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THE CORRELATION BETWEEN FREQUENCY OF MINERAL WATER CONSUMPTION, COFFEE, LENGTH OF EMPLOYMENT WITH SERUM CREATININE LEVELS AND ESTIMATED GLOMERULAR FILTRATION RATE AMONG BRICK CRAFTSMEN

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ABSTRACT
Chronic Kidney Disease (CKD) leads to a decline in renal function, thereby affecting fluid and electrolyte balance in the body. Risk factors for CKD include advanced age, chronic diseases, kidney disorders, unhealthy lifestyles, and adverse environmental conditions. Prolonged exposure to extreme heat, combined with unhealthy lifestyle behaviors such as inadequate water intake and frequent consumption of caffeinated beverages, may lead to dehydration. Prolonged dehydration can reduce extracellular fluid volume, leading to impaired kidney function. This study aimed to analyze the correlations between the frequency of coffee consumption, water intake, and length of employment with serum creatinine levels and estimated glomerular filtration rate (eGFR) among brick craftsmen in Sokaraja Sub-District, Banyumas. The study employed a cross-sectional design involving 23 respondents selected using accidental sampling. Data analysis was conducted using Spearman and Pearson correlation tests at the 95% confidence level, and a multivariate analysis was performed with multiple linear regression. The bivariate analysis showed significant correlations between coffee consumption, water intake, and work duration and serum creatinine levels and eGFR values ($p < 0.05$). However, age and length of employment were not statistically significantly associated in the bivariate analysis ($p > 0.05$). Multivariate analysis indicated that water intake had a significant effect on serum creatinine and eGFR, although this effect was influenced by respondents' age. An increase in coffee consumption was associated with elevated creatinine levels and reduced estimated glomerular filtration rate (eGFR). Inadequate water intake results in dehydration, thereby impairing renal function in the elimination of metabolic waste. Prolonged working hours in hot environments increase the risk of oxidative stress and renal tubule injury.

Keywords: brick craftsmen; creatinine; coffee consumption; eGFR; mineral water

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INTRODUCTION

Chronic Kidney Disease (CKD) is a condition characterized by a sustained decrease in glomerular filtration rate (GFR), leading to a progressive decline in kidney function. The decline in kidney function affects fluid and electrolyte balance, thereby disrupting the body's metabolism (Marni et al., 2023). Based on data from the World Health Organization (WHO), kidney disease ranks 9th among the causes of death worldwide from 2000 to 2021, with the number of deaths increasing by 95% each year. There are 850,000 deaths of individuals caused by CKD annually, and it is estimated that this will increase to over 850,000 deaths by 2030 (World Health Organization, 2024). Based on RISKESDAS 2018 data, the prevalence of kidney disease in Indonesia is 3.8 (0.38%) individuals per 1,000 population, with about 60% of patients undergoing hemodialysis. The highest prevalence of kidney disease is in North Kalimantan Province at 0.64%, and the lowest prevalence is in West Sulawesi Province at 0.18% (Kementerian Kesehatan, 2023). The prevalence of chronic kidney disease in Central Java Province in 2023 is 0.2% (Dinas Kesehatan Jawa Tengah, 2023). The

increasing prevalence of chronic kidney disease each year requires a special review, especially regarding risk factors such as the environment and community habits that trigger chronic kidney disease.

The risk factors for CKD are caused by hypertension, diabetes mellitus, obesity, advanced age, or a history of other kidney diseases. However, CKD risk factors are also influenced by environmental factors, especially among workers in hot-exposure areas. Heat exposure in the workplace can trigger dehydration, leading to decreased extracellular volume, subclinical ischemic kidney injury, and reduced glomerular filtration rate (GFR). These physiological disturbances pose a risk of causing permanent kidney damage over a long period (Nerbass et al., 2017). Dehydration cases due to heat exposure usually occur in workers who work outdoors, such as farmers, fishermen, construction workers, traditional brickmakers, and other workers who are directly exposed to sunlight (Ginting and Pirgahayu 2021).

Brick artisans work in the manufacturing sector. The brick industry is classified as a micro business operated individually by utilizing natural resources, specifically clay that is processed, and each kiln house employs 4-10 workers. According to the Banyumas Regency Industry Office (2019), there are 278 brick industry businesses across 6 districts in Banyumas. Sokaraja District has the highest number of brick artisans, with 78 (28%) business houses located in 7 villages. Wiradadi Village has the most brick business houses, with 30, followed by Pamijen Village with 16. (Rahajuni and Gunawan., 2021). Traditional brick artisans risk repeated exposure to extreme heat while firing bricks nonstop for 4-7 days in the kiln. Not only that, the process of making the brick mixture outside the kiln exposes the artisans to direct sunlight, and this activity is carried out repeatedly every day (Ginting and Pirgahayu, 2021).

