Prevalence and Incidence of Child Stunting from Birth to Two Years of Life in Thai Children: Based on the Prospective Cohort Study of Thai Children (PCTC)

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Objective: *To determine the percentages of prevalence and incidence in child stunting at birth, 6, 12, 18, and 24 months of age and to investigate the association between factors and child stunting outcome*
Material and Method: *The Prospective Cohort Study of Thai Children (PCTC) was carried out during 2000-2002, data from five districts were examined, and anthropometric measurements were performed by the physician and research assistants. WHO's growth reference standard year 2005 was used.*
Results: *Four thousand two hundred forty five children were included at the start of the present study of which 3,898 were in the final analysis. The prevalence in child stunting presented an increasing percentage at birth 6, 12, 18, and 24 months was 6.0, 6.9, 9.5, 14.6, and 16.6%, and incidence indicated decreasing at birth,6,12,18, and 24 months was 6.0, 4.3, 4.1, 5.2, and 3.2% respectively. The GEE analysis showed that gender, mother height, mother education, income, and Nan-Hill Tribe areas were significantly correlated with child stunting ($p < 0.001$).*
Conclusion: *Finding from the present study indicates that to reduce child stunting in Thailand in early infant's life, early nutritional interventions and quality antenatal care are vital.*

Keywords: *Prevalence, Incidence, Children growth, Child stunting, Cohort study*

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There are more than 200 million stunted children under 5 years of age in developing countries, of which 72% were from Asia[1]. South Central Asia showed the second highest prevalence of growth stunting in the world at 44%. The prevalence in South-East Asia was also high 33%[1-5]. Stunting means that the length/height for a given age is less than -2SD (standard deviation score) and is highly prevalent in developing countries especially among the poor and deprived segments of society[4]. Prevalence of child stunting in early age is increasing. From WHO reviewed studies, it was reported that stunted infants started from two or three months. To improve child growth, efforts should be done before 12 months[1]. Several studies showed that child stunting increased between 6 to 23 months then declined after 24 months[6-9].

Child stunting is an indicator for assessing nutrition status. Even though community-based management approaches have been implemented in many developing countries, there has been little recent improvement in the situation. This is despite child stunting projects that have been the attention of many organizations such as WHO, UNICEF, and Asian Development Bank (ADB)[2,3]. In an optimistic scenario, the ADB projected that child stunting prevalence in Southeast Asia will be the highest in the world in year 2020[5]. Previous studies indicated that not only child stunting leads to increasing morbidity and mortality, but also can reduced cognitive development, brain, or IQ development[3-5,10]. Many researchers point out that stunted children can lead to have short adult

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stature and later chronic disease[11-15]. World Health Organization (WHO) has undertaken a major initiative to develop new growth references for infants and young children[14]. It was little known about prevalence of child stunting in early child age, particularly in longitudinal study by using new growth standard reference. The present study sought to address two questions: 1) what are the prevalence and incidence in infants by using WHO currently growth standard reference and 2) what are the associations between demographic characteristics and child stunting prevalence as well as incidence rate by using WHO current growth standard. The Prospective Cohort Study of Thai Children (PCTC) was the first ongoing prospective cohort study in Asia. It is encouraging evidence that determining prevalence and incidence in longitudinal study from birth to 2 years by using WHO new growth reference standard which will be more efficient to promote an early remedial[30] action to prevent malnutrition than a previous study. The result may help to formulate evidence-based recommendations, not only for parents of infants but also to improve a child growth-monitoring program and child health development policy.

Material and Method

The data from the prospective cohort study of Thai children (PCTC) is detailed below. From birth to two years-old children in the prospective study were measured anthropometrically which was performed by physicians and specially trained research assistants. The present study included a total of 4,245 children from five districts in four different provinces namely Panomtuan District in Kanchanaburi, Thepa District in Songkla, Kranuan District in Khon Kaen, Muang District in Nan, and Bangkok.

Sampling: The prospective cohort study of Thai children

The study design was an observational, community-based study designed to follow all fetuses from the 28 to 38 weeks gestational age from four selected districts in different regions and the Bangkok metropolitan area. The birth cohort started during 2000-2002 in each site and was followed-up until the children reached the age of 24 months and time of measurement was every 6 months. The children who were eligible for the PCTC project with parental consent during pregnancy were sampled for inclusion in the present study. Children were not recruited for the present study if they were not registered and had frequently migrated. Children delivered as twins and children with significant health problems such as birth defects, deficits of physical development, and delayed development were excluded for the present study.

