MALNUTRTION IN DIARRHEA, MALARIA AND DENGUE AMONG CHILDREN IN THA SONG YANG, TAK, THAILAND

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ABSTRACT

We retrospectively investigated the association of malnutrition with diarrhea, malaria and dengue. Our study included 225 children, divided into 3 groups of 75 patients, who attended Tha Song Yang Hospital, Tak Province in Thailand before the end of December 2015. Six (8.0%), 0 and 6 (8.0%) were severe cases in diarrhea, malaria and dengue, respectively. Seven (9.3%), 11 (14.7%) and 9 (12.0%) cases in the diarrhea, malaria and dengue groups, respectively, had malnutrition [Cut-off points for BMI for thinners in children equivalent to children at 18 years old age with BMI 17 for patients aged ≥ 5 years old and weigh-for-age z score, weight-for-height z score or height-for-z score < -2 for patients aged < 5 years old]. Four (5.3%) diarrhea, 7 (9.3%) malaria and 0 dengue patients had severe malnutrition. There was no statistical difference in the prevalence of malnutrition between the 3 diseases. The prevalence of severe malnutrition was significantly highest in malaria. The prevalence of severe malnutrition was significantly higher in malaria compared to dengue in the patients aged < 5 years old in a subgroup analysis. In conclusion, severe malnutrition was associated with malaria for children aged < 5 years old. Studying malnutrition in Tha Song Yang may help solve the malnutrition problem in this rural area on Thai-Myanmar border.

KEY WORDS: MALNUTRITION/CHILDREN/DIARRHEA/MALARIA/DENGUE

50 pages

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LIST OF ABBREVIATIONS

Abbreviations	Terms
AC/A	Arm circumference for age
CRF	Case record form
DF	Dengue fever
DHF	Dengue hemorrhagic fever
DSS	Dengue shock syndrome
GCS	Glasgow coma scale
HA	Height-for-age
HAZ	Height-for-age z score
Hb	Hemoglobin concentration
Hct	Hematocrit
HIV	Human immunodeficiency virus
ID	Identification
IPD	Inpatient department
IQR	interquartile range
MoPH	Thai Ministry of Public Health
NCHS	National Centre for Health Statistics
OPD	Outpatient department
PHC	Primary Health Care
SD	Standard deviation
UNICEF	United Nations Children's Fund
UFI	Undifferentiated febrile illness
WA	Weight-for-age
WAZ	Weight-for-age z score
WHO	World Health Organization
WHZ	Weight-for-height z score

CHAPTER I
INTRODUCTION

The global problem on malnutrition is improving year by year, but malnutrition is still one of major problems especially in the tropical and sub-tropical developing countries. It is recognized that a child should take adequate nutrition to keep normal regulations of host defenses and to control risk of both acute and chronic diseases. Especially the undernutrition is well-known to be one of common causes of immunodeficiency.[1]

At present, infectious diseases are still account for more than 25% of global diseases. Some tropical diseases have been eliminated, but, diarrhea, malaria, and dengue still have high incidence.[2]

There are many studies showing how the nutritional status has impact on tropical diseases including diarrhea, malaria and dengue. Some studies showed undernutrition influenced severity of diarrhea.[3, 4] However conclusions on both malaria and dengue are still controversial.[5, 6]

Recognition of association between nutritional status and common diseases help us understand the significance of nutritional status on some specific diseases to improve the disease burdens. Tha song Yang district is in Tak province, the Thai-Myanmar border area. UNICEF report showed the prevalence of undernutrition under 5 year-old Thai-children was 9.2% in 2012. However the population covered by Tha Song Yang hospital comprise hill-tribes and refugees and it is much harder for patients to access health care facilities compared to other areas in Thailand so it is difficult to estimate the exact prevalence of malnutrition, which may be much higher than expected. The numbers of children with obesity is so small in this area. Therefore, in this study, we paid attention to only undernutrition and the term “malnutrition” is used interchangeably with “undernutrition”. We evaluated undernutrition in diarrhea, malaria, and dengue among children in Tha Song Yang hospital, a poor rural area on Thai-Myanmar border.

CHAPTER II
OBJECTIVES

The primary objective is to evaluate the prevalence of undernutrition in children who have diarrhea compared with children who have dengue at Tha Song Yang, Tak, Thailand.

The secondary objectives are to

1. evaluate the prevalence of undernutrition in children who have diarrhea compared with children who have malaria
2. evaluate the prevalence of undernutrition in children who have malaria compared with children who have dengue
3. assess association between nutritional status and severity of each disease.

CHAPTER III
REVIEW OF LITERATURE

3.1 Malnutrition

Malnutrition is one of major health problems all over the world. About 2 billion people suffer from micronutrient deficiency and nearly 800 million people suffer from calorie deficiency. Out of 667 million children under age of 5 worldwide, 159 million are too short for their age (stunted), 50 million do not weight enough for their height (wasted) and 41 million are overweight.[7] There is a close relationship between undernutrition and infections. People with undernutrition tend to be suffered from disease due to lower level of immunity. Additionally, infections reduce patient's appetite and absorption of foods but increase energy utilization and excretion, so patients may become undernourished. These result in a vicious cycle of infection and malnutrition.[8] Therefore, many programs have been implemented to improve the malnutrition.

3.2 Malnutrition in Thailand

Thailand is known as one of successful countries for improving nutritional program. Since 1982, the Primary Health Care (PHC) strategy helped increasing quality of health care even in rural areas so that the prevalence of malnutrition among mother, infants and children aged < 5 years old was declining significantly. The more nutritional status improvement, the more reduction in mortality and morbidity due to common infections such as diarrhea and respiratory problems was observed.[9] The trend of nutritional status in children aged < 5 years old in Thailand based on national representative surveys using NCHS growth reference or WHO growth standard is getting better year by year and prevalence of underweight children became under 10% in 2006.

Recently, not only undernutrition but also overweight and obesity are becoming important health issues in Thai children because of changing eating behaviors like western countries.[10] The UNICEF 2016 report showed the ranking of under-5 overweight prevalence in each country, which had an average prevalence of 10.9 %.[7]

Although the prevalence of undernutrition is reducing, it is still be a problem to be solved for development.

3.3 Diarrhea

Diarrhea is the second leading cause of death in children aged < 5 years old and around 760,000 children are killed every year. Children who are malnourished or have impaired immunity as well as people living with HIV are most at risk of life-threatening diarrhea.[11]

In developing countries, children aged < 3 years old experience on average three episodes of diarrhea every year. Episodes of diarrhea cause malnutrition and malnourished children are more likely to fall ill from diarrhea.[11]

For preventing diarrhea, it is important to improve the accessibility to safe drinking-water and sanitation, to wash hands with soap, to breastfeed exclusively for first six month of life, to have good personal and food hygiene, to provide health education about infection preventions and use rotavirus vaccine.[11]

3.4 Diarrhea in Thailand

In Thailand, diarrhea remains an important cause of morbidity and mortality among children. Even though the diarrhea-related mortality rate has decreased from 1.11 deaths/100,000 population in 1988 to 0.23 death/100,000 population in 2002, the diarrhea-related morbidity rate has remained stable (1488 and 1687 cases/100,000 population in 1993 and 2002, respectively).[12] The age group < 5 years old had the highest morbidity rate, 10,610 cases/100,000 population.

