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Influence of body mass index on skin grafting in pediatric burns

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ABSTRACT

Background: There is heterogeneous literature on the association of obese and underweight body habitus on burn outcomes in adult and pediatric literature. We examine the effect of standardized pediatric body mass index (BMI) categories skin graft utilisation.

Methods: A retrospective chart review was performed on children who underwent burn treatment from January 1995 to November 2011. BMI was categorized by standard definitions: underweight (<5%), normal (5–85%), overweight (85–95%), obese (>95%).

Results: There were 1164 patients: 77 underweight, 604 normal, 215 overweight, and 268 obese patients. No differences existed between group demographics. Grafts were performed in 39% of underweight, 27% of normal, 22% of overweight, and 27% of obese patients. Underweight children had nearly a 2 fold increase in their risk of full thickness burns and were 1.8 times more likely to undergo skin grafting than normal BMI children. Overweight children had a significant decrease in the incidence skin grafting by 23% then compared to normal weight children. There were no differences in percent TBSA burned or percent TBSA grafted using ANOVA.

Conclusions: Underweight pediatric burn victims have an increased risk for skin grafting while mildly overweight children are slightly protected from skin grafting.

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Burns are a substantial pediatric trauma burden across the globe [1]. There are approximately 1 million pediatric burns annually in the United States alone [2]. Most of these injuries are due to scald burns [2,3]. Current adult trauma literature has heterogeneous results when correlating body mass index (BMI) with morbidity and mortality in trauma [4–12]. There is a paucity of data describing the impact of BMI on burn outcomes [13–20]. Given the growing prevalence of obesity and malnutrition in the pediatric population, we sought to investigate the impact of body mass index (BMI) on burn outcomes specifically the need for skin grafting in pediatric burns.

1. Methods

After obtaining institutional review board approval (#1111-199E), a retrospective chart review was performed on all children who received burn treatment at a dedicated children's hospital burn unit from January 1995 to November 2011. The primary outcome measure was the need for skin grafting. Additional data collection included demographics, percent total body surface area (TBSA), incidence of full thickness burns, percent TBSA grafted, incidence of non-accidental

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trauma, mechanism of burn, anatomic area burned, and burn depth. High risk burn sites were defined as those involving the face, genitals/perineum, hand and feet. TBSA was estimated based on the Lund and Browder burn diagram [21]. Recorded height and weight on admission was used to calculate the BMI using the standard formula of weight (kilograms) divided by the square of the height (meters). BMI percentiles were estimated using standards based on patients' age and gender. Weight groups were categorized based on standard definitions: underweight (<5th percentile), normal (5th-85th percentile), overweight (85th-95th percentile), and obese (>95 percentile). Patients with total body surface area (TBSA) burns greater than 30% were excluded as most underwent transfer to a specialized pediatric burn center prior to completion of burn treatment. Children were excluded if anthropometric measurements or TBSA percentiles could not be located in their chart. All children underwent similar burn treatment and nutritional treatment protocols in a dedicated pediatric burn unit.

Data for continuous variables are expressed as mean \pm standard deviation unless otherwise stated. Statistical analysis was performed using 2-tailed Student's t-test, analysis of variance (ANOVA), and χ^2 with Yates correction where appropriate. Both univariate and multivariate logistic regression was performed. SPSS (Chicago, IL) 20.0 statistical software was utilized. A *p*-value of less than 0.05 was considered significant.

2. Results

Of the 1939 children treated for burns in our hospital, 1164 met inclusion criteria. BMI distribution included: 77 (6.6%) underweight, 604 (51.9%) normal, 215 (18.5%) overweight and 268 (23%) obese children. Mean age was 5.3 ± 4.8 years (range 0.1-18.2 years). There were no significant differences between weight groups in terms of gender distributions or racial proportions.

The most common mechanism of burn was scald. Non-accidental trauma was evident in 4.6%. The most common burn location was the trunk, followed by legs, arms, hands, legs and face. The mean percent TBSA burned was $6.5\% \pm 6\%$ (range 0.25-30%) and percent of grafted body surface area was

Table 1 – Burn outcomes.

	% TBSA	Full thickness (%)	Need for grafting (%)	% TBSA grafted
Normal	6.14 \pm 5.72	26.32	26.66	3.6 \pm 4.39
Underwt	6.73 \pm 6.39	42.86	38.96	4.12 \pm 4.49
Overwt	6.72 \pm 6.46	22.79	21.86	3.71 \pm 4.94
Obese	6.83 \pm 6.28	27.99	27.24	4.5 \pm 5.13

TBSA: percent total body surface area. Weight groups categorized based on standard definitions: underweight (<5th percentile), normal (5th-85th percentile), overweight (85th-95th percentile), and obese (>95 percentile). All data is presented as mean \pm standard deviation unless otherwise specified.

Table 2 – Comparison of skin grafting and incidence of third degree burns among body mass index groups.

BMI	Skin grafting (P value)	Full thickness burn (P value)
Normal:overwt	0.17	0.32
Normal:obese	0.81	0.68
Overwt:obese	0.17	0.21
Underwt:obese	0.07	0.02
Underwt:normal	0.03	<0.01
Underwt:overwt	<0.01	<0.01

BMI: body mass index. Weight groups categorized based on standard definitions: underweight (<5th percentile), normal (5th-85th percentile), overweight (85th-95th percentile), and obese (>95 percentile).

$3.9\% \pm 4.7\%$ (range 1-30%). Full thickness burns and skin grafting occurred in 27 and 26.7% overall, respectively.

Table 1 presents the TBSA, incidence of full thickness burns, need for grafting and percent TBSA grafted for each weight category. There was no significant difference among the BMI groups in terms of percent TBSA burned or percent TBSA grafted using one-way ANOVA. Direct comparisons between BMI groups for incidence of skin grafting and full thickness burns are listed in Table 2. Skin grafts were required in 26.8% of burns overall (39% of underweight, 26.7% of normal, 21.9% of overweight, and 27.5% of obese patients). Univariate logistic regression was used to compare skin grafting in children with normal weight to each of the other three weight categories in Table 3. Full thickness burns were documented in 42.9% of underweight, 26.3% of normal, 22.8% of overweight and 27.9% of obese children. Univariate logistic regression was used to compare the incidence of full thickness burns in children with normal weight to each of the other three weight categories in Table 4. Average number of days from burn to skin grafting was 14.5 ± 20 days. Multivariate analysis indicated that there was no affect of the weight categories on the incidence of skin grafting when controlled for percent TBSA, age, incidence of full thickness burns, and high risks burns (Table 5). Only the presence of full thickness burns predicted the need for skin grafting in multivariate analysis. Table 6 illustrates that there was no significant difference detected between burn mechanism and weight class. There was also no significance difference between burn mechanism and need for skin grafting. There were no mortalities.

Table 3 – Incidence of skin grafting.

	P value	OR	CI
All groups	0.04	-	-
Normal:underwt	0.03	1.76	1.07-2.87
Normal:overwt	0.17	0.77	0.53-1.11
Normal:obese	0.86	1.03	0.75-1.42

OR: odds ratio, CI: confidence interval. Weight groups categorized based on standard definitions: underweight (<5th percentile), normal (5th-85th percentile), overweight (85th-95th percentile), and obese (>95 percentile).

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