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Pattern of Kidney Stress Symptoms and Associated Factors among Outdoor Workers in Port Harcourt, Rivers State

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ABSTRACT

Background: Outdoor workers experience prolonged exposure to heat, solar radiation and strenuous physical activity, which may promote dehydration and kidney stress. This study assessed self-reported kidney stress symptoms and associated factors among outdoor workers in Port Harcourt, Nigeria.

Methods: A descriptive cross-sectional study was conducted among 150 outdoor workers. Data were collected using a structured interviewer-administered questionnaire covering socio-demographic characteristics, outdoor work exposure, hydration practices and kidney stress symptoms. Symptoms assessed included dark urine, oliguria, dysuria, flank or back pain and leg or stomach cramps. Data were analysed using descriptive statistics and chi-square tests in SPSS. Statistical significance was set at $p<0.05$.

Results: Of the participants, 82 (54.7%) were male, while 58 (38.7%) were aged 40–49 years. Most participants worked outdoors daily, 122 (81.3%), and 121 (80.6%) spent at least 6 hours outdoors each day. Leg or stomach cramps were the most common symptom, reported by 28 (18.7%) participants, followed by dark urine, 12 (8.0%); flank or back pain, 8 (5.3%); oliguria, 6 (4.0%); and dysuria, 2 (1.3%). Dark urine was significantly more common among participants with poor hydration practices than among those with good hydration practices, 16.7% versus 3.9% ($\chi^2=7.20$, $p=0.007$). Heat-exposure classification was significantly associated with oliguria ($\chi^2=26.56$, $p<0.001$), although oliguria occurred more frequently among those classified as not heat exposed.

Conclusion: Kidney stress symptoms were generally uncommon, although muscular cramps and dark urine occurred most frequently. Poor hydration practice was significantly associated with dark urine. Workplace interventions should promote adequate hydration, rest breaks, shade and early evaluation of recurrent symptoms.

KEYWORDS: outdoor workers; kidney stress; heat exposure; dehydration; Port Harcourt

1.0 INTRODUCTION

Rising global temperatures and increasingly frequent periods of extreme heat have intensified occupational health risks among outdoor workers. Individuals engaged in agriculture, construction, road maintenance, waste management, transportation, security services and other outdoor occupations often perform strenuous physical activities under direct solar radiation, high temperatures and elevated humidity. These conditions impair heat dissipation and may lead to excessive sweating, dehydration, electrolyte imbalance and physiological heat strain.1–4 Outdoor workers are therefore particularly vulnerable to heat-related illnesses, reduced productivity and kidney dysfunction.1,2

The kidneys play an essential role in maintaining fluid, electrolyte and acid–base balance during physical activity and environmental heat exposure. Excessive sweating reduces circulating blood volume and increases serum osmolality, activating hormonal mechanisms that conserve water and maintain blood pressure. However, prolonged dehydration and heat strain may reduce renal blood flow and glomerular filtration.5,6 Repeated reductions in kidney perfusion can cause renal ischaemia, oxidative stress, inflammation and tubular injury. Experimental evidence indicates that hyperthermia and dehydration independently increase the risk of acute kidney injury, while their combined occurrence produces a greater renal burden.7

Occupational heat exposure has consequently emerged as an important determinant of kidney dysfunction. Studies have associated repeated exposure to heat, strenuous workload and inadequate hydration with acute kidney injury and chronic kidney disease of non-traditional or unknown origin.5,6,8–10 This condition has been reported among agricultural and manual workers in Central

America, South Asia and the United States, including individuals without conventional risk factors such as diabetes mellitus or longstanding hypertension.8,9

Field investigations have demonstrated measurable changes in kidney function during or after hot work shifts. Among agricultural workers in California and Florida, dehydration, high workload and elevated heat indices were associated with reduced kidney function and increased occurrence of acute kidney injury.11–13 Similar reductions in estimated glomerular filtration rate have been documented among sugarcane workers across harvest seasons.14–16 Kidney stress has also been reported among construction workers, brickmakers, rice workers and other occupational groups exposed to prolonged heat and strenuous physical activity.17–20 These findings indicate that occupational kidney stress extends beyond agriculture and constitutes a broader public health concern.

