Prevalence of Hospital Malnutrition at Admission and Outcomes in Pediatric Patients

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Abstract: *Background*: Hospitalized children are at risk of malnutrition and vulnerable for many adverse outcomes.

Objectives: This study aimed to determine the prevalence of hospital malnutrition in pediatric patients admitted at Chiang Mai University (CMU) hospital and evaluate correlation between malnutrition and outcomes including length of hospital stay (LOS), total hospital cost and mortality.

Methods and Study Design: A prospective cohort study was conducted at CMU hospital. Patients aged 1 month to 15 year-old who admitted to general pediatric wards were included. Demographic data, anthropometric assessments including weight, length/height and outcomes were collected. Malnutrition was classified by the WHO growth reference.

Results: A total of 217 patients with mean age 68.8 ± 53.8 month-old were analyzed. Majority of them were male (65.4%) while leading diagnosis were oncologic, infectious and congenital heart diseases. The prevalence of all malnutrition was 59.9%. According to the WHO classification, percentages of the patients who were stunted, wasted, both of stunted and wasted, and overweight were 29.9%, 9.2%, 17.1%, and 3.7%, respectively. Moreover, compared to previous study of this center in 1985, more than half of hospitalized children have still assessed as under-malnourished patients. For the hospital outcomes, wasting regardless of stunting had significantly longer LOS (8 vs 5 days, p = 0.001) and higher hospital expenditure (37,283.0 vs 23,630.0 Baht, p = 0.004) while mortality was not different.

Conclusions: The prevalence of malnutrition in hospitalized children is common and remains unchanged. Acute malnutrition significantly impact on total hospital cost and prolong LOS comparing with other groups.

Keywords: Undernutrition, Malnutrition, Hospitalized children, Hospital outcomes, Hospital cost.

INTRODUCTION

In 2015, 1 in 7 children were estimated to be underweight in less developed regions. Regarding to Global Health Observatory data 2015, the prevalence of wasting, stunting and overweight in under-five children are 7.4%, 23%, and 6.2%, respectively. However, the overall rates of childhood malnutrition especially, under-nutrition have been declining over several decades after policies for prevention and treatment of childhood malnutrition have been established by WHO, United Nation (UN) and their partners [1].

Hospital malnutrition is one aspect of childhood malnutrition that might be unrecognized by healthcare professionals [2] despite the prevalence in regardless of the country's income level is common [3]. Recently, a large multi-centers studies conducted in14 tertiary centers of 12 European countries reported the overall malnutrition is 13.4% which is less than one-third of the malnourished children received nutritional support during their hospitalization [4]. Acute and chronic diseases directly impact to the nutritional status by decreasing an appetite, poor dietary intake and hyper-catabolic state while the nutritional status also influences the deterioration of illness as well.

In accordance with outcomes of the hospital malnutrition, adult studies largely documented that it associated with detrimental outcomes and also increase health care costs [5]. Likewise, the hospital malnutrition in pediatric patients associated with longer length of hospital stay [4, 6-8], risk of hospital complication [8], increase mortality [9], and significantly impact on quality of life in patients themselves and their family [10].

In Thailand, there are only two studies which were published in 1985 and 1995. Both studies were performed at Chiang Mai University Hospital by Tienboon P [11, 12]. The overall rates of malnutrition in hospitalized children aged 1-15 year-old were up to 50% in terms of both acute and chronic malnutrition and had been unchanged over a decade. In addition, the stunted, wasted, as well as both of stunted and wasted patients were reported approximately 36.5%, 11% and 9%, respectively [11].

This study principally aimed to assess the nutritional status of the patients at admission and to determine the prevalence of malnutrition in terms of both under- and

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over-nutrition as well as the baseline factors contributed to malnutrition. The secondary objective was to evaluate the association between malnutrition and outcomes such as length of hospital stay (LOS), total hospital cost and mortality.

