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Nutritional Status and Wound Healing among Patients with Burn Injury: A Correlational Study

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Abstract: **Burn is a global health disaster with overwhelming pathophysiological effects. Optimum nutrition is key factor in maintaining all healing phases. However, nutritional support post-burn is sophisticated matter therefore, it is important that nurses assess caloric requirements to avoid malnutrition. Aim: to assess the relationship between nutritional status and wound healing among patients with burn injury. Research questions: What is the nutritional status among patients with burn injury, What is the relation between nutritional status and wound healing among patients with burn injury. Methods: A descriptive correlational study conducted over 10 months. 70 convenient patients included. Nutritional status assessed by 24hr. dietary recall, anthropometric measurements, wound status by BWAT. Results: 62.9% were male, 61.4% married, 91.4% had severe injury, 85.7% had second and third degrees, thermal injury 78.6%. Food intake in 1st reading was below need 57.1%, 14.3%, 25.7%, 67.1% for protein, carb, fat, calories respectively. There was significant difference in wound status (t=8.617, p=0.000) 80% had wound of mild severity in 1st reading, improved to minimal severity 45.7% in 3rd reading. Regarding BWAT scores, at 3rd reading, there was positive moderate relation with carbohydrate (r=0.38) P≤0.001, positive moderate relation with calories (r=0.33) and positive moderate relation (r=0.34) with fat while negative weak relation in 1st reading (r=-0.25).Inadequate nutrition might cause impaired healing as wound :Conclusions easing carbohydrate and fat over needed requirements. Indeteriorated when incr addition, improvement in wound .severity level was observed when increasing protein intake**

Keywords: **Burn, Bates-Jensen tool, Nutritional assessment, and Wound healing.**

1. INTRODUCTION

Burn injury is a major global public health disaster where 67 million patients had burn injuries, resulting in 2.9 million hospitalizations (Global Burden of Disease, 2016). According to the World Health Organization (2018), burns are estimated to cause approximately 300,000 deaths annually, most deaths due to burns which occur in the developing world, particularly in Southeast Asia.

The pathophysiological response to a burn injury exceeds the site of injury and includes alterations in the liver, heart, gastrointestinal tract, muscle, bone, kidneys functions, and the circulating serum levels of catecholamine and corticosteroids which increase by ten to twenty fold post burns. Gluconeogenesis can lead to an increased incidence of wound sepsis, and overall small rates of morbidity and mortality (Hall, Shahrokhi, & Jeschke, 2012). Additionally, inflammatory and immune responses are activated with increased production of interleukins, tumor necrosis factor alpha. Sinwar (2016) added that in patients with burn injuries of 20% Total Body Surface Area (TBSA) or larger is involved; a

severe catabolic status can take place, leading to total body protein breakdown and decreased body mass. Also, inadequate protein stores result in increased skin breakability, reduced immune function with poor healing (Landén, Li, & Ståhle, 2016).

The process of normal wound healing involves four stages that can alter in duration, with nutritional processes playing essential roles throughout each stage. The hemostasis phase in which there is a damaged endothelial lining and outflow of lymphatic fluid and blood (Wallace & Bhimji, 2018). Then, the inflammatory phase starts within 24 hours after the skin is injured and takes 1 to 5 days, the proliferative phase which begins 3-5 days after injury and can last up to 3 weeks in which angiogenesis and epithelialization take place. Finally, the remodeling phase starts 2 weeks post-injury and can continue up to 2 years, during which collagen maturation and stabilization take place (Simon, 2018).

On the other hand, optimum nutrition is a key factor in maintaining all phases of wound healing. Nutrition should provide adequate support for exaggerated energy needs through the wound healing process. In addition, the composition of the calories should be assessed with carbohydrates, proteins, and fats, as each plays an important role in the wound healing process (Quain & Khardori, 2015). Molnar, Underdown, and Clark (2014) revealed that carbohydrates induce the production of insulin, which is beneficial in the anabolic pathways of wound healing, especially through the proliferative phase. In addition, adequate fat intake can provide extra energy to the wound healing process. Fat intake is also crucial in the part of absorbing fat-soluble micronutrients as omega-3, omega-6 fatty acids, and vitamin A.