Kidney injury may initially occur without clear clinical manifestations. Nevertheless, dehydration and heat strain can produce symptoms such as intense thirst, dry mouth, reduced urine output, dark urine, painful urination, flank discomfort, muscle cramps, headache, dizziness, weakness, nausea and unusual fatigue.1,2,21 Although some symptoms are not specific to kidney injury, their occurrence alongside prolonged heat exposure and reduced urination may signal impaired renal perfusion. Symptom-based assessment may therefore support early identification of workers who require clinical evaluation and kidney-function testing.

The occurrence of kidney stress symptoms may be influenced by environmental, occupational, behavioural and individual factors. Relevant workplace conditions include high temperature, direct sunlight, long shifts, strenuous workload, inadequate drinking water, limited rest periods, lack of shade and restrictive clothing.3,11,12 Individual factors may include age, obesity, inadequate heat acclimatisation, hypertension, diabetes, previous kidney disease and the use of medicines that affect renal perfusion.5,6 Fluid restriction, consumption of sugar-sweetened beverages and inappropriate use of non-steroidal anti-inflammatory drugs may further increase susceptibility.6,8,13

Despite increasing evidence of heat-related kidney dysfunction, limited research has examined how kidney stress symptoms occur and cluster among outdoor workers, particularly in tropical low- and middle-income settings. This study therefore assessed the pattern of kidney stress symptoms among outdoor workers and determined the socio-demographic, behavioural, occupational, environmental and health-related factors associated with their occurrence in Port Harcourt Metropolis.

2.0 METHODOLOGY

2.1 Study Design

The study adopted a descriptive cross-sectional design to assess the pattern of self-reported kidney stress symptoms and the factors associated with their occurrence among outdoor workers in Port Harcourt, Rivers State, Nigeria.

2.2 Study Area

The study was conducted in commercial motor park in Port Harcourt, the capital of Rivers State, Nigeria. Port Harcourt has a tropical climate characterised by relatively high ambient temperatures and humidity throughout much of the year. A considerable proportion of residents engage in occupations that require prolonged outdoor activity, including driving, trading, farming, food vending, engineering, transportation and other informal or formal outdoor work.

2.3 Study Population

The study population comprised adult outdoor workers in a commercial motor in Port Harcourt. Outdoor workers were defined as individuals whose routine occupational activities required them to spend a substantial proportion of their working hours outside enclosed or temperature-controlled environments.

2.4 Sample Size and Sampling

A total of 150 outdoor workers participated in the study. Eligible participants were recruited from selected from the commercial motor within Port Harcourt. Participants were included if they were adults, worked outdoors and provided informed consent. Individuals who were unable to complete the interview or who did not routinely engage in outdoor work were excluded.

2.5 Study Instrument

Data were collected using a structured interviewer-administered questionnaire. The questionnaire was designed to obtain information on the participants' socio-demographic characteristics, occupational heat exposure, hydration practices and self-reported kidney stress symptoms.

The socio-demographic section assessed sex, age, occupation, place of residence, marital status, monthly income and highest level of education. Occupational heat exposure was assessed using variables such as frequency of outdoor work and the average duration spent working outdoors per day. Frequency of outdoor work was classified into daily, several times a week, occasionally, sometimes a week and rarely, while daily outdoor work duration was grouped into less than 1 hour, 1–5 hours, 6–10 hours and more than 10 hours.

The questionnaire also assessed hydration-related practices, including participants' reported water intake and other behaviours related to fluid replacement during outdoor work. Hydration practices were subsequently classified as either good or poor based on the scoring criteria developed for the questionnaire.

Measurement of Kidney Stress Symptoms

The principal outcome variables were self-reported symptoms suggestive of kidney stress. Participants were asked whether they had experienced dark urine, oliguria, dysuria, flank or back pain, and leg or stomach cramps. Each symptom was recorded as a dichotomous response of "Yes" or "No."

Dark urine referred to urine that appeared unusually concentrated or darker than normal. Oliguria referred to a noticeable reduction in the frequency or volume of urine passed. Dysuria referred to pain, discomfort or a burning sensation during urination. Flank or back pain referred to pain experienced around the side of the lower back or posterior abdominal region. Leg or stomach cramps referred to painful involuntary muscular contractions affecting the lower limbs or abdominal region.

2.6 Data Collection Procedure

Trained research assistants administered the questionnaire through face-to-face interviews. The purpose of the study was explained to each eligible participant before enrolment. Participants were interviewed in a setting that ensured privacy and allowed them to respond freely. The interviewers reviewed each completed questionnaire immediately after administration to identify missing or inconsistent responses.

