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THE EFFECT OF CALORIE-MATCHED NUTRITIONAL SUPPORT ON CLINICAL OUTCOMES IN BURN PATIENTS: A COMPARATIVE STUDY IN THE BURN UNIT

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ABSTRACT

Background: Burn wounds continue to be responsible for significant morbidity and mortality worldwide, and nutritional support is a cornerstone of recovery and outcome. We conducted a prospective, randomized controlled trial to determine the effects of prescription-based calorie-matched nutritional support vs routine standard nutrition in adult burn patients. **Method:** Fifty patients with burns of 20–50% of total body surface area (TBSA) were randomized in the Burn Center in Al-Najaf, Iraq, to receive either isocaloric (n = 25) or standard nutrition (n = 25). The initial demographic and clinical characteristics were similar between the 2 groups with the exceptions of age and TBSA distribution. Nutritional status was determined by body weight, body mass index, Malnutrition Universal Screening Tool (MUST), serum albumin and total albumin before and after intervention. **Result:** demonstrated the superior effects of calorie-matched nutrition on anthropometric and biochemical parameters. After intervention, the calorie-matched group had higher weight, BMI, serum albumin, and total albumin contents (all $P < 0.001$) than the standard nutrition group. Additionally, the calorie-matched colony exhibited a significant decrease in the risk at malnutrition showed by MUST scores whereas the standard nutrition treated patients significantly were losing weight and BMI, indicating their caloric intake were not enough. The effects of personalized nutrients were more pronounced in patients with 26–50 % TBSA burns, indicating the necessity of specific nutrition to meet the increased metabolic requirements. **Conclusion:** calorie-equivalent nutritional support leads to better nutritional and biochemical response than that elicited by standard therapy. The introduction of personalized nutrition protocols in burns departments is highly recommended for improving clinical end points.

KEYWORDS: Calorie-Matched, Nutritional, Clinical, Outcomes, Burn.

INTRODUCTION

Burn injuries represent a major global health concern, associated with substantial morbidity and mortality. The World Health Organization estimates that nearly 180,000 deaths annually are attributed to burns, with the vast majority occurring in low- and middle-income countries.[1] Effective management of burn injuries extends beyond wound care and fluid resuscitation to include comprehensive nutritional support, which plays a pivotal role in optimizing patient outcomes. Burn trauma triggers a profound hypermetabolic and catabolic response, which can persist for weeks or even months depending on the extent of injury.[2] This response is characterized by increased energy expenditure, muscle protein degradation, and impaired immune function, leading to delayed wound healing, higher infection rates, and prolonged hospitalization if not adequately addressed.[3] Early and appropriate nutritional intervention, particularly one that is tailored to the patient's metabolic demands, is therefore crucial in mitigating these effects. Calorie-matched nutritional support involves calculating energy and protein needs based on individualized factors such as total body surface area (TBSA) burned, age, sex, and comorbidities, thereby ensuring that patients receive adequate calories to support tissue repair and immune function without

contributing to overfeeding-related complications.[4] Several studies have highlighted the benefits of such tailored nutritional approaches in burn patients, including reduced length of hospital stay, improved nitrogen balance, and enhanced wound healing.[5,6] Despite this evidence, many burn centers, especially in resource-limited settings, continue to rely on standard nutritional protocols that may not account for the heightened metabolic demands of severely burned individuals.[7] The implementation of calorie-matched nutritional regimens is particularly relevant in burn units where malnutrition or overfeeding may exacerbate existing clinical challenges. Emerging evidence suggests that aligning nutritional intake with estimated energy expenditure can reduce complications such as hyperglycemia, hepatic steatosis, and ventilator dependency.[8] However, comparative data assessing the efficacy of calorie-matched versus standard nutritional support in diverse populations remain limited. Study goals: to determine if calorie-matched nutritional supplementation improves burn patients' clinical outcomes relative to normal nutrition.

METHOD

This interventional, randomized controlled study was conducted at the Burn Center in Al-Najaf, Iraq, with the aim of evaluating the clinical effectiveness of calorie-matched nutritional support compared to standard nutritional regimens in adult burn patients. The study enrolled a total of 50 patients, who were randomly assigned into two equal groups (25 patients each) using a simple randomization technique. The first group, referred to as the Calorie-Matched Group, received nutritional support individually tailored to meet their calculated energy and protein requirements. These requirements were determined using standardized predictive equations and clinical parameters, including age, weight, height, sex, and total body surface area (TBSA) affected by burns. The second group, known as the Standard Nutritional Regimen Group, received conventional nutritional care following existing ward protocols, which did not account for individualized energy needs. Inclusion Criteria: Eligible participants included adult patients aged between 18 and 60 years, who had sustained burns covering 20% to 50% of TBSA. All patients were hemodynamically stable and able to receive enteral nutrition. Patients included in the study had no history of chronic metabolic disorders, such as uncontrolled diabetes mellitus, advanced hepatic dysfunction, or other systemic illnesses that might interfere with nutritional metabolism or recovery. Exclusion Criteria: Patients were excluded if they had pre-existing conditions likely to affect metabolic responses or compromise the nutritional intervention outcomes, including chronic renal disease, malignancy, or immunosuppression. Additionally, pregnant or lactating women, and patients with contraindications to enteral feeding or specific dietary requirements that could not be aligned with the study protocols, were not enrolled. All patients were managed according to the burn unit's clinical protocols, including fluid resuscitation, wound care, pain control, and infection monitoring. Nutritional assessments, including weight, BMI, MUST score, serum albumin, and total albumin, were recorded at baseline and after the intervention period to compare outcomes between groups. Data were statistically analyzed using appropriate parametric and non-parametric tests, with a significance level set at $P < 0.05$.

