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Research Article

Prevalence of Respiratory Failure and Associated Factors in Adult Intensive Care Unit of Saint Paul's and Addis Ababa Burn, Emergency and Trauma Hospital, Ethiopia 2020

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Abstract

Background: Severe respiratory failure is a common reason for admission to the intensive care unit that occurs for several reasons, including pulmonary disease, neuromuscular disease, shock and the necessity for airway protection or temporary breathing support after major surgery. For patients with ARF, mechanical aeration is the cornerstone of management.

Objective: to assess the prevalence of respiratory failure and associated factors among patients admitted the adult intensive care unit of Saint Paul's Millennium Medical College and Addis Ababa Burn, Emergency and Trauma hospitals Addis Ababa, Ethiopia, 2020.

The prevalence of respiratory failure was high. Multiple factors influence the development of respiratory failure. Older age, cardiac disease, Human Immune Deficiency Virus and trauma were at risk of developed respiratory failure Therefore, Health care professionals, policy makers and other concerned bodies should give emphasis to the factors that contribute to the development of respiratory failure. They should give priority especially for older, HIV, cardiac, and trauma patients to provide easily accessible and quality care.

Keywords: prevalence; respiratory failure and associated factors; ethiopia

Introduction

Respiratory failure is a disorder, characterized by inability of the respiratory system to support effective and continuous gas exchange. The most common causes of acute respiratory failure are pneumonia, acute respiratory distress syndrome (ARDS), sepsis, asthma, drug ingestion, and trauma. In the aging, pneumonia, heart failure, chronic obstructive pulmonary disease (COPD), ARDS, and sepsis predominate [1].

Severe respiratory failure is a common reason for admission to the intensive care unit that occurs for several reasons, including pulmonary disease, neuromuscular disease, shock and the necessity for airway protection or temporary breathing support after major surgery. For patients with ARF, mechanical aeration is the cornerstone of management. [2, 3]

The magnitude of acute respiratory failure has become one of the most epidemiological tasks facing today's health systems in all intensive care units around the world.[4] Though, it is difficult to enumerate because the cause of death is more likely to be registered as pneumonia, COPD, or another underlying condition, rather than respiratory failure [5]. Respiratory failure endure a major cause of morbidity and mortality in the intensive care location, RF may be responsible for as many as 10–15% for admissions to medical ICU and for as many as 50–75% of those patients who require ICU stays longer than 7 days [6].

It also grounds numerous complications such as pulmonary embolism, reduced cardiac output, arrhythmias, acute kidney injury, incidence of acute respiratory failure admitted to ICU department is ranged 500 patients in the year 2016 affording to the statistical record of Assiut University Hospital [7].

Despite significant technological advances in mechanical ventilator support, the mortality is considerably high, exceeding 40% in many series [8, 9]. other studies also show, despite advances in the management of ARF with mechanical ventilator, death has not decreased significantly and costs continue high [10, 11].

A prospective cohort study conducted in Brazil showed that, among 1732 enrolled patients, 843 (49%) were admitted to an ICU with ARF and the remaining 889 (51%) patients who were admitted without ARF, 141(8%) developed ARF during their stay in the ICU and among total of ARF case (984),475 (48%) died during the ICU stay [12].

A retrospective study showed by the American Journal of Surgery, patients who developed respiratory failure (21%) had a 42% mortality compared with a 6% mortality in patients who did not develop respiratory failure [13]. A

prospective cohort study conducted at the Intensive care department, Saint-Louis Hospital University Paris, among 99 patients were admitted for acute respiratory failure, the 30-day mortality rate was 26.2% [14]

In a descriptive study conducted at Assiut University Hospital, the age of patients, admission category to ICU, and cardiac disease were significantly associated with respiratory failure development [7]. A prospective cohort study conducted at Brazilian showed, patients age, type of ICU admission and length of stay in ICU are significantly associated with respiratory failure [12].

A retrospective descriptive chart review was conducted in Addis Ababa, Ethiopia. The finding revealed that respiratory failure was the leading complication or immediate cause of death accounts (32.8%) followed by cardiovascular failure (16.1%) [15].

The objective of this research was to assess the prevalence of respiratory failure and associated factors in adult ICU of St. Paul's Hospitals Millennium Medical College, and AaBET, Addis Ababa, Ethiopia.