The morbidity rate of severe diarrhea was gradually decreasing from 18.96/100,000 population in 1994 to 0.22/100,000 population in 2003. The mortality

rate was reported to decrease from 0.25/100,000 population in 1994 to 0.01/100,000 population in 2003.[13]

At the Tha Song Yang hospital, the number of patients suffering from diarrhea visiting both OPD and IPD was about 1,600 cases per year (1884 cases in 2013, 1571 cases in 2014 and 1533 cases in 2015). The largest age group was 0-4 years old, which accounted for about 60%, followed by age group of 5-9 years old (8%) (unpublished data). As there are 8,500 children aged 0-4 years old in this area, the morbidity of diarrhea in the age group is about 11,000 cases/100,000 populations.

3.5 Impact of malnutrition on diarrhea

Many studies suggested that malnutrition influenced on severity of diarrhea.[14] However, the actual outcome in most of these studies was case fatality, not severity of dehydration. A study in rural Bangladesh showed that malnourished children had more severe diarrhea compared to well-nourished children.[15]

3.6 Malaria

Malaria is one of serious diseases and a major public health problem which caused death of many people over the world. There are five *Plasmodium* species infecting human (*P. falciparum*, *P. vivax*, *P. malariae*, *P. ovale* and *P. knowlesi*). *P. falciparum* is the major cause of severe malaria.[16, 17] Many programs for malaria elimination have been performed so far, and the incidence rate and mortality rate are decreasing year by year (Table 3.1).

Table 3.1 Estimated malaria incidence and death rate, by WHO region, 2000-2015[17]

	Estimated malaria incidence rate per 1000 at risk of malaria		Change	Estimated malaria death rate per 10,000 at risk of malaria		change
WHO region	2000	2015	2000-2015 (%)	2000	2015	2000-2015 (%)
African	427	246	-42	153	52	-66
Americas	40	9	-78	2.6	0.7	-72
Eastern Mediterranean	59	18	-70	9.3	3.3	-64
European	28	0	-100	0	0	-100
South-East Asia	44	23	-49	6.9	3.5	-49
Western Pacific	11	4	-65	2.4	0.9	-65
World	146	91	-37	47	19	-60

Similarly, the estimated number of malaria deaths in children aged < 5 years old are decreasing remarkably (Table 3.2). So, the leading cause of death among children aged < 5 in sub-Saharan Africa changed from malaria in 2000 to acute respiratory infectious diseases in 2015.

Table 3.2 Estimated number of malaria deaths in children aged under 5 years, by WHO region, 2015[17]

	Estimated number of malaria death in children aged under 5 years		Change	Estimated malaria death rate per 10,000 children aged under 5 years		Change
WHO region	2000	2015	2000-2015 (%)	2000	2015	2000-2015 (%)
African	694,000	292,000	-58	7.84	2.26	-71
Americas	400	100	-66	0.06	0.02	-64
Eastern Mediterranean	5,300	2,200	-58	0.44	0.14	-69
European	0	0		0	0	
South-East Asia	19,000	10,000	-49	0.22	0.11	-48
Western Pacific	4,700	1,500	-68	0.18	0.06	-69
World	723.000	306,000	-58	3.12	1.10	-65

3.7 Malaria in Thailand

Malaria incidence rate and mortality rate in Thailand are gradually decreasing similarly to worldwide scale,[17] but malaria remains a major health problem in Thailand, especially, in the area along Thai-Myanmar border and Thai-Cambodia border. For example, Tak Province, located along Myanmar Border in Thailand, is one

of high prevalence areas for malaria. The malaria morbidity rate per 100,000 population in this province was 1400 in 2008, 1606 in 2009 and 1617 in 2010, which was higher than any other part of Thailand.[18] Recently, the incidence of malaria in this area is decreasing and decreasing. The data from Tha Song Yang hospital showed that the number of malaria patients was 780 cases in 2013, 349 cases in 2014 and 156 cases in 2015 and malaria morbidity rate per 100,000 population in this area was 1040 in 2013, 470 in 2014 and 210 in 2015 (unpublished data).

3.8 Effect of malaria on malnutrition

Some cross-sectional studies showed that there was no association in prevalence of malnutrition and malaria infection.[19, 20] A systematic review on the relationship between malaria and nutritional status revealed that most of the studies which classified incidence of malaria infection as exposure and compared nutritional status as outcome did not show an association between malaria and malnutrition, although several studies suggested that incidence of malaria infection influence on the nutritional status.[5]

3.9 Impact of malnutrition on malaria

In the systematic review mentioned above, most of studies showed that malnutrition did not have a great impact on malaria morbidity. However, three evaluations showed a risk of association between malnutrition and malaria incidence in children: (1) underweight on *P.vivax* incidence,[21] (2) AC/A on *P. falciparum* incidence[22] and (3) stunting on *P. falciparum* incidence.[23] Moreover, it was revealed that malnutrition had prospective association with malaria.[24, 25] Several studies also showed a risk of association between malnutrition and malaria mortality or neurological sequelae in children.[26, 27, 28]

3.10 Dengue

Dengue is a mosquito-borne viral disease. The dengue viruses, which consist of 4 serotypes (DEN-1, DEN-2, DEN-3 and DEN-4), are transmitted by *Aedes* species, especially *A. aegypti* and *A. albopictus*.[29]

Dengue is one of emerging diseases in many parts of the tropical and sub-tropical areas and the incidence of dengue are remarkably growing to be world-wide during recent decades. Currently, about 2.5 billion people, or 40% of the world's population, live in areas where there is a risk of dengue transmission. Dengue is endemic in at least 100 countries in Asia, the Pacific, the Americas, Africa, and the Caribbean. The World Health Organization (WHO) estimates that 50 to 100 million dengue infections occur yearly, including 500,000 DHF cases and 22,000 deaths, mostly among children. At present, the main method to control or prevent the transmission of dengue virus is to combat vector mosquitoes. And, in late 2015 and early 2016, dengue vaccine is registered in some countries. It is expected to reduce burden of dengue.[30]

3.11 Dengue in Thailand

In 1949, the first cases of dengue disease in Thailand was reported. Bangkok has become an endemic area of dengue hemorrhagic fever (DHF) since 1958.[31, 32]

A reporting system for dengue surveillance in Thailand was started in 1958. Now, Thai Ministry of Public Health (MoPH) performs dengue surveillance, including dengue fever (DF), dengue hemorrhagic fever (DHF) and dengue shock syndrome (DSS). Between 2000 and 2011, more than 860,000 dengue cases were reported, corresponding to an annual average of approximately 72,000 cases and 100 deaths, and an average annual incidence of 115 cases per 100,000 population.[32] The data in Tha Song Yang hospital showed that the number of dengue disease was 295 cases in 2013, 21 cases in 2014 and 436 cases in 2015. The morbidity rate of dengue per 100,000 population in this area was 393 in 2013, 28 in 2014 and 581 in 2015 (unpublished data).

