vs. 68.5%, $p < 0.01$) and the prevalence of diabetes was higher among individuals without kidney (30.9% vs. 27.2%), although this difference was not statistically significant.

Table 2 presents the mean and standard deviation of the quantitative variables studied in the elderly with and without kidney stones. The TyG index mean was 4.77±0.33in those with kidney stones, while it was 4.75±0.34 in those without kidney stones. The kidney stone group had a higher average BMI (28.4 vs. 28.06) and uric acid levels (5.32 vs. 5.10). In addition, the PASE score was greater in those who did not have kidney stones (101.32 vs. 94.69); however, none of these differences reached statistical significance.

Table 1. Baseline characteristics of elderly participants with and without kidney stones AHAP 2016–2017

Characteristic	With kidney stone (n = 349) Number (percentage)	Without kidney stone (n = 349) Number (percentage)	P -value
Age group			
60-64	90 (25.8)	90 (25.8)	
65-69	95 (27.2)	95 (27.2)	
70-74	65 (18.6)	65 (18.6)	1.00
75-79	52 (14.9)	52 (14.9)	
80-84	35 (10)	35 (10)	
85 ≤	12 (3.4)	12 (3.4)	

Characteristic	With kidney stone (n = 349) Number (percentage)	Without kidney stone (n = 349) Number (percentage)	P -value
Sex			
female	126 (36.1)	126 (36.1)	1.00
male	223 (63.8)	223 (63.8)	
Hypertension			
Yes	277 (79.6)	239 (68.5)	0.01
No	72 (20.6)	110 (31.5)	
Diabetes			
Yes	95 (27.2)	108 (30.9)	0.27
No	254 (72.7)	241 (69)	

Table 2. Mean and standard deviation of quantitative variables studied in elderly individuals with and without kidney stones in AHAP 2016–2017

Variable	With kidney stone Mean± SD	Without kidney stone Mean± SD	P-value
TyG index	4.77±0.33	4.75±0.34	0.47
BMI (kg/m^2)	28.40±4.65	28.06±4.77	0.94
PASE score	94.69±56.33	101.32±61.34	0.13
FBS (mg/dl)	110.51±46.19	112.38±46.68	0.59
Triglyceride (mg/dl)	152.64±90.83	144.85±84.83	0.24
Cholesterol (mg/dl)	187±50.74	187.55±43.14	0.87
Uric acid (mg/dl)	5.32±1.73	5.10±1.91	0.11
Daily protein intake (gr)	60.51±22.68	61.78±22.17	0.45
Daily carbohydrate intake (gr)	295.19±103.26	302.58±111.05	0.36
Daily fat intake (gr)	52.28±26.92	54.18±27.09	0.35

SD: standard deviation, BMI: body mass index, PASE: physical activity scale for the elderly, FBS: fasting blood sugar.

By employing the TyG index, the data were divided into tertiles, as shown in table 3. It is notable that in tertile 1, there was a higher number of individuals with kidney stones (119 vs. 114), whereas in tertile 3, there was a higher number of individuals without kidney stones (121 vs. 111). However, the difference did not reach a statistically significant level. This research employed logistic regression models in three types to analyze the impact of confounding variables on kidney stones, as shown in table 4. The results in models 1–3 showed that the adjusted odds ratio (OR) and 95% confidence interval (CI) for the highest TyG tertile compared to the lowest were 1.13 [0.79–1.63], 0.94 [0.60–1.47], and 0.88 [0.61–1.51], respectively. Nevertheless, none of these ratios attained statistical significance.

Table 3. Frequency distribution and percentage of case and control groups based on TyG index tertile

Group type		<4.58	4.58-4.86	>4.86	P -value
With kidney stone	**Frequency**	119	119	111	0.72
	Percentage	34.1%	34.1%	31.8%	
Without kidney stone	**Frequency**	114	114	121	
	Percentage	32.7%	32.7%	34.7%	

Table 4. Adjusted odds ratio for the association between TyG index and kidney stone AHAP 2016-2017

Variable	Model 1 aOR [CI 95%]	P value	Model 2 aOR [CI 95%]	P value	Model 3 aOR [CI 95%]	P- value
TyG Tertile 1	1.00 (reference)	0.72	1.00 (reference)	0.95	1.00 (reference)	0.97
TyG Tertile 2	1.00 [0.69 – 1.43]	1.00	0.94 [0.64 – 1.38]	0.78	0.96 [0.65 – 1.41]	0.84
TyG Tertile 3	1.13 [0.79 – 1.63]	0.48	0.94 [0.60 – 1.47]	0.80	0.96 [0.61 – 1.51]	0.88

Note: adjusted covariates: Model 1: age, gender; Model 2: Model 1 plus hypertension, BMI, diabetes, PASE score, uric acid, and cholesterol; Model 3: Model 2 plus daily protein, fat, carbohydrate, and energy intake, CI, confidence interval; aOR, adjusted odds ratio.

