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Magnitude and Factors Associated with Acute Kidney Injury Among Patients Admitted in Jimma University Medical Centre South West Ethiopia 2020

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Abstract: Acute kidney injury (AKI) is the sudden loss of organ function and the third leading cause of mortality after bleeding and brain trauma among admitted patients. There is a paucity of epidemiological data concerning AKI in Sub-Saharan African countries including Ethiopia with predominant admission of chronic cases. Methods: An institution-based cross-sectional study was conducted from 15 August- 14 October 2020. Epi-Data version 3.2 was used for data entry. In addition, STATA/14 was used for analysis. A Logistic regression model was used to determine the association of independent variables with the outcome variable and adjusted odds ratios (AOR) with 95% confidence interval was used to estimate the strength of the association at P<0.05. Result: Two hundred eighty-eight (288) card of inpatient were selected for analysis making the overall response rate 97.8%. The mean (±SD) age of the respondents was 44.16 (±18.29) years. The overall magnitude of AKI was 23.32% (95%CI: 18.91--29.36). Cases at baseline having hemoglobin level≤10.9mg/dl (AOR=11.4: 95%CI: 4.2, 31.2), bing cancer cases 6.87 (AOR=6.87; 95%CI: 1.76--26.73, P<0.005), and having creatinin levels > 1.36 mg/dl (>121 Micromole/L) was 5.78 (AOR=5.77; 95%CI: 1.93--17.27), were significantly associated with AKI. Conclusions: According to KDIGO-definitions of AKI, the high magnitude was reported among hospitalized patients and predicted by being cases of cancer, anemic and creatinine levels were significantly associated with AKI.

Keywords: Acute Kidney Injury, Glomerular Filtration, Comorbidity, Ethiopia

1. Introduction

Acute kidney injury (AKI) is an abrupt deterioration in kidney function, manifested by an increase in serum creatinine levels with or without reduced urine output [1]. AKI was defined according to KDIGO based on change in serum creatinine levels (≥0.3 mg/dL within 48 hours or ≥ 50% within 7 days) or urine output volume less than 0.5 mL/kg/hour for > 6 hours [1, 2]. Globally, AKI affects more than 13 million populations, and result in 1.7 million deaths each year around the world. Even a mild form of AKI is associated with 50% abrupt death [3]. Despite this, there is a particular paucity of epidemiological data on AKI that comes from the developed world, but there reported predominant AKI cases in Sub-Sahara African countries [4]. AKI is difficult to define, particularly in a setting where renal function wreck and hard ever early hastened to biomarker test [5]. According to KDIGO admission criteria, 21.6% of adults and 33.7% of children were encountered for AKI in the course of after hospital admission [6, 7]. In the UK up to 100,000 deaths each year in hospitals are associated with AKI. However, 30% could be preventable with the right care and treatment [2, 8]. The long hospital admission of surgical procedure has to be a risk factor for kidney adverse outcomes, including drug toxicity, and dose adjustment issues [9]. Currently, the prevalence of AKI is alarmingly increased becoming double burden and associated with hypertension (32.3%), urinary tract infection (12.3%) [10], diabetes 30%-50% [11],

hyperlipidemia [12], and 7.5% post-surgery [13]. Study result by Chertow et al [1] found that increased on serum creatinine (SCr) of≥0.3mg/dl (26.5 Umol/l) independently associated with Mortality [1]. However, evidence from Sudan (60%) AKI cases were reversible by little supportive and treatment [14]. The high morbidity and mortality associated with AKI in Ethiopia is an important challenge to the health community. The aim of this study is to the assessed magnitude of AKI and associated factors among admitted patients.

2. Methods

2.1. Study Area and Setting

A hospital-based retrospective cross-sectional study was employed for 292-cards admitted patient cards were used for analysis, in Jimma medical center from August 14- October 15, 2020. The hospital is located in Jimma town, 350 kilometers Southwest of Addis Ababa. It provides specialized healthcare services through its nine medical (with 80beds & 2 renal units) and 10 surgical departments (with 85 beds) for inpatients treatment.