Whereas, protein plays a primary role in all stages of wound healing. It is essential for collagen synthesis, angiogenesis, fibroblast proliferation, immune status, tissue remodeling, and wound contraction (Bishop, Witts, & Martin, 2018). Ensuring sufficient protein stores and adequate intake is critical as protein deficiency results in impaired fibroblast proliferation and collagen synthesis during the proliferative phase of healing (Avishai, Yeghiazaryan, & Golubnitschaja, 2017). in a systematic review conducted from 1990 to 2013 on the role of micronutrients in the rate of recovery of burn patients by Adjepong, Agbenorku, Brown, and Oduro (2016); they revealed that the wound healing and sepsis rates were decreased by the supplementation of the antioxidant micronutrients. While, amino acids have been implicated in the role of wound healing, specially, arginine and glutamine (Chow & Barbul, 2014).

Moreover, vitamins work as the cofactor in enzymatic processes related to wound healing. As vitamin A has been shown to be useful in wound healing as it increases collagen cross-linking, epithelial growth and fibroblasts. On the other hand, deficiency of vitamin A causes altered immune function and antibody production during the inflammatory phase and decreased collagen synthesis in the remodeling phase (Saghaleini et al., 2018). Whereas, vitamin C is involved in all phases of wound healing and has antioxidant functions. Deficiencies affect the maturation phase by altering collagen tensile strength and production with scar formation (Moores, 2013). Also, minerals represent another essential micronutrient as enzyme structural factors. Zinc, copper, and iron have been claimed to be beneficial in burn wound healing, it functions as antioxidants and modulates tissue repair and growth (Lin et al., 2018).

Nutritional support following a burn injury is a sophisticated matter. Assessment which is the main core of nursing practice and essential for planning and provision of patient care, through which nurses are effective that clinical issues or deterioration are recognized early, provide adequate management and appropriate nursing care (Toney-Butler & Unison-Pace, 2018). One of the important roles that nurses should assess the caloric requirements to meet the increased demands due to hypermetabolism to avoid malnutrition which can cause a deficiency in the immune system, infections, delayed wound healing, prolonged hospital stay, and mortality (Preiser et al., 2015). Nurses play an essential role for the patient with burn injury starting from the emergent phase until the rehabilitation stage. Also, one of the nursing crucial responsibilities for these patients is to evaluate the predisposing factors related to malnutrition such as poor appetite, failure to feed oneself or requiring assistance to eat... etc. Nurses should assess and monitor clinical markers of malnutrition like significant weight loss, loss of subcutaneous fat and extremes in body mass index (Bharadwaj et al., 2016).

Quain and Khardori (2015) said that suboptimal nutrition can change immune function, collagen synthesis, and wound tensile strength, all of which are necessary for the wound healing process. Likewise, to promote wound healing in the shortest time possible, it is important to assess the nutritional status of patients with burn injury and explore its correlation with wound outcome. It is hoped that the findings of the current study might establish evidence-based data that can promote nursing practice research. Furthermore, hopefully, this study might add to the nursing body of knowledge as few

nursing researches were conducted to assess the nutritional status for patients with burn as the main aim of the current study is to assess the relationship between nutritional status and wound healing among patients with burn injury.

Research Questions

1. What is the nutritional status among patients with burn injury?

2. What is the relation between nutritional status and wound healing among patients with burn injury?

Operational definitions:

The following operational definitions were used in this study:

Nutritional status:

The condition of the body in patients with burn injury is influenced by dietary intake, it will be assessed through dietary history, body mass index (BMI), Muscle wasting through assessment of Lean Body Mass (LBM), triceps skinfold (TSF), mid-upper arm circumference (MAC), mid-upper arm muscle circumference (MAMC) about which the researchers are concerned.