Methods And Materials

Method: An institution based retrospective cross-sectional study was conducted from August 26 to September 25, 2020. Among a total of 2198 population, 384 samples were selected using systematic random sampling. A multivariable logistic regression analysis was used to identify predictors of respiratory failure using odds ratio, 95% confidence interval, and p-value < 0.05 to be considered as significant.

Study area and period

This study was conducted in Addis Ababa Ethiopia. Addis Ababa is the capital city of Ethiopia. Addis Ababa is administratively divided into ten sub-cities and 116 districts. Data was collected from two hospitals, namely Saint Paul's Hospital Millennium Medical College and Addis Ababa Burn, Emergency and Trauma Hospital from August 26 to September 25, 2020.Saint Paul's Hospital Millennium Medical College is a specialty hospital providing care to the underserved population in the outskirts of Addis Ababa. It currently has 580 beds, with an annual average of 200,000 patients and a catchment population of more than 5 million.

Addis Ababa Burn, Emergency and Trauma Hospital is a newly established 250 bed and 14 ICU bed, teaching and public referral hospital in Addis Ababa, Ethiopia, affiliated with St. Paul's Hospital Millennium Medical College. Addis Ababa Burn, Emergency and Trauma Hospital provides 24/7 specialty services in emergency medicine, critical care, trauma and acute care surgery, orthopedics, neuro-surgery, and forensic medicine; patients presenting with complaints requiring additional specialty services (example cardiology, gastroenterology) are stabilized and transferred to nearby SPHMMC. There are 40 nurses and 11 mechanical ventilators in ICU.

Sample Size determination

The sample size was estimated using single population proportion formula by assuming the prevalence of respiratory failure is assumed as 50% since there is no previous related study; and desired precision level of 5%, 95% confidence level. For single proportion population,

no= $\frac{(Za/2)^2 p(1-p)}{(d)^2}$ Where, no=sample size, p=prevalence respiratory failure is 50% and d=margin of error (0.05)

Hence, the sample size was calculated as [no= (Zα/2) ²p (1-p) /d2] = (1.96) ²× (0.5x0.5)/ (0.05) ² = 384. Therefore, the final calculated sample size is 384.

Data Collection Procedures and tools

The checklist for this study was adapted with some modification from research conducted at Assiut University Hospital [7]. It was first translated from English to Amharic and then retranslated back to English by a linguistic graduate to assure its consistency. The checklist was pretested before the actual data collection. The data collectors were two BSc critical care nurses. The principal investigator and the supervisors were checked for missed values and completeness on daily basis.

Data Management and analysis

This data was entered into Epi data 3.1 and export to SPSS version 24 statistical software packages for cleaning and analysis. Binary logistic regression model was fitted to identify the association between independent versus out-come variable. All independent variables with a p-value of 0.25 and less in the bivariable analysis was entered into multivariable logistic regression models in order to identify independent predictors of respiratory failure. Crude and adjusted odd ratios were computed with their corresponding 95% confidence interval. P-value with < 0.05 was used to declare statistical significance of the results.

Socio demographic Information

Among a total, more than half of respondents 193(50.3%) were male. More than half of the respondent's' age distribution, 202(52.6%) were between 18–40 years, 37(9.6%) were in the age group of 41–50 years and the remaining 145(37.8%) were above 50 years of age with a mean age of 43.55 ± 19.49 of standard deviation (Table 1).

Variables (n = 384)	Frequency	Percent (%)
Age group		
18–40 years	202	52.6
41–50 years	37	9.6
>50 years	145	37.8
Sex		
Male	193	50.3
Female	191	49.7

Table 1: Socio-demographic characteristics of respondents who had admitted ICU from September 2014 to August 2020, at Saint Paul's Hospital Millennium Medical College and Addis Ababa Burn Emergency and Trauma (AaBET) Hospital Addis Ababa, Ethiopia, 2020

Medical, surgical and trauma related characteristics of respondent's response

This research tried to assess respondent's admission type, medical, surgical and trauma related characteristics, and their history of diseases condition. In this study the prevalence of respiratory failure was 139(36.2%). Among the total admitted patients, 259(67.4%) were admitted by medical case. Majority of them 319(83.1%) were admitted for the first time. Most of the respondents

had history of 291(75.8%) pneumonia, 243(63.3%) sepsis, 209(54.4%) renal and 162(42.2%) cardiac disease respectively (Table 2).