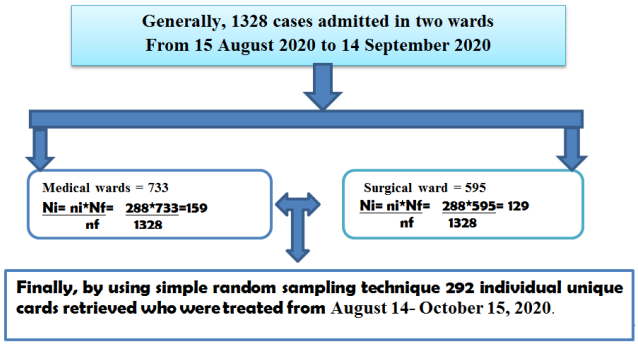

Figure 1. *Schematic presentation for sampling procedure of AKI in Jimma medical center.*

2.2. Source Population

The source populations for this study are all patients admitted at medical and surgical wards in JUMC, with inclusion of study of all patients admitted in both wards at JUMC from August 15 - 14 October 2020, with age ≥ 18 years.

2.3. Sample Size Determination

The sample size of this study was calculated based on two ways, using a single population proportion formula as Proportion (P) of AKI patients from previous study (17%), Z a/2=0.05 both sides, and margin of error at 5% using this formula

$$n = \frac{(Z\alpha/2)^2\, p\,(1-p)/d^2}{d^2} = \frac{(1.96)^2\, 0.17\,(0.83)}{(0.05)^2} = 217$$

Adding 10% incomplete data files, the final sample size will be 228, and for the second objective using double population proportion formula was used in EPI INFO version 3.2 by considering different significant variables from a previous study [12, 14]. The sample size was determined using a formula for two population proportions by taking the level of significance to be 5% and the power 80%. Patients who are diagnosed diabetic mellitus are considered as risk factors for our study of AKI. P1 = proportions of diabetic Mellitus individuals which were = 64.6%. The proportion of non-cases of diabetic Mellitus 47.9% with r is a ratio of population among exposed to non-exposed and which was 1.1. Based on the above assumption, and the addition of 5% incomplete data, 292 as the final sample size was calculated.

2.4. Operational Definition

AKI:- was defined using the Kidney Disease Improving Global Outcomes (KDIGO) AKI criteria, defining confirmed AKI as an increase in serum creatinine of greater than 26.5µmol/L within 48 hours, using admission creatinine as a baseline measurement [14]. There for, AKI defined as the change in serum creatinine levels (0.3 mg/dL within 48 hours 50% within 7 days) or urine output volume less than 0.5 mL/kg/hour for >6 hours [4].

Outcome variables: the outcome of interest is an admitted case diagnosed AKI/ Not. Independent variables include socio-demographic factors, medication types, and clinical variables (baseline Systolic, and diastolic blood pressure, diabetes mellitus, dyslipidemia, HIV/AIDS, urine output, respiratory rate, Pulse rate, temperature,

2.5. Data Collection Procedure and Quality Control

Data was collected from the randomly selected admitted patient card by using prepared checklists developed specifically for this study of both the operation registration book and medical admission logbook in two wards. The checklist is the consistency of socio-demographic date of medical and surgical condition of patient-related variables. Three staff BSc Nurses & one medical doctor were given one day of training about data extraction, principal investigation, and supervision of research, respectively. Data were collected through checklists with 5% pretested and necessary amendments were incorporated. Pretest was conducted on 10% of the patient before data collection to assess the clarity of the checklist possible amendments were incorporated into the checklist.

