The Differences of Nutrition Status, Energy Delivery and Outcomes between Metropolis and Regional University-Based Thai Surgical Intensive Care Units

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Objective: *The objective of this study was to compare the differences of nutrition status, nutrition delivery, and the outcomes between the metropolis (MUH) and regional university based hospitals (RUH) in Thailand.*

Material and Method: *The nutrition data were retrieved from the THAI-SICU database. A total of 1,686 patients (MUH 927 patients vs. RUH 759 patients) with completion of nutrition status and nutrition delivery data were included in this analysis. The enrolled patients from study centers located in Bangkok were defined as MUH, and the patients from Chiang Mai were defined as RUH. Patient characteristics, nutrition status using the subjective global assessment (SGA) and nutrition risk screening (NRS), nutrition delivery, and outcomes of treatment were recorded. The outcome associations were analyzed by a multivariable regression model.*

Results: *At admission, there were significant differences of age, gender, body mass index, disease severity, albumin level, and diagnosis. RUH had significantly poorer nutritional status than MUH (RUH vs. MUH: SGA class B and C, 57.7% vs. 37.1%, p<0.001; NRS at risk, 56.3% vs. 38.4%, p<0.001). The tendency of total calories and enteral nutrition delivery per day of RUH was significantly lower than MUH especially in the first three weeks of hospitalization. Carbohydrates were the main resource for parenteral nutrition. Although there was no difference of protein delivery, MUH had a significantly higher prescription of fat emulsion especially in the 1st-2nd weeks. Even though there were higher occurrences of intensive care unit (ICU) mortality, 28-day mortality, sepsis occurrence, ICU length of stay (LOS), and hospital LOS in RUH, the multivariable analysis did not demonstrate the statistical value of these outcomes.*

Conclusion: *RUH had a poorer nutritional status. MUH had more total caloric intake and enteral nutrition delivery per day especially during the first three weeks. However, the treatment outcomes showed no differences in multivariable analysis.*

Keywords: *Surgical ICUs, Nutrition status, Nutrition delivery, Nutrition outcomes*

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Nutrition management is an important aspect in the intensive care unit (ICU). Currently, there is still much controversy regarding the route, amount of energy target, nutrient compositions, route of nutrient delivery, and timing of starting the nutrients. Although enteral nutrition (EN) was promoted and has had enhanced utilization in ICUs during the last decade, some limitations and patient characteristics were different in each ICU. Also, early enteral nutrition might be difficult to initiate in some surgical settings of critically ill patients. In addition, the ICU system and density of ICU staffing might result in different nutrition management and treatment outcomes. The previous report of the Thai RESOURCE I survey found that the outcome indicators of crude mortality and ICU length of hospital stay (LOS) were impacted by the ICU characteristics and staff density in the ICU(1). In addition, there were several aspects of differences between metropolis and regional hospitals in Thailand such as higher density of staff in metropolis hospitals, numbers of trainees and rotations, and the different life styles of patients which led to non-similar nutrition status(1-3). Therefore, the objective of this study was to compare the differences of nutritional status, nutrition delivery, and the outcomes between the metropolis and regional university-based hospitals in Thailand.