Anthropometric measurements

PCTC project growth instrument was developed locally by the Nutrition Institute, Mahidol University of Thailand. It was used for anthropometric measurements. Anthropometric measurements were taken according to recumbent length and were measured in all children using a graduate board with a fixed headboard and movable footboard (1 m/0.1 cm). They were recorded to the nearest 0.1 cm. A portable length/height board was used. All research assistants (RA) team members were trained to use standardized methods, anthropometric measurement and outcome collecting procedure, which had a rigorous standard of recording. However, it was simple to apply for physicians and research assistants who recorded the data into the case report form. The Cronbach's alpha was assessed for the instruments reliability and overall rating score was 0.85.

Data management

Cleaning, editing, systemic verification, and other data quality assurance were performed by using a statistical package. If delivery occurred at home, the infant length was measured during home visits. The RA measured the subject again at 6 (+ 1 week), 12 (+ 1 week), 18 (+ 2weeks), and 24 (+ 2 weeks) months. For the present study, five measurements of the child's length/ height were taken and the mean recorded. The present study used the WHO's new reference anthropometric software package, launched in 2005. The program will recheck for standard data and export as length/height for age during 45 to 120 centimeters. These measurements are expressed in the form of Z-scores. Child stunting main outcome were used a Z-score is less than -2SD.

Characters variables

The data related to demographic variables, determinant variables of children from birth to two years of life were drawn from the database of The PCTC Project: Child gender was categorized into two groups, girls (group 1) and boys (group 2). Maternal height was classified into four groups, < 145 cm, 145-150 cm, 151-155 cm and > 156 cm. Maternal Education was classified into four groups, primary school and lower, high school, college, and University. Family income

was categorized into four levels, group 1- lowest income < Percentile 25, group 2- low income = percentile 25 to 50, group 3- middle income > percentile 50 to 75 and group 4- high income > percentile 75. The present study areas were classified into seven regions, Central area, South-Muslim, South-Buddhist, North Eastern, North-City, North-Hill Tribe, and Bangkok.

Data analysis

Numbers and percentages were used to describe prevalence and incidence of child stunting at each age and estimated classification of the stunting was based on definition of the WHO newest reference[1]. Child stunting incidence was estimated for each of five different points in time.

The rate of child stunting were presented in prevalence and incidence density from one stage to another. The prevalence was the number of persons with child stunting divided by the population at a specific time. The incidence was the number of new cases in a defined population, within a specified period *i.e.,* if incidence at 12 months then the cases of stunted children at 12 months was selected and stunting children at birth and at 6 months were ignored. Regarding the longitudinal study, Generalized Estimation Equation (GEE) model was approached for explainable variables for child stunting from birth to two years of life. For initial of GEE model all possible five variables would be explored by backward elimination method.

Ethical clearance

The present study was approved by the National Ethical Committee, Ministry of Public Health. All families were informed about the study proce-dures and possible risks before signing the consent form. The present study was further approved by the Ethics Committee, Khon Kaen University.

Results

Four thousand two hundred forty five children were included in the present study. Sixty infants were twins. Thus, the present report included only the 4,185 singletons. Thirty-four children died leaving 4,151 children for investigation of child stunting. Length was recorded at birth for 3,867 infants (93.1%), at 6 months for 3,490 infants (84.1%), at 12 months for 3,974 infants (95.7%), at 18 months for 3,940 infants (94.9%), and at 24 months for 3,725 infants (89.7%). The data missing occurred for the highest number of 661 (15.9%) at age of 6 months and the lowest number was 177 children (4.3%) at the age of 12 months. In comparing the two references between the National Center for health Statistic (NCHS) or the old reference and the WHO new growth standard reference, the data showed an increasing percentage of child stunting prevalence by current standard in comparing to NCHS. The highest prevalence was at 24 months in both growth standards. Child stunting prevalence in this sample by new reference varied from 6.0-16.6% and NCHS (old) reference varied from 4.9-16.6% as shown in Fig. 1.

The demographic characteristics of the presented subjects regarding gender of boys and girls are almost similar in number. Their families mostly were the lowest income, their mother's height was about 56% during 151-155 cm, and mother's education was about 53% of primary school. By using WHO new reference 2005, the present study found that the prevalence in child stunting in term of percentage increased after birth. At birth it was 6.0%, at 6 months, it was 6.9%, at 12 months, it was 9.5%, at 18 months, it was 14.6%, and at 24 months, it was 16.6%. The incidence in terms of percentage decreased from the time at birth it was 6.0%, at 6 months, it was 4.3%, at 12 months, it was 4.1%, at 18 months, it was 5.2%, and at 24 months, it was 3.2% as shown in Table 1.