3.12 Impact of malnutrition on dengue

There are many previous studies examining the nutritional status and severity of dengue disease. Some studies found that over-weight patients were at increased risk for severe DHF and undernutrition decreased risk for severe DHF, possibly because immune system of malnourished patients were suppressed. On the other hand, some studies showed that nutritional status did not have impact on severity of dengue.[6, 33]

CHAPTER IV
MATERIAL AND METHODS

4.1 Study site

The study was conducted at Tha Song Yang hospital, in Tha Song Yang district of Tak province, Thailand, which located along Thai-Myanmar border. Tha Song Yang is one of malaria endemic area.[34]

4.2 Study design and participants

This was a retrospective cross-sectional study and was based on the medical records at the Tha Song Yang hospital. The medical records from patients who attended the hospital before 31 December 2015 were retrieved until 75 subjects for each disease were reached (sample size calculation in detail are described below). Participants in this study were children aged 0 to 14 who diagnosed as acute diarrhea, malaria or dengue coded by ICD-10 and met the study case definition, including both inpatient and outpatient visits to Tha Song Yang hospital. Exclusion criteria were co-infection, the children with underlying chronic illnesses or congenital diseases that might affect weight (e.g.; HIV, nephrotic syndrome, congenital heart diseases), pregnant women and those whose data were not adequate to study. Co-infection was defined as 2 or 3 diseases at the same time among diarrhea, malaria and dengue. Additionally, each case was recruited only once. The first episode in the study period was chosen as a subject.

4.3 Demographic data collection

The demographic data including age, gender, birth date, the day visiting to the hospital or the admission day, discharge day, length of hospital stay (for inpatients) and number of days of fever before coming to hospital were collected.

4.4 Data on nutritional status and definition of malnutrition

Data on nutritional status including body height and weight were collected. For 0 to 60 month-old children, standard deviation (SD) scores (z scores) of height-for-age (HA), weight-for-age (WA) and weight-for-height (WH) were computed based on the National Centre for Health Statistics (NCHS)-WHO growth reference curves using the nutrition module.[35]

Underweight was defined as a weight-for-age z (WAZ) score of < -2;
Stunting as height-for-age z (HAZ) score of < -2;
Wasting as a weight-for-height z (WHZ) score of < -2.
Severe malnutrition was defined as WAZ, HAZ or WHZ < -3.

For 5 to 14 year-old children, WHO criteria defines BMI cut-off points under 18.5 as underweight and classifies BMI under 16 as a severe thinness (severe malnutrition), BMI 16 to 17 as moderate thinness and BMI 17 to 18.5 as mild thinness.

In this study the malnutrition was adopted by the BMI cut-offs that were equivalent to children aged 18 years old with BMI 16, 17 and 18.5 (Table 4.1).

Table 4.1 Cut-off points for BMI for thinners in children equivalent to children aged 18 years old with BMI 16, 17 and 18.5[36]

	Boys			Girls		
Age/BMI	16	17	18.5	16	17	18.5
5.0	12.66	13.31	14.21	12.50	13.09	13.94
5.5	12.58	13.22	14.13	12.40	12.99	13.86
6.0	12.50	13.15	14.07	12.32	12.93	13.82
6.5	12.45	13.10	14.04	12.28	12.90	13.82
7.0	12.42	13.08	14.04	12.26	12.91	13.86
7.5	12.41	13.09	14.08	12.27	12.95	13.93

Table 4.1 Cut-off points for BMI for thinners in children equivalent to children aged 18 years old with BMI 16, 17 and 18.5[36] (cont.)

	Boys			Girls		
Age/BMI	16	17	18.5	16	17	18.5
8.0	12.42	13.11	14.15	12.31	13.00	14.02
8.5	12.45	13.17	14.24	12.37	13.08	14.14
9.0	12.50	13.24	14.35	12.44	13.18	14.28
9.5	12.57	13.34	14.49	12.53	13.29	14.43
10.0	12.66	13.45	14.64	12.64	13.43	14.61
10.5	12.77	13.58	14.80	12.78	13.59	14.81
11.0	12.89	13.72	14.97	12.95	13.79	15.05
11.5	13.03	13.87	15.16	13.15	14.01	15.32
12.0	13.18	14.05	15.35	13.39	14.28	15.62
12.5	13.37	14.25	15.58	13.65	14.56	15.93
13.0	13.59	14.48	15.84	13.92	14.85	16.26
13.5	13.83	14.74	16.12	14.20	15.14	16.57
14.0	14.09	15.01	16.41	14.48	15.43	16.68
14.5	14.35	15.28	16.69	14.75	15.72	17.18

In the study, malnutrition was defined when WAZ, HAZ or WHZ was < -2 in 0-60 month-old children. For children aged 5-14 years old, we used two cut-off points of BMI for malnutrition, <17 and <18.5. Severe malnutrition was defined as WAZ, HAZ or WHZ < -3 for children aged 0-60 month-old or the cut-off point of BMI < 16 for children aged 5-14 years old.

The body weight on discharge day was used to calculate for inpatients to minimize impact of dehydration. When there were only data of body weight on visit day

for outpatient or first admission day for inpatients, we calculated adjusted body weight. A fluid deficit of 6% of body weight for a moderate dehydration case and fluid deficit of 10% for a severe dehydration case were added.[37]

4.5 Definitions of cases and severities

All diseases

In this study, we recruited the cases whose symptom started within seven days of hospital visit and evaluated nutritional status among the three diseases. When the outpatients became inpatients within seven days, the patients were classified as 'IPD' group. Both the maximum and minimum laboratory data were collected. In the case whose laboratory sample was taken only once, the same data were entered for both maximum and minimum values.

Diarrhea

In this study, the definition of diarrhea and severity of diarrhea were as followed. The severity of diarrhea were categorized into 2 groups, 'Severe' and 'Non-severe'.[38]

(1) Diarrhea was defined as three or more abnormally loose or watery stools during the previous 24 hours; a new episode was defined if the interval the between the 2 episodes was over 3 days.[37]

(2) Severe diarrhea was defined as diarrhea with moderate or severe dehydration.