2.6. Data Processing and Analysis

The data were entered after cleaned and edited into Epi-Data version 3.1 and then exported to STATA/R version 14 (SE) for analysis. The descriptive statics such as frequency and percentage mean and slandered deviation were computed. Bi-variable logistic regression analysis was used to select candidate-transferred using criteria P<0.25. At Adjusted odds ratio (AOR) with a 95%Confidence interval (CI) was claimed statically significant variables at p-value<0.05 during multivariable binary logistic regression after adjustment of potential confounding. The Hosmer & Lemeshow goodness of fit test was mad at p>0.05.

3. Result

3.1. Demographic and Clinical Characteristic of Patients

Two hundred eighty-eighth (288) cards of an admitted patient were selected for analysis making a response rate of 98.6%. Four (4) patient cards were excluded from analysis because the card was not available on the lists. The mean (±SD) age of the patients was 41.95 (±17.2). The minimum and maximum ages were 18 & 85 years old, respectively. The majority 108 (37.5%) of patients were found in the age group of 46-65 years, while (23.2%) of participants were ≥ 65 years old. Of the total 288 participant, 168 (58.5%) cases were from urban area. Nearly half of 133 (46.98%) participants were Muslim religion followers, whereas the bottom number 34 (11.81%) were catholic believers. Moreover, 128 (44.5%) study participant had monthly income ≥ 5000birr per month. More than half of 163 (56.6%) admitted cases had multiple comorbidities (Table 1).

Table 1. *Socio-demographic and baseline clinical profiles of the patient admitted in JUMC 2020.*

Variable	Category	Frequency	Percept
Age	18-25	38	13.4
	26-45	74	25.4
	46-65	108	37.5
	>65	68	23
Sex	Male	100	34.3
	Female	188	65.7
Religion	Orthodox	86	29.8
	Muslim	133	46.18
	Catholic	34	11.81
	Protestant	35	12.15
Residence	Urban	168	58.3
	Rural	120	41.61
Educational status	Has no formal education	135	46.88
	Has formal education	153	53.13
Monthly Income	≤100 birr/month	80	27.4
	1001-5000 birr/month	80	27.4
	≥5000 birr/ month	128	44.4
Mode of Admission	Medical	159	55.6
	Surgical	129	44.4
Baseline admission comorbidity	One case diagnosed admission	125	43.40
	More than one case diagnosis	163	63.2
ACEI drug has taken before admission	Yes	158	54.2
	No	130	45.5
Urine output	≤400ml/day (<0.5 mL/kg/h for 6 hours)	141	48.96
	>401ml/dl (>0.5 mL/kg/h for 6 hour)	147	51.04
Blood urine Nitrogen (BUN)	≤14.5 mg/dl	171	59.3
	>14.1 mg/dl	171	59.38
Baseline creatinine	≤26.5 µmol/L (≤0.3 mg/dL) /48 h after admission	120	41.7
	>26.5 µmol/L (≤0.3 mg/dL) /48h after admission	168	58.3
Glomerular filtration	≤120 mL/min/1.73 m^2	153	49.6
	>121mL/min/1.73 m^2	145	50.35
Haemoglobin level (Haematocrit*1/3)	≤ 10.9mg/dl	131	45.49
	>11 mg/dl	157	54.5
Baseline BMI	≤18.5kg/m^2	120	41.6
	≥18.6kg/m^2	168	58.33
Systolic BP (mmHg),	≤140mmHg	204	70.8
	>140mmHg	84	29.6
DBP	≤90mmHg	189	63.9
	>90mmHg	99	18.38
Temperature	≤ 37.5C	110	38.19
	>37.6 C	178	61.8
Diabetic Mellitus	Yes	180	64.34
	No	103	35.76
Hypertension	Yes	96	33.3
	No	192	66.6
Chronic liver disease	Yes	48	16.7
	No	240	83.3
HIV /AIDS	Seropositive	63	21.88
	Seronegative	225	78.13
Cancer	Yes	39	13.54
	No	249	86.45