MATERIAL AND METHODS

Study Design and Participants

A prospective cohort study was performed at Chiang Mai University Hospital, a tertiary hospital in northern Thailand. Pediatric patients aged from 1 month-old to15 year-old who were hospitalized in general pediatric wards were included. The data had been collected from June to September 2015. The exclusion criteria consist of the patients who stayed in hospital less than 24 hours and critically-ill patients. Regarding to re-admitted patients, the overall data were analyzed separately in each admission as a new patient. This study was approved by the Ethics committee of the Faculty of Medicine, Chiang Mai University.

Demographic Data and Anthropometric Assessment

Demographic data including age, gender, nationality, reason for hospitalization and underlying disease were collected from medical records while anthropometric assessment such as weight, recumbent length (for children less than 2 year-old) or standing height (for children equal and more than 2 year-old), and mid-upper arm circumference (MUAC) were measured on admission date by using the similar type of weighing scale and standard tools.

In addition, weight for age z-score (WAZ), weight for length/height z-score (WHZ), height for age z-score (HAZ) and body mass index z-score (BMIZ) were calculated by using WHO software; “WHO Anthro” (version 3.2.2 January 2011) and “WHO AnthroPlus” (version 2009).

Malnutrition was defined regarding to the WHO cut-off values; acute malnutrition (wasting) were defined if WHZ (patients aged ≤ 60 month-old) or BMIZ (patients aged > 60 month-old) less than -2 standard deviation scores (SDS) while chronic malnutrition (stunting) is suggested if HAZ less than -2 SDS [6]. Furthermore, the hospital outcomes including mortality, length of hospital stay (LOS) and total hospital expenditures were analyzed when the patients were discharged from the hospital.

Statistical Analysis

The sample size was calculated by using an infinite population proportion formula. According to the recent reports [4], the prevalence of malnutrition was 13.4% and the degree of precision was 5%. Therefore at least 179 participants would be recruited to the study.

Statistical analysis was performed by using the IBM SPSS Statistics program (version 15.0; SPSS Inc., Chicago, IL, USA). Descriptive statistics were used to describe the study population, with continuous outcomes summarized as mean ± SD or median (range) depended on data distribution while categorical outcomes presented as a percentage. All variables were tested for normal distribution using Kolmogorov–Smirnov test. Chi-square or Fisher’s exact test were used for comparing qualitative data while the quantitative data were compared by using an appropriated tool. A p-value of less than 0.05 was considered as statistical significance.

RESULTS

Demographic Data and the Prevalence of Malnutrition

A total of 217 pediatric patients were included for analysis. Majority of them were male with average age 68.8 ± 53.8 month-old. Almost of the patients were Thai while only 12% were non-Thai (i.e., Hill-tribal, Burmese or others). According to reason for admission, oncologic disease was the most common cause followed by infectious disease and cardiovascular disease. The overall prevalence of malnutrition in terms of stunting, wasting, both of stunting and wasting and overweight were 29.9%, 9.2%, 17.1% and 3.7%, respectively. All hospital outcomes including LOS, total hospital cost and mortality were presented in Table **1**.

Nevertheless, when the patients were classified by nutritional status, the result showed mean age was higher significantly in overweight patients whereas gender, nationality and disease category were not different among all groups. According to the hospital outcomes, the present study found significant differences in LOS and total hospital cost. The wasted patients regardless of stunting seem to have longer LOS and higher hospital expense when compared with other groups. On the other hand, the mortality was not different which was reported only 1.1% in well-nourished patients (Table **2**).