The prevalence of child stunting at birth, 6, 12, 18 and 24 months and characteristic, among boys was 6.5, 8.5, 11.8, 16.6, and 19.4% respectively. For those children whose mothers were less than 145 cm tall, it was 18.8, 26.1, 35.6, 46.2 and 52.0% respectively. For those children whose mothers' education was less than primary school, it was about 6.7, 8.0, 12.6, 19.8 and 22.3% respectively. Children whose families had a low income, it was 8.0, 10.8, 16.6, 27.8 and 28.7% respectively. Regarding those children whose study areas were in North, the Hill-Tribe showed the highest rate of child stunting, it was 10.1, 33.6, 39.5, 58.9 and 59.7% respectively as shown in Table 2.

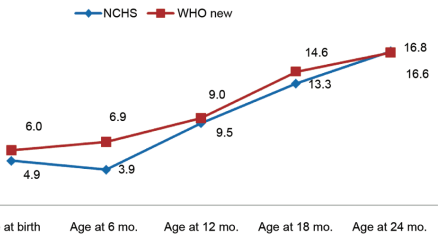

Fig. 1 Graph comparing prevalence by using the NCHs and growth reference

Table 1. Demographic characteristics of child stunting study of age from birth to 24 months

Factors	Number (%)
Prevalence of child stunting	
At birth	
Normal	3,635 (94.0)
Stunting	232 (6.0)
At 6 months	
Normal	3,248 (93.1)
Stunting	242 (6.9)
At 12 months	
Normal	3,597 (90.5)
Stunting	377 (9.5)
At 18 months	
Normal	3,366 (85.4)
Stunting	574 (14.6)
At 24 months	
Normal	3,105 (83.4)
Stunting	620 (16.6)
Incidence of child stunting	
At birth	
Normal	3,635 (94.0)
Stunting	232 (6.0)
At 6 months	
Normal	3,879 (95.7)
Stunting	176 (4.3)
At 12 months	
Normal	3,944 (95.9)
Stunting	170 (4.1)
At 18 months	
Normal	3,905 (94.8)
Stunting	215 (5.2)
At 24 months	
Normal	3,994 (96.9)
Stunting	130 (3.2)
Length-age (WHO Z-score): mean (SD) cm	
At birth	-0.071 (1.245)
At 6 months	-0.371 (1.110)
At 12 months	-0.520 (1.214)
At 18 months	-0.827 (1.156)
At 24 months	-0.911 (1.118)
Gender	
Girl	2,088 (50.3)
Boy	2,063 (49.7)
Mother height	
<145 cm	135 (3.61)
145-150 cm	850 (22.70)
151-155 cm	2,110 (56.36)
>156 cm	649 (17.33)
Mother education	
Primary school & lower	2,178 (52.94)
High school	1,171 (28.46)
College	353 (8.58)
University	412 (10.01)
Family Income	
< percentile 25	990 (23.54)
Percentile 25-percentile 50	1,127 (26.80)
Percentile 51-percentile 75	1,038 (24.68)
> percentile 75	1,051 (24.99)
Study areas	
Central area	771 (18.6)
South-Buddha	327 (7.9)
South-Muslim	716 (17.3)
North East	855 (20.6)
North-city	642 (15.5)
North-hill tribe	119 (2.9)
Bangkok	717 (17.3)

The incidence of child stunting at birth, 6, 12, 18, and 24 months and characteristic, among boys was 6.5, 5.4, 5.0, 5.5, and 3.3% respectively. For those children whose mothers were less than 145 cm tall, it was 18.8, 11.9, 9.0, 10.5 and 6.7% respectively. For those whose mothers' education was less than primary school, it was 6.6, 5.1, 5.9, 7.5, and 4.6% respectively. For those whose families had a lower income, it was 8.0, 6.7, 7.6, 10.0 and 4.9% respectively. In addition, for those in North-Hill Tribe, it was 10.1, 25.2, 12.6, 18.5 and 5.9% respectively as shown in Table 3.

Predictors by GEE analysis, for changed overtime from birth to 24 months of child stunting prevalence and incidence, crude and adjusted analysis showed that all factors, gender, mother height, mothers' education, and income were significantly associated with child stunting at all ages ($p < 0.05$) and the factor of North-Hill Tribe areas was the highest association compared to the other factors as shown in Table 4.

