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THE CORRELATION OF BODY MASS INDEX AND POST-RESUSCITATION ALBUMIN LEVELS WITH THE MORTALITY OF BURN PATIENTS AT PROF NGOERAH GENERAL HOSPITAL PERIOD 2020-2022

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ABSTRACT

Background: Burn injuries are associated with high mortality and morbidity. The incidence of death resulting from burns can be influenced by various prognostic factors, with nutritional status being a significant contributor. Therefore, assessing nutritional status through the calculation of body mass index (BMI) and post-resuscitation albumin levels becomes imperative.
Purpose: This study aims to explore the correlation between BMI and post-resuscitation albumin levels with the mortality of burn patients at Prof Ngoerah General Hospital during the period 2020-2022.
Methods: This research adopts an observational analytical approach, utilizing a cross-sectional research design and consecutive sampling techniques. The study relies on secondary data, specifically medical records of burn patients. Out of a total of 134 medical records, 100 were selected based on adherence to inclusion and exclusion criteria.
Results: The study reveals median values for age (42,5), BMI of 23,9 and albumin levels 24 hours post resuscitation recorded at 2,235. The Spearman test analysis conducted on 100 samples reveals a notable correlation between these variables and the mortality of burn patients (r = 0,263; PR 1,707; 95% CI 1,163 – 2,504; *p* = 0,008). The chi-square test analysis regarding the association between post-resuscitation albumin levels and burn patient mortality also demonstrates a significant relationship (PR 2,390; 95% CI 1,358 – 4,207; *p* = 0,000).
Conclusion: In conclusion**,** there is a statistically significant association between mortality and both BMI and post-resuscitation albumin levels among burn patients treated at the Prof Ngoerah General Hospital during the period 2020-2022.

Keywords: Post resuscitation albumin., mortality., BMI., burns

INTRODUCTION

A wound is characterized as a break or interruption in the normal structure and continuity of body tissue resulting from various forms of trauma, including physical, mechanical, chemical, or thermal causes. Such trauma can inflict damage to the skin barrier, triggering an inflammatory response.[1] Among injuries encountered in everyday life, burns are a common type that can lead to temporary, permanent disability and even death across all age groups. The risk of mortality and morbidity associated with burns is notably high.[2]

According to the World Health Organization (WHO) Global Burden Disease Report in 2017, an estimated 180.000 people succumbed to death as a result of burns.[3] Burns contribute to 1% of the global burden of disease, ranking fourth among all traumatic incidents in terms of severity. The Ministry of Health's 2018 Basic Health Research data reports a prevalence of burns at 0,7%, with a concerning 40% mortality, particularly for cases involving severe burns.[4]

Severe burns often coincide with comorbidities, such as sepsis, multi-organ failure, and pose a high risk to the nutritional status of burn patients. These comorbidities emerge when burn wounds are not promptly and correctly treated.[5] Nutritional status is a key factor that can heighten the risk of mortality in burn patients. Additionally, mortality is influenced by various prognostic factors, including age, pre-existing comorbidities as an indicator of each patient's premorbid condition, total body surface

area (TBSA) percentage, and inhalation injury as an indicator of burn severity.[6]

In this study, the evaluation of nutritional status depends on the computation of the patient's BMI and post-resuscitation albumin levels. Previous research has established a correlation between increased BMI and elevated mortality. Burn patients also experience albumin loss, with albumin synthesis decreasing to around 80% of normal levels within 24 hours of the burn injury.[7] Hence, it is crucial for burn patients to undergo serum albumin level checks within the first 24 hours of hospitalization to estimate the risk of mortality.

Given the elevated mortality among burn patients and the existing research gap at Prof Ngoerah General Hospital, there is limited exploration of the relationship between BMI and post-resuscitation albumin levels and mortality.

This study purposes to establish an association between BMI and post-resuscitation albumin levels with the mortality among burn patients at the Prof Ngoerah General Hospital, during the period 2020-2022.

MATERIALS AND METHODS

This study employs an analytical research approach to examine the relationship between variables, utilizing cross-sectional research that measures all variables at a specific point in time. Data is collected retrospectively by recording the patient's height, weight, and post-resuscitation albumin levels, along with mortality data extracted from death certificates within the patient's medical records. The patient's weight and height are calculated to derive the BMI, and subsequently, BMI and post-resuscitation albumin levels are associated with the mortality of burn patients at the Prof Ngoerah General Hospital, during the 2020-2022 period.

The study population comprises burn patients at Prof Ngoerah General Hospital during the 2020-2022 period. Study samples were assembled based on inclusion criteria, including burn patients at the hospital during the specified period and those aged 18 and above upon hospital admission. The study samples were further refined by excluding burn patients with incomplete medical records and those who experienced death in the emergency room. Non-probability sampling techniques, specifically consecutive sampling, were employed to obtain the research samples.