3.2. Comorbidity and Vital Signs

There were 163/288 (54.6%) participants admitted by a manifold or concomitant cases diagnosed, commonly diabetic Mellitus 103 (33.76% with chronic liver disease 48 (16.43%), or hypertension 119 (41.32%) with stroke 5 (1.74%) were registered. Vital signs are an indispensable measure to ensure body haemostatic. However, more than half of >147 (51.04%), and nearly one-third 97 (33.68%) of the admitted case has PR> 100beat/minute and RR ≥25 breath /minute, respectively. The majority 168 (58.33%) admitted cases had BMI >18.5 kg/me^2 and above. Likewise, 158 (54.86%) of patients took medication two weeks from the counter.

3.3. Baseline Clinical Kidney Biomarkers

Of all admitted cases, nearly half of 141 (48.96%) study participants had a history of oliguria ≤ 400ml/day urine 24 hours after admission and hypovolemic 98 (34.2%) during admission. Regarding biomarkers of Kidney function, nearly six out of ten 171 (59.38%) respondents had blood nitrogen levels (BUN) >14.1 mg/dl. Likewise, nearly half 140 (48.61%) of admitted cases had glomerular test >121mL/min/1.73 m^2. The rapid worsening of kidney function is substantiated by serum creatinine levels. Nearly half of study cases 140 (48.61%) had serum creatinine >121mL/min/1.73 m^2.

3.4. Magnitude and AKI

Of all admitted 1328 cases from 15 August 2020 to 14 September 2020in in Jimma university medical center, there were totally (63/288, 21.88%) diagnosed with AKI and authorized for treatment. And the overall magnitude of acute kidney injury was determined as 21.87% (95% CI: 17.45--27.05) (Table 2).

Table 2. *Baseline clinical laboratorial & hematologic result of patient admitted in JUMC, 2021.*

Variables	Categories	AKI	Non-AKI	Chi-2	P-value
		Yes	No		
Sex	Male	16 (25.3%)	84 (37.3%)	3.0939	0.179
	Female	47 (74.5%)	141 (62.7%)		
Age	18-25 years	5 (7.9%)	32 (14.2%)	55.9020	0.012
	26-45 years	8 (12.6%)	61 (27.1%)		
	46-65years	10 (15.8%)	95 (42.2%)		
	≥66years	40 (63.4%)	37 (16.4%)		0.001
Residence	Urban	46 (73.5%)	117 (52%)	8.85	0.031
	Rural	17 (26.5%)	108 (48%)		
creatinine level	≤26.5 µmol/L (≤0.3 mg/dL) /48 h	9 (14.2%)	114 (52%)		
	>26.5 µmol/L (>0.3 mg/dL) /48 h	54 (85.2%)	111 (49.33%)	26.65	0.001
Glomerular filtration	≤120 mL/min/1.73 m^2	14 (22.2%)	131 (58.2%)		
	>121mL/min/1.73 m^2	49 (77.8%)	94 (41.8%)	25.5	0.001
Haemoglobin level	≤ 11mg/dl	46 (73.03%)	38 (16.5%)		
	>11 mg/dl	17 (26.9%)	187 (83.11%)	75.1	0.001
Systolic BP (mmHg)	≤140mmHg	31 (49.6%)	173 (60.8%)		
	>140mmHg	32 (51.4%)	32 (14.5%)	18.25	0.001
Temperature	≤ 37.5C	16 (25.4%)	146 (85.6%		
	>37.6 C	47 (74.5%)	79 (35.11%)	31.2	0.001
Diabetic Mellitus	Yes	43 (68.25%)	62 (27.5%)	35.2	0.001
	No	30 (31.7%)	163 (72.44%)		
Hypertension	Yes	35 (55.5%)	81 (36%)	12.1	0.02
	No	25 (44.5%)	144 (64%)		
Cancer Diagnosed	Yes	20 (31.07%)	19 (8.4%)	22.8	0.01
	No	43 (68.25%)	206 (91.55%)		
BMI	≤18.5kg/m^2	26 (41.3%)	94 (41.77%)		
	>18.6kg/m^2	37 (58.9%)	131 (58.2%)	0.53	0.96
BUN	≤14.5 mg/dl	16 (25.4%)	101 (44.8%)		
	>14.5 mg/dl	47 (74.8%)	124 (55.1%)	7.753	0.05
HIV	Seropositive	26 (41.2%)	37 (16.6%)	17.74	0.001
	Seronegative	37 (58.7%)	188 (83.4%)		