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Material and Method

The database of THAI-SICU study were

retrieved. The details of the study methodology of THAI-SICU study were obtained as a reference[3]. This was a large multi-center Thai university-based surgical intensive care unit study with nine centers joining in the study. The summarized data extraction was demonstrated in Fig. 1. Regarding the nutrition records, the patients were enrolled from only three centers (Sites A and B located in Bangkok and site C located in Chiang Mai). The ethics committees of all study sites approved this study. The authors defined the centers located in Bangkok as Metropolis University based hospitals (MUH) and the center located in Chiang Mai was a regional university-based hospital (RUH). A total of 563/2,249 patients were excluded from this analysis due to limited records of nutrition, very short stays, non-survival within 24 hours after ICU admission, or missing data. The geographic data of age, sex, body weight, height, body mass index (BMI), diagnosis categories, and APACHE II score were recorded at ICU admission. Data of nutrition status, nutrition provision during ICU admission within 28 days were recorded utilizing two nutrition assessment tools, the subjective global assessment (SGA) and the nutrition risk screening (NRS)[4,5]. Regarding the enteral nutrition (EN), the caloric intake was recorded in kilocalories. These calculations were not separated into their composition of carbohydrate, fat, and protein. On the other hand, the macronutrient components of the parenteral nutrition (PN) were recorded. The commercial PN formula compositions were calculated by their ingredient label. The total caloric intake was the sum of both the EN and PN on the individual day. The outcomes of ICU mortality, 28-day mortality, sepsis occurrence after admission, ICU length of stay (LOS), and hospital LOS were used for comparison between groups.

Regarding statistical analysis, STATA version 12.0 (STATA Inc., College Station, TX) was used in these analysis. The categorized data were reported as percent and compared by Chi-square. The continuous data were reported as median (interquartile range, IQR) and mean (standard deviation, SD) and the comparison between groups of continuous data were performed by t-test and Mann-Whiney U test on parametric and non-parametric distribution, respectively. The multivariable regression analysis of outcomes was performed by possible confounders of unbalanced baseline patient admission characters. All of the predictor variables on the regression model were tested for the multicollinearity association by variance inflation factors (VIF)[6,7]. The authors were concerned that there were multicollinearity associations between the nutrition assessment tools of SGA and NRS (VIF >3.0). Therefore, the authors separately analyzed them by multivariable analysis as model I using the SGA and model II using NRS on the model. The statistically significant differences between groups were defined as *p*-value <0.05.

Results

A total of 1686 patients with completion of nutrition status and nutrition delivery data were included in this analysis (MUH, 927 and RUH, 759) (Fig. 1). MUH were significantly higher on age ($p<0.001$), admission body weight ($p<0.001$), BMI (<0.001), and APACHE II score ($p<0.001$). The male gender was significantly predominant in RUH (MUH vs. RUH; 53.6 vs. 61.1%; $p = 0.002$). While a total of 330/759 (43.5%) in RUH were abdominal surgical patients, but only 263/927 (28.4%) in MUH were admitted in this diagnosis category. The albumin level was significantly lower in RUH ($p<0.001$). The nutrition status, SGA class A and no risk of NRS classification were significantly higher in MUH (MUH vs. RUH; SGA (A) 62.9 vs. 45.3%; $p<0.001$ and NRS (no risk) 61.6 vs. 43.7; $p<0.001$) (Table 1).

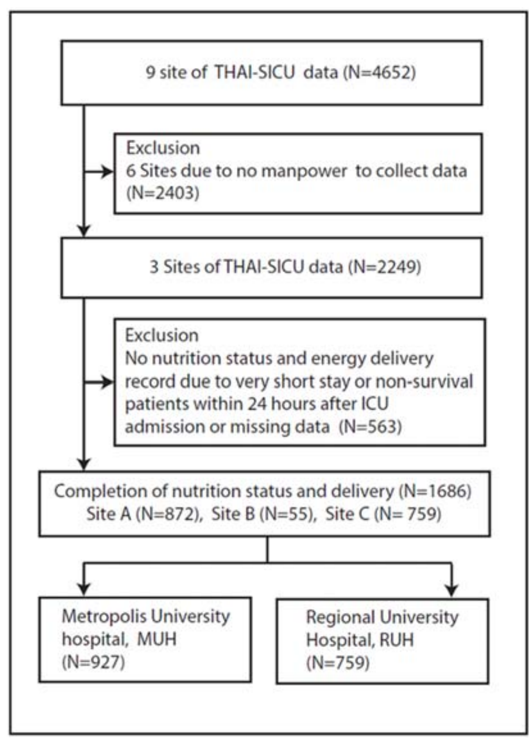

Fig. 1 Study flow of this study and analysis.