(3) Moderate dehydration was defined as one or more of the following signs: restlessness, irritability, sunken eyes, drinking eagerly, thirsty and skin pinch goes back slowly.[37]

(4) Severe dehydration was defined as two or more of the following signs: lethargy or unconsciousness, sunken eyes, drinks poorly or not able to drink, and skin pinch goes back very slowly (over 2 seconds).[37]

Malaria

Severity of malaria was defined following the Guidelines for the Treatment of Malaria 2015. If more than one manifestation was 'Yes', the case was included into 'Severe' group.[16]

Severe falciparum malaria

Clinical manifestation:

Impaired consciousness: GCS<11 in adult or Blantyre coma scale < 3 in children

Prostration: unable to sit, stand or walk without assistance

Multiple convulsion: more than 2 episodes within 24 hours

Acidosis: a base deficit over 8 mEq/L or if not available, a plasma bicarbonate level under 15 mmol/L or venous plasma lactate over 5 mmol/L.

Severe acidosis manifested clinically as respiratory distress (rapid, deep, labored breathing).

Hypoglycemia: blood or plasma glucose under 2.3 mmol/L (under 40 mg/dL)

Severe malarial anemia: hemoglobin concentration under 5 g/dL or hematocrit under 15% in children less than 12 years of age (under 7 g/dL and under 20%, respectively, in children over 12 years) with a parasite count over 10,000/ µL

Renal impairment: plasma or serum creatinine over 265 µmol/L (3 mg/dL) or blood urea over 20 mmol/L

Jaundice: plasma or serum bilirubin over 50 µmol/L (3 mg/dL) with a parasite count over 100,000/ µL

Pulmonary edema: radiologically confirmed or oxygen saturation under 92% in room air with a respiratory rate over 30/min, often with chest indrawing and crepitations on auscultation

Significant bleeding: including recurrent or prolonged bleeding from the nose, gums or venipuncture sites; hematemesis or melena

Shock: Compensated shock is defined as capillary refill over 3 seconds or temperature gradient on leg (mid to proximal limb), but no hypotension. Decompensated shock was defined as systolic blood pressure under 70 mmHg in children under 12 years

or under 80 mmHg in children over 12 years, with evidence of impaired perfusion (cool peripheries or prolonged capillary refill).

Hyperparasitemia: *P. falciparum* parasitemia over 10%

Severe vivax and knowlesi malaria

Severe vivax malaria was defined as for falciparum malaria with no parasite density thresholds. Severe knowlesi malaria was defined as for falciparum malaria with two differences

P. knowlesi hyperparasitemia: parasite density over 100,000/µL

Jaundice and parasite density over 20,000/µL

Dengue

Patients were defined as dengue if they met the WHO 1997 criteria for dengue or had positive confirmatory laboratory diagnosis (e.g. dengue NS1, IgM ELISA). Categorizing dengue to undifferentiated febrile illness (UFI), dengue fever (DF), dengue hemorrhagic fever (DHF) and dengue shock syndrome (DSS) was in accordance with the WHO criteria.[39] Severe dengue was defined as DHF or DSS.

4.6 Ethical consideration

The study was approved by the Ethical Committee, Faculty of Tropical Medicine, Mahidol University. Because this study was retrospectively descriptive, relevant medical records were retrieved and data were extracted and informed consent from individual patient was impossible. Permission from the hospital director was obtained instead of individual informed consent.

4.7 Statistical analysis

The data from medical records were extracted into CRF (case record form), and the verified data were entered using Microsoft Excel 2013 and analyzed by IBM SPSS® statistics version 18. The demographic data were summarized using median with IQR or number with percentage as appropriate. The proportions of undernutrition were

calculated and evaluated by chi-square test or Fisher's exact test as appropriate (significance level p=0.05). The severities of malaria, dengue and diarrhea were evaluated between under-nourished group vs well-nourished group by chi-square test or Fisher's exact test as appropriate.

4.8 Sample size calculation

Sample size calculation was performed by using OpenEpi version 3.01.[40] In a previous study, the proportion of malnutrition in diarrhea among children aged < 5 years old in Bangladesh was about 28%.[3] In contrast, for malaria and dengue, there was no association between nutritional status and prevalence of disease.[5, 6] The sample size was calculated based on the ability to detect the statistical significance if the proportion of odds ratio of malnutrition in diarrhea and dengue is over 3.5 with 95% confidence level and 80% power. The sample size for unmatched case control study was at least 75 cases in each group.

4.9 Research fund

Research fund was provided by the Faculty of Tropical Medicine, Mahidol University, Thailand.

CHAPTER V
RESULTS

5.1 Demographic characteristics

A total of 225 children aged 0 to 14 years old were recruited (75 children in each group) in this study (Table 5.1). There were 123 males (54.7%) and 102 females (45.3%). The median age was 9 years [IQR; 6, 11]. In children aged < 5 years old, 8 children in malaria group and 4 children in dengue group had HAZ < 2, 6 and 1 children in respective groups had both HAZ and WAZ < -2, and 1 and 3 children in the respective groups had WHZ < -2. The number of malnutrition in children aged < 5 years old in malaria group was 9 and in dengue group was 6. The prevalence of malnutrition in children aged < 5 years old was 15/36 (41.7%) and in children aged ≥ 5 years old (BMI < 18.5) was 44/189 (23.3%). Male was dominant in diarrhea and malaria but female was dominant in dengue. There were no children aged < 5 years old in diarrhea group, although 21.3% of malaria and 26.7% of dengue were in this age group. All malaria cases were non-severe. About 30% of cases were admitted. The median length of hospital stay in dengue was 4 days, the longest among 3 groups.

Table 5.1 Demography and nutritional status of studied patients

		Diarrhea (N=75)	Malaria (N=75)	Dengue (N=75)
Gender	Male	46 (61.3%)	48 (64.0%)	29 (38.7%)
	Female	29 (38.7%)	27 (36.0%)	46 (61.3%)
Age	(years) *median[IQR]	9 [7,11]	9 [5, 12]	7 [4, 11]
	0 to 4	0 (0.0%)	16 (21.3%)	20 (26.7%)
	5 to 9	39 (52.0%)	24 (32.0%)	29 (38.6%)
	10 to 14	36 (48.0%)	35 (46.7%)	26 (34.7%)
severity	severe	6 (8.0%)	0 (0.0%)	6 (8.0%)
	non-severe	69 (92.0%)	75 (100.0%)	69 (92.0%)
Illness days before visiting hospital	(days) *median[IQR]	1 [1,3]	3 [2,4]	3 [1,4]
Number of admission		18 (24.0%)	26 (34.7%)	23 (30.1%)
Length of hospital stay	(days) *median[IQR]	2 [1,2]	2 [2,3]	4 [3,5]
Nutritional status	Malnutrition			
	Age < 5	0/0 (-)	9/16 (56.3%)	6/20 (30.0%)
	Age ≥ 5			
	: BMI cut off 17	7/75 (9.3%)	2/59 (3.4%)	3/55 (5.5%)
	: BMI cut off 18.5	20/75 (26.7%)	12/59 (20.3%)	12/55 (21.8%)
	Severe malnutrition			
	Age < 5	0/0 (-)	6/16 (37.5%)	0/20 (0.0%)
	Age ≥ 5	4/75 (5.3%)	1/59 (56.3%)	0/55 (0.0%)

5.2 Characteristics of diarrhea patients

Table 5.2 shows the demographic data in patients with diarrhea. 18.7 % of the patients had dysentery. Most of the diarrhea cases had mild dehydration. Only 6.7% of the patients had moderate dehydration and 1.3% had severe dehydration.