Table 2: Medical, surgical and trauma related characteristics of respondents (n = 384) in adult ICU from September 2014 to August 2020 at SPHMMC and AaBET Hospital Addis Ababa, Ethiopia, 2020

Variables (n = 384)	Frequency	Percent (%)
History of respiratory failure		
Yes	139	36.2
No	245	63.8
Admission type to ICU		
First time admission	319	83.1
Recurrent admission	65	16.9
History of hypertension		
Yes	139	36.2
No	245	63.8
History of diabetes mellitus		
Yes	65	16.9
No	319	83.1
History of COPD		
Yes	128	33.3
No	256	66.7
History of pneumonia		
Yes	291	75.8
No	93	24.2
History of asthma		
Yes	60	15.6
No	324	84.4
History of tuberculosis (TB)		
Yes	100	26
No	284	74
History of cardiac disease		
Yes	162	42.2
No	222	57.8
History of renal disease		
Yes	209	54.4
No	175	45.6
Case of ICU admission		
Medical	259	67.4
Surgical	73	19

Variables (n = 384)	Frequency	Percent (%)
Gynecology	52	13.5
History of sepsis		
Yes	243	63.3
No	141	36.7
Acute Respiratory Distress Syndrome		
Yes	193	50.3
No	191	49.7
History of malignancy/lung cancer		
Yes	22	5.7
No	362	94.3
Status of HIV/AIDS		
Reactive	39	10.2
Nonreactive	345	89.8
History of trauma/injury		
Yes	159	41.4
No	225	58.6
History of anemia		
Yes	199	51.8
No	185	48.2
History of pulmonary edema		
Yes	73	19
No	311	81
Hx of pulmonary thrombo embolism (PTE)		
Yes	44	11.5
No	340	88.5

Regarding duration of ICU stay, more than half of respondents 203 (52.9%) were stay in ICU greater than 15 days, 55(14.3%) of them were stay between 11–15 days, whereas 63(16.4%) of them between 5–10 days and the remaining 63(16.4%) were stay less than five (5) days; with a mean duration of 3.04 ± 1.162 of standard deviation (Figure 1).

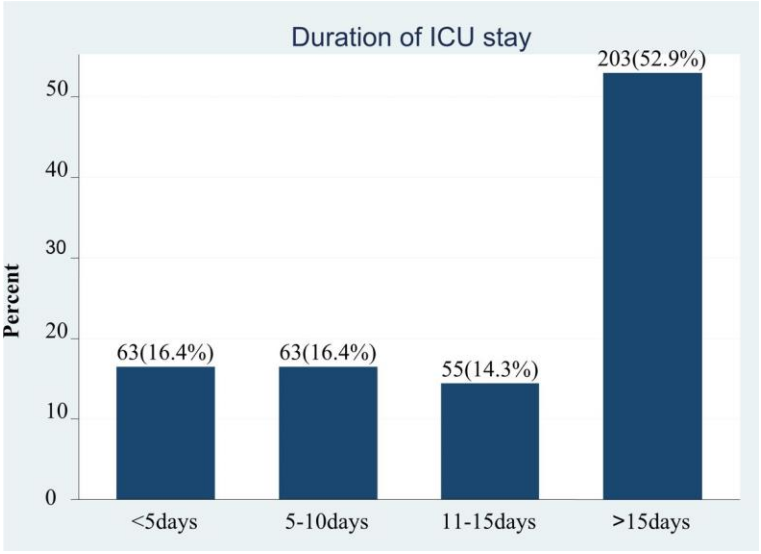

Figure 1: Duration of stay in adult intensive care unit at Saint Paul's Hospital Millennium Medical College and Addis Ababa Burn, Emergency and Trauma Hospital from September.2014 to August 2020.

Factors associated with respiratory failure

In simple binary logistic regression age, duration of ICU stays, COPD, TB, Cardiac disease, Renal disease, Asthma, case of ICU admission, sepsis, ARDS, HIV, pulmonary edema and trauma were significantly associated with respiratory failure at p-value less than 0.25. In multivariable logistic regression age > 50 years, duration of stay > 15 days, COPD, CHD, Asthma, sepsis, HIV and trauma were significant at p-value less than 0.05 and 95% confidence interval.