Wound healing:

The factors which are associated with size, depth, type and amount of exudate, peripheral tissue edema and induration, skin color surrounding wound, granulation tissue, and epithelialization; the researchers are following it up.

2. METHODOLOGY

Research Design

A descriptive correlational design was utilized in the current study. The descriptive research design is one in which information is collected without changing the environment, while the correlational design is concerned with establishing correlations, determining the nature, strength, and type of a relationship between two variables (Grove, Gray, & Burns, 2015). Thus, the selected design helped to find the correlation between nutritional status and wound healing among patients with burn injury.

Research Setting

The proposed study was conducted at the burn department at one of the Ministry of Health hospitals in Assuit Governorate which consists of five rooms; three inpatient rooms including thirteen beds, hydrotherapy room consists of two baths and one outpatient room. The department receives patients with all types and degrees of burns. It delivers care starting from fluid resuscitation, pharmacological therapy, nutritional management, hydrotherapy, & physical therapy as well as providing dressing to outpatients. The department provides services over 24 hours. The total number of nurses affiliated to the units is sixteen; twelve nurses in the morning shift, two nurses throughout the evening shift and two nurses at night shift. Total annual admission number of adult patients with burn injury in 2016 was 85 patients (Assuit Statistical record, 2016).

Research Sample

A convenient sample of 70 adult male and female patients with burn injury who fulfilled the inclusion criteria were recruited for the current study which has been taken up to 10 months for data collection from June 2017 to April 2018. **The inclusion criteria** included an adult male and female patient ≥ 18 yrs., patients with TBSA ≥ 15% up to 50%, patients with second and third-degree burns based on (National Health Services, 2015). Regarding the burn severity, adopted from the American Burn Association (2006) as a moderate and severe burn. Patients with burn for the first time and after 48 hrs. post burn based on (Williams, Branski, Jeschke, & Herndon, 2012). **While, the exclusion criteria;** patients with chronic diseases that have a nutritional impact (diabetes, renal failure, and hepatic failure), or those who had a history of a recent diet regimen, pregnant or lactating mothers were excluded from the study.

Tools of Data Collection:

Data was collected using the following tools

1. Structured interview schedule: it was developed by the researchers. This tool consists of four parts: Part I: Demographic data, by asking patients about age, gender, residence, occupation…etc. Part II: Medical data related questions such as degree and severity of burn.…etc. Part III: Physical examination related data such as BMI, LBM, TSF, MAC, and MAMC. Part IV: Dietary data including 24 hr. dietary intake assessment.

2. Bates-Jensen Wound Assessment Tool (BWAT): developed by Jensen and colleagues. This tool was modified to contain nine items which describe wound condition regarding wound size, depth, exudate type & amount, skin color, peripheral edema, peripheral induration, granulation, and epithelialization. Each item of BWAT was assessed and scores were measured on a five-point Likert scale, where one indicates the best condition of the wound and five, the worst condition. The total score is obtained as the sum of all the items, and ranged between nine to forty-five points, with higher scores indicating the worst wound conditions. The tool reliability was established by Cauble (2010) as it was ($r=0.91$, $p=0.001$) but as the researchers did few modifications for Bates-Jensen tool to suit the current study based on the Juries suggestions; thus they re-tested its reliability as $r= 0.69$.

Validity and Reliability

Content validity of the designed tool was reviewed by a panel of three experts in the field of Medical-Surgical Nursing and nutrition. Also its internal consistency and reliability were statistically examined.

Pilot Study

A pilot study was conducted on 10% of the sample to ensure objectivity, clarity, feasibility, and reliability of the study tool and determine the time required to fill the different data collection tools. Necessary modifications were done according to the modifications required, the pilot study sample was included in the study.

Ethical Consideration

Written approval was obtained from the Ethics and Research Committee of the Faculty of Nursing. Similarly, official permission was obtained from hospital administrators to conduct the study. The purpose and nature of the study, as well as the importance, were explained to the potential patients who met the inclusion criteria. Signed consent was obtained from the patients who accepted to participate in the study. Furthermore, anonymity and confidentiality were assured through coding the data. Patients were assured that their participation is voluntary and they have the right to withdraw from the study at any time without any penalty.