Table 5.2 Clinical characteristics of diarrhea patients

	n (%) or median [IQR]
Clinical manifestation	
Frequency of loose or watery stool	4 [3, 6] (n=75)
Dysentery	14/75 (18.7)
Restlessness or irritability	0/75 (0.0)
Lethargy or unconsciousness	0/75 (0.0)
Sunken eyes	0/75 (0.0)
Drinking eagerly	0/75 (0.0)
Thirsty	5/75 (6.7)
Drinking poorly or not able to drink	1/75 (1.3)
Skin pinch goes back slowly	0/75 (0.0)
Skin pinch goes back very slowly (>2sec)	0/75 (0.0)
Dehydration state	
Mild dehydration	69/75 (92.0)
Moderate dehydration	5/75 (6.7)
Severe dehydration	1/75 (1.3)

5.3 Characteristics of dengue patients

Table 5.3 shows the clinical characteristics of dengue patients. All patients had fever. Headache occurred in 89.7% and rash in 25.0% of children with dengue. The other symptoms had lower prevalence. Laboratory exam was performed for all cases. Repeated laboratory examinations were performed in 61 cases (61/75; 81.3%). Almost all cases were diagnosed by NS-1 antigen test and the other by dengue IgM (n=70, n=5 respectively). Numbers of patient who had leukopenia (< 5,000 cell/µl), thrombocytopenia (< 100,000 cells/µl) and rising hematocrit over 20% were 51/75 (68.0%), 20/75 (26.7%) and 6/60 (10.0%), respectively. 42/75 (56.0%) were classified as UFI, 26/75 (34.7%) as DF and 7/75 (9.3%) as DHF. There was no case of DSS in this study.

Table 5.3 Clinical characteristics of dengue patients

	n (%)		n (%) or median [IQR]
Clinical manifestation		Laboratory data	
Fever > 2days	75/75 (100.0)	WBC min (cell/µl)	3990 [2970. 5540] (n=75)
Headache	52/58 (89.7)	WBC max (cell/µl)	7440 [5360, 9610] (n=75)
Retro orbital pain	2/2 (100)	Hb min (g/dL)	11.5 [10.8, 12.3] (n=75)
Myalgia	8/8 (100)	Hb max (g/dL)	12.3 [11.5, 13.3] (n=75)
Arthralgia	0/0 (-)	Platelet count min (cell/µl)	135000 [84000, 204000] (n=75)
Rash	8/32 (25.0)	Platelet count max (cell/µl)	247000 [166000, 288000] (n=75)
Tourniquet test positive	0/1 (0.0)	Hematocrit min (%)	36.7 [34.8, 39.1] (n=74)
Purpura	0/38 (0.0)	Hematocrit max (%)	39.1 [36.6, 42.3] (n=74)
Ecchymosis	1/39 (2.6)	Alb min (mg/dL)	3.7 [3.1, 4.2] (n=5)
Epistaxis	3/43 (7.0)	Alb max (mg/dL)	3.5 [2, 3.7] (n=3)
Gum Bleeding	0/40 (0.0)	NS-1 positive	70/75 (93.3)
Hematemesis and/or melena	0/40 (0.0)	IgM positive	5/75 (6.7)
Hepatomegaly	1/32 (3.1)	Pleural effusion (chest X ray)	2/2 (100.0)
Shock	0/75 (0.0)		
Diagnosis			
UFI	42/75 (56.0)	DF	26/75 (34.7)
DHF	7/75 (9.3)	DSS	0/75 (0.0)

5.4 Characteristics of malaria patients

Table 5.4 reveals the clinical characteristics of malaria patients. All cases were uncomplicated (non-severe malaria). 29.3% of patients were caused by *P. falciparum* and 70.7% were caused by *P. vivax*.

Table 5.4 Clinical characteristics of malaria patients

Clinical manifestation	n (%)	Laboratory data	n (%) or median [IQR]
Impaired consciousness	0/75 (0.0)	Hemoglobin (g/dL)	11.0 [10.0, 12.4] (n=38)
Prostration	0/75 (0.0)	Hematocrit (%)	34.7 [32.0, 37.9] (n=40)
Multiple convulsion	0/75 (0.0)	Plasma bicarbonate (mmol/L)	22.3 [20.5, 23.6] (n=20)
Significant bleeding	0/75 (0.0)	BUN (mg/dL)	13.5 [10.8, 18.6] (n=9)
Shock	0/75 (0.0)	Cr (mg/dL)	0.69 [0.55, 0.72] (n=9)
Pulmonary edema	0/75 (0.0)	T-bil (mg/dL)	1.6 [1.3, 1.8] (n=9)
		blood glucose (mg/dL)	115 [110, 132] (n=16)
		Species of parasite	
		P. falciparum	22/75 (29.3)
		P. vivax	53/75 (70.7)
		Parasite count (Thick film)	
		Many	29/75 (38.7)
		Moderate	22/75 (29.3)
		Few	24/75 (32.0)
		Pulmonary edema CXR	0/3 (0.0)

5.5 Evaluation of nutritional status among diarrhea, dengue and malaria patients

Table 5.5-5.8 show nutritional status among diarrhea, dengue and malaria patients. There was significant difference only in severe malnutrition among these 3 diseases (Table 5.5).

Table 5.5 Prevalence of malnutrition among diarrhea, malaria and dengue

BMI cut-off point 16 or WAZ, HAZ or WHZ < -3			
	Severe Malnutrition	Non-severe malnutrition	p value
Diarrhea	4 (5.3%)	71 (94.7%)	
Malaria	7 (9.3%)	68 (90.7%)	0.012*
Dengue	0 (0.0%)	75 (100.0%)	
BMI cut-off point 17 or WAZ, HAZ or WHZ < -2			
	Malnutrition	Non-malnutrition	p value
Diarrhea	7 (9.3%)	68 (90.7%)	
Malaria	11 (14.7%)	64 (85.3%)	0.603
Dengue	9 (12.0%)	66 (88.0%)	
BMI cut-off point 18.5 or WAZ, HAZ or WHZ < -2			
	Malnutrition	Non-malnutrition	p value
Diarrhea	20 (26.6%)	55 (73.3%)	
Malaria	21 (28.0%)	54 (72.0%)	0.851
Dengue	18 (24.0%)	57 (76.0%)	

*: Fisher’s exact test

There was no significant difference in nutritional status between diarrhea and dengue (Table 5.6).