3.5. Factors Associated with AKI

During binary logistic regression analysis, those variables that had P-value < 0.25 significance level were considered in multiple binary logistic regression. After adjustment of significant confounding in multivariable logistic regression, age of the patient, being cancer cases, diabetic multiuse cases, anemic cases, admission (creatinine levels glomerular filtration rate, hemoglobin, being cancer case) has significantly associated with AKI at P<0.05.

Cases at baseline having hemoglobin level≤10.9mg/dl (AOR=11.4: 95%CI: 4.2, 31.2), being cancer cases 6.87 (AOR=6.87; 95%CI: 1.76--26.73, P<0.005), and having creatinin levels >1.36 mg/dl (>121 Micromole/ L) was 5.78 (AOR=5.77; 95%CI: 1.93--17.27), were significantly

associated with AKI. Case having hemoglobin level≤10.9mg/dl (AOR=11.4: 95%CI: 4.2, 31.23 were some of the associated variables with AKI incidence. The odd of developing AKI among admitted patients having cancer diagnosis were 6.87 (AOR=6.87; 95%CI: 1.76--26.73, P<0.005) times higher than counter groups. The odd of developing AKI among patients who were admitted by creatinin levels were 3.64 (AOR= 3.6: 95%CI: 1.35--9.78, P< 0.010) times higher with not diabetic admission patients. The odd of developing AKI among admitted patients with creatinine levels >1.36 mg/dl (>121 Micromole/ L) was 5.78 (AOR=5.77; 95%CI: 1.93--17.27, P<0.002) times higher than with admitted cases having creatinine level ≤1.36 mg/dl (>121 Micromole/ L) (Table 3).

Table 3. *Binary and multivariable logistic regression analyses of factors associated with acute kidney injury among patients admitted to medical and surgical wards, JUMC, 2020.*

Variables	Categories	AKI	Non-AKI	COR	AOR	P-Value
		Yes	No			
Sex	Male	16	84	1.75 (0.92--3.5)	1.6 (0.67--4.6)	0.32
	Female	47	141	Ref	Ref	
	18-25 years	5	32	Ref	Ref	
Age	26-45 years	8	61	0.83 (0.23—2.7)	0.6 (.12---2.3)	0.49
	46-65years	10	95	0.67 (0.3—2.11)	0.63 (.13--3.2)	0.56
	≥66years	40	37	6.9 (2.43—18.9)	2.6 (0.79 –13.3)	0.28
Residence	Urban	46	117	2.5 (1.35--4.6)	1.2 (0.4--3.5)	0.41
	Rural	17	108	Ref	Ref	
Creatinine level	≤26.5 µmol/L (≤0.3 mg/dL) /48 h	9	114	Ref	Ref	
	>26.5 µmol/L (>0.3 mg/dL) /48h	54	111	6. (2.9 --13.)	5.78 (1.9--17.3)	0.002*
Glomerular filtration	≤120 mL/min/1.73 m^2	14	131	Ref	Ref	
	>121mL/min/1.73 m^2	49	94	4.9 (2.4--- 9.3)	2.1 (0.98 --8.3)	0.42
Haemoglobin	≤ 11mg/dl	46	38	13.3 (6.9--25.6)	11.4 (4.2--31.2)	0.01*
	>11 mg/dl	17	187	Ref	Ref	
Systolic BP	≤140mmHg	31	173	Ref	Ref	
	>140mmHg	32	32	3.4 (1.9 -6.15)	1.2 (0.9-- 8.4)	0.317
Temperature	≤ 37.5C	16	146	Ref	Ref	
	>37.6 C	47	79	5.43 (2.9--10.2)	1.6 (0.9--- 8.8)	0.21
Diabetic Mellitus	Yes	43	62	5.7 (3.1--10.4)	3.8 (8.5--9.77)	0.322
	No	20	163	Ref	Ref	
Hypertension-Dx	Yes	38	81	2.7 (1.5 ---4.8)	2.4 (0.89---6.3)	0.72
	No	25	144	Ref	Ref	
Cancer- Dx	Yes	20	19	5.04 (2.5--10.24)	6.8 (2.77--26)	0.001*
	No	43	206		Ref	

