Original Article

Association between hyperlipidemia and chronic kidney disease in a Japanese population; a cross-sectional study

Yuko Ago Shiraishi, MD[1]; Yukiko Ishikawa, MD, PhD[1]; Joji Ishikawa, MD, PhD[2]; Masami Matsumura, MD, PhD[1]; Shizukiyo Ishikawa, MD, PhD[3]

1 Division of General Medicine, Center for Community Medicine, Jichi Medical University School of Medicine, 3311-1 Yakushiji, Shimotsuke, Tochigi, 329-0498, Japan
2 Department of Cardiology, Tokyo Metropolitan Geriatric Hospital and Institute of Gerontology, 35-2 Sakae, Itabashi, Tokyo, 173-0015, Japan
3 Division of Public Health, Center for Community Medicine, Jichi Medical University School of Medicine, 3311-1 Yakushiji, Shimotsuke, Tochigi, 329-0498, Japan

Abstract

Background: Strategies to prevent the development and progression of chronic kidney disease (CKD) are important in clinical practice as life expectancy increases. The present study investigated the prevalence of CKD as well as lipid profiles affecting CKD, especially triglyceride (TG) levels.
Methods: In total, 5,169 subjects were eligible for a cross-sectional analysis of baseline data from the Jichi Medical School Cohort Study. We examined CKD subjects with an estimated glomerular filtration rate (eGFR) of less than 60 mL/ min/1.73m^2 and independent factors associated with reductions in eGFR.
Results: The prevalence of CKD was 17.7%. Age, systolic blood pressure, and hyperlipidemia were defined as related CKD factors. The lowest, second, third, and highest quartile ranges of total cholesterol (TC) were ≤166, 167-188, 189-212, and ≥213 mg/dL, respectively; the quartile ranges of TG were ≤71, 72-100, 101-148, and ≥149 mg/dL, respectively. The odds ratio (OR) of Q2 to Q4 of TC relative to that of Q1 for CKD increased linearly (OR [95%CI]: Q2, 1.3 [1.0-1.7]; Q3, 1.38 [1.1-1.8]; Q4, 1.5 [1.4-2.4]). The ORs of Q2 and Q3 of TG for CKD did not increase, whereas that of Q4 did (OR [95% CI]: Q2, 0.95 [0.7-1.2]; Q3, 0.98 [0.8-1.2]; Q4, 1.21 [1.0-1.5]).
Conclusion: Increases in TC and TG levels were both independently associated with CKD. The relationship with CKD became stronger as TC increased, and the TG had threshold was 149 mg/dL.
(Keywords: chronic kidney disease, cohort study, hyperlipidemia, hypertriglyceridemia)

Introduction

Chronic kidney disease (CKD) is a global problem in clinical practice due to increased life expectancy. In 2005, 13% of Japanese adults who participated in the annual health check program were reported to have CKD[1]. Another cohort study in Japan showed that the prevalence of CKD was increasing. The progression of CKD ultimately results in end-stage renal disease and dialysis[2]. In Japan, 339,841 patients were receiving dialysis in 2018, with this number increasing by approximately 5,000 patients annually[3].

Many studies investigated the association between hyperlipidemia and CKD and the parameters of hyperlipidemia. Although metabolic syndrome (MetS), and total cholesterol (TC) are well-known risks, the association with triglycerides (TG) currently remains unclear[4]. MetS consists of at least three of the following five disorders: abdominal obesity, hypertriglyceridemia, low high-density lipoprotein cholesterol (HDL-C), hypertension, and hyperglycemia. A systematic review identified MetS as a predictor of the development of CKD[5]. Schaeffner et al.[6] demonstrated in a prospective study that renal dysfunction was more common in men with TC greater than 240 mg/dL. However, the threshold level of TG that affects the development of CKD has not yet been established. Limited