Table 5.6 Prevalence of malnutrition, comparison between diarrhea and dengue

	BMI cut-off point 16 or WAZ, HAZ or WHZ < -3		
	Severe Malnutrition	Non-severe malnutrition	p value
Diarrhea	4 (5.3%)	71 (94.7%)	0.12*
Dengue	0 (0.0%)	75 (100.0%)	
	BMI cut-off point 17 or WAZ, HAZ or WHZ < -2		
	Malnutrition	Non-malnutrition	p value
Diarrhea	7 (9.3%)	68 (90.7%)	0.597
Dengue	9 (12.0%)	66 (88.0%)	
	BMI cut-off point 18.5 or WAZ, HAZ or WHZ < -2		
	Malnutrition	Non-malnutrition	p value
Diarrhea	20 (26.7%)	55 (73.3%)	0.707
Dengue	18 (24.0%)	57 76.0%)	

*: Fisher's exact test

There was also no significantly difference in nutritional status between diarrhea and malaria (Table 5.7).

Table 5.7 Prevalence of malnutrition, comparison between diarrhea and malaria

	BMI cut-off point 16 or WAZ, HAZ or WHZ < -3		
	Severe Malnutrition	Non-severe malnutrition	p value
Diarrhea	4 (5.3%)	71 (94.7%)	0.533*
Malaria	7 (9.3%)	68 (90.7%)	
	BMI cut-off point 17 or WAZ, HAZ or WHZ < -2		
	Malnutrition	Non-malnutrition	p value
Diarrhea	7 (9.3%)	68 (90.7%)	0.315
Malaria	11 (14.7%)	64 (85.3%)	
	BMI cut-off point 18.5 or WAZ, HAZ or WHZ < -2		
	Malnutrition	Non-malnutrition	p value
Diarrhea	20 (26.7%)	55 (73.3%)	0.855
Malaria	21 (28.0%)	54 (72.0%)	

*: Fisher's exact test

The proportion of severe malnutrition in dengue patients was significantly lower than in malaria patients (Table 5.8).

Table 5.8 Prevalence of malnutrition, comparison between malaria and dengue

	BMI cut-off point 16 or WAZ, HAZ or WHZ < -3		
	Severe Malnutrition	Non-severe malnutrition	p value
Malaria	7 (9.3%)	68 (90.7%)	0.013*
Dengue	0 (0.0%)	75 (100.0%)	
	BMI cut-off point 17 or WAZ, HAZ or WHZ < -2		
	Malnutrition	Non-malnutrition	p value
Malaria	11 (14.7%)	64 (85.3%)	0.631
Dengue	9 (12.0%)	66 (88.0%)	
	BMI cut-off point 18.5 or WAZ, HAZ or WHZ < -2		
	Malnutrition	Non-malnutrition	p value
Malaria	21 (28.0%)	54 (72.0%)	0.577
Dengue	18 (24.0%)	57 (76.0%)	

*: Fisher's exact test

5.6 Nutritional status and severity of diseases

Regarding the association between malnutrition and severity of diseases, there was no statistically significant association between malnutrition and diarrhea and dengue (Table 5.9 and Table 5.10). As there was no severe malaria case in this study, the association between malnutrition and severe malaria could not be evaluated.

Table 5.9 Evaluation of nutritional status and severity of diarrhea

	Severe	Non-severe	p value
BMI cut-off point 16 or WAZ, HAZ or WHZ < -3			
Severe malnutrition	0 (0.0%)	4 (100.0%)	1.000*
Non-severe malnutrition	6 (8.5%)	65 (91.5%)	
BMI cut-off point 17 or WAZ, HAZ or WHZ < -2			
Malnutrition	0 (0.0%)	7 (100.0%)	1.000*
Non-malnutrition	6 (8.8%)	62 (91.2%)	
BMI cut-off point 18.5 or WAZ, HAZ or WHZ < -2			
Malnutrition	0 (0.0%)	20 (100.0%)	0.184*
Non-malnutrition	6 (10.9%)	49 (89.1%)	

*: Fisher's exact test

Table 5.10 Evaluation of nutritional status and severity of dengue

	Severe	Non-severe	p value
BMI cut-off point 16 or WAZ, HAZ or WHZ < -3			
Severe malnutrition	0 (-)	0 (-)	-
Non-severe malnutrition	8 (10.7%)	67 (89.3%)	
BMI cut-off point 17 or WAZ, HAZ or WHZ < -2			
Malnutrition	1 (11.1%)	8 (88.9%)	1.000*
Non-malnutrition	7 (10.6%)	59 (89.4%)	
BMI cut-off point 18.5 or WAZ, HAZ or WHZ < -2			
Malnutrition	2 (11.1%)	16 (88.9%)	1.000*
Non-malnutrition	6 (10.5%)	51 (89.5%)	

*: Fisher's exact test

We also try to perform subgroup analyses in children aged < 5 years old and aged ≥ 5 years old. The prevalence of severe malnutrition was statistically significantly higher in patients with malaria compared to dengue in children aged < 5 years old (Table 5.11).

Table 5.11 Prevalence of malnutrition among diarrhea, malaria and dengue in children aged < 5 years old

	Severe Malnutrition	Non-severe malnutrition	p value
Diarrhea	0 (-)	0 (-)	
Malaria	6 (37.5%)	10 (62.5%)	0.04*
Dengue	0 (0.0%)	20 (100.0%)	
	Malnutrition	Non-malnutrition	p value
Diarrhea	0 (-)	0 (-)	
Malaria	9 (56.3%)	7 (43.7%)	0.112**
Dengue	6 (30.0%)	14 (70.0%)	

*: Fisher's exact test between malaria and dengue

**: chi-square test between malaria and dengue

As there was no diarrhea children aged < 5 years old, the difference of nutritional status could not be assessed between diarrhea and other two diseases. For children aged 5-14 years old, there were no difference in nutritional status among three diseases. (Table 5.12-5.15).

Table 5.12 Prevalence of malnutrition among diarrhea, malaria and dengue in children aged 5-14 years old

	BMI cut-off point 16		
	Severe Malnutrition	Non-severe malnutrition	p value
Diarrhea	4 (5.3%)	71 (94.7%)	
Malaria	1 (1.7%)	58 (98.3%)	0.190
Dengue	0 (0.0%)	55 (100.0%)	
	BMI cut-off point 17		
	Malnutrition	Non-malnutrition	p value
Diarrhea	7 (9.3%)	68 (90.7%)	
Malaria	2 (3.4%)	57 (96.6%)	0.388
Dengue	3 (5.5%)	52 (94.5%)	
	BMI cut-off point 18.5		
	Malnutrition	Non-malnutrition	p value
Diarrhea	20 (26.7%)	55 (73.3%)	
Malaria	12 (20.3%)	47 (79.7%)	0.659
Dengue	12 (21.8%)	43 (78.2%)	

*: Fisher's exact test

Table 5.13 Prevalence of malnutrition, comparison between diarrhea and dengue in children aged 5-14 years old