Procedure:

The study was conducted through two phases: the initial and the follow-up phase through 3 visits for each patient. **The initial phase**; The first visit began at the first contact with patients after 48 hrs. of burn injury. Patients were recruited individually to explain the nature and purpose of the study. Written consents have been taken from each patient or their relatives who are willing to participate in the study. Demographic, medical, physical examination and dietary data were gathered. Afterwards, at dressing starting time, weight was taken with light clothes using a digital weight and data related to Bates-Jensen wound assessment tool was collected. **The follow-up phase;** the second and third visit were conducted to collect data using the above-mentioned tools except for demographic data questions with the same order with one week separation between each visit.

Data Analysis:

Collected data was analyzed. Descriptive results in the form of mean SD, frequency, and percentage in addition to inferential analysis in form of paired T-test and correlation test using statistical package for the social science (SPSS) program, version 20.

3. RESULTS

The data was presented in 3 main sections. The first section delineated the demographic and medical data of the study using descriptive analysis. While the second part focused on the presentation of answering the first research question. Finally, the third section was concerned about answering the second research question. Knowing that the second and third sections were using inferential analysis with $p \leq 0.05$

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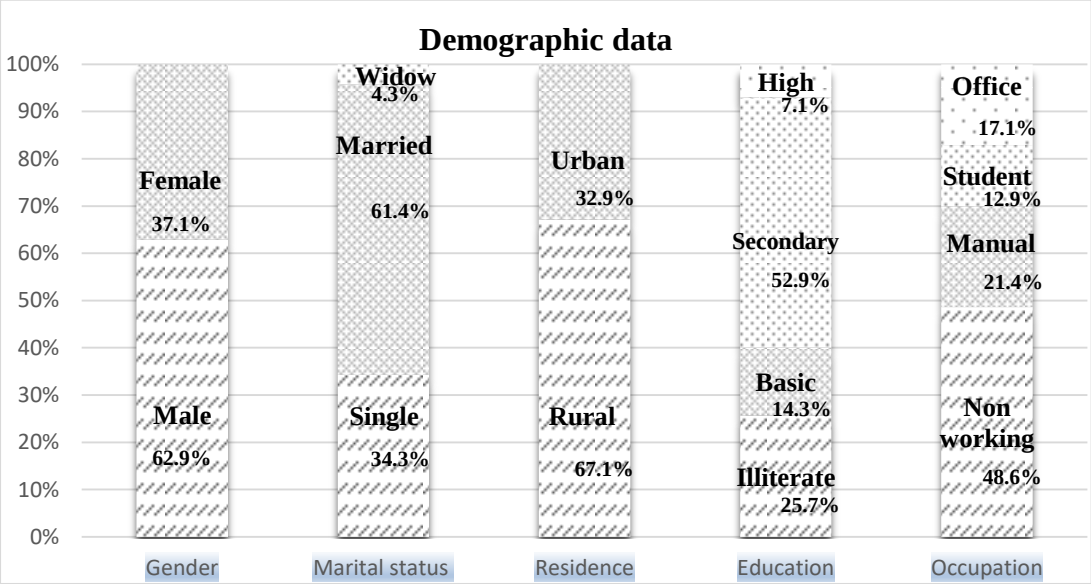
First section represented the demographic and medical data results Fig. 1 and table 1.



* Basic education = primary and preparatory. *manual work= farmer or machinery

Fig. 1. Characteristics of the Study Subjects

Figure 1 showed that 62.9% of the studied sample were male, and 61.4% were married. As regard to residence, 67.1% of the patients were from rural areas. The same figure displayed that 52.9% of the patients had secondary education. While, 48.6% were unemployed.