Discussion

From previous studies in many countries, the data indicated that the prevalence of stunting children aged 0-36 months in Mexico[22,26] was 4.9%, in South Africa[9,7,24,30,28] ranged 6.1-36%, in Arabia[25] ranged 19-32% and in Asia, Philippines[6] and Pakistan[8] ranged 3.6- 28%. By comparing those countries, Thailand ranged 6-16.6% and had a wider rate than Mexico but narrower rate than South Africa as well as in Arabia[25]. Furthermore, among South East Asian nations, the prevalence from Thailand was narrower than Pakistan and the Philippines. The reasons of this difference might the change in economics. In the

Table 2. Prevalence of child stunting age from birth to two years of life and child characteristic

Factor	At birth		At 6 months		At 12 months		At 18 months		At 24 months	
	Total	Stunted (%)	Total	Stunted (%)	Total	Stunted (%)	Total	Stunted (%)	Total	Stunted (%)
Gender										
Girl	1,947	108 (5.55)	1,746	94 (5.38)	2,003	145 (7.24)	1,978	249 (12.59)	1,883	263 (13.97)
Boy	1,920	124 (6.46)	1,744	148 (8.49)	1,971	232 (11.77)	1,962	325 (16.56)	1,842	357 (19.38)
Mother height										
<145 cm	128	24 (18.75)	115	30 (26.09)	132	47 (35.61)	130	60 (46.15)	127	66 (51.97)
145-150 cm	783	62 (7.92)	736	80 (10.87)	812	127 (15.64)	809	208 (25.71)	770	206 (26.75)
151-155 cm	1,989	105 (5.28)	1,785	102 (5.71)	2,028	150 (7.40)	2,012	243 (12.08)	1,915	279 (14.57)
>156 cm	599	23 (3.84)	532	14 (2.63)	616	32 (5.19)	604	36 (5.96)	560	34 (6.07)
Mother education										
Primary school & lower	2,057	137 (6.66)	1,922	153 (7.96)	2,098	264 (12.58)	2,070	410 (19.81)	2,024	452 (22.33)
High school	1,088	59 (5.42)	999	62 (6.21)	1,114	83 (7.45)	1,111	131 (11.79)	1,040	134 (12.88)
College	322	15 (4.66)	264	16 (6.06)	336	18 (5.36)	334	19 (5.69)	300	21 (7.00)
University	372	20 (5.38)	286	11 (3.85)	394	12 (3.05)	395	14 (3.54)	334	11 (3.29)
Family income										
< percentile 25	908	73 (8.04)	864	93 (10.76)	940	156 (16.60)	934	259 (27.73)	905	260 (28.73)
Percentile 25-percentile 50	1,046	68 (6.50)	975	68 (6.97)	1,058	104 (9.83)	1,044	154 (14.75)	1,035	188 (18.16)
Percentile 51-percentile 75	949	51 (5.37)	860	44 (5.12)	975	63 (6.46)	966	97 (10.04)	908	114 (12.56)
> percentile 75	939	40 (4.26)	774	37 (4.78)	973	52 (5.34)	970	62 (6.39)	854	55 (6.44)
Study areas										
Central area	740	38 (5.14)	689	18 (2.61)	740	41 (5.54)	721	51 (7.07)	736	74 (10.05)
South-Buddha	305	22 (7.21)	292	14 (4.79)	321	25 (7.79)	320	37 (11.56)	317	44 (13.88)
South-Muslim	656	39 (5.95)	614	53 (8.63)	698	105 (15.04)	688	201 (29.22)	643	200 (31.10)
North East	782	52 (6.65)	774	55 (7.11)	822	64 (7.79)	817	103 (12.61)	821	132 (16.08)
North-city	629	52 (8.27)	554	50 (9.03)	621	74 (11.92)	631	91 (14.42)	619	80 (12.92)
North-hill tribe	119	12 (10.08)	119	40 (33.61)	119	47 (39.50)	119	70 (58.82)	119	71 (59.66)
Bangkok	632	17 (2.69)	444	12 (2.70)	649	21 (3.24)	640	20 (3.13)	467	18 (3.85)