The caloric delivery during ICU stay demonstrated a total of MUH 3,669 days and RUH 4,084 days observed in ICU. Fig. 2 established the median and IQR after surgical ICU admission until the 28th day. Although there was a similar trend of overall caloric delivery between MUH and RUH, the EN and PN trend were different. The tendency of the median of EN was significantly higher in MUH especially after 2nd week. Table 2 demonstrated the energy delivery pattern between MUH and RUH. The total caloric intake of MUH was significantly higher than RUH except in the 4th week during ICU stay. These differences were a concomitant trend with higher EN delivery during the ICU stay in MUH. The first week of total caloric intake was lower than the later weeks. After the first week of admission, although the median of caloric intake in PN was decreased especially in the MUH (2nd, 3rd, and 4th week: 134, 57 and 0 kcal respectively), there were comparable results in the RUH (173, 161, and 167 kcal, respectively). Regarding the PN composition, carbohydrate was the main caloric intake on all observed days. The amino acid solution and fat emulsion was given in a lower proportion. The fat emulsion was prescribed significantly higher in MUH especially in the first two weeks (Table 2).

On Table 3, although there were higher occurrences of ICU mortality, 28-day mortality, and new sepsis occurrence as well as longer ICU and hospital LOS in RUH, the multivariable analyses did not demonstrate significant differences between groups after adjustment of the possible confounders of unbalanced patient characteristics of age, sex, BMI,

Table 1. Patient characteristics

Variables	MUH (n = 927)	RUH (n = 759)	*p*-value
Age (IQR)	67 (54-77)	62 (51-74)	<0.001
Male (%)	496 (53.62)	463 (61.08)	0.002
Body weight, kg, (IQR)	60 (51-70)	54 (47-64)	<0.001
Height, cm, median (IQR)	160 (155-165)	160 (153-165)	0.208
BMI, kg/m^2 (IQR)	23.4 (20.7-26.5)	21.2 (18.7-24.2)	<0.001
Diagnosis (%)			
Cardiovascular	170 (18.34)	131 (17.28)	<0.001
Respiratory	105 (11.33)	112 (14.78)	
Abdominal (GI-HBP)	263 (28.37)	330 (43.54)	
Head and neck	55 (5.93)	4 (0.53)	
Sepsis	20 (2.16)	19 (2.51)	
Trauma	34 (3.67)	57 (7.52)	
Metabolic	31 (3.34)	6 (0.79)	
Hematological	1 (0.11)	0 (0.00)	
Renal and urology	70 (7.55)	69 (9.10)	
Obstetrics and gynecology	52 (5.61)	4 (0.53)	
Musculoskeletal	91 (9.82)	24 (3.17)	
Others	35 (3.78)	2 (0.26)	
APACHE II score, median (IQR)	9 (6-14)	15 (11-20)	<0.001
Albumin at admission, g/dL, median (IQR)	3 (2.4-3.6)	2.5 (2-3.2)	<0.001
Nutrition status (%)			
Subjective global assessment (SGA)			
Class A	583 (62.89)	344 (45.32)	<0.001
Class B	249 (26.86)	264 (34.78)	
Class C	95 (10.25)	151 (19.89)	
Nutrition risk screening (NRS)			
No risk	571 (61.60)	332 (43.74)	<0.001
At risk	356 (38.40)	427 (56.29)	

MUH = metropolises located university based hospital; RUH = regional located university based hospital; IQR = interquartile range; GI-HBP = gastrointestinal and hepato-biliary-pancreas diseases; APACHE II = acute physiologic and chronic health evaluation II score