Table 1: Medical Data of Study Subjects

Variables	No.	%
Severity of burn		
-Moderate	6	8.6%
-Severe	64	91.4%
Degree of burn		
-Second degree	10	14.3%
-Third degree	0	0%
-Mixed	60	85.7%
Cause of burn		
-Thermal	55	78.6%
-Electrical	15	21.4%
-Chemical	0	0%
Affected area		
-Face		
-No	14	20.0%
-Yes	56	80.0%
-Arm		
-No	8	11.4%
-Yes	62	88.6%
-Chest		
-No	55	78.6%
-Yes	15	21.4%
-Abdomen		
-No	54	77.1%
-Yes	16	22.9%
-Posterior trunk		
-No	64	91.4%
-Yes	6	8.6%

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-Lower extremities		
-No	17	24.3%
-Yes	53	75.7%
Length of stay		
- < 7 days	5	7.1%
-7 < 14 days	20	28.6%
-14 < 21 days	18	25.7%
-21 < 28 days	7	10.0%
-28 to 35 days	4	5.7%
- < 35 days	16	22.9%
Mean ± SD	24.3 ± 20.4	

Based on the above table, 91.4% of the patients had severe burn injury, 85.7% had a burn injury of both second and third degrees. As regard to the cause of burn injury, thermal injury accounted for 78.6%. Regarding the affected area; arm, face and lower extremities were the most affected areas with a percentage of 88.6%, 80%, and 75.7% respectively. As regard to the length of hospital stay, 28.6% of the patients stayed from 7 to less than 14 days with mean of 24.3 ± 20.4.

Second section represented the nutritional related data results; table 2 to 4

Table 2: Physical Examination Data of Study Subject's

Variables	1st reading	2nd reading	3rd reading
	Mean ± SD	Mean ± SD	Mean ± SD
BMI	26.6 ± 6.19	26.07 ± 5.9	24.18 ± 8.8
LBM	50.78 ± 8.5	50.14 ± 8.24	46.5 ± 15.1
TSF	8.3 ± 9.4	7.7 ± 8.9	6.5 ± 7.9
MAC	28.9 ± 4.86	28.04 ± 4.37	25.5 ± 8.1
MAMC	26.3 ± 3.69	25.6 ± 3.13	23.49 ± 7.1

BMI= body mass index, LBM= Lean Body Mass, TSF= triceps skin fold, MAC= mid upper arm circumference, MAMC= mid upper arm muscle circumference

As regard to body composition assessment, table 2 revealed that there was a significant reduction between measurements at 1st reading (48 hrs. Post burn) and at 3rd reading (at day 16).

Table 3: Dietary Intake Data of Study Subjects

Variables	1st reading		2nd reading		3rd reading	
	N	%	N	%	N	%
Protein intake						
-Not taken	0	0%	0	0%	4	5.7%
-Normal	13	18.6%	19	27.1%	20	28.6%
-Below need	40	57.1%	20	28.6%	15	21.4%
-Above need	17	24.3%	31	44.3%	31	44.3%
Mean ± SD	107.4 ± 58.7		140.6 ± 59.69		142.15 ± 69	
Carbohydrate intake						
-Not taken	0	0%	0	0%	4	5.7%
-Normal	54	77.1%	56	80.0%	54	77.1%
-Below need	10	14.3%	4	5.7%	1	1.4%
-Above need	6	8.6%	10	14.3%	11	15.7%
Mean ± SD	284.3 ± 144.4		331.4 ± 123.8		329.3 ± 139.1	
Fat intake						
-Not taken	0	0%	0	0%	4	5.7%
-Normal	30	42.9%	22	31.4%	22	31.4%
-Below need	18	25.7%	12	17.1%	11	15.7%
-Above need	22	31.4%	36	51.4%	33	47.1%
Mean ± SD	112.4 ± 69.2		133.4 ± 66		124.1 ± 69.17	