Correspondence to: Yuko Ago Shiraishi, Division of General Medicine, Center for Community Medicine, Jichi Medical University School of Medicine, 3311-1 Yakushiji, Shimotsuke, Tochigi, 329-0498, JAPAN. Tel: +81-285-58-7498 Fax: +81-285-40-5160 E-mail: agoyuko818@jichi.ac.jp
Received: 14 April 2022, Accepted: 29 July 2022

information is currently available on the relationship between TG levels and CKD. In a Chinese cross-sectional study, increases in TG levels were linearly associated with mild declines in renal function in subjects with an estimated glomerular filtration rate (eGFR) of between 60 and 90 mL/min/1.73m^2 [7]. Another cross-sectional study in Taiwan reported that TG levels ≥200 mg/dL were associated with the development of CKD in subjects recruited from a medical screening program[8].

Herein, we investigated lipid profiles related to CKD, especially the TG level related to CKD, in a cross-sectional study of Japanese community-based residents. The aim of this study was to investigate the frequency of CKD and the association of CKD-related factors, especially lipids and CKD. We conducted a cross-sectional analysis of baseline data from the Jichi Medical School (JMS) Cohort Study.

Methods

Subjects

The objective of the JMS Cohort Study was to evaluate the relationship between risk factors and cardiovascular diseases (CVD) in a general Japanese population. Details on the JMS cohort have been described previously[9]. Subjects were recruited from mass screening examinations for CVD by the Health and Medical Service Law for the Aged conducted by 11 communities between April 1992 and July 1995. The baseline data of this cohort were used in this cross-sectional study. The total number of subjects in the cohort was 12,490 (4,913 men and 7,577 women) and they were aged between 19 and 93 years. After the exclusion of subjects whose serum creatinine (SCr) value was not obtained, 5,169 subjects (1,870 men and 3,299 women) remained eligible for the CKD study.

Variables

Baseline information on age, sex, body mass index (BMI), systolic blood pressure (SBP), diastolic blood pressure (DBP), blood sugar (BS), TC, and TG was collected. Information on the smoking and drinking status as well as previous medical histories were obtained from questionnaires. Diabetes was defined as fasting BS ≥ 126 mg/dL and/or casual BS ≥200 mg/dL and receiving medication for diabetes. Hyperlipidemia was defined as TC ≥220 mg/dL and/or TG ≥150 mg/dL and receiving medication for hyperlipidemia. We calculated eGFR according to the modification of diet in renal disease eGFR (MDRD-eGFR) for Japanese using the following equations: eGFR in men = $194 \times SCr^{-1.094} \times Age^{-0.287}$, while eGFR in women = $194 \times SCr^{-1.094} \times Age^{-0.287} \times 0.739$[10]. Subjects were classified into CKD stages based on the definition of the Kidney Disease Outcomes Quality Initiative according to eGFR[11]. In the present study, subjects with eGFR less than 60 mL/min/1.73m^2 were defined as the CKD group.

We obtained informed consent individually in writing and all subjects agreed to participate in the present study. Each community government and the Institutional Review Board of Jichi Medical University approved the study design and methods. (Ethical approval number: Epidemiology 03-01).

Statistical analysis

Continuous variables were expressed as means and standard deviations (SD). Categorical variables were expressed as percentages (%). The differences in mean values between CKD and non-CKD were calculated using the *t*-test, while differences in percentages were calculated using the χ^2 test. We performed a multiple linear regression analysis to assess the relationships between various factors and reductions in eGFR adjusted for age, sex, BMI, SBP, hyperlipidemia, diabetes, current smoking habits, and alcohol habits. β, standard errors (SE), and P values were calculated using this model. We performed a logistic regression analysis to evaluate related factors for the CKD group. In addition, we calculated the odds ratios (OR), 95% confidence intervals (95% CI), and P values adjusted for age, sex, BMI, SBP, the category of hyperlipidemia, diabetes, current smoking habits, and alcohol habits. To assess lipid profile risks, we used TG ≥150 mg/dL, TC ≥220 mg/dL, and both TC ≥220 mg/dL and TG ≥150 mg/dL as independent variables for categories of hyperlipidemia. We then examined the OR of the quartiles of TC and TG for CKD adjusted for age, sex, BMI, SBP, diabetes, current smoking habits, and alcohol habits by logistic regression analysis.