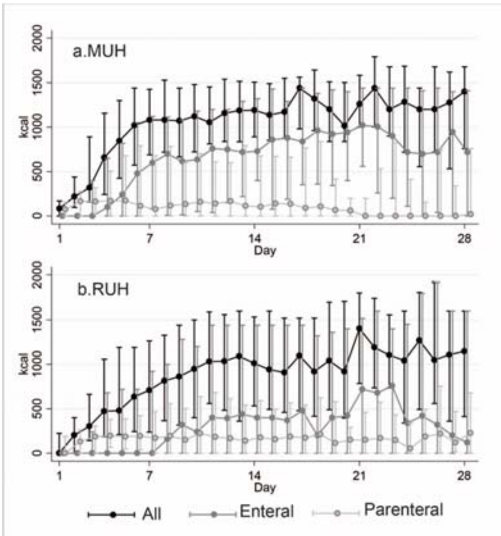

Fig. 2 Caloric delivery between (a) MUH and (b) RUH divided by enteral, parenteral, and all caloric intake during ICU stay within 28 days of admission.

diagnostic categories, admission APACHE II score, and albumin level. The models were separately demonstrated by nutritional status categories with SGA or NRS due to the multicollinearity of variables. There were no statistically significant differences between MUH and RUH in terms of ICU mortality, 28-day mortality, and new sepsis occurrence as well as longer ICU and hospital LOS (p>0.05) (Table 3).

Discussion

This study is a first report on the variation of nutrition status and delivery in surgical ICU comparison between hospitals divided by their locations in Thailand. In regards to patient characteristics, MUH had significantly higher age, proportion of females, and BMI. In addition, the nutrition status in MUH was classified as higher proportion in well-nourished or no nutrition risk than RUH by SGA and NRS. These might reflect the differences of lifestyle, nutritional intake and activity in various parts of the

Table 2. Energy delivery pattern (per day) between MUH and RUH

Median of calories (IQR)	MUH	RUH	*p*-value
First week analysis day	*n day = 2,557*	*n day = 2,574*	
All calories	228 (72-770)	244 (0-640)	0.009
Enteral	0 (0-240)	0 (0-100)	<0.001
Parenteral	115 (0-252)	136 (0-288)	0.901
Carbohydrate	109 (0-244)	129 (0-272)	0.867
Protein	0 (0-0)	0 (0-0)	0.256
Fat	0 (0-100)	0 (0-50)	<0.001
Second week analysis day	*n day = 636*	*n day = 827*	
All calories	1,102 (765-1,487)	954 (436-1,480)	<0.001
Enteral	720 (120-1,200)	300 (0-1,300)	<0.001
Parenteral	134 (0-676)	173 (0-591)	0.324
Carbohydrate	98 (0-402)	153 (0-345)	0.095
Protein	0 (0-100)	0 (0-126)	0.328
Fat	0 (0-128)	0 (0-0)	<0.001
Third week analysis day	*n day = 294*	*n day = 460*	
All calories	1,215 (900-1548)	986 (469-1,600)	<0.001
Enteral	940 (300-1,400)	400 (0-1,440)	<0.001
Parenteral	57 (0-583)	161 (0-524)	0.068
Carbohydrate	0 (0-341)	136 (0-308)	0.014
Protein	0 (0-100)	0 (0-100)	0.495
Fat	0 (0-0)	0 (0-0)	0.061
Forth week analysis day	*n day = 182*	*n day = 223*	
All calories	1,200 (720-1,680)	1,133 (556-1,617)	0.432
Enteral	840 (110-1,440)	530 (0-1,600)	0.234
Parenteral	0 (0-362)	167 (0-528)	0.002
Carbohydrate	0 (0-268)	143 (0-312)	0.004
Protein	0 (0-43)	0 (0-100)	0.339
Fat	0 (0-0)	0 (0-0)	0.434

Table 3. Outcomes comparison and multivariable analysis comparison of RUH with MUH