Table 3. Incidence of child stunting age from birth to 2 years

Factor	At birth		At 6 months		At 12 months		At 18 months		At 24 months	
	Total	Stunted (%)	Total	Stunted (%)	Total	Stunted (%)	Total	Stunted (%)	Total	Stunted (%)
Gender										
Girl	1,947	108 (5.55)	2,042	68 (3.33)	2,069	67 (3.24)	2,072	103 (4.97)	2,074	63 (3.04)
Boy	1,920	124 (6.46)	2,013	108 (5.37)	2,045	103 (5.04)	2,048	112 (5.47)	2,050	67 (3.27)
Mother height										
< 145 cm	128	24 (18.75)	134	16 (11.94)	134	12 (8.96)	134	14 (10.45)	134	9 (6.72)
145-150 cm	783	62 (7.92)	831	57 (6.86)	841	59 (7.02)	841	81 (9.63)	843	31 (3.68)
151-155 cm	1,989	105 (5.28)	2,068	80 (3.87)	2,096	78 (3.72)	2,100	96 (4.57)	2,102	74 (3.52)
> 156 cm	599	23 (3.84)	631	12 (1.90)	640	15 (2.34)	642	13 (2.02)	642	8 (1.25)
Mother education										
Primary school & lower	2,057	137 (6.66)	2,136	109 (5.10)	2,159	127 (5.88)	2,160	162 (7.50)	2,163	99 (4.58)
High school	1,088	59 (5.42)	1,147	47 (4.10)	1,162	37 (3.18)	1,163	46 (3.96)	1,163	25 (2.15)
College	322	15 (4.66)	344	12 (3.49)	350	4 (1.14)	351	5 (1.42)	352	3 (0.85)
University	372	20 (5.38)	396	8 (2.02)	409	2 (0.49)	412	2 (0.49)	412	1 (0.24)
Family income										
< percentile 25	908	73 (8.04)	949	64 (6.74)	962	73 (7.59)	962	96 (9.98)	962	47 (4.89)
Percentile 25-percentile 50	1,046	68 (6.50)	1,076	47 (4.37)	1,090	43 (3.94)	1,091	65 (5.96)	1,094	39 (3.56)
Percentile 51-percentile 75	949	51 (5.37)	1,000	34 (3.40)	1,012	33 (3.26)	1,013	36 (3.55)	1,014	29 (2.86)
> percentile 75	964	40 (4.15)	1,030	31 (3.01)	1,050	21 (2.00)	1,054	18 (1.71)	1,054	15 (1.42)
Study areas										
Central area	740	38 (5.14)	758	13 (1.72)	762	28 (3.67)	762	24 (3.15)	764	24 (3.14)
South-Buddha	305	22 (7.21)	319	11 (3.45)	325	13 (4.00)	327	17 (5.20)	327	9 (2.75)
South-Muslim	656	39 (5.95)	693	38 (5.48)	709	54 (7.62)	709	85 (11.99)	709	35 (4.94)
North East	782	52 (6.65)	845	40 (4.73)	851	25 (2.94)	851	39 (4.58)	852	42 (4.93)
North-city	629	52 (8.27)	635	35 (5.51)	639	30 (4.69)	639	26 (4.07)	639	8 (1.25)
North-hill tribe	119	12 (10.08)	119	30 (25.21)	119	15 (12.61)	119	22 (18.49)	119	7 (5.88)
Bangkok	632	17 (2.69)	682	9 (1.32)	705	5 (0.71)	709	1 (0.14)	710	4 (0.56)

Table 4. Crude and adjusted odds ratio of factors affecting prevalence and incidence of child stunting from birth to 24 months result from GEE