Table 1: Demographic Data and Outcomes of all Pediatric Patients

Data	All patients (n = 217)
Age (months), mean ± SD	68.68 ± 53.80
Gender, male number (%)	142 (65.4)
Nationality, Thai number (%)	191 (88.0)
Disease category for admission, number (%)	
Oncology	64 (29.5)
Infectious disease	49 (22.6)
Cardiology	39 (18.0)
Neurology	17 (7.8)
Endocrinology	14 (6.5)
Nephrology	11 (5.1)
Gastroenterology	10 (4.6)
Others	13 (6.0)
Nutritional status, number (%)	
Normal	87 (40.1)
Stunting	65 (29.9)
Wasting	20 (9.2)
Both of stunting and wasting	37 (17.1)
Overweight	8 (3.7)
LOS (days), median (range)	6 (2-10)
Total hospital cost (Baht), median (range)	25,786.0 (12,522.0 – 52,376.0)
Mortality, number (%)	1 (0.5)

Table 2: Comparison of Demographic Data and Outcomes among Different Nutritional Status

Parameters	Normal (n=87)	Stunting (n=65)	Wasting (n=20)	Stunting & wasting (n=37)	Overweight (n=8)	*p*-value
Age (months), mean ± SD	51.7 ± 45.8	74.8 ± 54.0	73.8 ± 61.2	79.0 ± 54.0	142.4 ± 29.6	<0.01[§]
Gender, male number (%)	61 (70.1)	41 (63.1)	11 (55.0)	22 (59.5)	7 (87.5)	0.37[¶]
Nationality, Thai number (%)	81 (93.1)	55 (84.6)	16 (80.0)	31 (83.8)	8 (100.0)	0.15[¶]
Disease category for admission, number(%)						0.05[¶]
Oncology	22 (25.3)	21 (32.3)	7 (35.0)	11 (29.7)	3 (37.5)	
Infectious disease	24 (27.6)	9 (13.8)	7 (35.0)	7 (18.9)	2 (25.0)	
Cardiology	10 (11.5)	14 (21.5)	3 (15.0)	12 (32.4)	0	
Neurology	8 (9.2)	8 (12.3)	1 (5.0)	0	0	
Endocrinology	3 (3.4)	8 (12.3)	0	2 (5.4)	1 (12.5)	
Nephrology	6 (6.9)	1 (1.5)	1 (5.0)	1 (2.7)	2 (25.0)	
Gastroenterology	5 (5.7)	2 (3.1)	1(5.0)	2 (5.4)	0	
Others	9 (10.3)	2 (3.1)	0	2 (5.4)	0	
LOS (days), median (range)	5 (1-82)	5 (1–57)	10.5 (1-35)	7 (1-45)	6 (1-42)	0.01[†]
Total hospital cost (Baht), median (range)	19,823.0 (2,569.0 – 626,376.0)	25,246.0 (4,568.0 – 274,590.0)	44,728.5 (3,173.0 – 193,886.0)	33,086.0 (3,643.0 – 772,438.0)	26,289.5 (3,771.0 – 264,006.0)	0.03[†]
Mortality, number (%)	1 (1.1)	0	0	0	0	0.77[¶]

[§]One way ANOVA; [¶]Chi-square or Fischer's exact test; [†]Kruakal-Wallis H test.