Age of the respondent was significantly associated with respiratory failure of intensive care unit patient. Patients whose age greater than > 50 years were 5 times more likely to develop respiratory failure than patients whose age between 18–40 years (AOR = 4.88(95%CI: 2.1, 11.4). Patients who stayed more than 15 days of duration in intensive care unit were 76% (AOR = 0.24(95%CI: 0.086,0.65) less likely to develop respiratory failure as compared to the patients who's stayed less than 5 days duration.

Patients who had history of chronic obstructive pulmonary disease were 2 times more likely develop respiratory failure as compared to patients who had not history of chronic obstructive pulmonary disease (AOR = 2.3(95%CI: 1.98, 4.79) (Table 3). Patients who had history of asthma were 77% (AOR = 0.23(95%CI: 0.087, 0.6) less likely to develop respiratory failure compared to patients who had no history of asthma. Patients who got cardiac disease were 3 times more likely to develop respiratory failure as compared to patients who did not have cardiac disease (AOR = 3.01(95%CI: 1.36, 6.66) (Table 3).

Regarding to history of sepsis, patients who had sepsis were 57% (AOR = 0.43(95%CI: 0.2, 0.94) less likely to develop respiratory failure than patients who had no history of sepsis. Patients who were HIV reactive were 4 times more likely to develop respiratory failure as compared to patients who were HIV non-reactive patients (AOR = 4.3(95%CI: 1.34, 13.92). Patients who had history of trauma were 3 times more likely to develop respiratory failure as compared to patients who were had not history of trauma (AOR = 2.93(95%CI: 1.36, 6.35) (Table 3).

Variable	Respiratory failure		COR(95%CI)	AOR(95% CI)	P-value
	Yes	No			
Age group					
18–40 years	34(8.9)	168(43.8)	1	1	
41–50 years	7(1.8)	30(7.8)	1.15(0.47,2.84)	0.96(0.27,3.37)	0.95
> 50 years	98(25.5)	47(12.2)	10.3(6.2,17.1)	4.88(2.1,11.4)	0.0001**
Duration of stay					
< 5 days	20(5.2)	43(11.2)	1	1	
5–10 days	15(3.9)	48(12.5)	0.67(0.31,1.47)	0.5(0.16,1.51)	0.22
11–15 days	19(5)	36(9.4)	1.14(0.53,2.45)	1.77(0.63,4.96)	0.28
> 15 days	85(22.1)	118(30.7)	1.55(0.85,2.82)	0.24(0.086,0.65)	0.005**
History of COPD					
Yes	74(19.3)	54(14.1)	4.02(1.5,8.4)	2.3(1.98,4.79)	0.0001**
No	65(17)	191(49.6)	1	1	

History of asthma					
Yes	13(3.4)	47(12.2)	0.44(0.23,0.84)	0.23(0.087,0.6)	0.001**
No	126(32.8)	198(51.6)	1		
TB					
Yes	45(11.7)	55(14.3)	1.65(1.04,2.63)	2.03(0.87,4.75)	0.1
No	94(24.5)	190(49.5)	1	1	
Cardiac disease					
Yes	98(25.5)	64(16.7)	6.76(4.26,10.74)	3.01(1.36,6.66)	0.006**
No	41(10.7)	181(47.1)	1	1	
Renal failure					
Yes	103 (26.9)	106 (27.7)	3.86(2.44, 6.11)	0.77(0.36,1.64)	0.5
No	35(9.1)	139 (36.3)	1	1	
Cases of admission					
Medical	102(26.6)	157(40.9)	2.16(1.08,4.32)	0.84(0.28,2.49)	0.75
Surgical	25(6.5)	48(12.5)	1.73(0.78, 3.89)	0.97(0.28,3.37)	0.95
Gynecology	12(3.13)	40(10.4)	1	1	
Sepsis					
Yes	101(26.3)	142(37)	1.92(1.23,3.03)	0.43(0.2,0.94)	0.034**
No	38(9.9)	103(26.8)	1	1	
ARDS					
Yes	94(24.5)	99(25.8)	3.1(2, 4.77)	0.52(0.23,1.15)	0.11
No	45(11.7)	146(38)	1	1	
HIV status					
Reactive	20(5.2)	19(5)	2(1.03,3.9)	4.3(1.34,13.92)	0.014**
Non-reactive	119(31)	226(58.8)	1	1	
Trauma					
Yes	99(25.8)	60(15.6)	7.6(4.78,12.2)	2.93(1.36,6.35)	0.006**
No	40(10.4)	185(48.2)	1	1	
Pulmonary edema					
Yes	32(8.3)	41(10.7)	1.49(0.89,2.5)	1.7(0.74,3.93)	0.21
No	107(27.9)	204(53.1)	1	1	
Where: 1 = reference, ** Significant at p-value of ≤ 0.05					