Factors	Prvalence of child stunting						Incidnence of child stunting					
	Number	Stunting (%)	Crude OR	Adjusted OR	95% CI for adjusted	p-value	Number	Stunting (%)	Crude OR	Adjusted OR	95% CI for adjusted	p-value
Gender						<0.001						<0.001
Girl	1,883	263 (13.97)	1	1			2,074	63 (3.04)	1	1		
Boy	1,842	357 (19.38)	1.44	1.5	1.30, 1.74		2,050	67 (3.27)	1.29	1.3	1.16, 1.47	
Maternal height						<0.001						<0.001
Mum height <145 cm	127	66 (51.97)	1	1			134	9 (6.72)	1	1		
Mum height 145-150 cm	770	206 (26.75)	0.37	0.52	0.39, 0.71		843	31 (3.68)	0.59	0.81	0.67, 0.98	
Mum height 151-155 cm	1,915	279 (14.57)	0.18	0.3	0.22, 0.40		2,102	74 (3.52)	0.34	0.56	0.46, 0.68	
Mum height >156 cm	560	34 (6.07)	0.09	0.19	0.13, 0.28		642	8 (1.25)	0.18	0.35	0.26, 0.46	
Mother education						<0.001						<0.001
No formal education & less than primary school	2,024	452 (22.33)	1	1			2,163	99 (4.58)	1	1		
High school	1,040	134 (12.88)	0.59	0.83	0.69, 0.99		1,163	25 (2.15)	0.62	0.82	0.70, 0.95	
College	300	21 (7.00)	0.37	0.78	0.53, 1.14		352	3 (0.85)	0.37	0.69	0.50, 0.96	
University	334	11 (3.29)	0.25	0.58	0.38, 0.88		412	1 (0.24)	0.27	0.52	0.35, 0.76	
Family Income						<0.001						<0.001
< p25	905	260 (28.73)	1	1			962	47 (4.89)	1	1		
p25-p50	1,035	188 (18.16)	0.56	0.73	0.60, 0.87		1,094	39 (3.56)	0.63	0.77	0.66, 0.89	
p51-p75	908	114 (12.56)	0.38	0.67	0.54, 0.82		1,014	29 (2.86)	0.47	0.77	0.65, 0.92	
> p75	854	55 (6.44)	0.25	0.66	0.51, 0.86		1,054	15 (1.42)	0.31	0.78	0.63, 0.97	
Study areas						<0.001						<0.001
Panomtuan	736	74 (10.05)	1	1			764	24 (3.14)	1	1		
Tapha Buddha	317	44 (13.88)	1.52	1.37	0.98, 1.94		327	9 (2.75)	1.36	1.22	0.92, 1.62	
Tapha Muslim	643	200 (31.10)	3.39	2.38	1.87, 3.02		709	35 (4.94)	2.25	1.74	1.42, 2.14	
Kranuan	821	132 (16.08)	1.74	1.59	1.23, 2.04		852	42 (4.93)	1.44	1.33	1.07, 1.64	
Nan (city)	619	80 (12.92)	1.98	1.82	1.39, 2.39		639	8 (1.25)	1.43	1.38	1.10, 1.73	
Nan (Hill tribe)	119	71 (59.66)	10.37	4.73	3.35, 6.67		119	7 (5.88)	4.86	2.78	2.20, 3.51	
Bangkok	467	18 (3.85)	0.49	0.66	0.45, 0.96		710	4 (0.56)	0.31	0.41	0.28, 0.59	

Philippines children, this influence might cause different rate in current time. However, the data from the Philippines was lost to follow-up in more than 50%[6].

When comparing to a Thai study, the present study found that the prevalence in child stunting for children from birth to two years of life ranged 6-16.6%. This is higher than the estimation of the cross sectional survey in the same age groups by Panpanich et al, in Thailand year 2000[29], which found malnutrition was 12.1% among Thai children. The present study showed a prevalence rate close to the study by the Ministry of Public Health (MOPH)[27] of Thailand, which was 9.9%, in year 2003. However, the MOPH investigated child stunting prevalence age at 0-5 years, which had a wider range of age-groups than the present study.

Even though, the Thai child stunting prevalence showed a declining rate from 21.5% in 1987[5] to 10.8% in the recent year[5]. However, by comparing with the international child stunting prevalence (should be less than 5%, by the US reference[3]), the present study found that Thai children's stunting prevalence was two times higher than the international standard. Therefore, the present study suggests that early interventions are essential.

The incidence in terms of percentage decreased from the time at birth, it was 6.0%. This finding indicates that the highest number of new cases occurred with children age at birth, which shows clearly that prenatal care is needed in this population. The incidence of children that declined at 6 months was 4.3%, at 12 months was 4.1% and at 24 months was 3.2%. However, at 18 months, it increased by 5.2%. Even though, the investigation for new cases showed a slow decrease in children of age 6 and 12 months, it increased in children of 18 months. This indicated that to reduce the new case of child stunting, further quantitative research regarding the factors such as age of introduction of food and breast feeding, which are affecting child stunting, is needed. A qualitative research on the reasons of the incidence will help everyone involved.