The sample size in this study was obtained based on the Lemeshow formula, as follows:

$$n = \frac{Z^2 x\, P(1-P)}{d^2}$$

The sample size calculation in this study for type I error (α) was determined at 0,05, with the P value obtained from previous research determined at 4% or 0,04.

Consequently, the minimum sample size obtained was 60 samples.Patients meeting the inclusion and exclusion criteria will have their body weight and height measured using medical record data. Subsequently, this information will be used to calculate the BMI and classify patients based on WHO criteria. Patients with a BMI < 18,5 kg/m^2 are categorized as underweight, those with a BMI between 18,5 – 24,9 kg/m^2 are categorized as normal range, those with a BMI between 25 – 29,9 kg/m^2 are considered overweight, patients with BMI ≥ 30 kg/m^2 are classified as obese.

Following resuscitation with a TBSA of > 20%, the patient's albumin level will be measured 24 hours later. Patients with post-resuscitation albumin levels < 2,5 g/dL are classified as having severe hypoalbuminemia, while albumin levels ranging from 2,5 to 3,5 g/dL are classified as mild hypoalbuminemia. Data about the deaths of burn patients within the research sample can be extracted from medical record data of patients declared deceased based on death certificates. The study also collects variables related to the gender and age of the study sample. The gender variable is categorized as male and female, and age is measured in years.

The collected data will undergo univariate and bivariate analysis using the IBM SPSS Statistics 20 for Windows program. Univariate analysis will be conducted through a statistical test, specifically a normality test using the Kolmogorov-Smirnov test.

The Kolmogorov-Smirnov test is a valid method for sample sizes equal to or greater than 50 samples. This analysis aims to determine whether there is a correlation between BMI and mortality due to burns, as well as between post-resuscitation albumin levels and mortality due to burns.[8,9] The statistical tests employed for this research are the Spearman test and the Chi-square test, given that the collected data is non-parametric or categorical.

RESULTS

This research utilized secondary data from medical records of burn patients at Prof Ngoerah General Hospital during the period January 1st, 2020, to December 31st, 2022. A total of 134 medical records were available, and 100 met the inclusion and exclusion criteria, establishing them as subjects for the study. The data extracted from medical records encompassed information on gender, age, BMI, albumin levels 24 hours post-resuscitation, and death records for burn patients. Table 1 details the characteristics of burn patients at Prof Ngoerah General Hospital during the specified period.

Table 1. Characteristics of Burn Patients at Prof Ngoerah General Hospital 2020-2022 Period

Variable	Frequency (n)	Percentage (%)	Median	*p*-value
Gender				
Male	66	66		
Female	34	34		
Age (year)			42,5	0,028
19-44	56	56		
45-59	26	26		
≥ 60	18	18		
Body Mass Index (kg/m^2)			23,9	0,006
Underweight (<18,5)	6	6		
Normal (18,5-24,9)	59	59		
Overweight (25-29,9)	25	25		
Obese (≥30)	10	10		
Albumin Levels 24 Hours Post Resuscitation			2,235	0,000
Mild Hypoalbuminemia	38	38		
Severe Hypoalbuminemia	62	62		
Number of Deaths				
Non-Survive	49	49		
Survive	51	51		

p = <0,05

From the analysis in Table 1, it is evident that male patients constitute a larger proportion of burn cases compared to females, with 66 individuals, accounting for 66% of the total sample. Consequently, the study's findings suggest that male patients have a higher likelihood of experiencing burn than their female counterparts.

Further examining Table 1 reveals that the age category most susceptible to burns is the adults aged 19-44 years, comprising 56 individuals or 56% of the total sample. This indicates that adults are more vulnerable to burns.

Based on the results of the analysis in Table 2, it becomes apparent that patients with a normal BMI dominate the total sample. Male burn patients, numbering 41 individuals, represent 69,5% of this group, and the majority fall within the adult age range. Conversely, the underweight category exhibits the lowest frequency, including five male patients and one female patient. The majority of individuals in this sample fall within the adult age range, constituting 83,3% of the population.