Statistical analyses were performed using SPSS ver. 21 (IBM SPSS Statistics 21.0).

Results

The baseline general characteristics of CKD and non-CKD subjects are shown in Table 1. The total number of subjects was 5,169 and 36.2% were men. The mean age of subjects was 53.9 ([SD] 11.2) years, 53.6 (11.4) years for men, and 54.1 (11.0) years for women. Age, the percentage of men, BMI, SBP, DBP, TC, TG, hyperlipidemia, and BS were higher in the CKD group than in the non-CKD group. No significant differences were observed in the prevalence of diabetes between the two groups. The percentage of subjects with current smoking and alcohol habits was lower in the CKD group than in the non-CKD group. The prevalence of CKD was 17.7% (15.7% in men, 18.9% in women). The numbers of subjects with eGFR of 90 mL/min/1.73m^2 or higher, 60-89 mL/min/1.73m^2, 30-59 mL/min/1.73m^2, or ≤30 mL/min/1.73m^2 were 1,194 (23.1%), 3,058 (59.2%), 913 (17.7%), and 4 (0.08%) respectively. The number of subjects with positive proteinuria was 67 (1.3%). Because the percentage of those subjects was very small, we did not use the findings of proteinuria for the definition of CKD. The number of subjects with hyperlipidemia was 1,891

Table 1. General characteristics of participants in CKD and non-CKD groups

Variables	All patients (n = 5,169)	CKD group (n = 917)	non-CKD group (n = 4,252)	P value
Age (years), mean (SD)	53.9 (11.2)	59.9 (6.8)	52.6 (11.5)	<0.001
Male (%)	36.2	32.1	37.1	0.004
BMI (kg/m^2), mean (SD)	23.1 (3.0)	23.4 (3.0)	22.9 (3.0)	<0.001
SBP (mmHg), mean (SD)	126.1 (18.9)	131.7 (19.0)	124.9 (18.7)	<0.001
DBP (mmHg), mean (SD)	76.3 (11.6)	78.3 (11.1)	75.8 (11.7)	<0.001
TC (mg/dL), mean (SD)	191.2 (34.7)	202.2 (34.7)	188.8 (34.3)	<0.001
TG (mg/dL), mean (SD)	122.5 (77.9)	132.3 (76.1)	120.4 (78.2)	<0.001
Hyperlipidemia (%)	36.6	48.3	34.1	<0.001
BS (mg/dL), mean (SD)	107.9 (28.3)	111.4 (31.2)	107.2 (27.7)	<0.001
Diabetes (%)	3.3	3.3	3.4	0.934
Current smoking habits (%)	22.9	14.9	24.6	<0.001
Current alcohol habits (%)	41.5	35.0	42.9	<0.001

CKD, chronic kidney disease; SD, standard deviation; BMI, body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure; TC, total cholesterol; TG, triglycerides; BS, blood sugar

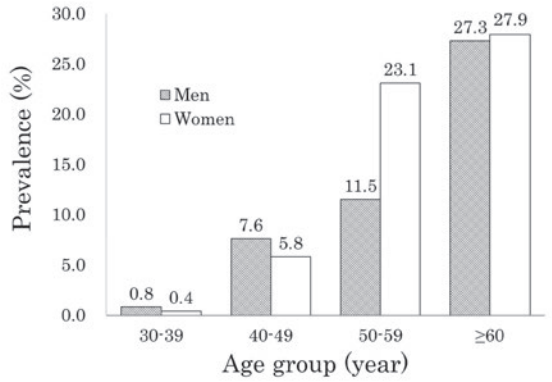

Figure 1. Prevalence of chronic kidney disease by age and sex

The prevalence of chronic kidney disease by age and sex is shown as percentages in each age group of 30-39, 40-49, 50-59, and ≥60 years.