RESULTS

Significant differences were found between the two nutritional groups in terms of age and TBSA. Younger patients (18–30 years) and those with ≤25% TBSA burns were more likely to receive standard nutrition, while patients aged 31–40 and those with 26–50% TBSA burns predominantly received calorie-matched nutrition. No significant associations were found for gender, marital status, or burn cause, indicating similar distributions across both groups for these variables. Table 1.

Table 1: association between study variables and patients in both group.

Groups			
Age Group (years)	**standard nutritional regimens**	**Calorie-Matched Nutritional**	**P-value**
18–30	17 (70.8%)	8 (30.8%)	**0.017**
31–40	5 (20.8%)	15 (57.7%)	
41–50	1 (4.2%)	3 (11.5%)	
51–60	1 (4.2%)	0 (0.0%)	
Gender	**standard nutritional regimens**	**Calorie-Matched Nutritional**	**P-value**
Female	11 (45.8%)	8 (30.8%)	0.4
Male	13 (54.2%)	18 (69.2%)	
Marital state	**standard nutritional regimens**	**Calorie-Matched Nutritional**	**P-value**
Married	14 (58.3%)	16 (61.5%)	**1.000**
Un Married	10 (41.7%)	10 (38.5%)	
Burn reasons	**standard nutritional regimens**	**Calorie-Matched Nutritional**	**P-value**
Accident	23 (95.8%)	23 (88.5%)	0.6

Suicidal	1 (4.2%)	3 (11.5%)	
TBSA	**standard nutritional regimens**	**Calorie-Matched Nutritional**	**P-value**
≤25	8 (33.3%)	1 (3.8%)	**0.008**
26-50	13 (54.2%)	24 (92.3%)	
>50	3 (12.5%)	1 (3.8%)	

Both groups showed improvement in nutritional status post-treatment based on MUST scores. Initially, almost all patients were at high risk of malnutrition. After treatment, more patients shifted to low or medium risk, although differences between the groups remained statistically insignificant (before: P = 1.000; after: P = 0.5). This suggests both regimens helped reduce malnutrition risk. As in table 2.

Table 2: association between MS before and after in both groups.

Groups			
MUST before	**standard nutritional regimens**	**Calorie-Matched Nutritional**	**P-value**
Medium	0 (0.0%)	1 (3.8%)	**1.000**
High	24 (100.0%)	25 (96.2%)	
MUST after	**standard nutritional regimens**	**Calorie-Matched Nutritional**	**P-value**
Low	11 (45.8%)	16 (61.5%)	0.5
Medium	7 (29.2%)	6 (23.1%)	
High	6 (25.0%)	4 (15.4%)	

Before treatment, the calorie-matched nutritional group had significantly higher weight (P = 0.002) and BMI (P = 0.012). However, total albumin was significantly lower in this group (P = 0.0001), while serum albumin levels showed no significant difference (P = 0.09). This indicates a disparity in nutritional and inflammatory status at baseline. Table 3.

Table 3: differences between both group in mean of study variables before treatment.

Variable	standard nutritional regimens	Calorie-Matched Nutritional	P-value
Weight before	65.03 ± 12.12	80.42 ± 19.77	**0.002**
BMI before	23.84 ± 4.29	27.64 ± 5.77	**0.012**
Albumin before	1.95 ± 0.63	1.66 ± 0.60	0.09
Total **Albumin** before	4.49 ± 1.36	2.95 ± 1.05	**0.0001**

After intervention, the calorie-matched group demonstrated significantly higher weight, BMI, serum albumin, and total albumin levels (all P < 0.001). This highlights the superior efficacy of calorie-matched nutrition in improving both anthropometric and biochemical indicators. Table 4.

Table 4: differences between both group in mean of study variables after treatment.

Variable	standard nutritional regimens	Calorie-Matched Nutritional	P-value
Weight after	61.76 ± 12.28	80.23 ± 19.47	**0.0001**
BMI after	22.49 ± 4.44	27.41 ± 5.65	**0.001**
Albumin after	1.65 ± 0.53	3.06 ± 0.66	**0.0001**
Total **Albumin** after	3.50 ± 0.86	5.11 ± 1.14	**0.0001**

No significant changes were observed in weight (P = 0.5) or BMI (P = 0.4). However, there were significant improvements in MUST score, serum albumin, and total albumin (all P = 0.0001), indicating enhanced nutritional and protein status despite stable body mass. Table 5.