2.7 Validity and Reliability of the Instrument

The questionnaire was reviewed by experts in occupational health, public health and epidemiology to assess its clarity, relevance and content validity. It was pretested among outdoor workers in a setting with characteristics similar to the study area but outside the selected study locations. Observations from the pretest were used to improve the wording, sequence and comprehensibility of the questionnaire.

2.8 Data Analysis

Data were entered, cleaned, coded and analysed using the Statistical Package for the Social Sciences v25 (IBM, USA). Descriptive statistics were used to summarise the study variables. Frequencies and percentages were calculated for categorical variables, including demographic characteristics, occupational heat exposure, hydration practices and kidney stress symptoms.

Inferential statistics were used to examine associations between the independent variables and the reported kidney stress symptoms. The chi-square test was used to assess the association between occupational heat exposure and each kidney stress symptom, as well as the relationship between hydration practices and the reported symptoms. Fisher's exact test was applied where the assumptions of the chi-square test were not satisfied. Statistical significance was set at a p-value of less than 0.05.

2.9 Ethical Considerations

Ethical approval for the study was obtained from the Rivers State Ministry of Health. Permission was also obtained from the relevant authorities at the selected study locations. Each participant received information about the purpose, procedures, potential benefits and minimal risks of the study. Participation was voluntary, and informed consent was obtained before data collection. Participants were informed that they could decline participation or withdraw from the study without penalty. No personal identifiers were included in the analytical dataset, and all information obtained was treated confidentially.

The results section below presents the findings objectively, following the sequence of the study objectives and retaining the statistical values reported in the attached file.

3.0 RESULTS

Socio-demographic characteristics of the participants

A total of 150 outdoor workers participated in the study. Of these, 82 (54.7%) were male, while 68 (45.3%) were female. The largest proportion of participants were aged 40–49 years, accounting for 58 (38.7%), followed by those aged 50–59 years, 41 (27.3%), and 30–39 years, 28 (18.7%). Only 2 (1.3%) participants were aged 70 years and above.

Drivers constituted the largest occupational group, with 49 (32.7%) participants, followed by business owners, 37 (24.7%), traders, 20 (13.3%), and civil servants, 15 (10.0%). Most participants, 85 (56.7%), resided in semi-urban areas, while 33 (22.0%) lived in urban areas and 32 (21.3%) lived in rural areas.

The majority of participants were married, 127 (84.7%), while 21 (14.0%) were single and 2 (1.3%) were widowed. Regarding monthly income, 56 (37.3%) earned between ₦30,000 and ₦79,999, while 44 (29.3%) earned between ₦150,000 and ₦200,000. Most participants had tertiary education, 95 (63.3%), while 40 (26.7%) had secondary education and 15 (10.0%) had primary education.

Table 1. Socio-demographic characteristics of outdoor workers

Variable	Category	Frequency, n=150	Percentage, (%)
Sex	Male	82	54.7
	Female	68	45.3
Age group	18–29 years	6	4.0
	30–39 years	28	18.7
	40–49 years	58	38.7
	50–59 years	41	27.3
	60–69 years	15	10.0
	≥70 years	2	1.3
Occupation	Business owner	37	24.7
	Civil servant	15	10.0
	Clergy	3	2.0
	Dance instructor	1	0.7
	Driver	49	32.7
	Engineer	4	2.7
	Farmer	3	2.0
	Fashion designer	6	4.0
	Food vendor	2	1.3
	Marine engineer	1	0.7
	Media personnel	4	2.7
	Public servant	2	1.3
	Retired	1	0.7
	Teacher	2	1.3
	Trader	20	13.3
Place of residence	Rural	32	21.3
	Semi-urban	85	56.7
	Urban	33	22.0
Marital status	Married	127	84.7
	Single	21	14.0
	Widowed	2	1.3
Monthly income	<₦30,000	22	14.7
	₦30,000–₦79,999	56	37.3
	₦80,000–₦149,000	28	18.7
	₦150,000–₦200,000	44	29.3
Education	Primary	15	10.0
	Secondary	40	26.7
	Tertiary	95	63.3

Occupational heat exposure

Most participants, 122 (81.3%), reported working outdoors daily. Fourteen (9.3%) worked outdoors several times a week, while 10 (6.7%) worked outdoors occasionally. Regarding the duration of outdoor exposure, 71 (47.3%) participants spent between 6 and 10 hours outdoors daily, while 50 (33.3%) spent more than 10 hours outdoors. Thus, 121 (80.6%) participants reported spending at least 6 hours outdoors daily.