Table 2. Factors affecting eGFR in a multiple linear regression analysis

Variables at baseline	β	SE	P
Age (years)	-.308	0.027	<0.001
Sex	-.037	0.766	0.033
BMI (kg/m^2)	-.005	0.101	0.740
SBP (mmHg)	-.134	0.016	<0.001
Hyperlipidemia	-.056	0.613	<0.001
Diabetes	.076	1.603	<0.001
Current smoking habits	.052	0.800	0.001
Current alcohol habits	.005	0.681	0.769

eGFR, estimated glomerular filtration rate; SE, standard error; BMI, body mass index; SBP, systolic blood pressure

(36.6%), of which 85 (1.7%) had been treated. The number of subjects with a TG ≥150 mg/dL alone, TC ≥220 mg/dL alone, or both TC ≥220 mg/dL and TG ≥150 mg/dL were 860 (16.7%), 610 (11.8%), and 410 (7.9%), respectively. The prevalence of CKD in each age group of 30-39, 40-49, 50-59, and ≥60 years were 0.8, 7.6, 11.5, and 27.3% in men and 0.4, 5.8, 23.1, and 27.9% in women, respectively (Fig. 1).

In a multiple linear regression analysis model, age (P <0.001), sex (P <0.05), SBP (P <0.001), and hyperlipidemia (P <0.001) were associated with reductions in eGFR in Table 2.

The ORs for the CKD group adjusted for multiple variables are shown in Table 3. Age (OR [95%CI]: 1.07, [1.06-1.09]), SBP (1.01, [1.00-1.01]), TG ≥150 mg/dL alone (1.34, [1.07-1.66]), TC ≥ 220 mg/dL alone (1.55, [1.23-1.94]), and high TG and TC (1.94, [1.48-2.54]) correlated with CKD. An additive effect of TG and TC on CKD was observed (data not shown). The synergistic effect of TG and TC on CKD was also noted in this regression model in another evaluation.

The OR of TC and TG in quartiles for CKD adjusted according to multiple variables are shown in Fig.2. The lowest, second, third, and highest quartile ranges of TC were ≤166, 167-188, 189-212, and ≥213 mg/dL, respectively; the quartile ranges of TG were ≤71, 72-100, 101-148, and ≥ 149 mg/dL, respectively. The OR of Q2 to Q4 of TC relative to Q1 for CKD increased linearly (OR [95%CI]: Q2, 1.3 [1.0-1.7]; Q3, 1.38 [1.1-1.8]; Q4, 1.5 [1.4-2.4]). Although the OR of Q2 and Q3 of TG for CKD did not increase, the OR of Q4 of TG for CKD was significantly higher than that for Q1 (OR [95% CI]: Q2, 0.95 [0.7-1.2]; Q3, 0.98 [0.8-1.2]; Q4, 1.21 [1.0-1.5]). The OR according to TG elevations significantly

Table 3. Odds ratios for CKD in a logistic regression analysis

		CKD+	
Variables at baseline	OR	95% CI	P
Age (years)	1.07	1.06 - 1.09	<0.001
Sex	1.00	0.80 - 1.25	0.990
BMI (kg/m^2)	1.01	0.98 -1.04	0.462
SBP (mmHg)	1.01	1.00 -1.01	<0.001
TC <220 and TG <150	Ref.		
TG ≥150 mg/dL, alone (TC <220)	1.34	1.07 -1.66	0.010
TC ≥220 mg/dL, alone (TG <150)	1.55	1.23 -1.94	<0.001
TC ≥220 mg/dL and TG ≥150 mg/dL	1.94	1.48 -2.54	<0.001
Diabetes	0.72	0.46 -1.13	0.153
Current smoking habits	0.70	0.55 -0.90	0.005
Current alcohol habits	0.97	0.79 -1.18	0.740

CKD, chronic kidney disease; OR, odds ratio; CI, confidence interval; BMI, body mass index; SBP, systolic blood pressure; TC, total cholesterol; TG, triglycerides

