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Impact of Cigarette Smoking on Serum Cystatin C and Creatinine Levels and MAU: A Case-Control Study

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Abstract

Background: Smoking-related hemodynamic events may adversely influence renal function. The aim of this study was to evaluate renal impairment biomarkers among healthy people influenced by cigarette smoke.

Methods and Results: In this case-control study, 90 subjects were enrolled: 60 were smokers, and 30 were non-smokers (apparently healthy control). Serum CysC was measured using a semi-automated, specific protein analyzer Mispa-i2 (Germany). Serum creatinine and MAU were assayed in the fully automated biochemistry analyzer (Mindray BS380). The mean concentration of CysC was significantly higher in cigarette smokers than in non-smokers (0.793±0.125 vs. 0.619±0.103, *P*=0.000). Also, the mean of MAU and serum creatinine levels were significantly higher in cigarette smokers than in non-smokers (18.33±3.41 vs. 12.70±0.517, 1.06±0.161 vs. 0.810±0.058, respectively, *P*=0.000 in both cases). The mean concentration of CysC and MAU was significantly greater in heavy smokers than in light smokers (*P*=0.000 and *P*=0.001, respectively). Serum CysC and MAU levels were positively correlated with the age of cigarette smokers (r=0.734 and r=0.730, respectively*;* *P*=0.000 in both cases) and the duration of smoking (r=0.773 and r=0.790, respectively; *P*=0.000 in both cases).

Conclusion: cigarette smoking increases the specific renal biomarkers considered risk factors for renal impairment. Using such inflammatory biomarkers as diagnostic tools can be a necessary precaution in the development of chronic kidney disease caused by smoking and in the avoidance of acute renal consequences linked to cigarette smoking.(**International Journal of Biomedicine. 2023;13(1):58-61.**)

Keywords: cigarette smoking • inflammatory biomarkers • chronic kidney disease

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Abbreviations

CKD, chronic kidney disease; **CysC**, cystatin C; **ESRD**, end-stage renal disease; **MAU**, microalbuminuria.

Introduction

The fight against cigarette smoking is a global challenge. Worldwide, 1.2 billion people smoked in 2000, a number that is projected to increase to 1.6 billion by 2030.[1] The 21st century is likely to see 1 billion tobacco deaths, most of them in low-income countries.[2] Chronic cigarette consumption is harmful in both active and passive smokers. It has a role in the initiation and progression of chronic kidney disease (CKD), type 2 diabetes mellitus, diabetic nephropathy, and cardiovascular complications of diabetes mellitus. It is also evident that chronic kidney failure raises the risk of cardiovascular morbidity and mortality; thus, tobacco use can be considered as a factor that induces or aggravates processes that diminish life quality or even shorten life expectancy. Noteworthy is the human "memory for smoking", namely, the harmful effects of tobacco consumption do not last only until the cessation of cigarette smoking but even for many years.[1]

A recent preliminary report suggests that smoking-related hemodynamic events may have an acute influence on renal function[3] and be a risk factor for the development and progression of CKD in the community,[4] which is a risk factor for end-stage renal disease (ESRD).[5] Regarding the adverse effect of smoking on renal biomarkers, many studies suggest a higher prevalence of microalbuminuria in smokers compared to non-smokers and raise the possibility of renal glomerular injury.[6] Microalbuminuria (MAU) (urinary albumin excretion of 30-300 mg/day) is an early sign of renal damage. It is demonstrated that renal risk is elevated even in the high normal range of MAU<30 mg/day.[7]

Cystatin C (CysC) is a basic protein with a molecular weight of 13 kDa and is a member of the cysteine protease inhibitor family that is measurable in body fluids. The glomerulus completely filters it, and its concentration is closely correlated with the glomerular filtration rate. Serum CysC levels are less affected by biological factors and rise 1–2 days earlier than creatinine in the setting of acute kidney injury. Therefore, CysC can be used as an alternative renal biomarker to creatinine because it is filtered in the glomeruli and is reabsorbed in the proximal tubule, where it is completely catabolized.[8,9] Serum creatinine level is commonly used to estimate renal function.[10]

The aim of this study was to evaluate renal impairment biomarkers among healthy people influenced by cigarette smoke.

Materials and Methods

In this case-control study, 90 subjects were enrolled: 60 were smokers, and 30 were non-smokers (apparently healthy control). All subjects were referred to Elriada Specialized Center in Khartoum state from June to December 2020. Exclusion criteria were diabetes mellitus, hypertension, obesity, alcoholism, and diagnosed diseases.

Serum CysC was measured using a semi-automated, specific protein analyzer Mispa-i2 (Germany). Serum creatinine and MAU were assayed in the fully automated biochemistry analyzer (Mindray BS380).

Statistical analysis was performed using statistical software package SPSS version 21.0 (Armonk, NY: IBM Corp.). For descriptive analysis, results are presented as mean (M) ± standard deviation (SD). Inter-group comparisons were performed using Student's t-test. Pearson's Correlation Coefficient (r) was used to determine the strength of the relationship between the two continuous variables. A probability value of $P<0.05$ was considered statistically significant.