	BMI cut-off point 16		
	Severe Malnutrition	Non-severe malnutrition	p value
Diarrhea	4 (5.3%)	71 (94.7%)	0.137*
Dengue	0 (0.0%)	55 (100.0%)	
	BMI cut-off point 17		
	Malnutrition	Non-malnutrition	p value
Diarrhea	7 (9.3%)	68 (90.7%)	0.517*
Dengue	3 (5.5%)	52 (94.5%)	
	BMI cut-off point 18.5		
	Malnutrition	Non-malnutrition	p value
Diarrhea	20 (26.7%)	55 (73.3%)	0.526
dengue	12 (21.8%)	43 (78.2%)	

*: Fisher's exact test

Table 5.14 Prevalence of malnutrition, comparison between diarrhea and malaria in children aged 5-14 years old

	BMI cut-off point 16		
	Severe Malnutrition	Non-severe malnutrition	p value
Diarrhea	4 (5.3%)	71 (94.7%)	0.384*
Malaria	1 (1.7%)	58 (98.3%)	
	BMI cut-off point 17		
	Malnutrition	Non-malnutrition	p value
Diarrhea	7 (9.3%)	68 (90.7%)	0.298*
Malaria	2 (3.4%)	57 (96.6%)	
	BMI cut-off point 18.5		
	Malnutrition	Non-malnutrition	p value
Diarrhea	20 (26.7%)	55 (73.3%)	0.394
Malaria	12 (20.3%)	47 (79.7%)	

*: Fisher's exact test

Table 5.15 Prevalence of malnutrition, comparison between malaria and dengue in children 5-14 years old

	BMI cut-off point 16		
	Severe Malnutrition	Non-severe malnutrition	p value
Malaria	1 (1.7%)	58 (98.3%)	1.000*
Dengue	0 (0.0%)	55 (100.0%)	
	BMI cut-off point 17		
	Malnutrition	Non-malnutrition	p value
Malaria	2 (3.4%)	57 (96.6%)	0.671*
Dengue	3 (5.5%)	52 (94.5%)	
	BMI cut-off point 18.5		
	Malnutrition	Non-malnutrition	p value
Malaria	12 (20.3%)	47 (79.7%)	0.847
Dengue	12 (21.8%)	43 (78.2%)	

*: Fisher's exact test

CHAPTER VI
DISCUSSION

6.1 Prevalence of malnutrition in the studied population

Although the economic status is much improving year by year in developing countries, malnutrition is still a major health problem for children especially in Asian and African countries. Prevalence of underweight in children aged < 5 years old was high, 29.6% in Myanmar, 28.8% in Cambodia and 41.3 % in Bangladesh.[41]

The prevalence of underweight in Thailand was decreasing and became 9.2% for children aged < 5 years old. Children in northeastern and southern region has higher prevalence than in other regions. (10.7% and 10.0%, respectively).[41]

In this study, 12% of all patients had malnutrition according to BMI cut-off point 17 or WAZ, HAZ or WHZ < 2 (26.2% of children at BMI cut-off point 18.5 or WAZ, HAZ or WHZ < 2). The prevalence was higher than that of overall Thailand. This may be because Tha Song Yang has a lot of Karen who have low socio-economic status. Hill tribe people in North Thailand including Karen also have high risk of malnutrition. Thai Red Cross reported that about 62% of Karen children aged 0-5 years were malnourished.[42] In children > 5 years, BMI cut-off point at 18.5 was used, the prevalence of malnutrition would be so much higher than cut-off point at 17. Cut-off point at 17 may be appropriate for first step intervention of malnutrition while cut-off point at 18.5 may be more appropriate on second step intervention.[36]

6.2 Validity of this study

This study was a cross sectional and age distribution was wide so we had some limitations.

We used different malnutrition criteria for children aged < 5 and ≥ 5 years old. This is difficult for us to compare the results with other similar studies. Although

malnutrition is considered important and most studies have been conducted in children aged < 5, it is still important to explore the scope of this problem in older children.

The power of this study was decided based on the data from the diarrhea study in children aged < 5 years old in Bangladesh because diarrhea was more influenced by malnutrition than dengue and malaria.[15] Unfortunately there was no other study of association malnutrition and disease for children aged 0-14 years old.

This cross sectional study only detect the association between diseases and malnutrition but cannot define which is the cause and which is the result. There are also many confounding factors for malnutrition including gestational age and birth weight and other underlying diseases. Even though the exclusion criteria in this study was chronic underline diseases such as congenital heart, there may be other diseases that could affect nutritional status.

Another limitation on this study that may affect the validity of the study is that there were no diarrhea patients aged < 5 years old in this study. It occurred accidentally as we recruited the patients from the list of patients who had diarrhea and there was no cases aged < 5 during that period. Actually, diarrhea and malnutrition are the most common disease in children aged < 5. The absence of diarrhea cases in children under aged < 5 in our study may be because all diarrhea episodes were mild and the patients could be managed in health care center and did not need hospital visit. This impacted on the comparison with dengue and diarrhea. Moreover, if we paid attention to only diarrhea for children aged < 5, we could find that malnourished children is more likely to have severe diarrhea than well-nourished children as previous study in Bangladesh.[15]

Regarding malaria, children aged < 5 years old was accounted for 21.3%, which was a characteristic of high transmission malaria endemic area. Most of the children may be partially immuned to malaria and therefore the illness was not severe. Another reason of having no severe malaria in this study may be that most of the infections were caused by *P. vivax*. In addition, Tha Song Yang Hospital is a community hospital with limited facility, severe malaria cases may directly go to a provincial hospital.

6.3 Association of malnutrition on diseases

Dengue and malnutrition

In this study, no case of dengue had severe malnutrition. A previous study found that malnutrition decreased the risk of dengue.[43] Obesity is one of high risk factors of severe dengue, which are related to mast cell on immunity.[44] Therefore, immune compromised people such as children suffered from severe malnutrition might be more likely to be asymptomatic than well-nourished people. However, there are high risks for getting of other infectious diseases due to immunocompromised status, so severe malnutrition must be treated even if severe malnutrition is a protective factor for dengue. It is most important to prevent mosquito biting for dengue infection.

Malaria and malnutrition

In this study, malaria patients had highest prevalence of severe malnutrition (9.3%) compared to diarrhea (5.3%) and dengue (0%). Although there was no difference between malaria and diarrhea, there was statistically significant difference from dengue. The possible explanation may be that malaria is one of disease of poor people, living in a jungle are. Poor people usually have low socioeconomic status and poor hygiene, hence poor nutritional status. Other explanation may be that the patients previously have multiple malaria infection or subclinical malaria, affecting their health and nutritional status. The findings on non-statistical significant difference may be due to too small sample size. Further studies with larger sample size are warrant.

Association of malnutrition with severe disease

Most of diseases were not severe in this study. A larger sample size is needed to study association of malnutrition with severe disease.

6.4 Future

This study had many limitations. So, it is better to conduct a prospective observational study to know the correlation of malnutrition especially severe malnutrition and prevalence and severity of diarrhea, malaria and dengue. It is

challenging due to difficulties to approach some patients living in Tha Song Yang Hospital, but it may be possible to study in co-operation with hospital staffs and health workers in the community.