Table 2. The Characteristics of BMI Based on Gender and Age

BMI	Gender		Age		
	Male	Female	Adult	Pre-Elderly	Elderly
	n (%)	n (%)	n (%)	n (%)	n (%)
Underweight	5 (83,3)	1 (16,7)	5 (83,3)	-	1 (16,7)
Normal	41 (69,5)	18 (30,5)	34 (57,6)	13 (22)	12 (20,3)
Overweight	17 (68)	8 (32)	11 (44)	11 (44)	3 (12)
Obese	3 (30)	7 (70)	6 (60)	2 (20)	2 (20)

Table 3. The Characteristics of Albumin Levels Post-Resuscitation Differ Based on Gender and Age

Albumin Levels Post Resuscitation	Gender		Age		
	Male	Female	Adult	Pre-Elderly	Elderly
	n (%)	n (%)	n (%)	n (%)	n (%)
Mild Hypoalbuminemia	25 (65,8)	13 (34,2)	23 (60,5)	9 (23,7)	6 (15,8)
Severe Hypoalbuminemia	41 (66,1)	21 (33,9)	33 (53,2)	17 (27,4)	12 (19,4)

Table 4. The Correlation Between BMI and Mortality in Burn Patients

Body Mass Index	Deaths		Total	r	*p*-value
	Non-Survive	Survive			
	n (%)	n (%)	n (%)		
Obese	7 (70)	3 (30)	10 (100)	0,263	0,008
Overweight	17 (68)	8 (32)	25 (100)		
Normal	23 (39)	36 (61)	59 (100)		
Underweight	2 (33,3)	4 (66,7)	6 (100)		

r = correlation coefficient, $p = < 0,05$

Table 5. The Correlation Between Post-Resuscitation Albumin Levels and Mortality in Burn Patients

Albumin Levels Post-Resuscitation	Deaths		Total	PR (95% CI)	*p*-value
	Non-Survive	Survive			
	n (%)	n (%)	n (%)		
Severe Hypoalbuminemia	39 (62,9)	23 (37,1)	62 (100)	2,390 (1,358 – 4,207)	0,000
Mild Hypoalbuminemia	10 (26,3)	28 (73,7)	38 (100)		

PR = Prevalence Ratio, 95%CI = 95% Confidence Interval, $p = < 0,05$

Based on the results of the analysis shown in Table 3 reveals that post-resuscitation albumin levels in all burn patients, regardless of gender, were uniformly low. Additionally, these levels were notably low across age categories. A significant portion of burn patients experienced severe hypoalbuminemia, with 41 male patients (66,1%) and 21 female patients (33,9%) presenting with this condition. The prevalence of severe hypoalbuminemia was also higher in the adult age group, with 33 individuals (53,2%).

To further explore the relationship between the BMI variable and burn injury mortality, the initial step involved univariate analysis. The Kolmogorov-Smirnov test was conducted to assess the normality of the data. The results, detailed in Table 1, indicate a significance value (*p*) of 0,006 ($p < 0,05$) for the BMI variable. This suggests that the BMI variable is not normally distributed. Subsequently, a non-parametric correlation test, specifically the Spearman test, was employed for variables that were not normally distributed.

The Spearman test analysis conducted on 100 samples indicates a significant relationship between BMI and burn patient mortality, with a *p*-value of 0,008 ($p < 0,05$). The correlation coefficient (r) of 0,263 suggests a weak positive correlation between BMI and mortality due to burns. This positive correlation implies that as BMI increases, the likelihood of death in burn patients also increases.

Further analysis of the Prevalence Ratio (PR) for BMI categories (BMI $\geq$ 25 kg/m^2 and BMI < 25 kg/m^2) on burn patients mortality reveals that BMI $\geq$ 25 kg/m^2 has a 1,707 times greater chance of mortality than BMI < 25 kg/m^2. The 95% confidence interval (95%CI 1,163 – 2,504) indicates the significance of this PR value in the general population, with a *p*-value of 0,008, demonstrating its statistical significance.

The Kolmogorov-Smirnov test for post-resuscitation albumin levels, as seen in Table 1, yields a *p*-value of 0,000 ($p < 0,05$). This result indicates that post-resuscitation albumin level values are not normally distributed. Consequently, a non-parametric test, specifically the chi-square test, was employed for the analysis of data that is not normally distributed.

The chi-square test analysis indicates a significant relationship between post-resuscitation albumin levels and mortality in burn patients, with a *p*-value of 0,000 ($p < 0,05$). The Prevalence Ratio (PR) demonstrates that severe hypoalbuminemia carries a 2,390 times higher chance of mortality compared to mild hypoalbuminemia. The 95% confidence interval (95% CI 1,358 – 4,207) confirms the significance of this PR value in the general population. Based on pathophysiological aspects, poor glycemic control, and the associated pro-inflammatory state may contribute to increased mortality in obesity. The overproduction of adipocytokines and adipokines from adipose cells contributes to a pro-inflammatory environment, promoting chronic systemic inflammation. Furthermore, insulin resistance, which is adversely affected by non-esterified fatty acids, interferes with glucose homeostasis, resulting in inadequate glycemic control.

