



## Breastfeeding and Nutritional Status among Children in Thailand

Patarapan Odton\*

University of the Thai Chamber of Commerce, Thailand

**\*Corresponding author:** Patarapan Odton, PhD Post-doctoral researcher, Research Institute for Policy; Evaluation and Design (RIPED), University of the Thai Chamber of Commerce; 126/1 Building 21, 7<sup>th</sup> Floor, Vibhavadi Rangsit Road, Dindang, Bangkok, 10400, Thailand; Email: podton@riped.utcc.ac.th

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### Abstract

**Background:** Breastfeeding is the gold standard when it comes to infant nutrition, and no artificially produced infant formula will ever be able to replace it. In the first years of life, breast milk protects infants from infections by passing on their mothers' antibodies. In Thailand, there were many studies on prevalence and determinants of breastfeeding since National Breastfeeding Project began in 1989. Only few studies related to effects of breastfeeding on child's nutritional status.

**Objective:** The objective of this study is to investigate impact of breastfeeding practices on nutritional status of children.

**Methodology:** The Thailand Multiple Indicator Cluster Survey (MICS3 and MICS4) are the main data source. For assessing the nutritional status of children, we use three anthropometric indices, weight-for-age, height-for-age, and weight-for-height. Regression models are performed to assess the effects of breastfeeding on child's nutritional indices, including demographic and socio-economic factors.

**Findings:** Based on weight-for-age, height-for-age, and weight-for-height z-score, infant aged 0-5 months with exclusively and non-exclusively breastfed are not significantly different in all those three indices. During ages 6-11 months, infants who never been breastfed are moderately underweight and moderately stunted, much smaller and shorter than who ever been breastfed. There are no different in height-for-age when they get older, aged 24-59 months. Results from regression models indicate that infant with less than 6 months of breastfed are significantly higher in weight-for-age z-score than who never been breastfed. Children have been longer breastfed (24 months and over) are smaller than who never been breastfed. It's clear that longer breastfed than 12 months can effects to lower weight-for-height.

**Conclusion:** Breastfeeding effect to nutrition indices when infant aged 6-11 months. Longer breastfed can effect to lower weight-for-age, height-for-age, and weight-for-height when they aged 12-47 months. At the fifth year of life, all children are in the standard weight and height.

**Keywords:** Breastfeeding; Weight-for-age; Height-for-age; Weight-for-height

**Abbreviations:** MICS: Multiple Indicator Cluster Survey; RSV: Respiratory Syncytial Virus; UNICEF: United Nations International Children's Fund; WHO: World Health Organization.

### Introduction

Breastfeeding is the gold standard when it comes to infant nutrition, and no artificially produced infant

formula will ever be able to replace it. In the first years of life, breast milk protects infants from infections by passing on their mothers' antibodies, and it also helps establish the all-important and life-long physical and emotional bond between a mother and her baby. Breast milk is not only the source of essential nutrients that every child needs to develop; it is also economical and safe. The exclusive use of infant formula to feed a baby can

lead to growth faltering, micronutrient malnutrition and result in serious diarrhoeal illnesses if the formula is not prepared properly.

UNICEF and WHO recommend exclusive breastfeeding for the first six months of life for all children, with continued breastfeeding for up to two years of age together with complementary food. In Thailand, only 12.3 per cent of children are being exclusively breastfed for the first six months of life, as recommended by UNICEF and WHO. The highest rates of exclusive breastfeeding are found in the North and Northeast regions (19.6 and 13.8 per cent), while the rates in the South, Central region and Bangkok are 12.2, 7.9 and 8.2 per cent, respectively [1]. This percentage of children of exclusively breastfed for the first six months of life was increase from the last survey, from 5.4 per cent in the Thailand Multiple Indicator Cluster Survey (MICS) 2005 [2]. The report published in April 2007 by the Agency for Healthcare Research and Quality [3], show the limited benefits of breastfeeding for maternal and infant health outcomes.

The report included systematic reviews/meta-analyses, randomized and non-randomized comparative trials, prospective cohort and case-control studies published in English and which had a comparative arm with formula feeding or different duration of breastfeeding. The report noted that the breastfeeding literature includes many observational studies, that there were limited randomized controlled clinical trials, that definitions of breastfeeding and “exclusive breastfeeding” were not consistent among the studies, that some 3 studies failed to control for confounding factors, and that there was not always reliable data collection regarding other feeding behaviors. Breastfed infants have a lower incidence of many neonatal and infant infections than do formula-fed infants. Breastfed infants who are exposed to microorganisms that cause infectious diseases generally have a milder form of the infection and are less likely to require hospitalization.