Outcomes	MUH	RUH	Adjusted value	Model*	Value*	95% CI	*p*-value
ICU mortality (%)	64 (6.9)	107 (14.1)	OR	I (SGA)	1.07	0.65 to 1.76	0.801
				II (NRS)	1.07	0.66 to 1.73	0.792
28 day mortality (%)	81 (8.7)	147 (19.4)	OR	I (SGA)	1.29	0.83 to 2.00	0.253
				II (NRS)	1.27	0.84 to 1.93	0.261
Sepsis occurrence (%)	216 (23.3)	263 (34.7)	OR	I (SGA)	0.79	0.57 to 1.08	0.139
				II (NRS)	0.83	0.61 to 1.13	0.242
ICU LOS (IQR)	2 (1-4)	3 (2-6)	Coeff.	I (SGA)	0.46	-0.36 to 1.27	0.275
				II (NRS)	0.50	-0.33 to 1.33	0.869
Hospital LOS (IQR)	13 (8-22)	17 (10-28)	Coeff.	I (SGA)	1.48	-1.31 to 4.27	0.298
				II (NRS)	2.25	-0.45 to 4.95	0.103

* Multivariable analysis were adjusted by age, sex, body mass index, diagnosis, admission APACHE II score, admission albumin level, and subjective global assessment (Model I) or nutrition risk screening (Model II)
Coeff = coefficient value; CI = confidence interval; ICU = intensive care unit; IQR = interquartile range; LOS = length of stay in day; MUH = metropolis located university based hospital; OR = odds ratio; RUH = regional located university based hospital

country which are affected by urbanization[8]. While the surgical ICU in RUH had a higher proportion of abdominal and trauma patients, the MUH had a higher proportion of head and neck surgery, obstetrics and gynecological patients, and musculoskeletal surgical patients. The cause of these findings might have occurred from different of admission policies, the referral system, and local health problems. These differences led to the variations in nutrition delivery for the ICU.

The EN slowly increased during the first week after ICU admission in both MUH and RUH. However, while MUH continued to increase EN, the rate of EN had a slower increase in the RUH. These findings might be explained due to RUH having a higher proportion of abdominal surgical patients and trauma patients. The abdominal surgical patients had a higher risk of bowel ileus, abdominal distention, and gastro-intestinal paresis[9]. The occurrence on one cross-sectional study was nearly 40% of surgical ICU patients having unsuccessful gastric enteral feedings[10]. In addition, the RUH had a significantly higher severity score of APACHE II score and low albumin level. These might aggravate bowel dysfunction, higher use of sedation or inotropic agents resulting in the delay of EN in RUH[11,12].

Although the European Society of Enteral and Parenteral Nutrition (ESPEN) recommended the PN should be started early if the patient is not expected to be on a normal diet within three days or they cannot tolerate EN[13]; PN was used in a small proportion in this study especially for the MUH. The reason of these findings might be a higher proportion of EN delivery in MUH. Regarding the PN composition, the energy delivery source of PN was primarily carbohydrates. The lipid emulsion was used more in MUH. This might have occurred due to the difference of re-imbursement policy of PN in each hospital where the patient had to pay for some kind of PN in RUH during the study period.

Although the caloric deficit may produce worse outcomes in ICU[14], the total caloric intake per day in RUH was significantly lower than MUH in the first three weeks. However, these effects might be confounded by the differences in patient characteristics as previously mentioned. In addition, an accurate measurement of caloric deficit might be assessed by the indirect calorimetry which was not performed in this study.

Although the VIF in multivariable regression analysis of more than ten is a common rule of thumb for determining the multicollinearity association between predictors in regression model, Allison proposed that a more conservative estimate of these associations might be of concern when the VIF is more than 2.5[6,7]. The multiple regression models were analyzed by separating nutrition assessment parameters as model I and II based on the suggestion of Allison[6]. In addition, SGA and NRS had a common intersection of variables in their assessment. The separation of models led to more clarification on the association values.

The strength of this study was its large multicenter cohort feature. This was a pioneer report that compared and demonstrated the differences of nutrition status and energy pattern in Thai surgical ICUs. However, there were some inevitable limitations in this study. First, the energy delivery patterns were not followed after ICU discharge. Second, there was a wide variation of the EN compositions. The individual proportion of composition of protein, carbohydrates and fats were not calculated in this study. Therefore, the association of outcomes and nutrient composition could not be concluded from this study.