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Calories per day						
-Not taken	0	0%	0	0%	4	5.7%
-Normal	13	18.6%	19	27.1%	17	24.3%
-Below need	47	67.1%	32	45.7%	28	40.0%
-Above need	10	14.3%	19	27.1%	21	30.0%
Mean ± SD	2390.5 ± 1029.5		2940.3 ± 928.5		2844.7 ± 1155.5	

Table 3 displayed that protein, carbohydrates and fat intake were below patient needs in 57.1%, 14.3%, and 25.7% of the patients in the 1st reading respectively. While, calories consumption was below needs in 67.1%, 45.7%, and 40% of the patients in the three readings respectively. Mean level of protein, fat, carbohydrates and calories was 107.4 ± 58.7, 140.6 ± 59.69, 142.15 ± 69 and 284.3 ± 144.4, 331.4 ± 123.8, 329.3 ± 139.1 and 112.4 ± 69.2, 133.4 ± 66, 124.1 ± 69.17 and 2390.5 ± 1029.5, 2940.3 ± 928.5, 2844.7 ± 1155.5 respectively in the three readings.

Table 4: Wound status of study subjects

Total score of BWAT	**1st reading**		**2nd reading**		**3rd reading**	
	No.	**%**	**No.**	**%**	**No.**	**%**
-Not assessed	0	0%	0	0%	4	5.7%
-Healthy tissue	0	0%	0	0%	3	4.3%
-Minimal wound severity	0	0%	9	12.9%	32	45.7%
-Mild wound severity	56	80.0%	47	67.1%	27	38.6%
-Moderate wound severity	14	20.0%	14	20.0%	4	5.7%
-Extensive wound severity	0	0%	0	0%	0	0%
Mean ± SD	24.58 ± 3.15		23.35 ± 4.85		17.02 ± 7.44	
T-Test	8.617					
Sig.	0.0000					

*significant at P ≤ 0.05, ** highly significant at P ≤ 0.001, BWAT= Bates-Jensen Wound Assessment Tool

Table 4 revealed up that 80% of the patients had wounds of mild severity in the 1st reading, which improved to minimal severity 45.7% in 3rd reading. The same table showed that there was a statistically highly significant difference in wound status between 1st and 3rd time at P level ≤ 0.001; t= 8.617, p= 0.000.

Section three shown up the correlational results presented in table 5.

Table 5: Relation between nutritional status and wound status

Nutrition in the Three readings	**Total score of BWAT**		
	1st	**2nd**	**3rd**
	r	**r**	**r**
Protein intake			
1st	-0.03	-0.23	0.15
2nd	-0.23	-0.11	0.01
3rd	-0.03	-0.12	0.2
Carbohydrate intake			
1st	-0.01	-0.19	0.04
2nd	0.05	-0.12	-0.01
3rd	0.16	-0.08	0.38**
Fat intake			
1st	-0.25*	-0.24*	-0.01
2nd	-0.08	-0.05	0.1
3rd	0.07	0.01	0.34**
Calories per day			
1st	-0.07	-0.26*	0.08
2nd	-0.09	-0.11	0.02
3rd	0.07	-0.1	0.33**

* significant P ≤ 0.05, ** highly significant at P ≤ 0.001, BWAT= Bates-Jensen Wound Assessment Tool

The above table displayed that no statistical correlation was found in relation to protein intake and the total score of BWAT (r= -0.03, -0.11 and 0.2) in the three readings respectively. There was a positive moderate relationship between carbohydrates intake and the total score of BWAT in the 3rd reading (r= 0.38) at P ≤ 0.001. In addition, there was a negative weak relationship between fat intake and BWAT in the 1st reading (r= -0.25) at P ≤ 0.05. While in the 3rd reading there was a positive moderate relationship (r= 0.34). Regarding calories, there was a positive moderate relationship to the total score of BWAT at the 3rd reading (r= 0.33) at P ≤ 0.001.

4. DISCUSSION

The aim of the current study was to assess the correlation between nutritional status and wound healing among patients with burn injury. In order to answer the current research questions; the following discussion presented in the following manner: First part discussed the related demographic data. The second part focused on medical data condition for patients with burn injury. Finally, the third part shed light on the relation between nutritional status and wound healing.