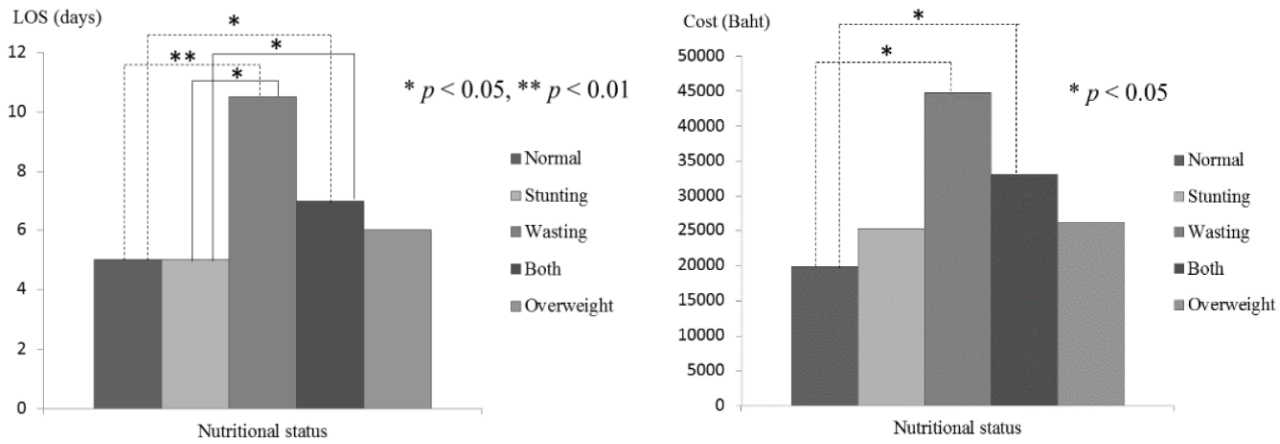

Figure 1: Comparing median of the LOS and the total hospital cost in each nutritional status.

Focusing on the hospital outcomes, the median LOS was significantly longer in wasted patients (with or without stunting) compared to well-nourish and stunted patients. In addition, the median LOS was double in wasted patients (10.5 vs 5 days, $p < 0.01$) while prolong approximately 40% in both of wasting and stunting group compared with well-nourished group (7 vs 5 days, $p < 0.05$). Moreover, the total hospital cost was also higher significantly in the wasted patients without regard to stunting compared to normal group (Figure **1**).

Noticeably, when those patients were divided into wasting and non-wasting group, the LOS and total hospital cost had still significantly increased in wasted patients whereas the baseline characteristics includes of age, gender, nationality and disease category were not different (Table **3**).

After adjusted confounding factors by multivariate binary logistic analysis (Table **4**), the nutritional status was the only factor which significantly effected on longer LOS and higher total hospital expenditure than median value of all patients (95% CI, 1.03-1.65 and 1.13-1.85, respectively).

DISCUSSION

Principally, the present study also highlighted the prevalence of pre-existing malnutrition at admission

Table 3: Comparison between Non-Wasting and Wasting Group

Parameters	Non-Wasting (n=160)	Wasting (n=57)	*p-value*
Age (months), mean ± SD	65.7 ± 52.8	77.2 ± 56.1	0.17[§]
Gender, male number (%)	109 (68.1)	33 (57.9)	0.16[¶]
Nationality, Thai number (%)	144 (90.0)	47 (82.5)	0.13[¶]
Disease category for admission, number (%)			
Cardiology	24 (15.0)	15 (26.3)	
Endocrinology	12 (7.5)	2 (3.5)	
Gastroenterology	7 (4.4)	3 (5.3)	
Infectious disease	35 (21.9)	14 (24.6)	0.24[¶]
Nephrology	9 (5.6)	2 (3.5)	
Neurology	16 (10.0)	1 (1.7)	
Oncology	46 (28.8)	18 (31.6)	
Others	11 (6.8)	2 (3.5)	
Length of hospital stay (days), median (range)	5 (1-82)	8 (1-45)	0.001[†]
Total hospital cost (Baht), median (range)	23,630.0 (2,569.0-626,000.0)	37,283.0 (3,173-772.0,000.0)	0.004[†]
Mortality, number (%)	1 (0.6)	0	0.55[¶]

[§]One way ANOVA; [¶]Chi-square or Fischer's exact test; [†]Kruakal-Wallis H test.

Table 4: Multivariate Analysis of LOS and Total Hospital Cost

Factors	LOS more than 7 days	Cost more than 26,000 Baht
Age	0.99 (95% CI, 0.99-1.00)	1.00 (95% CI, 0.99-1.00)
Gender	1.27 (95% CI, 0.70-2.29)	1.52 (95% CI, 0.84-2.75)
Nationality	2.14 (95% CI, 0.89-5.15)	2.01 (95% CI, 0.80-5.06)
Category of diseases	1.09 (95% CI, 0.96-1.23)	0.99 (95% CI, 0.88-1.12)
Nutritional status	1.30 (95% CI, 1.03-1.65)	1.45 (95% CI, 1.13-1.85)

and confirmed its drawbacks in hospitalized pediatric patients. The overall prevalence was nearly two-third while almost of them was classified as under-nourished patients in terms of stunting, wasting, and both of stunting and wasting. Refer to the hospital outcomes, only acute malnutrition was strongly impact on LOS and total hospital cost while stunting and overweight patients were unaffected on the outcomes. In addition, the nutritional status was single factor associated with longer median LOS and higher median total hospital cost with regardless of age, gender, nationality and disease category.