Table 2. Pattern of occupational heat exposure

Variable	Category	Frequency, n=150	Percentage, (%)
Frequency of outdoor work	Daily	122	81.3
	Several times a week	14	9.3
	Occasionally	10	6.7
	Rarely	3	2.0

Variable	Category	Frequency, n=150	Percentage, (%)
	Sometimes a week	1	0.7
Duration spent outdoors	<1 hour	2	1.3
	1–5 hours	27	18.0
	6–10 hours	71	47.3
	>10 hours	50	33.3

Pattern of self-reported kidney stress symptoms

Leg or stomach cramps were the most frequently reported symptoms, occurring among 28 (18.7%) participants. Dark urine was reported by 12 (8.0%) participants, while 8 (5.3%) experienced flank or back pain. Oliguria was reported by 6 (4.0%) participants, and dysuria was the least frequently reported symptom, affecting 2 (1.3%) participants.

Table 3. Prevalence of self-reported kidney stress symptoms

Symptom	Yes, n (%)	No, n (%)
Dark urine	12 (8.0)	138 (92.0)
Oliguria	6 (4.0)	144 (96.0)
Dysuria	2 (1.3)	148 (98.7)
Flank or back pain	8 (5.3)	142 (94.7)
Leg or stomach cramps	28 (18.7)	122 (81.3)

Association between heat exposure and kidney stress symptoms

Among the 137 participants classified as heat exposed, 10 (7.3%) reported dark urine compared with 2 (15.4%) of the 13 participants who were not classified as heat exposed. This association was not statistically significant (χ^2=1.06, p=0.304).

Oliguria was reported by 2 (1.5%) heat-exposed participants and 4 (30.8%) participants who were not classified as heat exposed. The association between heat exposure and oliguria was statistically significant (χ^2=26.56, $p<0.001$).

There were no statistically significant associations between heat exposure and dysuria (χ^2=0.19, p=0.661), flank or back pain (χ^2=0.80, p=0.371), or leg or stomach cramps (χ^2=1.37, p=0.241).

Table 4. Association between heat exposure and kidney stress symptoms

Category	Heat exposed n = 137 (%)	Not heat exposed n = 13 (%)	χ^2 (p-value)
Dark urine			
Yes	10 (7.3)	2 (15.4)	1.06 (0.304)
No	127 (92.7)	11 (84.6)	
Oliguria			
Yes	2 (1.5)	4 (30.8)	**26.56 (<0.001)***
No	135 (98.5)	9 (69.2)	
Dysuria			
Yes	2 (1.5)	0 (0.0)	0.19 (0.661)
No	135 (98.5)	13 (100.0)	
Flank or back pain			
Yes	8 (5.8)	0 (0.0)	0.80 (0.371)
No	129 (94.2)	13 (100.0)	
Leg or stomach cramps			
Yes	24 (17.5)	4 (30.8)	1.37 (0.241)
No	113 (82.5)	9 (69.2)	

*Statistically significant at $p<0.05$.

Relationship between hydration practices and kidney stress symptoms

Dark urine was reported by 8 (16.7%) of the 48 participants with poor hydration practices compared with 4 (3.9%) of the 102 participants with good hydration practices. The relationship between hydration practice and dark urine was statistically significant (χ^2=7.20, p=0.007).

Oliguria was more frequently reported among participants with poor hydration practices, 3 (6.3%), than among those with good hydration practices, 3 (2.9%); however, the difference was not statistically significant (χ^2=0.93, p=0.335). Similarly, hydration practice was not significantly associated with dysuria (χ^2=0.95, p=0.329), flank or back pain (χ^2=0.12, p=0.732), or leg or stomach cramps (χ^2=0.78, p=0.379).