Heat exposure from brick kiln burning raises body temperature, prompting excessive sweating to stabilize it. The loss of body fluids decreases blood volume, reducing blood flow to the kidneys and triggering a decline in renal perfusion. Additionally, poor lifestyle habits among brick artisans worsen dehydration through practices such as consuming energy drinks (e.g., caffeine), smoking, and insufficient intake of mineral water. (Khusna et al. 2025). Prolonged work hours in a hot environment may increase the risk of dehydration among brick artisans. Prolonged dehydration leads to decreased kidney function, which is reflected in abnormal levels of urea, creatinine, eGFR, or albumin. Abnormal creatinine levels indicate impaired kidney function in filtering waste. Creatinine is a waste product from metabolism that the body excretes and serves as a marker of kidney damage, which can be seen in blood or urine tests. Abnormal creatinine levels, along with eGFR (estimated glomerular filtration rate) assessment, help detect early kidney health issues by measuring how well the kidneys filter waste from the blood. (Bevi et al. 2025; Yanti and Bausad 2025; Tommerdahl, et al. 2022).

Many studies have linked the habit of consuming mineral water, coffee, and work duration with kidney health, one of which is a study by Tommerdahl et al (2022), which shows a significant relationship between coffee consumption and serum creatinine levels and eGFR values. Coffee can cause kidney injury due to ischemic inflammation and hemodynamic dysregulation, which trigger metabolic imbalance and lead to significant oxidative stress in the kidneys. The research was conducted by Massimo et al., (2022) shows a significant relationship between water intake and serum creatinine and eGFR levels. Dehydration increases toxins in the kidneys, reducing renal filtration and leading to a rise in creatinine levels. The research of Bevi et al., (2025) and Nurhadi et al., (2024) The longer the length of service, the more it correlates with creatinine levels and eGFR values. Extended employment can result in higher creatinine levels due to prolonged working hours and excessive physical activity, which in turn contribute to decreased eGFR values.

Research on the relationships between mineral water consumption, coffee intake, with length of employment, and creatinine levels and eGFR values among brick artisans in Banyumas remains limited. Therefore, it is important to investigate the relationship between these lifestyle-related factors and the potential risk of kidney disease among brick artisans who are vulnerable to it. Understanding the factors that can influence kidney function is an effort to maintain the health of brick artisans' kidneys. This indicates that specific studies are needed to determine the relationship between risk factors for declining kidney function among brick artisans.

METHOD

This study employed an analytical cross-sectional design. The study employed non-probability sampling via accidental sampling during the research period from May to December 2024. The subjects of this study were brick artisans in Wiradadi Village and Pamijen Village, Sokaraja District, Banyumas Regency. A total of 23 respondents were willing to sign informed consent and participate in the sampling process. This study has been approved by the Research Ethics Committee of Muhammadiyah University of Purwokerto, Banyumas, Indonesia, with the number: KEPK/UMP/101/III/2024. The research was conducted at the Medical Laboratory of the Medical Laboratory Technology Study Program, Faculty of Health Sciences, Muhammadiyah University of Purwokerto.

The characteristics of the respondents were obtained through a questionnaire covering age, gender, frequency of coffee consumption, drinking water, length of employment, and working hours. Blood samples were collected via venipuncture of the median cubital vein using a 3mL syringe, followed by serum separation (Jumadewi et al., 2022). Creatinine testing using the Jaffe Reaction method, measuring the reaction between creatinine in serum or plasma samples with picric acid in a basic environment (NaOH) that forms a yellow-orange creatinine-picrate complex. The intensity of this color is then measured photometrically at a wavelength of 500 – 520 nm, with the rate of color formation being directly proportional to the creatinine concentration (Husni, et al, 2023). Based on the interpretation of serum creatinine levels in men, which range from 0.7 to 1.3 mg/dL, and in women, which range from 0.6 to 1.1 mg/dL (Christina et al., 2022). The estimated glomerular filtration rate (eGFR) assessment is performed on the National Kidney Foundation website, based on serum creatinine levels, age, and gender, using the 2021 Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI 2021) equation. The National Kidney Foundation and Kidney Disease Improving Global Outcomes (KDIGO) categorize the likelihood of CKD occurrence based on abnormal eGFRcr values below 60 ml/min/1.73 m^2.