Only one previous study of the incidence rate of child stunting from the Philippines[6] could be found. The result from the Philippine's study on the age distribution of new cases of stunting was that the peak in new cases occurred in child age at 8 months and during the age at 24 months. However, there were more new cases of stunting with a peak at 16 months of age, which is the period of starting additional food[17]. In the present study, the new cases occurred in every period of child age but slightly decrease when the child grew up, which is consistent with the Philippines' study. Even though the nutrition interventions were implemented, the present study showed that the prevalence rate was still increased and the incidence showed the consistent rate from birth to 24 months. To reduce child stunting, the present study suggests that to identify a new case of child stunting in Thailand a monitoring system should be established for an early diagnosis. In addition, introduction of food for children in an early child age and an antenatal care is essential for this population.

By using WHO new reference 2005[1], the prevalence by WHO's reference in every age group was higher than prevalence by NCHS reference. It is interesting that at age 6 months, the prevalence from new standard from WHO reached a higher number, more than almost two times higher than NCHS standard. In the present study, it indicated that the WHO new reference showed more sensitivity to detect the prevalence for child stunting in early age than the NCHS in this population. However, this finding indicated that the prevalence at child age of 24 months in both references showed the same result. The present study suggests confirming the study of child growth in higher age with different growth reference standard. Furthermore, comparing our growth rate with the other previous study should be explored.

With respect to demographic characteristic factors, the present study found that the prevalence and incidence was boy, mother height less than 145 centimeters, low education, low income and mostly lived in North-Hill Tribe had the highest rate of prevalence and increased when the children grew up. GEE analysis has done for factors affecting child stunting from birth to 2 years. The present study found that the North-Hill-tribe people showed the strongest predictors for both prevalence and incidence, which is similar to the study in Thailand in year 2000 by Panpanich[29]. However, the previous study investigated child stunting by using NCHS growth reference standard that did not standardize the growth in children in Asia. Only one birth cohort study from the Philippine's study[6] investigated the factors with the incidence rate and the present study found the same result. To confirm the growth reference standard, another study should be done. To reduce the malnutrition in this population, early intervention for children in an earlier age is essential, particularly in the North-Hill-tribe area. In addition, many factors influencing[23,28] child stunting in early young age were

not investigated. Those could be breast feeding pattern, introduction of food at early age, micro-nutrient, iodine intake, child rearing, dental health factors etc. A study of other factors affecting child stunting is needed. Moreover, the study of factors affecting factors by using difference growth standard measurement is also needed. Concerning confounding factors, the present study found that all explored factors showed high association with outcome. Therefore, factors such as study area, sex, and mothers' height should be controlled in further research. From previous studies[6,8,23,28], there are many factors that influence child stunting, hence studies of more factors affecting child stunting and factor of time change are needed.

The strengths of the present study were, first, by using a new growth standard that was adjusted for breast feeding, this current data was more appropriate. Second, the introduction of the birth cohort study design, the first birth cohort study was established in the UK in 1975[16,17]; and recently the British data have been producing continually sophisticated information to the world. In South East Asia, there was only one cohort study that was conducted in the Philippines in 1987[6]. However, the Philippines' study has been already terminated. Finally, the previous cohort studies demonstrated that the statistic analysis of time as co-variate was limited, the present study also conducted an analysis of GEE model concerning time change of child growth in a longitudinal study. For the limitation of the present study, there was average 9.1% of the sample lost to follow-up. However, the missing data for child age at 6 months was around 17%. Even though, this data showed normal distribution. There was sufficient numbers of subject collected. This is because it was conducted by purposive sampling in four communities and one hospital. However, the selection bias might influence the data.

Conclusion

By using new growth reference, this longitudinal study in the first two years of life demonstrated that the prevalence of child stunting had the increasing percentage. The birth prevalence was 6.0%, at 6 months was 6.9%, at 12 months was 9.5%, at 18 months was 14.6%, and at 24 months was16.6%. The incidence showed decreasing percentage at birth was 6.0%, at 6 months was 4.3%, at 12 months was 4.1%, at 18 months was increasing at 5.2% and at 24 months was 3.2%. The prevalence increased whereas the incidence decreased at all ages except age at 18 months when the child grew up. For GEE analysis, at all ages from birth to 24 months of child stunting prevalence and incidence, crude analysis showed that gender, mothers height, mothers education, income, and North-Hill Tribe areas were significantly correlated ($p < 0.05$) with child stunting. The present study demonstrated that the prevalence and the incidence of child stunting among infants children in Thailand remains a problem. To reduce the problems an early diagnosis, nutrition interventions, antenatal care and a monitoring system for the new cases of child stunting are vital. For further research, the present study suggests the introduction of food for infants and others factors affecting child stunting. Furthermore, factor and qualitative research are needed.