This study was approved by the Ethical Committee of the Al-Neelain University (Sudan). All participants provided written informed consent.

Results

The mean concentration of CysC was significantly higher in cigarette smokers than in non-smokers (0.793±0.125 mg/L vs. 0.619±0.103 mg/L, $P=0.000$). Also, the mean of MAU and serum creatinine levels were significantly higher in cigarette smokers than in non-smokers (18.33±3.41 mg/L vs. 12.70±0.517 mg/L, 1.06±0.161 mg/dL vs. 0.810±0.058 mg/dL, respectively, $P=0.000$ in both cases) (Table 1).

Table 1.

Mean concentrations of CysC, MAU and serum creatinine among cigarette smokers and non-smokers

Parameters	Smokers	Non-smokers	*P*-value
CysC, mg/L	0.793±0.125	0.619±0.103	0.000
MAU, mg/L	18.33±3.41	12.70±0.517	0.000
Creatinine, mg/dL	1.06±0.161	0.810±0.058	0.000

The mean concentration of CysC and MAU was significantly greater in heavy smokers than in light smokers ($P=0.000$ and $P=0.001$, respectively) (Table 2).

Table 2.

Mean concentrations of CysC, MAU and serum creatinine among light and heavy smokers

Parameters	Light smokers	Heavy smokers	*P*-value
CysC, mg/L	0.715±0.12	0.848±0.10	0.000
MAU, mg/L	16.71±2.51	19.49±3.51	0.001
Creatinine, mg/dL	1.06±0.19	1.06±0.14	0.883

In addition, serum CysC and MAU levels were positively correlated with the age of cigarette smokers (r=0.734 and r=0.730, respectively; $P=0.000$ in both cases) (Figures 1 and 2) and the duration of smoking (r=0.773 and r=0.790, respectively; $P=0.000$ in both cases) (Figures 3 and 4).

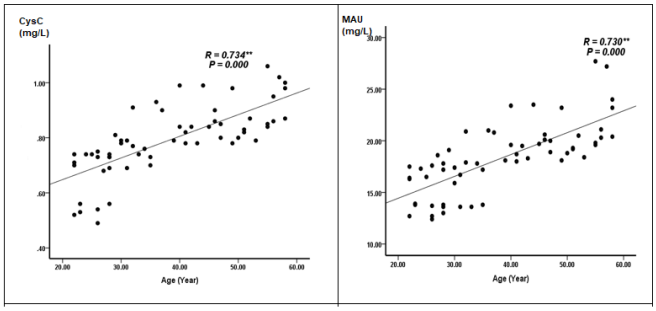

Fig 1. *Correlation between CysC and age.*

Fig. 2. *Correlation between MAU and age.*

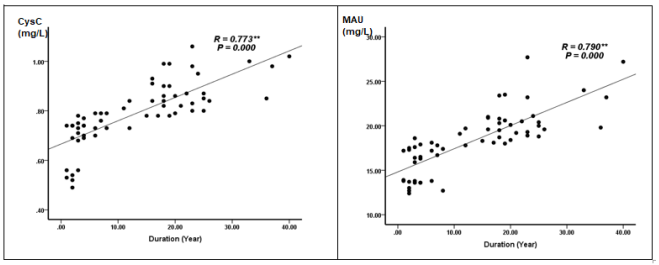

Fig. 3. *Correlation between CysC and duration of smoking.*

Fig. 4. *Correlation between MAU and duration of smoking.*

Discussion

In our study, the mean concentrations of CysC, MAU, and serum creatinine levels were significantly higher in cigarette smokers than in non-smokers (P=0.000 in all cases). Also, serum CysC and MAU levels were positively correlated with the age of cigarette smokers and the duration of smoking (P=0.000 in both cases). Many previous research studies showed similar findings in creatinine level and MAU.[11-14] In a study by Pinto-Sietsma et al.,[14] after adjustment for several potential confounding factors, persons who smoked 20 or fewer cigarettes/d and persons who smoked more than 20 cigarettes/d, respectively, showed a dose-dependent association between smoking and MAU (relative risk, 1.92 [CI 95%: 1.54-2.39] and 2.15 [CI 95%: 1.52-3.03]). In a study by Yoon,[15] current smoking was associated with a higher risk of proteinuria (urine dipstick for albuminuria > or =1+) than non-smoking (odds ratio=1.380, P<0.001). Gupta et al.[16] showed that among 80 smokers, 73(91.25%) had MAU >20 mg/L, and MAU level was directly related to the amount of smoking (pack-years). Similar data were obtained in a study by Abdallah et al.[17] Yamada et al.[18] showed that serum CysC was higher in smokers and obese subjects. In contrast, serum creatinine was lower in smokers and slender subjects.

Conclusion

Cigarette smoking increases the specific renal biomarkers considered risk factors for renal impairment. Using such inflammatory biomarkers as diagnostic tools can be a necessary precaution in the development of chronic kidney disease caused by smoking and in the avoidance of acute renal consequences linked to cigarette smoking.

Competing Interests

The authors declare that they have no competing interests.

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