The tools used in the research include a 3mL syringe, non-EDTA vacutainer tube, cooler box, micropipette, blue tip, yellow tip, microtube, test tube, incubator block, centrifuge, and photometer. The materials used in the research include serum samples, creatinine test kit (Glory), tissue, gloves, masks, and distilled water. Data analysis was conducted by testing the normality of the data distribution using the Shapiro-Wilk method. The relationship between variables such as mineral water consumption, coffee intake, length of employment, working hours, and age with creatinine levels and eGFR values were analyzed using Spearman and Pearson correlation tests at a 95% confidence level. Furthermore, a multivariate test was performed using multiple linear regression to determine the influence of risk variables on the respondents' creatinine levels and eGFR values.

RESULT

The characteristics of the sample in this study are traits that directly or indirectly can influence the respondent's creatinine levels and eGFR. The respondent characteristics in this study are as follows:

Table 1.
Respondent Characteristics

Variable	Category	Frequency	
		f	%
		23	100%
Age	>40 Years	21	91.3%
	≤40 Years	2	8.7%
Gender	Male	21	91.3%
	Female	2	8.7%
Coffee Consumption	≤ 4 glass/day	15	65.2%
	>4 glass/day	8	34.8%
Mineral Water Consumption	≤ 2 Liter/day	3	13.0%
	>2 Liter/day	20	87.0%
Length of Employment	≤ 15 Years	8	34.8%
	>15 Years	15	65.2%
Working Duration	>8 Hours	13	56.5%
	≤ 8 Hours	10	43.5%
Creatinine Level	Normal	10	43.5%
	Abnormal	13	56.5%
eGFR (*estimated glomerular filtration rate*)	≤60ml/minute/1.73m^2	9	39.1%
	>60ml/minute/1.73m^2	14	60.9%

Table 1 shows that the majority of respondents are male (91.3%) with an age group over 40 years (91.3%). Most respondents have more than 15 years of work experience (65.2%) and consume more than 2 liters of mineral water per day (87.0%). A total of 34.8% of respondents still consume a high amount of coffee (>4 cups per day) and are exposed to extreme heat for more than 8 hours. Based on kidney function parameters, more than half of respondents have abnormal serum creatinine levels, and the eGFR assessment of kidney filtration efficiency indicates that 39.1% have an eGFR ≤60 ml/min/1.73 m², indicating a decline in kidney function among brick kiln workers.

Table 2.
Results of univariate analysis of respondent data variables

Variable	N	Min – Max	Mean ± SD	*Sig.*
Creatinine Level (mg/dL)	23	0.707-1.859	1.32 ± 0.27	0.470
eGFR (ml/min/1.73m^2)	23	36 – 95	66.13 ± 17.00	0.778
Mineral Water Consumption (Lt/day)	23	1.0 - 7.5	3.53 ± 1.67	0.110
Coffee Consumption (glass/day)	23	0 – 7	2.89 ± 0.87	0.162
Age (Years)	23	35 – 75	54.04 ± 9.89	0.968
Length of Employment (Year)	23	4 – 57	26.61 ± 17.29	0.039
Working Duration (Hours/day)	23	4 – 12	9.74 ± 2.20	0.001

Sig. Value > 0.05, data distributed normally

Table 2 showed the results of the normality test for the data using the Shapiro-Wilk method showed that the serum creatinine level variable had a p-value of 0.470, eGFR had a p-value of 0.778, water consumption had a p-value of 0.110, coffee consumption had a p-value of 0.162, and respondent age had a p-value of 0.968. All these p-values are greater than 0.05, indicating that the data are normally distributed. (Sudirman *et al*., 2020)**.** Then, the normality test results for the work period variable *($p = 0.039$) and the work duration ($p = 0.001$) indicate that the data distributions are* not normal ($p < 0.05$).

