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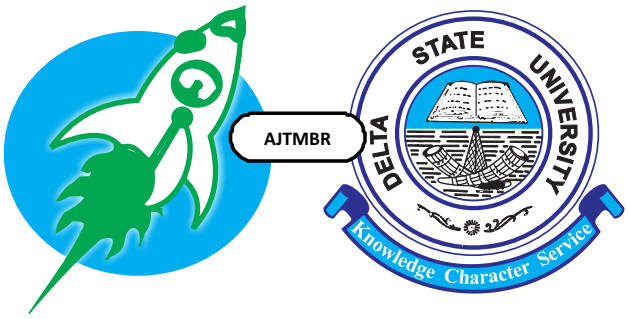

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Focus and Scope

The African Journal of Tropical Medicine and Biomedical Research is a multidisciplinary and international journal published by the College of Health Sciences, Delta State University of Abraka, Nigeria. It provides a forum for Authors working in Africa to share their research findings on all aspects of Tropical Medicine and Biomedical Sciences and to disseminate innovative, relevant and useful information on tropical medicine and biomedical sciences throughout the continent. The journal will publish original research articles, reviews, editorials, commentaries, short reports, case reports and letters to the editor. Articles are welcome in all branches of medicine and dentistry including basic sciences (Anatomy, Biochemistry, Physiology, Pharmacology, Psychology, Nursing etc) and clinical sciences (Internal Medicine, Surgery, Obstetrics and Gynaecology, Dental surgery, Child Health, Laboratory Sciences, Radiology, Community Medicine, etc). Articles are also welcome from social science researchers that document the intermediating and background social factors influencing health in countries of Africa. Priority will be given to publication of articles that describe the application of the principles of primary health care in the prevention and treatment of diseases.

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The title page should include the following information: 1. the title and sub-title; 2. the name(s) of the author(s); 3. the affiliation(s) of the author(s); 4. name and address of the corresponding author and 5. three to six key words for indexing and retrieval purposes.

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Acknowledgments

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Acute Kidney Injury in The Critically ill Patient: A Review of Epidemiological Studies in Low-middle Income Countries

Ajuyah R[1], Okoye O[2]

Abstract

Introduction

Acute kidney injury (AKI) refers to the sudden reduction in the kidney's ability to carry out its functions. AKI poses a major health burden in both low and middle income countries (LMIC) resulting in increased morbidity and mortality. It is a common complication in critically ill patients and has the potential of progressing to CKD.The objective of this article is to review the existing epidemiological studies on AKI in ICUs in LMIC.

Methods

Pubmed, Google Scholar, Web of Science and the Scientific Electronic Library online (SciELO) were searched for published reports, including article reviews on AKI in critically ill patients in LMIC. Search items included key words such as "acute kidney injury", 'critically ill patient", 'intensive care unit', 'epidemiology' low and middle income countries, 'developing countries'. The Search occurred between September to November 2022.Articles published from 2010 to 2022 were included in the search. The results reported according to PRISMA 2020 guidelines.

Results

Sixteen studies done in 13 LMIC were identified, with these studies analyzing data from 14835 patients from 51 ICUs within these countries from 2010 to 2022. Out of the studies reviewed, Six were from African countries and ten from non-African countries with male sex preponderance. The mean age of patients in the various studies ranged from 36 to 78 years with similar comorbidities reported such as hypertension, diabetes mellitus, stroke and heart failure. The overall incidence of AKI in ICU ranged from 29% to 58.5%. RIFLE criteria was used to define AKI in 4 of the reported studies with same number using AKIN criteria and lastly, KDIGO used in 8 studies. While most of the studies used just serum creatinine to define AKI, the study done by Passoni et al included urine output as well. Mortality rate was between 25.7% to 68%. Risk factors for AKI in critically ill patients reported from most of the studies reviewed include increasing age, male sex, sepsis, increasing length of ICU stay, hypovolemia and vasopressor use. Also, comorbidities such as hypertension (14%-46%) and diabetes mellitus (13%-45.9%) was common among patients. The length of ICU stay varied from 2 to 45 days with longer duration of stay noticed for patients with AKI for those reported.