CHAPTER VII
CONCLUSION

We conducted retrospective cross-sectional study on the prevalence of malnutrition in common tropical diseases for children, diarrhea, dengue and malaria. 225 patients (75 in each disease) were included in this study. There were no statistical difference in the prevalence of malnutrition between the 3 diseases. The prevalence of severe malnutrition was significantly highest in malaria. The prevalence of severe malnutrition was significantly higher in malaria compared to dengue in the patients aged < 5 years old in a subgroup analysis.

In conclusion, severe malnutrition was associated with malaria for children aged < 5 years old. Studying malnutrition in Tha Song Yang may help to solve the malnutrition problem in this rural area on Thai-Myanmar border.

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APPENDIX

Case record form

Comparison of nutritional status in
diarrhea, malaria and dengue among children in Tha Song Yang, Tak, Thailand

Subject No._____

A. General demographic data

1.	Gender	☐ Male	☐ Female
2.	Age	___years ___months	
3.	Birth of date (dd/mm/yy)	__/ __/ __	
4.	Visit date (dd/mm/yy)	__/ __/ __	
5.	Status	☐ OPD	☐ IPD
6.	Date of discharge (dd/mm/yy)(if IPD)	__/ __/ __	
7.	Illness days before visiting hospital	__days	
8.	Underline chronic disease	☐Yes(_____)	☐No
9.	Co-infection	☐Yes	☐No
10.	Congenital disease	☐Yes(_____)	☐No
11.	Pregnant woman	☐Yes	☐No

*co-infection
: 2 or 3 diseases at the same time among diarrhea, malaria and dengue

B. Anthropometric data

1.	Height	___cm
2.	Weight on date of OPD or admission	___kg
3.	Weight on date of discharge	___kg
4.	Corrected weight (if necessary)	___kg

C. Diagnosis and severity

1.	Diagnosis	☐diarrhea	☐malaria	☐dengue
2.	Severity	☐severe	☐non-severe	

Case record form for patient suffering from diarrhea

Comparison of nutritional status in
diarrhea, malaria and dengue among children in Tha Song Yang, Tak, Thailand

Subject No._____

D. Clinical manifestation

1.	Frequency of loose or watery stool	__times/day		☐Not recorded
2.	Dysentery	☐Yes	☐No	☐Not recorded
3.	Restlessness or Irritability	☐Yes	☐No	☐Not recorded
4.	Lethargy or Unconsciousness	☐Yes	☐No	☐Not recorded
5.	Sunken eyes	☐Yes	☐No	☐Not recorded
6.	Drinking eagerly	☐Yes	☐No	☐Not recorded
7.	Thirsty	☐Yes	☐No	☐Not recorded
8.	Drinks poorly or not able to drink	☐Yes	☐No	☐Not recorded
9.	Skin pinch goes back slowly	☐Yes	☐No	☐Not recorded
10.	Skin pinch goes back very slowly (>2 sec)	☐Yes	☐No	☐Not recorded

Severity* ☐severe ☐non-severe

*severe diarrhea includes
moderate dehydration (3, 5, 6, 7 or 9) and severe dehydration (4, 5, 8 or 10)

Case record form for patient suffering from malaria

Comparison of nutritional status in
diarrhea, malaria and dengue among children in Tha Song Yang, Tak, Thailand

Subject No._____

D. Clinical manifestation

1. Impaired consciousness	☐Yes	☐No	☐Not recorded
2. Prostration	☐Yes	☐No	☐Not recorded
3. Multiple convulsion	☐Yes	☐No	☐Not recorded
4. Significant bleeding	☐Yes	☐No	☐Not recorded
5. Shock	☐Yes	☐No	☐Not recorded
6. Pulmonary edema(SpO2<92% with RR>30)	☐Yes	☐No	☐Not recorded

E. Laboratory data

1. Hb	_____g/dl		☐Not recorded
2. Hematocrit	_____%		☐Not recorded
3. Base deficit	_____mEq/L		☐Not recorded
4. Plasma bicarbonate	_____mmol/L		☐Not recorded
5. Venous plasma lactate	_____mmol/L		☐Not recorded
6. BUN	_____mg/dL		☐Not recorded
7. Cr	_____☐mg/dL		☐Not recorded
8. T-Bil	_____☐mg/dL		☐Not recorded
9. Blood or plasma glucose	_____☐mg/dL		☐Not recorded
10. Species of parasite	☐P. falciparum	☐P. vivax	☐P. knowlesi
	☐P. malariae	☐P. ovale	☐Not recorded
11. Parasite count	☐Many	☐Moderate	
	☐Few	☐Not recorded	

F. Radiographic data

1. pulmonary edema (Radiologically confirmed)	☐Yes	☐No	☐Not recorded

Severity* ☐severe ☐non-severe

Case record form for patient suffering from dengue

Comparison of nutritional status in
diarrhea, malaria and dengue among children in Tha Song Yang, Tak, Thailand

Subject No._____

D. Clinical manifestation

1. Fever > 2 days	☐Yes	☐No	☐Not recorded
2. Headace	☐Yes	☐No	☐Not recorded
3. Retro orbital pain	☐Yes	☐No	☐Not recorded
4. Myalgia	☐Yes	☐No	☐Not recorded
5. Arthralgia	☐Yes	☐No	☐Not recorded
6. Rash	☐Yes	☐No	☐Not recorded
7. Tourniquet test positive	☐Yes	☐No	☐Not recorded
8. Purpura	☐Yes	☐No	☐Not recorded
9. Ecchymoses	☐Yes	☐No	☐Not recorded
10. Epistaxis	☐Yes	☐No	☐Not recorded
11. Gum bleeding	☐Yes	☐No	☐Not recorded
12. Hematemesis and/or melena	☐Yes	☐No	☐Not recorded
13. Hepatomegaly	☐Yes	☐No	☐Not recorded
14. Shock	☐Yes	☐No	☐Not recorded

E. Laboratory data

1. WBC	___/___cell/µl	(min/MAX)	☐Not recorded
2. Hb	___/___g/dL	(min/MAX)	☐Not recorded
3. Platelet count	___/___/µl	(min/MAX)	☐Not recorded
4. Hematocrit	___/___%	(min/MAX)	☐Not recorded
5. Alb	___/___mg/dL	(min/MAX)	☐Not recorded
6. NS-1 positive	☐Yes	☐No	☐Not recorded
7. Dengue IgM positive	☐Yes	☐No	☐Not recorded

F. Radiographic data

1. Pleural effusion (chest X-ray or ultrasound)

☐Yes ☐No ☐Not recorded

Diagnosis ☐DHF/DSS ☐DF ☐UFI

Severity* ☐severe ☐non-severe

severe: DHF or DSS

non-severe: UFI or DF

BIOGRAPHY

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