Table 3.
Correlation of creatinine serum coefficient and eGFR with risk variables

Variable	Creatinine serum (mg/dL)		eGFR (mL/menit/1.73m^2)	
	p-value	*r-value*	*p-value*	*r-value*
Age (Years)	0.715	0.081	0.302	- 0.021
Mineral Water Consumption (Liter/day)	**0.010**	**-0.523***	**0.027**	**0.461***
Coffee Consumption (Glass/day)	**0.001**	**0.643****	**0.001**	**-0.653****
Working Duration (Hours/day)	**0.027**	**0.460***	**0.010**	**-0.525***
Length of Employment (Years)	0.575	0.123	0.384	-0.191
Creatinine serum (mg/dL)	**-**	**-**	**0.001**	**-0.966****

** $p < 0.05$, ** $p < 0.001$, *** $p < 0.0001$.*

Table 3 shows that the frequency of mineral water consumption, coffee intake, and working duration have statistically significant relationships ($p < 0.05$) with serum creatinine levels and eGFR values. Coffee consumption has the strongest positive correlation with serum creatinine levels ($r = 0.643$; $p = 0.001$) and a negative correlation with eGFR ($r = -0.653$; $p = 0.001$), indicating that increased coffee intake is directly associated with decreased kidney filtration function. The relationship between mineral water consumption shows a positive correlation with eGFR ($r = 0.461$; $p = 0.027$) and a negative correlation with creatinine levels ($r = -0.523$; $p = 0.010$). The working duration variable shows a positive relationship with eGFR (r = 0.525; p = 0.010) and a negative relationship with creatinine levels ($r = -0.460$; $p = 0.027$), suggesting that longer working hours in hot environments contribute to a decrease in glomerular filtration rate. Additionally, the data analysis results show a very strong negative correlation between creatinine levels and eGFR ($r = -0.966$; $p = 0.001$). Conversely, age and years of work do not show statistically significant relationships ($p > 0.05$).

Table 4.
Multivariate analysis with regression test

Dependent Variable	Independent Variable	Exp(β)	Sig.
Creatinine Serum (mg/dL)	Age	-0.007	0.000
	Mineral Water Consumption	-0.041	0.031
	eGFR	-0.015	0.000
	(Constant)	1.407	0.000
eGFR (ml/minute/1.73m^2)	Age	-0.410	0.000
	Mineral Water Consumption	-2.143	0.058
	Creatinine serum	-61.328	0.000
	(Constant)	175.625	0.000

Table 4 shows the results of multivariate analysis, indicating that age (p = 0.000) and mineral water consumption (p = 0.031) significantly and negatively affect creatinine levels, meaning that increased water intake is associated with lower creatinine levels. The analysis results for age and creatinine levels (p = 0.000) significantly affect eGFR values, while mineral water consumption in the multivariate analysis does not show a significant effect on eGFR (p > 0.05) (Sudirman *et al*., 2020).

DISCUSSION

The Relationship Between Creatinine Levels and eGFR Values

Chronic Kidney Disease is characterized by a decrease in GFR, reflecting damage to glomerular filtration. The glomerular filtration rate plays an important role in assessing kidney function and evaluating the kidneys' efficiency in filtering waste and removing excess fluid from the bloodstream (Abdul *et al*. 2025). An increase in creatinine levels indicates the accumulation of metabolic waste that is not effectively filtered, leading to buildup in the kidneys. Serum creatinine levels and eGFR can serve as parameters to assess kidney function by providing an overview of nephron capacity and the progression of kidney damage (Sony., *et al.*, 2025)**.** Creatinine (α-methylguanidinoacetic

acid) is a non-protein nitrogen waste product from the metabolism of creatine (Cr), phosphocreatine (PCr), and dietary protein intake that is degraded extrarenally and excreted in urine. Creatinine synthesis begins in the kidneys through reactions involving the amino acids arginine and glycine, which break down proteins to form guanidinoacetic acid (GAA), the main precursor for creatine formation. In muscle tissue, creatine and phosphocreatine undergo a non-enzymatic dehydration process to form creatinine. Creatinine is released steadily into the bloodstream and is mostly excreted through glomerular filtration. Therefore, a decrease in glomerular filtration rate directly impairs creatinine filtration in the serum (Ávila, *et al.*, 2025).