DISCUSSION

The gender distribution data reveals a higher propensity for burn injuries among male patients, accounting for 66% of cases, in contrast to females. This aligns with findings from studies by Muthiah et al. (2019), who stated that the majority of subjects were male with a ratio of men to females of 4,8:1.[10] Similar results were observed in research conducted by Wardhana et al. (2017) at Cipto Mangunkusumo General Hospital in Jakarta, Indonesia, with a total sample of 304 burn patients, consisting of 67% male and 33% female.[11] Apart from that, there is also research conducted by Li et al. (2017) with a total sample of 6,235 burn patients in China with a sex ratio of 2:1 between males and females.[12] This increased vulnerability in males may be attributed to their more active lifestyle, which exposes them to elevated environmental and occupational risks.

In terms of age distribution, the medical record data categorizes patients into three groups: 19-44 years (56%), 45-59 years (26%), and $\geq$ 60 years (18%). The analysis highlights a

higher prevalence of burn injuries among adult patients, particularly in the age range of 19-44 years. This finding is consistent with the research conducted by Sanjaya et al. (2022), which stated the 17 – 44 year age group exhibited a higher proportion of burn injuries. Specifically, the 17 – 35 year age group had the highest proportion of emergency hospitalizations, and the 26-35 year age group had the highest non-emergency proportion.[13]

The research and analysis of medical record data from burn injury patients included as samples reveal a significant but weak correlation between BMI and mortality. Notably, the highest mortality is observed in the obese category, contributing to 70% of cases, followed closely by the overweight category at 68%. This aligns with the findings of Pauzenberger et al. (2020), who reported an increasing BMI linked to higher mortality.[14] Their research highlighted the peak in mortality for burns patients with a BMI falling within the class II obesity category, reaching 55,3%. Therefore, good and early glycemic control plays a very important role in burn patients because this can be associated with a reduction in mortality due to burns.[15] Furthermore, as BMI increases, the risk of surgical complications in burn patients also increases, including longer intervention times, higher intraoperative blood loss, and increased rates of surgical site infections.[16]

However, contrasting results are found in the study by Keshavarzi et al. (2019), where BMI, categorized as BMI $\geq$ 25 kg/m^2 and BMI < 25 kg/m^2, did not show a statistically significant in mortality. This implies that, in their study, there was no statistically significant correlation observed between elevated mortality and BMI. A BMI $\geq$ 25 kg/m^2 with a death percentage of 27,4% of 101 patients and a BMI < 25 kg/m^2 with a death percentage of 18%.[17]

In this study, an analysis was conducted to explore the relationship between post-resuscitation albumin levels and mortality, revealing a significant association between the two variables. Burns patients with severe hypoalbuminemia constituted the highest proportion of deaths, with 39 patients accounting for 62,9%, while those with mild hypoalbuminemia experienced a death proportion of 10 patients, equivalent to 26,3%. This finding aligns with a study by Muthiah et al. (2019), stating that individuals with severe hypoalbuminemia within the initial 24 hours of hospitalization confronted a significantly elevated risk of mortality, up to 14 times compared to those with hypoalbuminemia.[11]

Pathophysiologically, burns can inflict damage to the skin and blood vessels, leading to the release of inflammatory mediators. This process increases blood vessel permeability, prompting the leakage of plasma and blood proteins into the interstitial compartment. It triggers a decline in plasma proteins, notably albumin, resulting in hypoalbuminemia. The consequences of hypoalbuminemia include extravasation of plasma and protein into interstitial tissue, creating circumstances of intravascular hypovolemia, systemic hypotension, organ hypoperfusion, and potentially leading to death.[18] Serum albumin levels can decrease not only due to the fluid redistribution but also because of intravascular dilution resulting from intravenous (IV) solution administration aimed at enhancing tissue perfusion.[19]

The significance of blood sampling within the first 24 hours after resuscitation, lies in the ability of this variable to serve as a determinant associated with mortality. A decrease of 1 g/dL in albumin levels during the initial 24 hours corresponds to a 94% increase in the risk of mortality. Lower 24-hour albumin levels in burn patients imply that albumin levels at the time of hospital admission are also diminished.[20]

This study is subject to certain limitations, primarily stemming from the multifactorial nature of mortality in burn patients. The observed increase in BMI may not be the sole influencing factor, and there is potential for confusion with other confounding variables, including but not limited to comorbidities, burn severity, age, gender, etc. Comprehensive analysis is imperative to discern the nuanced interplay of these factors. Additionally, the obtained sample size, particularly in the underweight and obese BMI categories, was relatively small. To address this limitation, BMI categories were re-categorized into two broader groups, introducing a potential source of reduced accuracy and potential non-representativeness of the findings for the general population. These constraints underscore the need for cautious interpretation and suggest avenues for further research with larger and more diverse sample sizes to enhance the robustness and generalizability of the study's outcomes.

CONCLUSIONS

In conclusion, both BMI and post-resuscitation albumin levels exhibit a relationship or correlation with the mortality in burn patients at Prof Ngoerah General Hospital, during the period 2020-2022.

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