Table 5. Relationship between hydration practices and kidney stress symptoms

Category	Poor hydration practice n = 48 (%)	Good hydration practice n = 102 (%)	χ^2 (p-value)
Dark urine			
Yes	8 (16.7)	4 (3.9)	**7.20 (0.007)***
No	40 (83.3)	98 (96.1)	
Oliguria			
Yes	3 (6.3)	3 (2.9)	0.93 (0.335)
No	45 (93.8)	99 (97.1)	
Dysuria			
Yes	0 (0.0)	2 (2.0)	0.95 (0.329)
No	48 (100.0)	100 (98.0)	
Flank or back pain			
Yes	3 (6.3)	5 (4.9)	0.12 (0.732)
No	45 (93.8)	97 (95.1)	
Leg or stomach cramps			
Yes	7 (14.6)	21 (20.6)	0.78 (0.379)
No	41 (85.4)	81 (79.4)	

**statistically significant (p<0.05*

4.0 DISCUSSION

This study examined the pattern of self-reported kidney stress symptoms and their relationship with occupational heat exposure and hydration practices among outdoor workers in Port Harcourt. The principal findings showed that most participants worked outdoors daily and spent prolonged periods outside. Leg or stomach cramps constituted the most frequently reported symptom, followed by dark urine, flank or back pain, oliguria and dysuria. Poor hydration practice was significantly associated with dark urine. Heat-exposure classification was significantly associated with oliguria, although oliguria occurred more frequently among participants classified as not heat exposed. The remaining symptoms showed no statistically significant relationships with heat exposure or hydration practice.

More than four-fifths of the participants worked outdoors daily, while approximately four-fifths spent at least 6 hours outdoors. This pattern indicates substantial occupational exposure to ambient heat, humidity and solar radiation. Outdoor workers commonly experience combined environmental and metabolic heat loads because they perform physical activities under conditions in which the body has limited capacity to dissipate accumulated heat.3,4 Port Harcourt's tropical climatic conditions may intensify this exposure, especially when workers lack regular access to shade, rest periods, adequate ventilation and potable water. The prolonged exposure observed in this study is consistent with reports among agricultural and construction workers who frequently spend most of their shifts in hot environments.11–13,17

Leg or stomach cramps were the most commonly reported symptom, affecting 18.7% of participants. Muscular cramps may occur during prolonged heat exposure because excessive sweating produces fluid and electrolyte losses, particularly sodium loss.1,2 However, cramps are not specific indicators of kidney injury and may also arise from muscular fatigue, strenuous physical activity, prolonged standing or underlying medical conditions. Their predominance may therefore reflect the combined effects of physical workload, heat strain and inadequate replacement of fluids and electrolytes. The finding nevertheless has occupational-health relevance because heat cramps may represent an early indication of physiological heat strain and can precede more severe heat-related illness.

Dark urine was reported by 8.0% of participants and represented the second most common symptom. Dark or concentrated urine commonly reflects reduced fluid intake or increased fluid loss, although medications, foods, haematuria, liver disease and urinary tract disorders can also alter urine colour. In hot working environments, excessive sweating without sufficient fluid replacement causes the kidneys to conserve water, resulting in lower urine volume and increased urine concentration.5,6 Dark urine may therefore provide workers with a simple warning sign of inadequate hydration, but it cannot independently establish the presence of kidney injury.

Flank or back pain, oliguria and dysuria were reported by relatively small proportions of participants. Flank or back pain occurred in 5.3%, oliguria in 4.0% and dysuria in 1.3%. These findings suggest that overt urinary symptoms were relatively uncommon within the study population. Nevertheless, the low prevalence of reported symptoms should not be interpreted as evidence that occupational kidney stress was absent. Acute changes in renal perfusion and kidney function may occur without obvious symptoms, and workers may fail to recognise gradual reductions in urine output or other subtle manifestations.5,7 Objective investigations among heat-exposed workers have identified cross-shift elevations in serum creatinine, concentrated urine and tubular-injury biomarkers even where workers did not report severe clinical illness.11–14

Studies in other occupational populations have reported a higher burden of dehydration and kidney dysfunction than the symptom prevalence identified in this study. Among Florida agricultural workers, dehydration increased substantially across the work shift, and approximately one-third experienced acute kidney injury on at least one monitored workday.13 California agricultural workers also demonstrated associations between heat strain and cross-shift reductions in kidney function.11,12 Similarly, a longitudinal study among construction workers in Saudi Arabia identified dehydration and deterioration in kidney-related measures during periods of occupational heat exposure.17 The differences between these studies and the present findings may reflect the use of serum creatinine, urine specific gravity and other objective biomarkers in earlier investigations, whereas the present study relied on self-reported symptoms.