Based on the results of this study's bivariate test, there is a very significant negative correlation between creatinine levels and eGFR. These results are consistent with the research of Riyani *et al.*, (2024) which states that an increase in serum creatinine is inversely related to eGFR, meaning that an increase in serum creatinine causes a decrease in eGFR, and a decrease in eGFR results in a drastic increase in serum creatinine. Based on the multivariate analysis results, each 1 mg/dL decrease in eGFR increases creatinine by 0.015 mg/dL, and as creatinine increases, eGFR decreases by 61.328 mL/min/1.73 m², a relationship influenced by the respondent's age. Andersson *et al.*, (2022) found an increase in creatinine of 0.03 mg/dL in workers exposed to heat causes a decrease in eGFR, indicating acute tubular injury. Exposure to extreme temperatures in the workplace triggers dehydration, causing fluids in the bloodstream to shift toward the skin's surface to help regulate body temperature and maintain stability. The reduction in renal blood flow results in decreased glomerular filtration pressure, directly inhibiting creatinine clearance and leading to its accumulation in the bloodstream (Andersson *et al*., 2022; Suban & Luh, 2024).

The Relationship Between Mineral Water Consumption Frequency and Kidney Function Test Parameters

Common causes of a decline in kidney function include insufficient water intake. Additionally, an unhealthy lifestyle, such as consuming energy/flavored drinks, excessive activity, and work-related risk factors like exposure to nephrotoxins and heat, also affects kidney health (Hendrawan *et al*. 2025; Nurhadi *et al*. 2024)**.** The results of the bivariate analysis in this study indicate that water consumption is significantly associated with creatinine levels and eGFR. These results are consistent with Prasetio *et al*., (2021) studies among 41 workers handling tile fabric exposed to heat, an increase in creatinine levels was observed, influenced by water consumption. This is also supported by the research of Massimo *et al*., (2022) that increased intake of mineral water affects the decrease in creatinine levels. The multivariate test results showed that each increase in water consumption would reduce creatinine levels by 0.041 mg/dL. Water intake is influenced by age because aging triggers physiological changes; therefore, adequate water intake in the elderly is calculated at 30 mL/kg of body weight. (Simbolon 2025). Furthermore, the findings of this study indicate that mineral water intake does not affect eGFR values. These results are consistent with the statement of Massimo *et al*., (2022) which states there is no relationship between water intake and annual eGFR changes.

Adequate water intake is influenced by body weight and age. Someone with excess weight has a higher fat content, which requires sufficient fluids to maintain metabolic functions. According to the 2013 Recommended Nutrient Intake (RNI), the adequate fluid intake for ages 30–49 is 2,600 mL; for ages 50–64, 2,600 mL; for ages 65–80, 1,900 mL; and for those over 80 years old, 1,600 mL. Aging reduces the number of nephrons, leading to less efficient filtration of water by the kidneys in the elderly. Additionally, the risk of dehydration in older adults occurs because the opioid system's response to thirst stimuli diminishes. Therefore, minimizing the risk of dehydration by optimizing mineral water intake helps ensure that metabolic and waste-excretion processes function properly. (Ikhlasiah 2024)**.**

Dehydration among workers is triggered by environmental factors such as extreme heat stress and heavy workloads. This extreme heat stress increases body temperature among brickmakers. This condition triggers regulatory responses in which the body shifts water from the intravascular space to maintain fluid balance, while sweating excretes fluids and ions. A decrease in blood volume increases viscosity, which raises the workload on the kidneys. Additionally, a reduction in plasma volume triggers renal perfusion degradation, thereby hindering filtration pressure in the glomerulus, leading to suboptimal removal of metabolic waste and its accumulation in the bloodstream (Hidayanto *et al*. 2025; Suban and Luh 2024). In addition to hemodynamic factors, dehydration can affect glucose metabolism by inducing hyperosmolarity, which activates vasopressin signaling and aldose reductase. Aldose reductase converts glucose into fructose endogenously in the proximal tubule. Fructose metabolism by the enzyme fructokinase triggers oxidative stress and produces reactive oxygen species (ROS), leading to damage in the local tubules. Damage to the tubular cells results in impaired filtration of metabolic waste, which directly increases serum creatinine levels in the blood (Park, 2025)**.**

The Relationship Between Coffee Consumption Frequency and Kidney Function Test Parameters

Coffee has become one of the most favored beverages, so its consumption is related to people's lifestyles. The results of this study show a significant relationship between coffee consumption frequency and creatinine levels and eGFR values. The higher the frequency of coffee consumption, the greater the increase in creatinine levels and the greater the decrease in eGFR. This study is consistent with the research of Tommerdahl *et al*., (2022) and Cai *et al.*, (2024), shows a strong correlation between coffee consumption and serum creatinine levels and eGFR values. Additionally, the study of Cai *et al.*, (2024) stating that each additional glass of coffee consumed per day is associated with an annual decrease in eGFR of 0.03 ml/min/1.73m². In line with this, López *et al.*, (2021) explain that consuming more than 2 cups of caffeinated coffee per day will accelerate the decline in glomerular filtration rate within 1 year. Increased coffee consumption is associated with reduced daily intake of mineral water, which poses a risk of long-term disruption of kidney function.