Discussion

In this study of 698 adults, no significant statistical correlation was found between the TyG Index and kidney stones, both in crude and adjusted models. While prior studies have examined the relationship between insulin resistance indices and nephrolithiasis predominantly in younger populations, this study is the first to specifically assess the association between the TyG index and kidney stones within an elderly cohort. Previous research has shown mixed results. A large-scale study encompassing 120,000 participants reported no significant association between the TyG index and kidney stones (10). Similarly, a case control study found no significant association between the Homeostatic Model Assessment for Insulin Resistance Index (HOMA-IR) index and kidney stones (11). Some studies found variations in results based on gender, while some of them showed the association only in men (12, 13) and others only in women (14). Furthermore, some studies have found that the insulin resistance indices have a significant association with kidney stones, which contradicts our findings (15-16). Notably, in one study, the observed association was not observed in the extended logistic regression model (15).

Age-related differences may partly account for the discrepancies between our results and previous studies. Kidney stone prevalence peaks between ages 60 and 74, with 10–20% of cases occurring in individuals over 65 years old (17). Risk factors that predispose elderly individuals to nephrolithiasis, like decreased mobility, lowered fluid intake, chronic infection, menopause, decreased bone mass, and increased visceral fat, are more prevalent among the elderly (18). Additionally, no protective effect of dietary calcium against kidney stones exists in the elderly (19). Xingpeng et al. concluded that, contrary to other age groups, there is no association between systemic inflammation and kidney stones among individuals over 50 years old (20). It appears that some of the risk factors of kidney stones in the adult group may not encompass the elderly, with the TyG index potentially being one of them. Most of the discussed studies with a positive association used the NHANES data. And other studies using different data sources had equivocal findings, with the possibility of that race could influence this association. Both insulin resistance and kidney stone can be influenced by race. Studies have shown differences in insulin resistance (21) as well as the incidence of kidney stones (22) among the races. Despite that none of the articles were specifically conducted among the elderly or Iranian race, a previous study using AHAP data did not find an association between kidney stones and diabetes or metabolic syndrome (23), which is in agreement with the results of the current study.

Our study, while comprehensive, has some limitations that may affect the generalizability and interpretation of the results. The cross-sectional design makes not ideal in establishing cause-and-effect because of potential errors such as recording or recall bias. Recall bias is particularly common among elderly participants. To address this, we sought confirmation from their companions and reviewed the participants' medical prescriptions and records to improve accuracy. In addition, participants self-reported the incidence of kidney stones and not through verification by ultrasound or CT scan, which limits the accuracy of the study and impedes our ability to identify asymptomatic kidney stones. Furthermore, limitations include lacking information on participants' medication histories, a smaller sample size than similar studies, no investigation into other insulin resistance indices, insufficient data on sodium, calcium, oxalate, and fluid intake from diets, as well as no data on urinary calcium levels. Based on the result of this study, there is no significant association between the TyG

index and the occurrence of kidney stones in the elderly. These results suggest that the link between insulin resistance and kidney stones is complex and influenced by factors like age, race and gender. Further studies need to address the limitations of the present study to provide more precise data. Besides, future research should evaluate the impact of inflammation on kidney stones in elderly individuals to better understand its role in this condition. Understanding why the influence of insulin resistance on kidney stone formation may differ in elderly groups could help develop better ways to prevent kidney stones in this age group.

Acknowledgments

We sincerely appreciate the support of the Deputy for Research and Technology of Babol University of Medical Sciences, our team members at the Amirkola health centers, and all the elderly individuals who participated in this study.

Funding: The funding for this study was provided by the Deputy of Research and Technology at Babol University of Medical Sciences, under grant number 2242.

Ethics approval: The research conducted in this study adhered to the principles outlined in the Declaration of Helsinki and was approved by the Ethics Committee of Babol University of Medical Sciences (Ethical code No. IR.MUBABOL.HRI.REC.1401.261). Prior to any intervention, all participants provided written informed consent. The study was extracted from MD thesis of Parsa Aghajani of the Department of Health Research Institute, Babol University of Medical Sciences (thesis #3015). The authors have fully complied with ethical issues, such as plagiarism, data fabrication, and double publication.

Conflicts of interest: The authors have no conflicts of interest to disclose.

Authors' contribution: Supervision, Conceptualization and Data collection: Seyed Reza Hosseini; Data analysis: Ali Bijani; Manuscript drafting: Parsa Aghajani; Interpreted data and revised the manuscript: Seyed Reza Hosseini, Reza Ghadimi; Critical review and final editing: Seyed Reza Hosseini, Parsa Aghajani, Reza Ghadimi. All authors read and approved the final version of the manuscript.