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ความชุกและอุบัติการณ์ของภาวะเตี้ยของเด็กไทยในกลุ่มอายุตั้งแต่แรกเกิดถึงสองปี: โครงการวิจัยระยะยาวในเด็กไทย

อรุณศรี มงคลชาติ, บัณฑิต ถิ่นคำรพ, ลัดดา เหมาะสุวรรณ, อุไรพร จิตต์แจ้ง, จันทร์เพ็ญ ชูประภาวรรณ

วัตถุประสงค์: *เพื่อมุ่งเน้นศึกษาอัตราความชุก และอุบัติการณ์ของโรคภาวะเตี้ยของเด็กไทย ในกลุ่มอายุตั้งแต่แรกเกิดถึงสองปีโครงการวิจัยระยะยาวในเด็กไทย และเพื่อศึกษาปัจจัยพื้นฐานที่มีผลต่อภาวะเตี้ย ในช่วงอายุต่าง ๆ เมื่อแรกเกิด 6, 12, 18 และ 24 เดือน*

วัสดุและวิธีการ: *การศึกษาครั้งนี้เป็นการศึกษาระยะยาวโดยทำการศึกษาเด็กไทย จำนวน 4,245 คน ที่คลอดในระหว่างเดือนมิถุนายน พ.ศ. 2543 ถึง เดือนกรกฎาคม พ.ศ. 2545 ซึ่งอาศัยในเขตพื้นที่ 4 จังหวัด และกรุงเทพมหานคร โดยใช้มาตรฐานการเจริญเติบโตชุดใหม่ขององค์การอนามัยโลกฉบับใหม่ล่าสุด ซึ่งปรับด้านฐานประชากรที่เลี้ยงบุตรด้วยนมมารดาแล้ว การเก็บข้อมูลดำเนินการโดยทีมแพทย์ และผู้ช่วยนักวิจัยที่ถูกฝึกและอบรมอย่างเป็นระบบ และตรวจสอบคุณภาพอย่างต่อเนื่อง*

ผลการศึกษา: *พบว่าความชุกของการเกิดภาวะเตี้ยในเด็กไทยร้อยละ 6.0 เมื่อเด็กมีอายุที่แรกเกิด ร้อยละ 6.9 เมื่ออายุ 6 เดือน ร้อยละ 9.5 เมื่ออายุ 12 เดือน ร้อยละ 14.6 เมื่ออายุ 18 เดือน และร้อยละ 16.6 เมื่อเด็กมีอายุ 24 เดือน อุบัติการณ์การเกิดภาวะเตี้ยในเด็กไทย พบว่าแรกเกิดเป็นร้อยละ 6.0 เมื่อเด็กอายุ 6 เดือน 4.3 เมื่อเด็กอายุ 12 เดือน 4.1 เมื่อเด็กอายุ 18 เดือน 5.2 และ เมื่อเด็กอายุ 24 เดือน ร้อยละ 3.2 และเมื่อทำการวิเคราะห์โดยการวิเคราะห์ใช้สถิติ เพื่อการวิเคราะห์ข้อมูลโดยคำนึงถึงความเปลี่ยนแปลงทางด้านเวลาของการศึกษาระยะยาว ผลการศึกษาพบว่า ปัจจัย ที่มีผลต่อภาวะเตี้ยของเด็กอย่างมีนัยสำคัญตั้งแต่อายุแรกเกิดถึงสองปีคือ ปัจจัยด้านเพศ, ความสูงของมารดา, การศึกษาของมารดา, รายได้ครอบครัว และการอยู่อาศัยในพื้นที่ของจังหวัดน่านโดยเฉพาะชาวเขา ($p < 0.001$)*

สรุป: *ความชุกของภาวะเตี้ยในเด็กไทยมีมากขึ้นเมื่อเด็กอายุสูงขึ้นถึงสองปี และอุบัติการณ์การเกิดภาวะเตี้ยในเด็กไทยมีมากขึ้นชัดเจนในช่วงอายุ 1 ปี ครึ่ง ผลการศึกษาครั้งนี้มีข้อเสนอแนะเชิงนโยบายด้านการดูแลมารดาในระหว่างการตั้งครรภ์ การให้การส่งเสริมด้านอาหาร ตลอดจนงานวิจัยในระยะต่อไป สำหรับการพัฒนาความสูงของเด็กไทยโดยเฉพาะในช่วงต้นอายุหรือในวัยเด็กอ่อน*