Caffeine is the main component in coffee that has a stimulant effect on the human nervous system. After consumption, caffeine enters the body through absorption in the gastrointestinal tract and is then distributed throughout the body. Caffeine acts as a selective A1 adenosine receptor antagonist, inhibiting adenosine receptors and blocking sodium reabsorption. Low sodium levels will increase angiotensin II levels, which regulate increases in systemic blood pressure. High blood pressure accelerates the glomerular filtration process and causes blood vessels to constrict (vasoconstriction). This condition increases the workload on the kidneys to filter metabolic waste, thereby hindering creatinine excretion. Additionally, caffeine that accumulates in the glomerulus can impair kidney function in filtering waste/toxins and in removing excess fluids from the body (Khusna *et al.*, 2025; Qibetya, *et al*., 2025)**.** Adenosine is a neurotransmitter in the brain and peripheral nerves. Consuming large amounts of caffeine will increase alertness and muscle performance, triggering a catabolic reaction in muscle tissue. Muscle catabolism breaks down phosphocreatine within the muscles until the substance accumulates in the blood. This condition causes a significant increase in creatinine levels in the bloodstream (Bevi *et al*. 2025; Khusna *et al*. 2025)**.**

Consuming coffee does not always have negative implications for the body because it contains bioactive compounds such as phenolics, diperten, trigonelline, and melanoidin, which have anti-inflammatory and antioxidant properties. However, in epidemiological studies, three specific coffee components have been identified as directly related to CKD incidence. The compound glyco-deoxycholate is known to have a positive impact on kidney filtration function, while metabolites such as O-methylcatechol sulfate and 3-methylcatechol sulfate have a negative impact on kidney health (Cai *et al*. 2024). Based on SNI 1-7152-2006, the maximum caffeine intake in beverages is

set at 150mg per day. Meanwhile, *Food and Drug Administration* (2024) set a higher daily coffee consumption limit of 400mg/day or equivalent to 3-4 cups per day. However, in the research Qibetya, *et al.*, (2025) it is recommended that elderly groups consume no more than 2 cups of coffee per day. This is because, in old age, there is a physiological decline in nephrons, so excessive caffeine intake increases glomerular pressure in the kidneys, which adds to the burden.

The Relationship Between Daily Working Hours and Kidney Function Test Parameters

Exposure to nephrotoxic agents and heat exposure indirectly can affect kidney function if it occurs over a long period. The results of this study show a significant relationship between work duration and creatinine levels and eGFR values. This result is consistent with the research Chen and Yang, (2024) stating that the duration of daily work has a significant correlation with creatinine levels and eGFR values. Each 10-hour increase in weekly work duration is associated with a decrease in eGFR of 0.86 mL/min/1.73 m² per additional year of age.

Long working hours lead to prolonged exposure to high temperatures among brick artisans. Heat exposure in the work environment is a risk factor for kidney disease, especially among workers engaged in heavy physical activity under extreme environmental conditions. Intense and prolonged heat exposure can cause dehydration. Dehydration reduces blood volume, leading to decreased kidney perfusion and increased concentrations of nephrotoxic compounds in the kidneys (Khusna *et al*. 2025). Prolonged and intense physical activity also triggers the breakdown of phosphocreatine in muscles into creatine ions, which then enter the bloodstream. Additionally, conditions such as rhabdomyolysis or muscle tissue damage can cause CKD, in which damaged muscle components enter the bloodstream, increasing phosphocreatine levels. Based on research of Park and Kang (2025)**,** long working hours can worsen the progression of CKD through chronic inflammation and endothelial dysfunction, characterized by high levels of C-Reactive Protein (CRP) as an indicator of inflammation in the body. In addition to these conditions, long working hours are often associated with metabolic disorders such as hypertension, obesity, and diabetes.