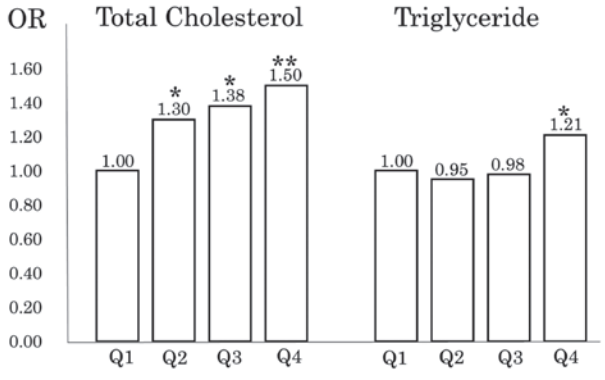

Figure 2. Odds ratios of quartiles of total cholesterol and triglycerides for chronic kidney disease

The odds ratios (ORs) of quartiles of total cholesterol (TC) and triglycerides (TG) for chronic kidney disease (CKD) and 95% confidence intervals were calculated with adjustments for age, sex, body mass index, systolic blood pressure, diabetes, current smoking habits, and drinking habits by logistic regression analysis. Q1, Q2, Q3, and Q4 quartile ranges of total TC were ≤166, 167-188, 189-212, and ≥213 mg/dL, respectively; the quartile ranges of TG were ≤ 71, 72-100, 101-148, and ≥149 mg/dL, respectively. The ORs of Q2, Q3, and Q4 of TC relative to Q1 for CKD were 1.3 (1.0-1.7), 1.38 (1.1-1.8), and 1.5 (1.4-2.4). The ORs of Q2, Q3, and Q4 of TG relative to Q1 for CKD were 0.95 (0.7-1.2), 0.98 (0.8-1.2), and 1.21 (1.0-1.5). *P <0.05 and **P <0.001, as compared with Q1.

increased only in the highest quartile at 149 mg/dL or higher. The OR of Q4 with a TG level of 149 mg/dL or more was higher than that of Q1 to Q3 (OR [95% CI]: 1.24 [1.0-1.5]).

Discussion

The prevalence of CKD in the present study was 17.7%, considered close to the prevalence of CKD in general populations in Japan. Another study conducted in 2005 reported that the prevalence of CKD was 13%[1]. This may be due to our subjects being recruited from mass screening examinations and their volunteering to participate[12]. The prevalence of CKD in the present study may also have been higher because 63.8% of our subjects were women, among whom those aged 50 years and older had a high prevalence of CKD.

In the present study, significant differences were observed in age, BMI, SBP, DBP, TC, TG, and hyperlipidemia between the CKD and non-CKD groups. Multiple linear regression analysis showed that age, sex, SBP, and hyperlipidemia were associated with reductions in eGFR. Our logistic regression analysis revealed that age, SBP, TG ≥150 mg/dL alone, TC ≥220 mg/dL alone, and high TC and TG were associated with CKD after adjustments for other risk factors. The OR of TC in quartiles for CKD increased linearly, whereas similar changes were not observed for elevations in TG. The risk of developing CKD appeared only at the highest TG quartile (≥149 mg/dL). Elevations greater than 149 mg/dL, even without increases in TC, may be a risk factor for CKD in this population. These results suggested that hyperlipidemia was a significant risk for CKD, whereas diabetes was not associated with CKD in our subjects recruited between 1992 and 1995. Additionally, the risk of CKD was clearly associated with those whose TG value became 149 mg/dL or higher, whereas the risk gradually increased in those whose TC value exceeded the normal range.