Conclusion

RUH patients had a poorer nutrition status than MUH patients. MUH had more total caloric intake and enteral nutrition delivery per day especially during the first three weeks. The treatment outcomes were, however, not different on multivariable analysis.

What is already known on this topic?

There were no previous reports on the situation of nutrition status and energy delivery in surgical ICUs as well as their outcomes comparing between the different settings of university based SICUs in Thailand.

What this study adds?

The study demonstrated the difference between regional and metropolitan hospitals in terms of nutrition status and energy delivery. However, there were no differences in the outcomes in the multivariable regression model.

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Potential conflicts of interest

None.

References

1. Chittawatanarat K, Sataworn D, Thongchai C. Effects of ICU characters, human resources and workload to outcome indicators in Thai ICUs: the results of ICU-RESOURCE I study. J Med Assoc Thai 2014; 97 (Suppl 1): S22-30.
2. Chittawatanarat K, Bhurayanontachai R, Thongchai C. Characters of physician and nurse staffing in Thai intensive care units (ICU-Resource I study). J Med Assoc Thai 2014; 97 (Suppl 1): S38-44.
3. Chittawatanarat K, Chaiwat O, Morakul S, Pipanmekaporn T, Thawitsri T, Wacharasint P, et al. A multi-center Thai university-based surgical intensive care units study (THAI-SICU study): methodology and ICU characteristics. J Med Assoc Thai 2014; 97 (Suppl 1): S45-54.
4. Kondrup J, Allison SP, Elia M, Vellas B, Plauth M. ESPEN guidelines for nutrition screening 2002. Clin Nutr 2003; 22: 415-21.
5. Detsky AS, McLaughlin JR, Baker JP, Johnston N, Whittaker S, Mendelson RA, et al. What is subjective global assessment of nutritional status? JPEN J Parenter Enteral Nutr 1987; 11: 8-13.
6. Allison PD. Multiple regression: a primer. Thousand Oaks, CA: Pine Forge Press; 1999.
7. O'Brien RM. A caution regarding rules of thumb for variance inflation factors. Quality and Quantity 2007; 41: 673-90.
8. Popkin BM. Urbanization, Lifestyle Changes and the Nutrition Transition. World Dev 1999; 27: 1905-16.
9. Caddell KA, Martindale R, McClave SA, Miller K. Can the intestinal dysmotility of critical illness be differentiated from postoperative ileus? Curr Gastroenterol Rep 2011; 13: 358-67.
10. Chittawatanarat K, Sathornviriyapong S, Polbhakdee Y. Gradual sucrose gastric loading test: A method for the prediction of nonsuccess gastric enteral feeding in critically ill surgical patients. Indian J Crit Care Med 2015; 19: 92-8.
11. Spain DA. When is the seriously ill patient ready to be fed? JPEN J Parenter Enteral Nutr 2002; 26: S62-8.
12. Lohsiriwat V, Chinswangwatanakul V, Lohsiriwat S, Akaraviputh T, Boonnuch W, Methasade A, et al. Hypoalbuminemia is a predictor of delayed postoperative bowel function and poor surgical outcomes in right-sided colon cancer patients. Asia Pac J Clin Nutr 2007; 16: 213-7.
13. Singer P, Berger MM, Van den BG, Biolo G, Calder P, Forbes A, et al. ESPEN Guidelines on Parenteral Nutrition: intensive care. Clin Nutr 2009;

28: 387-400.
14. Villet S, Chiolero RL, Bollmann MD, Revelly JP, Cayeux RNM, Delarue J, et al. Negative impact of hypocaloric feeding and energy balance on clinical outcome in ICU patients. Clin Nutr 2005; 24: 502-9.