The Relationship Between Length of Employment and Kidney Function Examination Parameters

Based on the results of this study, the work period variable does not show a significant relationship with creatinine levels and eGFR values. These results are consistent with previous research Ekiti *et al.*, (2018) which states that more than 15 years of work experience is not associated with CKD based on creatinine levels and eGFR parameters. This phenomenon may occur because workers with long work durations have undergone an acclimatization process to the work environment. However, this process does not eliminate the risk of health disturbances in workers. Physiologically, work duration can influence creatinine levels through several mechanisms, including chronic dehydration, physical stress, heat stress, and unhealthy lifestyle patterns. Heat stress in brick kiln workers can trigger oxidative stress that impacts systemic blood pressure stability. Uncontrolled blood pressure will affect kidney metabolism filtration. (Hidayanto *et al*. 2025; Syokumawena *et al*. 2018)**.** According to Hansson *et al.*, (2025), the risk of CKD disease due to heavy work in a hot environment can be minimized if workers maintain adequate fluid intake during work.

The Relationship Between Age and Kidney Function Test Parameters

Age is an important factor in the decline of kidney filtration function. As age increases, the kidneys' functional capacity tends to decrease due to nephron degeneration. The results of this study showed that bivariable analysis did not indicate a significant relationship between age and serum creatinine levels or eGFR. However, in the multivariable analysis that accounted for confounding variables, significant associations were observed between age and serum creatinine and between age and eGFR. This research is supported by the study of Prasetio *et al*., (2021) which states that age is a determining variable that influences the relationship between water consumption and increased serum creatinine levels in workers exposed to heat. Age is a risk factor for CKD because it is

closely associated with anatomical and functional changes in the kidneys. Physiologically, aging reduces kidney mass by up to 20 grams between the ages of 40 and 90, accompanied by a decrease in the number of nephrons. The reduction in nephron number and the limited regenerative capacity of cells affect the efficiency of creatinine secretion and filtration processes (Bevi *et al*. 2025; Suban and Luh 2024). A decrease in the number of nephrons causes the remaining functioning nephrons to take over the workload of the damaged nephrons, leading to hyperfiltration and worsening kidney function. Therefore, creatinine levels in the elderly group are higher compared to the younger age group. Clinically, the eGFR value generally remains stable until the age of 40 and then decreases at a rate of 8 mL/min/1.73m² after passing the age of 40 (Daryaswanti, *et al*., 2021)**.**

These findings can provide a basis for health interventions for brick artisans, especially in managing hydration intake by consuming more than 2000 mL of water per day, adjusted according to age/weight. Additionally, brick artisans are advised to limit coffee consumption to 2 cups per day and working hours to 8 hours per day. Clinically, estimated GFR calculated from serum creatinine is sufficient for diagnosing, staging, and monitoring the progression of CKD. However, interpretation of eGFR values is influenced by variables such as age, gender, and muscle mass. Therefore, supporting examinations such as urine volume measurement less than 0.5 mL/kg/hour over 6 hours, observation of urine sediment that appears cloudy brown, and detection of mild to moderate proteinuria are necessary (Ávila, *et al.*, 2025)**.**

This study has several limitations, including a questionnaire instrument that is not comprehensive enough, which results in limited information regarding the respondents' clinical data such as height, medical history, and current medications and antibiotics that are not documented in detail. Additionally, the researchers faced challenges in controlling for confounding variables and ensuring uniformity in the supporting examinations across all research subjects. This led to limited availability of data variables that could strengthen the overall assessment of the respondents' kidney function.

CONCLUSION

The results of the bivariate analysis showed significant associations between coffee consumption habits, water intake, and working duration and serum creatinine levels and eGFR values ($p < 0.05$), whereas work duration and age were not statistically significant ($p > 0.05$). In multivariate regression analysis, water intake was shown to have a significant effect on creatinine levels and eGFR values, with these effects influenced by respondents' age. Increased coffee consumption was associated with higher creatinine levels and lower eGFR values. Insufficient water intake leads to dehydration, which worsens kidney function in filtering metabolic waste. Long working hours in hot environments increase the risk of oxidative stress and kidney tubule injury.

Based on the study findings, it is recommended that brick artisans reduce coffee consumption and increase water intake to prevent kidney damage and decrease daily working hours. Additionally, future research is expected to apply inclusion criteria for age, medication use, and medical history to ensure that kidney function test results are not confounded. Furthermore, subsequent studies can include supporting examinations such as blood pressure, uric acid, and blood glucose to identify other potential causes. Future research is also encouraged to expand the scope by including additional kidney biomarkers, such as urea, BUN, and Cystatin C, to better understand the factors contributing to decreased kidney function among brick artisans.

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