Related to the demographic results, the findings of the current study revealed that two-thirds of the studied sample were males, same findings regarding marriage and more than third of them their age ranged between eighteen to less than thirty with mean of age 33.06 ± 12.16. This might be as a result that, patients at this age are physically active, engaged in risky activities or might be due to actions related to the nature of their work which predisposed them to injury as the majority of them were dealing with flames at ovens, home or electricity.

Regards to the residence, more than two-thirds of the studied sample lived in rural areas. Correspondingly, the results of the current study were in accordance with results of a study done by Rybarczyk et al. (2017) related to the epidemiology of burn injury in African areas which revealed that the majority of the studied sample were males, unemployed, lived in rural areas with age ranged from twenty to less than thirty years old. The researchers agreed that increasing the incidence of burn injuries in rural areas might be because that those people were less familiar with the precautions for avoiding burns and therefore, they were exposed to burn injury more frequently. Also, their surroundings and their lifestyle were less safe than those of urban areas. In addition, the use of open fires for cooking, heating, substandard housing and poverty let them be more susceptible to such flame accidents.

Regarding their educational level, the present study revealed that more than half of the patients had secondary education and approximately half of them were unemployed. The researchers noticed that despite the high education level of these patients, but they were injured and this may be due to lack of awareness personally or through social media about burn injury and its prevention. A study conducted by Alavi et al. (2012) to evaluate the epidemiology on two thousand two hundred seventy four patients from 2007 to 2010 in Iran, congruent with the current results as reported that the majority of the studied sample were males, married and had secondary education. Furthermore, a study done by He et al. (2017) to measure burn outcomes on one million and two hundred thousands patients in Bangladesh supported the same results of the current study as they mentioned that the majority of the studied sample were unemployed and married.

As regards to the second part related to medical data of the studied sample, the current study revealed that the mean length of hospitalization was 24.3 ± 20.4 days, with two days as minimum length of stay and the maximum length of stay was one hundred and five days which could be due to wound infection, TBSA, hemodynamic instability or the need for graft and other surgical procedures. Moreover, severe burn injury of both second and third degrees was observed in most of the patients which expected to be related to face area involvement, major TBSA or type of injury as electrical burn.

Thermal burn was the most common type of injury that observed in the majority of the studied sample which might be due to women using the kitchen or open fire for cooking, boiling water, using ovens and oils in making foods or nature of men work in ovens, petrol stations, and other flammable risky circumstances. It was also observed that the upper extremities were the most common body parts involved, followed by the face, while, the posterior trunk was the least common perhaps because people subconsciously use their extremities to protect the most important parts of the body when confronted with sudden trauma. Similar findings were found by Khongwar et al. (2016) who conducted a study on one hundred forty six patients with burns to appraise its epidemiology and revealed that the majority of the studied sample had thermal burn injury of both second and third degrees. Moreover, the results of the current study were in accordance with results of a study done by Tian et al. (2018) to assess the characteristics of one thousand one hundred twenty six

patients with severe burns from 2011 to 2015 in China, which revealed that the majority of the sample had a severe thermal injury where the extremities were the most frequent burned areas.

Regarding nutritional status, dietary intake revealed that there was a significant difference in food intake over time; the majority of the patients had low energy and protein intake when their intakes were compared with their requirements in the 1st reading which could be either related to the food type served by the hospital, little quantities of the food taken secondary to nausea, vomiting or other physiological parameters from the beginning in addition to the occurrence of the burn injury might devastate their biological condition. Carbohydrate intake was within normal in the majority of the patients, with a small percentage being below patient needs. However, food intake improved over measurements in the 2nd and 3rd readings which could be due to increased appetite, improvement in patients clinical condition or decreasing GIT manifestations.