ความแตกต่างระหว่างสถานะทางโภชนาการ การได้รับพลังงาน และผลของการรักษาระหว่างหออภิบาลผู้ป่วยหนักศัลยกรรมในโรงพยาบาลมหาวิทยาลัยในนครหลวงและส่วนภูมิภาค

กวีศักดิ์ จิตตวัฒนรัตน์, อรอุมา ชัยวัฒน์, สัณฐิติ โมรากุล, สุณีรัตน์ คงเสรีพงศ์

วัตถุประสงค์: *เปรียบเทียบสถานะทางโภชนาการ การได้รับพลังงาน และผลของการรักษาระหว่างหออภิบาลผู้ป่วยหนักศัลยกรรมในโรงพยาบาลมหาวิทยาลัยในนครหลวงและส่วนภูมิภาค*

วัสดุและวิธีการ: *ข้อมูลของการศึกษานำมาจากฐานข้อมูล THAI-SICU ผู้ป่วยจำนวน 1,686 คน (นครหลวง 927 คน และส่วนภูมิภาค 759 คน) ที่มีการบันทึกสถานะทางโภชนาการ และการได้รับพลังงานอย่างสมบูรณ์ โดยโรงพยาบาลที่ตั้งในกรุงเทพมหานครจัดในกลุ่มนครหลวง (MUH) และโรงพยาบาลที่ตั้งในเชียงใหม่จัดในกลุ่มส่วนภูมิภาค (RUH) ประเมินภาวะโภชนาการโดยใช้แบบประเมินของ SGA และ NRS ผลการรักษาทำการวิเคราะห์หาความสัมพันธ์โดยแบบจำลองพหุถดถอย*

ผลการศึกษา: *เมื่อผู้ป่วยเข้ารับการรักษาในหออภิบาล มีความแตกต่างของอายุ เพศ ดัชนีมวลกาย ความรุนแรงของโรค ระดับอัลบูมินในเลือด และการวินิจฉัยระหว่าง MUH และ RUH. ผู้ป่วย RUH มีสถานะทางโภชนาการแย่กว่า MUH อย่างมีนัยสำคัญ (RUH และ MUH: SGA ระดับ B และ C, ร้อยละ 57.7 และ ร้อยละ 37.1, $p<0.001$; NRS, ร้อยละ 56.3 และ ร้อยละ 38.4, $p<0.001$) แนวโน้มของพลังงานที่ได้รับทั้งหมดและอาหารที่ผ่านทางเดินอาหารต่อวันใน RUH มีระดับต่ำกว่า MUH อย่างมีนัยสำคัญโดยเฉพาะใน 3 สัปดาห์แรก เกี่ยวกับการให้อาหารผ่านหลอดเลือดดำ คาร์โบไฮเดรตเป็นพลังงานหลัก แม้ว่าจะไม่มีความแตกต่างของโปรตีนที่ให้กับผู้ป่วย MUH มีการสั่งจ่ายไขมันทางหลอดเลือดดำมากกว่าอย่างมีนัยสำคัญโดยเฉพาะใน 2 สัปดาห์แรก เกี่ยวกับผลการรักษาแม้ว่าจะมีอัตราการเสียชีวิตในหออภิบาล อัตราการเสียชีวิตที่ 28 วัน การเกิดภาวะพิษติดเชื้อ ระยะเวลานอนในหออภิบาลและโรงพยาบาลจะสูงกว่าใน RUH แบบจำลองแบบพหุถดถอยไม่พบความแตกต่างอย่างมีนัยสำคัญในผลการรักษาดังกล่าว*

สรุป: *RUH มีภาวะทางโภชนาการที่แย่กว่า MUH ได้รับพลังงานและอาหารผ่านทางเดินอาหารต่อวันสูงกว่าโดยเฉพาะใน 3 สัปดาห์แรก อย่างไรก็ตาม ผลการรักษาไม่มีความแตกต่างในแบบจำลองแบบพหุถดถอย*