Conclusion

it is reasonable to conclude that the high incidence of AKI and its contributory factors are persistent in LMICs with the associated poor outcomes.

Key words: acute kidney injury", 'critically ill patient", 'intensive care unit', 'epidemiology' low and middle income countries, 'developing countries'

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INTRODUCTION

Acute kidney injury (AKI) refers to the sudden drop in the kidney functional capacity following anatomical or physiological abnormalities or both.[1–3]Low Middle income Countries (LMICs) are countries in which the Gross National Income (GNI) per capita is less than four thousand two hundred and fifty five dollars; with the country Nigeria being a typical example.[4,5] LMICs are also known as developing countries AKI poses a major health burden in LMICs resulting in increased morbidity and mortality.[6] AKI is a common complication in critically ill patients and has the potential of progressing to CKD. Risk factors for AKI in critically ill patients include increasing age, male sex, hypovolaemia, nephrotoxic medications and presence of cormobidities.[6]

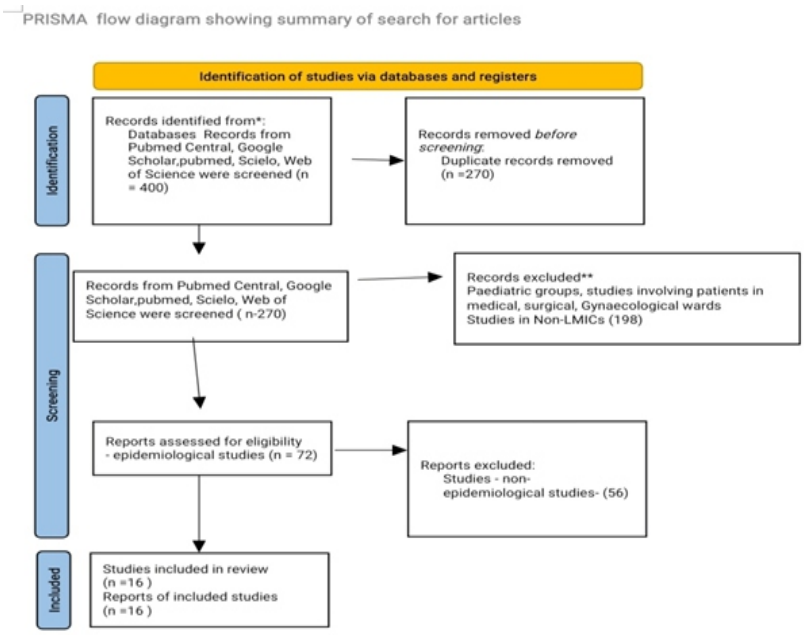
Epidemiological studies of AKI in ICU has showed variable results across different countries which could be due to factors such as the population studied (general, hospitalized, specific-patient sub-groups e.g surgical, ICU), differences in definition criteria used for the study, socio-demographic and economic status of populations studied.[7-9] AKI being more in older patients in high income countries may be due to advancement in medical care and interventional procedures; availability of well-equipped healthcare facilities and long lifespan. This is unlike low middle income countries where AKI in ICU patients is more in young adults which may be due to reduced lifespan, higher occurrence of infectious diseases and poor infrastructural development.[10-14] The objective of this article is to review the existing epidemiological studies on AKI in ICUs in LMICs to possibly provide insights into the modifiable factors that would improve disease outcome.

METHODS

Search Strategy and Selection Criteria

Pubmed, Google Scholar, Web of Science, WHO Global Health Library databases and the Scientific Electronic Library online (SciELO) were searched for published reports on AKI in critically ill patients in Low- and Middle-income Countries. The Search items included 'acute kidney injury'', 'acute renal failure', 'critically ill patient'', 'intensive care unit', 'epidemiology' low and middle income countries, 'developing countries', global south countries. The Search occurred between September to November 2022.Articles published from 2010 to 2022 were included in the search.