Additionally, fat intake was within normal in approximately half of the patients in the 1st reading. However, fat intake increased and became above patient needs in the 2nd and 3rd readings which might be due to increased appetite, favoring foods with high lipids secondary to their eating habits and culture, or may be due to their lack of knowledge about the adequate amount of fats needed. The researchers concur that the above normal fat intake may predispose patient to major problems as infection which might interfere with burn wound healing. This was supported by Jeschke, Kamolz, Sjöberg, and Wolf (2012) who explained that increased fat intake adversely affects immune function, causes significant accumulations of fat in the liver and may promote infectious complications.

Physical examination of body composition revealed that LBM and MAMC decreased over measurements over the three readings. The researchers illustrated that the subnormal measurements of MAMC and LBM might be either related to inadequate protein intake which did not compensate protein loss or hypermetabolic demands of burn injury. These results were supported by a study done by Jeschke (2016) to discuss the burn responses over the past 100 years with management alternatives to enhance burn outcomes and reported that proteolysis is markedly increased after burn injury as protein is utilized as an energy source when calories are restricted resulting in muscle wasting and a decrease in lean body mass. Also, TSF was decreased over the three readings which could be due to the hypermetabolic effects of burn injury. This was in accordance with a study done by Clark, Imran, Madni, and Wolf (2017) to review the actual condition of nutrition post burns, which reported that hypermetabolic consequences of burn injury result in nutrients movements, leading to a significant rise of peripheral at decomposition. Regarding MAC, the researchers elaborate that increasing MAC despite the reduction in TSF and MAMC in the 1st reading may return to inflammatory responses and edema formation.

Regarding the third part related to correlational data, the findings of the current study revealed that there was a highly significant reduction in the wound severity over time. The majority of the studied sample had wounds with mild severity in the 1st and 2nd readings which converted into minimal severity in less than half of the patients in the 3rd reading. The researchers highlight this finding as improvement in wound status might be related to age, the extent of TBSA, adequate nutrition, the using a proper aseptic technique in wound dressing procedures. In addition, there was no relation between total score of wound status and protein intake over the three readings as the researchers illustrated that adequate protein is needed for wound status improvement as inadequate amount of protein might predispose patients to underfeeding complications such as delayed wound healing. But, on the other hand, the researchers observed an improvement in wound severity levels within BWAT scale when increasing protein intake despite no correlation found, which could be related to genetic predisposition, young age of the patients or low TBSA.

Whereas there was a positive moderate relation between wound status scores in relation to carbohydrate, fat and calories intake at the 3rd reading which reflected a deterioration in wound condition when increasing carbohydrate, fat, and calories over the needed requirements. This was in accordance with results of a study done by Rowan et al. (2015) to review the new advances in burn care and they justified that extra carbohydrate intake can result in hyperglycemia that can exaggerate systemic inflammatory response. While, excessive fat ingestion may aggravate altered immunity, increase the infection risk and delay wound healing. Similarly, a study conducted by Mahakalkar et al. (2014) on 70 patients to evaluate the malnutrition incidence and its impact on patient outcomes, found that altered nutrition resulted in impairment of wound healing. Finally, based on the above discussion, the researches found that patients with burn injury were improved over time gradually and actually their nutritional status affected their wound healing process, thus the aim of the current study was attempted.

5. CONCLUSION

Nutrition is essential for wounds to heal and should be monitored closely to provide adequate amounts as inadequate nutrition might lead to altered immunity and impaired healing which was found in the results of the current study. Wound condition deteriorated when increasing carbohydrate and fat over the needed requirements. In addition, an improvement in wound severity levels was observed when increasing protein intake.

6. RECOMMENDATION

1. Further researches are needed on a larger scale to support the current findings in order to add to the body of knowledge.
2. Repeat the study on a full thickness degrees wound degree
3. Expand the follow-up period for patients with burn injury with 2nd and 3rd degrees
4. Assessing wound and nutritional requirements for patients with burn injury should be added to the routine burn care.
5. Establish liaison between nursing staff working at the burn department and nutritionist to design a meal plan built on nursing assessment of the nutritional requirements.

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