References

1. Partin AW, Peters CA, Kavoussi LR, Dmochowski RR, Wein AJ. Campbell-Walsh Urology. 12th ed. Review; Chapter Urinary Lithiasis. Elsevier 2020; pp: 9253.
2. Chewcharat A, Curhan G. Trends in the prevalence of kidney stones in the United States from 2007 to 2016. Urolithiasis 2021; 49: 27-39.
3. Spatola L, Ferraro PM, Gambaro G, Badalamenti S, Dauriz M. Metabolic syndrome and uric acid nephrolithiasis: insulin resistance in focus. Metabolism 2018; 83: 225-33.
4. Li H, Klett DE, Littleton R, Elder JS, Sammon JD. Role of insulin resistance in uric acid nephrolithiasis. World J Nephrol 2014; 3: 237-42.
5. Nowicki M, Kokot F, Surdacki A. The influence of hyperinsulinaemia on calcium-phosphate metabolism in renal failure. Nephrol Dial Transplant 1998; 13: 2566-71.
6. Cupisti A, Meola M, D'Alessandro C, et al. Insulin resistance and low urinary citrate excretion in calcium stone formers. Biomed Pharmacother 2007; 61: 86-90.
7. Araujo SP, Juvanhol LL, Bressan J, Hermsdorff HHM. Triglyceride glucose index: A new biomarker in predicting cardiovascular risk. Prev Med Rep 2022; 29: 101941.
8. Hosseini SR, Cumming RG, Kheirkhah F, et al. Cohort profile: the Amirkola Health and Ageing Project (AHAP). Int J Epidemiol 2014; 43: 1393-400.
9. Bijani A, Ghadimi R, Mikaniki E, et al. Cohort profile update: The Amirkola Health and Ageing Project (AHAP). Caspian J Intern Med 2017; 8: 205-12.
10. Lee MR, Ke HL, Huang JC, Huang SP, Geng JH. Obesity-related indices and its association with kidney stone disease: a cross-sectional and longitudinal cohort study. Urolithiasis 2022; 50: 55-63.
11. Devasia D, Meiyappan K, Mohanraj PS, et al. Association between adiponectin and insulin resistance in diabetic urolithiasis. Oman Medical Journal 2017; 32: 131.
12. Kim S, Chang Y, Jung HS, et al. Glycemic status, insulin resistance, and the risk of nephrolithiasis: A cohort study. Am J Kidney Dis 2020; 76: 658-68. e1.
13. Ando R, Suzuki S, Nishiyama T, et al. MP08-09 positive association between hyperinsulinemia and kidney stone formation in japanese men: a prospective cohort study. J Urol 2019; 201: e101-2.
14. Ando R, Suzuki S, Nagaya T, et al. Impact of insulin resistance, insulin and adiponectin on kidney stones in the Japanese population. Int J Urol 2011; 18: 131-8.
15. Jiang H, Li L, Liu J, et al. Triglyceride–glucose index as a novel biomarker in the occurrence of kidney stones: A cross-sectional population-based Study. Int J Gen Med 2021: 6233-44.

16. Shen X, Chen Y, Chen Y, et al. Is the METS-IR index a potential new biomarker for kidney stone development? Front Endocrinol (Lausanne) 2022; 13: 914812.
17. Knoll T, Schubert AB, Fahlenkamp D, et al. Urolithiasis through the ages: data on more than 200,000 urinary stone analyses. J Urol 2011; 185: 1304-11.
18. Carella A, Leo S, Infante B, et al. Nephrolithiasis in the elderly. J Gerontol Geriatr 2018; 66: 233-8.
19. Jackson RD, LaCroix AZ, Gass M, et al. Calcium plus vitamin D supplementation and the risk of fractures. N Engl J Med 2006; 354: 669-83.
20. Di X, Liu S, Xiang L, Jin X. Association between the systemic immune-inflammation index and kidney stone: A cross-sectional study of NHANES 2007-2018. Front Immunol 2023; 14: 1116224.
21. Chandalia M, Lin P, Seenivasan T, et al. Insulin resistance and body fat distribution in South Asian men compared to Caucasian men. PLoS One 2007; 2: e812.
22. Stamatelou KK, Francis ME, Jones CA, Nyberg LM, Curhan GC. Time trends in reported prevalence of kidney stones in the United States: 1976-1994. Kidney Int 2003; 63: 1817-23.
23. Moudi E, Hosseini SR, Bijani A. Nephrolithiasis in elderly population; effect of demographic characteristics. J Nephropathol 2017; 6:63-8.