The abstracts of all selected studies including the complete articles were reviewed for inclusion. Observational and cohort studies (retrospective or prospective) involving critically ill adults patients in LMICs were eligible for inclusion. Selected papers were from both English speaking and non-English speaking countries. However, papers from non-English speaking countries were available online in the English version Unpublished articles, reviews, case reports and Studies involving paediatric age groups, or patients on the open wards (medical, surgical or gynaecological and maternity ward) or outpatients were excluded. A further review of articles was done to ensure appropriateness and for subsequent data extraction. The results reported according to PRISMA 2020 guidelines



RESULTS

Sixteen studies done in 13 LMIC were identified, with these studies analyzing data from 14835 patients from 51 ICUs within these countries from 2010 to 2022. Out of the studies reviewed, six were from African countries and ten from non-African countries with male sex preponderance. The mean age of patients in the various studies ranged from 36[14] to 78 years[6,13] with similar comorbidities reported such as hypertension, diabetes mellitus, stroke and heart failure.[6,8,11,14,16] The overall incidence of AKI in ICU ranged from 29%[14] to 58.5%[15]. RIFLE criteria was used to define AKI in four of the studies, Acute Kidney Injury Network (AKI) criteria in four and Kidney Disease Improving: Global Outcomes (KDIGO) criteria used in eight studies. While most of the studies used just serum creatinine to define AKI, the study done by Passoni et al included urine output as well.

Risk factors for AKI in critically ill patients reported from most of the studies reviewed include increasing age, male sex, sepsis, increasing length of ICU stay, hypovolaemia and vasopressor use. Comorbidities such as hypertension (14%-46%) and diabetes mellitus (13%-45.9%) was common among patients. The length of ICU stay varied from 2 to 45 days with longer duration of stay noticed for patients with AKI for those reported. Mortality rate was between 25.7%[8] to 68%[11]. Table 1 provides detailed information on studies reviewed.

Table 1. Summary 0f Information About the Epidemiology of Aki in Critically Ill Patients in LMIC In Reviewed Articles

						Population Characteristics			Epidemiological Data				Length of ICU stay		
Author/ Year	Place	Study type	No. of Px	AKI Def. Criteria	Mean age (yrs)	Male (%)	Female(%)	Comor-bidities	Risk factors for AKI	Incidence (%)	RRT for AKI (%)	Mortality (%)	With AKI	Without AKI	Outcome
Park et al.[8] 2010	Korea	R	378	RIFLE	62.6	62.7	37.3	DM, HTN	Older age, male sex, pul.dx, malignancy	41.3		AKI-25.7	17.2+-17.2		Survivor 70%
Jiang et al.[15] 2019	China	Pros., cohort	3107 (30 ICUs)	KDIGO	65.5	61.2	38.8	HTN (39.3%),HF (7%),DM (17.1%), CKD (6.5%), COPD (5.3%)	Male sex, older age, sepsis, hypotension, drugs	51		AKI-27.7 Non-AKI-6.8	3-11 (average, 7)	2-6	
Ahmed et al.[14] / 2021	Sudan	Pros	211	KDIGO	41	64	36	DM (31%), HTN (14%),Resp dx (4%), GIT(5%), CNS (2%).	Male sex, middle age, increasing length of ICU stay, mechanical ventilation, sepsis	29	62	AKI-41	2-45 days (average , 22.5)	-	Recovery-48%, discharged on RRT-11%
Adelaja et al.[13] 2019	Nigeria	Prospective cohort	100	RIFLE and AKIN	41.3	59	41	-	Younger age, male sex,head injury, sepsis, malignancy, cardiothoracic, obstetrics	54	-	AKI-61.5 Non-AKI-35	10.2+-9.4	11.1+-10	Survival 14.9%
Passoni et al 2019.[12]	Brazil	Ret/ cohort	1500	KDIGO	53	-	-	HTN (40.6), DM (16.1 %), cancer (8.2%)	Middle age, sepsis	40.5	13	AKI-39.1	12-39	13-31	-
						Population characteristics			Epidemiological Data for AKI				Length of ICU stay		
Author	Country	Study type	No of px	Criteria for AKI	Mean ag (yrs)	Male (%)	Female (%)	comorbidities	Risk factors for AKI	Incidence	RRT for AKI	Mortality (%)	With AKI	Without AKI	Outcome
Masewu et al.[16]2016	DRC	Prospective cohort	476(7 ICUS)	AKIN	52	57	43	HTN (4 6 %),DM (20.4%), stroke (8.8%), HF (1.8%)	Male sex, CKD, NSAID, sepsis	52.7	-	AKI-58	-	-	
Banda et al 2020.[11]	India	Retr cohort	280	KDIGO	36	51.1	48.9	DM (13%),HTN (27%), HIV (38.5%)	Young age, NSAID, HIV	52.9	-	AKI-68	-		
Minja et al 2019.[17]	Tanzania	Pros. Cohort	320	KDIGO	35	56	44	CVD (34%), DM (16%), surgery, HTN, malignancy (6%)	Sepsis, drugs, DM	55.3	-		-	-	
Aylward et al 2019.[18]	South Africa	Pros. Cohort	849	KDIGO	42.5	58.9	41.1	HTN (31.6%),DM (13.6%),CKD (7.7%), active TB (6.1%)	Length of stay, DM, sepsis, hypovolaemia, vasopressors	58.5	-	AKI-31.8 Non-AKI-7.23	-	-	CKD-12.7
Oweis et al.[19] 2020	Jordan	Retrospective	2530	AKIN	54.3	58	42	HTN (45.7%), DM (45.9%), HF (6.7%)	Sepsis, neurological disorder	31.6		AKI-58 Non-AKI-51.3			
Halle et al 2018.[10]	Cameroun	pros. Cohort	2402	KDIGO	56	54.7	45.3	HTN (32.2%), DM (17.6%)	Male sex, middle age, infections	22.3	10	36.9	-	-	Recovery-84.2 CKD1.1 Partial recovery-14.1
Kim et al.[20]2015	Korea	retrospective	335	RIFLE				HTN (35%), DM (25%)	Surgery, nephrotoxin	15.5	34.6	AKI-40.4, Non-AKI-21.3	14	15	Recovery-17