Although the relationship between TC and CKD progression has been extensively examined, few studies have investigated the relationship between TG and CKD according to various lipid profiles and outcomes[5, 6]. Tsuruya et al.[13] reported that the TG/HDL-C ratio was linearly related to CKD. Muntner et al.[14] also indicated that hypertriglyceridemia and low HDL were markers of elevated SCr. Shimizu et al.[15] identified intima-media thickening and hypertriglyceridemia as risk factors for CKD. A study in Taiwanese adults conducted in 2009 reported a relationship between the TG threshold and CKD, and that the adjusted OR of CKD in subjects with TG ≥200 mg/dL was significantly higher than in those with TG <200 mg/dL (OR [95%CI]: 1.901, [1.07-3.36])[8]. Chinese studies reported that TG was a risk factor for CKD in 2020[16, 17]. The TG threshold may differ among countries or regions depending on lifestyles such as eating habits and physical

activities. The TG threshold may be used to stratify the risk of developing CKD among different backgrounds.

Hyperlipidemia is identified as one of the strongest risk factors for CVD. CKD is also an established risk factor for the development of CVD. Therefore, common factors, such as arterial inflammation caused by hyperlipidemia, may contribute to the progression of vascular damage in the heart and kidney[18]. On the other hand, lipid abnormalities secondarily caused by glomerulosclerosis have been proposed based on the hypothesis of lipid nephrotoxicity[19-21]. This lipid cycle is considered to accelerate the progression of CKD, and its mechanism is related to inhibition of the cascade of very-low-density lipoprotein degradation by apoproteins. Altered lipoprotein effects have been reported as a major factor affecting nephrotoxicity in hypertriglyceridemia[22]. Recent studies focused on changes in the n-3 polyunsaturated fatty acid profile and cholesterol metabolism that cannot be evaluated by lipoprotein levels[23, 24]. The management of hyperlipidemia may be important for preventing the progression of CKD and reducing total mortality rates.

Interventional studies on statins recently reported reductions in CVD events and possible renal protection[4]. A meta-analysis by Sandhu et al.[25] revealed that statins suppressed impairments in renal function, increases in urinary proteins, and the onset and recurrence of CVD events. Also, in a meta-analysis by Ting et al.[26], fibrates were shown to reduce CVD events and suppress declines in renal function in subjects with type 2 diabetes and renal impairment.

Limited information is currently available to support the beneficial effects of reductions in TG on the prognosis of CKD. Therefore, further interventional trials are necessary.

Although diabetes is one conventional CKD risk factor, it was not associated with CKD or reductions in eGFR in the present study. Glomerular hyperfiltration, as the underlying mechanism, has been suggested to increase eGFR in patients with diabetes[27, 28]. Smoking is another risk factor for CKD; however, it showed a negative relationship with CKD in the present study. This result may have been affected by the lower BMI of subjects who smoke.

The present study had the following limitations. First, TG data included pre-and post-prandial levels, which introduced a measurement bias. However, the impact of this bias was not large as the subjects in the present study were recruited from a large, multicenter general population[9]. Second, we did not use urinalysis for the definition of the CKD group, because the subjects with positive proteinuria were small. When we performed the same analysis after we included the subjects with positive proteinuria in the CKD group, there was no significant change in the results.

Conclusions

TC and TG elevations were both independently associated with CKD in a general Japanese population. The relationship with CKD became stronger as TC increased. A TG level of 149 mg/dL or higher may be the threshold for a relationship with CKD. As only a few interventional studies have been conducted exploring the association between TG and CKD, the relationship between TG levels and the development of CKD warrants further research. Interventional studies are expected because the management of TG may prevent the development and progression of CKD.

Declaration of interest

This study was ruled by the Conflict-of-Interest Committee of Jichi Medical University as having no conflicts of interest.

Acknowledgments

We thank all the participants and staff who helped us during this study's process.

This study was funded by a Grant-in-Aid for Scientific Research from the Ministry of Education, Culture, Sports, Science and Technology of Japan; grants from the Foundation for Community Development, Tochigi, Japan; a grant-in-aid from the Ministry of Health, Labor and Welfare of Japan; and Health and Labor Sciences Research Grants (Research on Health Services: H26-Junkankitou [Seisaku]-Ippan-001; H29-Junkankitou-Ippan-003 and 20FA1002).

References

1 Imai E, Horio M, Watanabe T, et al. Prevalence of chronic kidney disease in the Japanese general population. *Clin Exp Nephrol* 2009; **13**: 621-630.