The prevalence of hospital malnutrition in pediatric patients is largely reported in several regions in both developed and developing countries. However, the details including classification of malnutrition, the reference of growth standard being assessed, an appropriated tool for anthropometric measurement and hospital setting were different. Therefore when compared to the studies using the WHO criteria similar to the present study, the prevalence of acute malnutrition in developed and developing countries are 2.5-20% [4, 13-17] and 10.1-19% [3, 8, 18-22] while chronic malnutrition are reported as 6.5- 7% [13-14, 16] and 13-30% [3, 8, 18-22], respectively. Interestingly, there are only high income countries report the prevalence of overweight and obesity which the percentage is around 10% of all hospitalized children [13-14, 16].

In Thai context, general population regards of Thai national survey operated by National Health Examination Survey Office (NHESO) [23] the prevalence of stunting, wasting, and overweight in children aged 1-14 year-old were 13%, 10.6%, and 27.6%, respectively. On the other hand, the present study reported the different results which the proportion of stunting, wasting, both of wasting and stunting as well as overweight in hospitalized children were 29.9%, 9.2%, 17.1% and 3.7%, respectively. This information indicates that under-nutrition has still more common than overweight in hospital setting.

Over three decades, the prevalence of hospital malnutrition has been unchanged at Chiang Mai University Hospital. In 1985 [11], the prevalence of under-malnutrition is 56.5% while it is 56.2% in this study. As the results show, the combined acute and chronic malnutrition was higher in the current study comparing to the previous data (17.1% vs 9%). Moreover, the prevalence of overweight was only evident in this study. Baxter, *et al.* [24] who conducted the cross-sectional study in the Hospital for Sick Children, Canada also found that the rates of malnutrition of children admitted to the tertiary children's hospital remain high. According to the evidence, it is doubtful why the prevalence of malnutrition has been steady conversely to an advancement of modern health care services.

In view of the hospital outcomes, the acute malnutrition significantly associated with the longer hospitalization and expensed for medical treatment more than others who were not acutely malnourished. Nevertheless, the present study did not found the association between chronic malnutrition and those outcomes. Recently, a large cohort study conducted in 12 European countries shows the similar outcomes, the median length of hospital stay being significantly longer in moderate to severely under-nourished pediatric patients [4]. Furthermore, after controlling some confounding factors, the nutritional status also remained significantly affected on the median LOS and total hospital cost. However, because of the mortality rate was quite low thus there was no difference among the nutritional status in the current study.

To our knowledge, the present study is one of few studies which compared the prevalence of hospital malnutrition with previous reports in the same center. This information does not only raise the issue of hospital malnutrition but also indicates that the health care providers might overlook this problem in general. However, some limitations such as lack of nutritional assessments during hospitalization and when the

patients were discharged and other hospital acquired complication were not collected. Moreover, because of the nature of cohort study, the causality between hospital malnutrition and the outcomes cannot confirmed until the nutritional intervention was performed in the further clinical trial.

In summary, the hospital malnutrition in terms of under-malnutrition is prevalent in children admitted into the tertiary hospital. Surprisingly, the percentage remains high despite several aspects of medical therapy were rapidly improved. In addition, the hospital stay and total hospital cost significantly relate to acutely malnourished patients while the effect of chronic malnutrition has not yet documented.

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CONFLICT OF INTEREST

All authors have no financial relationships relevant to this article to disclose.

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No funding was secured for this study.

ABBREVIATIONS

MUAC = mid-upper arm circumference

WAZ = weight for age z-score

WHZ = weight for length/ height z-score

HAZ = height for age z-score

BMIZ = body mass index z-score

SD = standard deviation

LOS = length of stay

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