Yokota et al.[21] 2017	Brazil	Prospective	200	KDIGO	Elderly			DM, HTN (70.3%)	Sepsis, longer ICU stay	27		AKI-48.1 Non-AKI-15.7	11.4	5.2	
Santos et al 2015.[22]	Brazil	prospective	27	RIFLE	50	59.3	40.7	HTN, DM, heart dx		55.6		AKI-44.4			
Herrera-Mendez et al 2015.[23]	Mexico	prospective	360	AKIN	49	54.8	55.2	HTN, DM	Sepsis, shock, MODS	20.3		AKI-26.1,Non-AKI-16.6			
Boltansky et al.[24]2015	Chile	Retrospective	1769	AKIN		47		HTN (44%), DM (22%)		28.9		AKI-13.3 Non- AKI-6.0			

Abbreviations: AKIN - Acute Kidney Injury Network;HIV - Human Immunodeficiency Virus; KDIGO - Kidney Disease Improving: Global Outcomes; RIFLE - Risk, Injury, Failure, Loss, End-stage kidney disease; RRT – Renal replacement therapy; HTN-Hypertension; DM-Diabetes Mellitus, COPD- Chronic Obstructive Pulmonary disease,CKD- Chronic Kidney disease; CVD- Cerebrovascular disease,IHD-Ischaemic heart disease; PVD- Peripheral Vascular Disease, MODS- multiple organ dysfunction syndrome, Pros- prospective, R- Retrospective, DRC- Democratic Republic of Congo, AKI- Acute kidney injury

DISCUSSION

This study was aimed at reviewing the existing epidemiological studies on ICU-related AKI in LMIC. Our findings show that incidence rate of AKI was high, ranging from 29-58% based on the population studied and AKI definition criteria applied. The most common risk factors for AKI were modifiable and mortality rate was high.