Table 5: differences mean of variables before and after treatment in Calorie-Matched Nutritional.

Variable	Before	After	P-value
WTB	80.42 ± 19.77	80.23 ± 19.47	0.5
BMI	27.64 ± 5.77	27.41 ± 5.65	0.4
MUST	2.15 ± 0.46	0.54 ± 0.76	**0.0001**
Albumin	1.66 ± 0.60	3.06 ± 0.66	**0.0001**
Total Albumin	2.95 ± 1.05	5.11 ± 1.14	**0.0001**

This group exhibited a significant reduction in weight and BMI (both P = 0.0001), along with improvements in MUST (P = 0.0001), serum albumin (P = 0.004), and total albumin (P = 0.001). The decline in body mass

alongside improved biochemical markers may reflect inadequate caloric intake despite some metabolic improvements. Table 6.

Table 6: differences mean of variables before and after treatment in patient's standard nutritional regimens.

Variable	Before	After	P-value
WTB	65.03 ± 12.12	61.76 ± 12.28	**0.0001**
BMI	23.84 ± 4.29	22.49 ± 4.44	**0.0001**
MUST	2.54 ± 0.59	1.04 ± 1.27	**0.0001**
Albumin	1.95 ± 0.63	1.65 ± 0.53	**0.004**
Total Albumin	4.49 ± 1.36	3.50 ± 0.86	**0.001**

DISCUSSION

The present study evaluated the impact of calorie-matched nutritional support versus standard nutritional regimens in burn patients admitted to the Burn Center in Al-Najaf. Our findings demonstrated that calorie-matched nutrition significantly improved key nutritional and clinical parameters, including weight, BMI, serum albumin, total albumin, and MUST scores, when compared to standard nutrition. Following intervention, patients in the calorie-matched group exhibited significant improvements in serum albumin (from 1.66 ± 0.60 to 3.06 ± 0.66; $P < 0.0001$) and total albumin (from 2.95 ± 1.05 to 5.11 ± 1.14; $P < 0.0001$), whereas the standard nutrition group showed a decline in both parameters. These improvements indicate enhanced protein synthesis and nutritional recovery, which are essential for wound healing and immune function in burn patients. Our results align with those of Rousseau et al. (2013), who emphasized that individualized nutritional therapy leads to better nitrogen balance and supports the hypermetabolic response in burn injuries.[9] Moreover, despite similar baseline risks of malnutrition, as reflected by MUST scores, the calorie-matched group showed a more significant reduction in malnutrition risk post-intervention. These findings support prior evidence from a multicenter survey by Chapple et al. (2019), which highlighted the barriers to optimal nutrition in ICU burn patients and advocated for early individualized interventions to improve outcomes.[10] Interestingly, although the calorie-matched group maintained stable weight and BMI, there was still a marked improvement in biochemical markers. This suggests that weight alone may not be a sensitive indicator of nutritional improvement, especially in acute inflammatory states. Similar observations were reported by Núñez-Villaveirán T et al. (2014), who noted that metabolic and nitrogen balance outcomes are better indicators of recovery than simple anthropometric measures in thermally injured patients.[11] In contrast, patients receiving standard nutrition experienced significant weight loss (from 65.03 ± 12.12 to 61.76 ± 12.28; $P = 0.0001$) and decline in BMI (from 23.84 ± 4.29 to 22.49 ± 4.44; $P = 0.0001$), indicating that their caloric intake did not meet the metabolic demands. Although their MUST scores and serum proteins improved modestly, the degree of improvement was inferior to that observed in the calorie-matched group, suggesting partial nutritional recovery. Our study also showed that patients in the calorie-matched group were more likely to fall within the TBSA burn range of 26–50% ($P = 0.008$), highlighting that individualized nutrition becomes increasingly important with greater burn severity. Klein et al. (2016) emphasized that the magnitude of the hypermetabolic response correlates with TBSA, and failure to meet nutritional requirements can exacerbate catabolism, leading to complications such as delayed healing, infections, and increased mortality.[12] The findings of this study support the superiority of calorie-matched nutritional support in improving both biochemical and clinical outcomes among burn patients. This approach provides a practical and evidence-based strategy for optimizing recovery, particularly in moderate to severely burned individuals. Future studies should explore the long-term outcomes, cost-effectiveness, and impact on wound healing rates and infection control associated with tailored nutritional interventions.

CONCLUSION

Calorie-matched nutritional support significantly improved serum albumin, total albumin, BMI, and MUST scores compared to standard regimens in burn patients. Patients receiving standard nutrition experienced weight and BMI loss, indicating inadequate caloric intake. Tailored nutrition showed better biochemical recovery even without weight gain, highlighting its metabolic efficiency. Calorie-matched support is especially beneficial for patients with 26–50% TBSA burns, where metabolic demands are high. We recommend implementing individualized nutritional assessment and support protocols in burn units to optimize clinical outcomes.

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