Table 3: Multivariable logistic regression analysis of factors associated with respiratory failure in adult ICU at SPHMMC and AaBET Hospital Addis Ababa, Ethiopia, 2020

Discussion

Our study aimed to assess the prevalence of respiratory failure and its associated factors using 384 samples among a total of 2198 population admitted in adult intensive care unit from September 2014 to August 2020 at SPHMMC and AaBET Hospital Addis Ababa, Ethiopia.

The study reveals that, the prevalence of respiratory failure was 139(36.2%). The finding of this study is lower than the previous studies which was 57% (12) and (58%). (8) However, this study was slightly higher compared than the previous study which was (35%). (16) The difference might be due to methodological variations and differences in sociocultural, economical, health and health provision consumption characteristics between respondents of the referenced areas and the study place.

The finding of our study shows that, respondent's age category 50 and above were more likely to develop respiratory failure than respondents age category between 18 and 40 years. This study was consistent with the previous three studies. (12, 17, 18)

Regarding to duration in ICU stay, this finding revealed that patients stay fifteen (15) and above were 76% less likely to develop respiratory failure as compared to the patients who's stayed less than 5 days duration. This was in line with a previous study that reported patients stay longer time in ICU increase respiratory failure development. (12, 19) However in contrast with this finding, patients stay in ICU between five and teen were more likely develop respiratory failure. (20) The difference could be due to methodological variation (study design, exclusion and inclusion criteria), sociocultural difference, health service quality and study area.

The present finding revealed that, past history of chronic pulmonary disease, cardiac disorder and trauma was indicated the risk factors associated with respiratory failure. This is agreement with the previous finding. (21) Other studies also compatible with the present study, founded that COPD is the main risk factor of ARF. (20, 22)

Regarding to profile of sepsis, the present study indicated that patients who have sepsis were 57% less likely to develop respiratory failure than patients who had no history of sepsis. This was similar with the previous study which was reported that common risk factors for ARF include sepsis. (23)

This study showed that, patients who have history of asthma were 77% less likely to develop respiratory failure compared to patients who had no history of asthma. This was inconsistent with the previous study. (20) The difference might be due to sociocultural (life style) difference of the population, variation in study area and methodology.

Result:

The prevalence of respiratory failure in this study was 139(36.2%).The variables which were significantly associated with respiratory failure were, patients age >50 (AOR =4.88(95%CI: 2.1, 11.4),Duration of stay at intensive care unit >15 days (AOR=0.24(95%CI: 0.086, 0.65), prolonged obstructive pulmonary disease (AOR=2.3 (95%CI: 1.98, 4.79),Asthma (AOR=0.23(95%CI: 0.087, 0.6) , sepsis (AOR= 0.43 (95% CI:0.2,0.94) , cardiac disease (AOR= 3.01(95%CI: 1.36, 6.66)), Human Immune Deficiency Virus (AOR=4.3(95%CI: 1.34, 13.92) and trauma (AOR= 2.93(95%CI: 1.36, 6.35).

Conclusion

This study conducted that, patients with older age, prolonged length of ICU stay and previous history of chronic obstructed pulmonary disease, cardiac disease, asthma, sepsis, status of HIV and trauma have an increased risk of respiratory failure. More attention should be paid to prevent those leading factors in order to minimize the magnitude and the burden of respiratory failure.

Declarations

Ethical consideration

Ethical clearance was obtained from Saint Paul's Hospital Millennium Medical College Institute of Health Ethical Review Board. Information about the study was given to the selected participants in order to obtain their written consent before administering the questionnaires. Participants were informed that they have the right to discontinue or refuse to participate in the study. Answers to any question were completely confidential and the privacy of the respondents was maintained. All methods were performed in accordance with the relevant guidelines and regulations.

Availability of data and materials

Data will be available upon request from the corresponding author

Competing interests

The authors declare that they have no competing interests

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Authors' contributions

GB, YK and MB were involved in conception, designing methods, analysis, interpretation and drafting of the manuscript. KG and YK were participated in write-up of the manuscript. All authors have reviewed and approved the submission of the manuscript.

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