The high incidence of AKI in developing countries may be due to higher occurrence of communicable diseases, poor health seeking attitude and delay of appropriate intervention. In addition, most of the critically ill patients from the studies reviewed, had comorbidities such as hypertension, diabetes mellitus[8,12,14-16], probably increasing the disease burden and worsening the outcome. Other comorbidities present include, COPD, malignancies, CKD, ischaemic heart disease, HIV and peripheral vascular diseases.[11,14,16-19] The presence of comorbidities increase the risk for AKI directly or indirectly by altering the renal autoregulatory processes leading to renal hypoperfusion and injury.[28]

The young and middle age groups were mostly affected and this probably reflects the lower average life-span in LMIC compared to advanced countries. Furthermore, some of the risk factors for AKI such as sepsis, hypovolaemia from injuries, HIV and use of nephrotoxic medicines tend to be commoner in the younger age group. There were more critically ill males with AKI compared to females and this may be because in many LMIC, males tend to have better access to health care, being the head of the family and bread winner.

The risk factors reported in the studies reviewed include young and middle age groups[12-14], male sex[8,12,14,15], sepsis[12,13,15], surgeries[13], hypovolaemia, head injury[13], mechanical ventilation[14], HIV[11], nephrotoxic medicines such as NSAIDs[11,16,17] and increasing length of ICU stay.[14,18] Sepsis was a commonly reported risk factor and cause of AKI in critically ill patients across most of the studies reviewed. Sepsis was associated with worsened morbidity, leading to an increase in ICU stay[13,14,16-19]. Sepsis increases the risk for AKI by 48.1%.[20] The pathophysiological mechanisms of sepsis-induced AKI in critically ill patients is complex, often leading to glomerular, interstitial and tubular damage possibly explaining its severity and poor treatment outcomes.[25]

Besides sepsis, another critical risk factor for AKI is baseline renal dysfunction. Jiang et al, in a large multicenter study involving 30 ICUs using KDIGO AKI definition criteria observed that

AKI patients already had worse baseline renal function when compared with those without AKI.[15] Similarly, Masewu et al, in a large multicenter prospective study verified that AKI had worse baseline serum creatinine.[16] Hence, critically patients with background renal impairment should be carefully monitored and interventions promptly instituted to prevent further deterioration.

The length of ICU stay was higher in patients with AKI compared to those without. This may be attributed to the increased severity of illness and prolonged treatment required in those who develop AKI and sometimes other organ(s) dysfunction. Increased length of hospital stay among the critically ill is associated with increased the out-of-pocket health costs and further impoverishment of patients and their families.

The risk of death associated with AKI in the ICU is also high in LMIC and can be ascribed to late recognition, severity of illness and the limited resources available for the prompt management of the complication.[11,13,26] Furthermore, the presence of community and hospital acquired infectious diseases in developing nations contributes to this increase in patients' morbidity and mortality.[8,13,14,27,28] This study showed a mortality rate of 25.7% [8] to 61.5% [13] in patients with AKI compared to 6.8% [6] to 51.3% [18] in those without. Adelaja et al reported that the presence of AKI in critically ill patients resulted in poor outcome with a mortality rate of 65% compared to those without AKI, having a mortality rate of 35%.[13] These values were higher compared to what was reported in a larger multicenter study from China, with AKI patients having mortality rate of 27.7% and non -AKI patients having 6.8%.[15] Other studies had similar pattern, thereby confirming that AKI increases morbidity and mortality in critically ill patients.[18,19] However, the study conducted in Jordan showed an almost equivalent mortality rate between patients with (58%) and without AKI (51%). The reason for this observation is unclear but may be due to a generally severely ill cohort or inefficient ICU treatment protocols.

The limited number of articles reviewed may not adequately reflect the epidemiology of AKI in the ICUs of LMICs. However, the lack of national AKI registries in most of these countries makes the current study findings valuable.

CONCLUSION

This systematic review demonstrates that the burden of AKI in critically ill patients in developing countries is enormous. Having noted the methodological differences across studies, it is reasonable to conclude that the high incidence of AKI and its contributory factors are persistent in LMICs with the associated poor outcomes. The information provided in this study provides opportunities for promptly recognising high-risk patients and modifiable factors responsible for AKI in critically ill patients, thereby reducing the adverse outcomes. Relevant specialists should co-produce a simple AKI risk assessment tool to promptly identify at-risk patients and intervene.

More methodologically sound large prospective studies that would consider extensive potential risks factors are required from LMIC.

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