2 Yamagata K, Yagisawa T, Nakai S, et al. Prevalence and incidence of chronic kidney disease stage G5 in Japan. *Clin Exp Nephrol* 2015; **19**: 54-64.

3 Nitta K, Goto S, Masakane I, et al. Annualdialysis data report for 2018, JSDT Renl Data Registry: survey methos, facility data, incidence, prevalence, and mortality. *Renal Replacement Therapy* 2020; **6**: 41.

4 Cases A, Coll E. Dyslipidemia and the progression of renal disease in chronic renal failure patients. *Kidney Int Suppl* 2005; **99**: S87-S93.

5 Thomas G, Sehgal AR, Kashyap SR, et al. Metabolic syndrome and kidney disease: a systematic review and meta-analysis. *Clin J Am Soc Nephrol* 2011; **6**: 2364-2373.

6 Schaeffner ES, Kurth T, Curhan GC, et al. Cholesterol and the risk of renal dysfunction in apparently healthy men. *J Am Soc Nephrol* 2003; **14**: 2084-2091.

7 Hou X, Wang C, Zhang X, et al. Triglyceride levels are closely associated with mild declines in estimated glomerular filtration rates in middle-aged and elderly Chinese with normal serum lipid levels. *PLoS One* 2014; **9**: e106778.

8 Lee PH, Chang HY, Tung CW, et al. Hypertriglyceridemia: an independent risk factor of chronic kidney disease in

Taiwanese adults. *Am J Med Sci* 2009; **338**: 185-189.
9 Ishikawa S, Gotoh T, Nago N, et al. Jichi Medical School Cohort Study, The Jichi Medical School (JMS) Cohort Study: design, baseline data and standardized mortality ratios. *J Epidemiol* 2002; **12**: 408-417.
10 Matsuo S, Imai E, Horio M, et al. Revised equations for estimated GFR from serum creatinine in Japan. *Am J Kidney Dis* 2009; **53**: 982-992.
11 Inker LA, Astor BC, Fox CH, et al. KDOQI US commentary on the 2012 KDIGO clinical practice guideline for the evaluation and management of CKD. *Am J Kidney Dis* 2014; **63**: 713-735.
12 Imai E, Horio M, Iseki K, et al. Prevalence of chronic kidney disease (CKD) in the Japanese general population predicted by the MDRD equation modified by a Japanese coefficient. *Clin Exp Nephrol* 2007; **11**: 156-163.
13 Tsuruya K, Yoshida H, Nagata M, et al. Association of the triglycerides to high-density lipoprotein cholesterol ratio with the risk of chronic kidney disease: analysis in a large Japanese population. *Atherosclerosis* 2014; **233**: 260-267.
14 Muntner P, Coresh J, Smith JC, et al. Plasma lipids and risk of developing renal dysfunction: the atherosclerosis risk in communities study. *Kidney Int* 2000; **58**: 293-301.
15 Shimizu M, Furusyo N, Mitsumoto F, et al. Subclinical carotid atherosclerosis and triglycerides predict the incidence of chronic kidney disease in the Japanese general population: results from the Kyushu and Okinawa Population Study (KOPS). *Atherosclerosis* 2015; **238**: 207-212.
16 Zhang YB, Sheng LT, Wei W, et al. Association of blood lipid profile with incident chronic kidney disease: A Mendelian randomization study. *Atherosclerosis* 2020; **300**: 19-25.
17 Wang X, Chen H, Shao X, et al. Association of Lipid Parameters with the Risk of Chronic Kidney Disease: A Longitudinal Study Based on Populations in Southern China. *Diabetes Metab Syndr Obes* 2020; **13**: 663-670.
18 Mathur S, Devaraj S, Jialal I. Accelerated atherosclerosis, dyslipidemia, and oxidative stress in end-stage renal disease. *Curr Opin Nephrol Hypertens* 2002; **11**: 141-147.
19 Moorhead JF, Chan MK, El-Nahas M, et al. Lipid nephrotoxicity in chronic progressive glomerular and tubulo-interstitial disease. *Lancet* 1982; **2**: 1309-1311.
20 Heine GH, Eller K, Stadler JT, et al. Lipid-modifying therapy in chronic kidney disease: Pathophysiological and clinical considerations. *Pharmacol Ther* 2020; **207**: 107459.
21 Ruan XZ, Varghese Z, Moorhead JF. An update on the lipid nephrotoxicity hypothesis. *Nat Rev Nephrol* 2009; **5**: 713-721.
22 Vaziri ND. Dyslipidemia of chronic renal failure: the nature, mechanisms, and potential consequences. *Am J Physiol Renal Physiol* 2006; **290**: F262-F272.
23 Shoji T, Kakiya R, Hayashi T, et al. Serum n-3 and n-6 polyunsaturated fatty acid profile as an independent predictor of cardiovascular events in hemodialysis patients. *Am J Kidney Dis* 2013; **62**: 568-576.
24 Sonoda M, Shoji T, Kimoto E, et al. Kidney function, cholesterol absorption and remnant lipoprotein accumulation in patients with diabetes mellitus. *J Atheroscler Thromb* 2014; **21**: 346-354.
25 Sandhu S, Wiebe N, Fried LF, et al. Statins for improving renal outcomes: a meta-analysis. *J Am Soc Nephrol* 2006; **17**: 2006-2016.
26 Ting RD, Keech AC, Drury PL, et al. Benefits and safety of long-term fenofibrate therapy in people with type 2 diabetes and renal impairment: the FIELD Study. *Diabetes Care* 2012; **35**: 218-225.
27 Alicic, RZ, Rooney MT, Tuttle KR. Diabetic Kidney Disease: Challenges, Progress, and Possibilities. *Clin J Am Soc Nephrol* 2017; **12**: 2032-2045.
28 Fu, WJ, Li BL, Wang SB, et al. Changes of the tubular markers in type 2 diabetes mellitus with glomerular hyperfiltration. *Diabetes Res Clin Pract* 2012; **95**: 105-109.