*dx= Diagnosing at admission.

4. Discussion

Determine the magnitude of AKI and associated factors among admitted patients has paramount importance on the mortality and morbidity intervention. The overall magnitude of acute kidney injury among admitted patients was found (63/288, 21.89%) 95%CI (17.2--27.4). This finding is similar to the study report in Malawi 21.1% [15]. But lower than finding at Addis Ababa 64.7% [16], Tigry Ethiopia 31.51% [17], American 25% [18], Paris 42.5%[19], ISN global community screening 47% [20], and systematic review and mata-anlysis pooled prevalence 21% (32% sub Sahara Africa) [21]. Whereas, the reports is higher than finding in Desisse hospitals 19.0% [9], china 18.6% [22], Taiwan 12.3% [10], and Portugal 7.5% [13]. This might be, our study report revealed more than half of 54.86% respondents had taken NSAID and ACEI drugs. A study by L Phillips et al [14] highlighted the burden of renal injury is 10% associated with prescriptions of nephrotoxic drugs [14]. Likewise, vasopressors drugs had effect on systemic hemodynamics. Likewise, patient admitted with hemoglobin level≤10.9mg/dl were 11 times higher than patients with hemoglobin were >11mg/dl (AOR=11.4: 95%CI: 4.20---31.23, P< 0.001). This is similar to the study finding in [23, 24]. According to a study report in Korea Seoul indicated, anemia is strongly associated with (77.2%) critically ill chronic Kidney disease patients. The especially surgical procedure of malignance cause proxy incidence of pre-and postoperative anemia with deleterious impact for AKI [24]. Patients admitted with baseline creatinine levels >1.36 mg/dl (>121 Micromole/ L) was nearly 6 (AOR=5.77; 95%CI: 1.93--17.27, P<0.002) times more likely to developed AKI as compared with the counter group. This is similar to finding on cardiac surgery patients in Italy [25], North East Ethiopia [9]. The incidence of kidney dysfunction is associated with malignancy, and associated complications [22], because of aggressive cancer therapies [22]. The odd of developing AKI among admitted patients having cancer diagnosis were 6.87 (AOR=6.87; 95%CI: 1.76--26.73, P<0.005) times higher than counter groups. This is in line with the study finding Ethiopia [9], Nashville, Tennessee [18], Italy [25]. The might be the dropout rate of estimated GFR (eGFR) can triggering hypotension and hypovolemic caused accruals of wastes in the absence of dialysis, then followed acute per-tubular, and capillaries necrosis with long-term changes in renal function due to cancers.

5. Conclusion

According to KDIGO-defined AKI was common and high magnitude among hospitalized patients and predicted by being cancer cases, anemia, and baseline serum creatinine were significantly associated with AKI. Beforehand relevant intervention would give paramount importance for risky individuals.

Abbreviation

KDIGO: kidney disease improving global outcome, AKI: acute kidney injury, SCR serum creatinine, SBP systolic blood pressure, AOR: adjusted odd ratio.

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