Poor hydration practice was significantly associated with dark urine. Dark urine occurred among 16.7% of participants with poor hydration practices compared with 3.9% of those with good hydration practices. This finding agrees with the physiological expectation that inadequate fluid replacement during heat exposure increases urine concentration.5,6 It also supports findings from agricultural-worker studies in which inadequate hydration and increasing heat indices were associated with dehydration and acute changes in kidney function.11–13 Although dark urine remains a non-specific symptom, the magnitude of the difference between the hydration groups suggests that it may function as a useful, easily recognised indicator for hydration education and occupational surveillance.

Hydration practice was not significantly associated with oliguria, dysuria, flank or back pain, or leg or stomach cramps. Several factors may explain these findings. First, the symptoms occurred infrequently, limiting the statistical power to identify meaningful differences. Second, participants may have increased their fluid intake shortly before the interview without maintaining adequate hydration throughout their work shifts. A broad classification of hydration practice as good or poor may not capture the timing, quantity and type of fluids consumed, the intensity of sweating or workers' electrolyte replacement. Third, symptoms such as dysuria and flank pain may arise from urinary tract infections, musculoskeletal disorders, kidney stones or other conditions that are not directly related to hydration. Similarly, muscular cramps may reflect physical exertion as well as fluid and electrolyte loss.

The significant relationship between heat-exposure classification and oliguria requires particularly cautious interpretation. Oliguria was reported by 30.8% of participants classified as not heat exposed compared with 1.5% of heat-exposed participants. This direction of association contradicts the expected physiological relationship, since prolonged heat exposure and dehydration would ordinarily reduce renal perfusion and urine production.5–7 The result may reflect the very small size of the non-heat-exposed group, which contained only 13 participants, four of whom reported oliguria. Sparse observations can produce unstable percentages and chi-square estimates. Fisher's exact test would offer a more appropriate assessment where expected cell counts are small.

Exposure misclassification may also have contributed to the unexpected finding. All participants were described as outdoor workers, yet some were subsequently classified as not heat exposed. The criteria used to create these groups may not have adequately captured actual heat intensity, direct solar radiation, workload, clothing, access to shade or the time of day during which participants worked. Workers classified as less exposed may also have reduced their outdoor activities because of pre-existing urinary or health problems, creating the possibility of reverse causation. The finding should therefore not be interpreted as evidence that occupational heat protects against oliguria.

No significant associations emerged between heat exposure and dark urine, dysuria, flank or back pain, or cramps. This finding differs from broader evidence linking occupational heat strain with dehydration and kidney dysfunction.3,5,11–18 However, the present analysis measured symptoms rather than clinically confirmed kidney outcomes. Individual responses to heat also depend on workload, acclimatisation, clothing, fluid intake, underlying disease, medication use and access to rest and shade.6,17 A binary exposure measure may obscure these variations. Objective environmental measurements such as wet-bulb globe temperature, combined with work-shift duration and physical workload, would allow more precise evaluation of occupational heat exposure.

The findings have practical implications for occupational health. Employers and relevant authorities should ensure reliable access to potable water, shaded rest areas and scheduled work–rest cycles. Workers should receive education on early manifestations of heat strain and dehydration, including persistent thirst, muscular cramps, reduced urination and dark urine. Workers who repeatedly report these symptoms should undergo clinical assessment, including blood pressure measurement, urinalysis, serum creatinine testing and estimation of glomerular filtration rate. Preventive programmes should not rely exclusively on workers' symptoms because early kidney injury may remain clinically silent.

Pattern of Kidney Stress Symptoms and Associated Factors among Outdoor Workers in Port Harcourt, Rivers State

This study contributes evidence from an understudied population of outdoor workers in a tropical Nigerian city. It included workers from several occupations and assessed both occupational exposure and hydration-related factors. However, its cross-sectional design prevented the establishment of temporal or causal relationships. Self-reported symptoms and hydration practices were susceptible to recall and reporting biases. The study did not measure ambient heat, wet-bulb globe temperature, fluid intake volume, urine specific gravity, serum creatinine or kidney-injury biomarkers. Symptoms such as cramps, dark urine and back pain were also non-specific. The small number of participants in some symptom and exposure categories reduced statistical precision, while potential confounders such as hypertension, diabetes, medication use, previous kidney disease and workload were not incorporated into multivariable analysis.

5.0 CONCLUSION

Outdoor workers in a commercial motor park in Port Harcourt experienced prolonged occupational exposure, although self-reported kidney stress symptoms occurred at generally low frequencies. Leg or stomach cramps represented the most common symptom, while dark urine was significantly more frequent among workers with poor hydration practices.

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