日本の地域住民における高脂血症と慢性腎臓病の関連についての横断研究

白石　裕子[1]，石川由紀子[1]，石川　譲治[2]，松村　正巳[1]，石川　鎮清[3]

[1)] 自治医科大学地域医療学センター総合診療部門　〒329-0498　栃木県下野市薬師寺3311-1
[2)] 東京都健康長寿医療センター循環器内科　〒173-0015　東京都板橋区栄35-2
[3)] 自治医科大学地域医療学センター公衆衛生学部門　〒329-0498　栃木県下野市薬師寺3311-1

要　約

目的は地域一般住民における慢性腎臓病（CKD）の関連因子を明らかにすることである。対象者は，1992年から1995年に行われたJMSコホート研究参加者のうち5,169人である。eGFR 60mL/min/1.73m^{2}未満をCKD群と定義し，CKD群の罹患率は17.7%であった。群間比較の結果，CKD群では，年齢，BMI，収縮期血圧，拡張期血圧，血糖値および高脂血症の頻度が非CKD群と比較して有意に高かった。多変量解析では，血清総コレステロール（TC）と中性脂肪（TG）はそれぞれ独立してCKDに関連した。TCとTGの４分位での解析の結果，CKDのオッズ比はTCにおいては，直線的に増加した。一方TGでは，Q4（149mg/dL以上）のみで，CKDに対するオッズ比が有意に高かった。TG値149mg/dL以上でCKDとの関連を認め，閾値として有用性が示唆された。
（キーワード：慢性腎臓病，コホート研究，高脂血症，高中性脂肪血症）

連絡先：白石　裕子，自治医科大学地域医療学センター総合診療部門，〒329-0498　栃木県下野市薬師寺3311-1.
Tel：0285-58-7498　Fax：0285-40-5160　E-mail：agoyuko818@jichi.ac.jp
受付：2022年４月14日，受理：2022年７月29日