For example, breastfed infants who encounter rotavirus infection, a common cause of gastroenteritis in infants, are less likely to require intravenous fluids and hospitalization than are artificially fed infants. Most breastfed infants with rotavirus can continue breastfeeding throughout the illness.

Breastfed infants have decreased incidence and severity of otitis media, gastroenteritis, and respiratory syncytial virus (RSV) disease. However, empirical study on the effect of breastfeeding on

child health and development is challenging for several reasons. While some of the studies found an association between breastfeeding and cognitive benefits, these studies tended to be rated as having lower methodological quality. Those studies reporting a positive relationship between breastfeeding and cognitive development, tended to not control for confounding variables. Studies assessed as being for higher methodological and controlling for confounding factors, tended to not report a significant relationship between breastfeeding and cognitive development.

In Thailand, only about 12% of mothers exclusively breastfed for the first six months. This is among the lowest exclusive breastfeeding rates in Asia. Regional differences were reported with no statistical evidence on other determinants of breastfeeding. A thorough understanding of the factors that discourage mothers from exclusive breastfeeding could help in the development of strategies to overcome these obstacles. There were some studies on determinants of exclusive breastfeeding among Thai women, but those focused on sub-sample, limited area [4-6], or sample with specific problem [7]. Only few studies on the impact of breastfeeding to child's health and development outcomes among Thai population [8-10]. However, we lack for empirical study on effects of exclusive breastfeeding on child's health among Thai population based on national representative sample. Such studies need long-term panel data which allow for cause and effects measurement in the repeated sample unit.

MICS is only available national representative survey on children and women in Thailand. Even if MICS is cross-sectional survey data, we can use retrospective answers about breastfeeding practices, infant's health, so we can link to current outcomes. Statistical models allow us to examine the relationship between determinants and those outcomes with control confounding factors. This study attempts to use the comprehensive analysis on influence of breastfeeding on child nutritional status using the Thailand Multiple Indicator Cluster Survey (MICS).

## Data and Methodology

The Thailand Multiple Indicator Cluster Survey (MICS3 and MICS4) is the main data source because this is a population based sample of 26,850 – 43,440 households. This survey project was designed for monitoring the situation of children and women. There were about 22,256 – 34,187 women aged 15-49 years old and 9,444 – 9,757

under-five children included in the survey. Based on MICS survey, data from household and women questionnaires will be used as the determinants of breastfeeding. The information on breastfeeding practice and child development comes from the questionnaire for children under five. The child development section contains support for learning, learning materials (children's books and playthings) at home, inadequate care, early childhood development index (literacy-numeracy, physical, social-emotional, and learning domains), and attendance to early childhood education.

Regression models will be used to investigate the effects of breastfeeding on child nutritional status. For assessing the nutritional status of children, we use three anthropometric indices, weight-for-age, height-for-age, and weight-for-height. We use the pre-calculated values that [11] obtained from UNICEF. As described in the MICS final report the under-nourishment in a population can be evaluated by comparing children to reference distribution. The reference population used by MICS program is the WHO/CDC/NCHS reference. Each of the three nutritional status indicators can be expressed in standard deviation units, called "Z-score" from the median of this reference population [2]. The formula for Z-score is as follows:

$$z = \frac{\text{Child's measurement} - \text{Reference median}}{\text{Reference SD}} \quad (1)$$

Where,

Child's measurement = weight or height of given child at age X

Reference median = mean or 50<sup>th</sup> percentile of the reference population at age X

Reference SD = standard deviation of the reference population at age X

Using equation (1) and measurement of children's weight and height, we can obtain weight-for-age, height-for-age, and weight-for-height z-score. Relationship between breastfeeding practice and breastfeeding duration, including demographic and socio-economic factors, is then investigate using linear regression model as equation (2).

$$y = \alpha + \beta_i X_i + \epsilon_i \quad (2)$$

Where,

y are weight-for-age, height-for-age, and weight-for-height z-score,

$X_i$  is breastfeeding duration and other demographic and socio-economic characteristic of household, such as area, region, mother's education, and wealth index quintile, and  $\epsilon_i$  is the error term.

## Results

The children's weights and other three anthropometric indices, weight-for-age, height-for-age, and weight-for-height, are used as nutritional status indicators [12].

Figure 1 shows means with their 95% confidence intervals of body weights of children age 0-5 months who never been breastfed, exclusively breastfed, predominantly breastfed, breastfed with other milk or foods, and weaned. The infants with exclusively and predominantly breastfed are smaller than other groups.

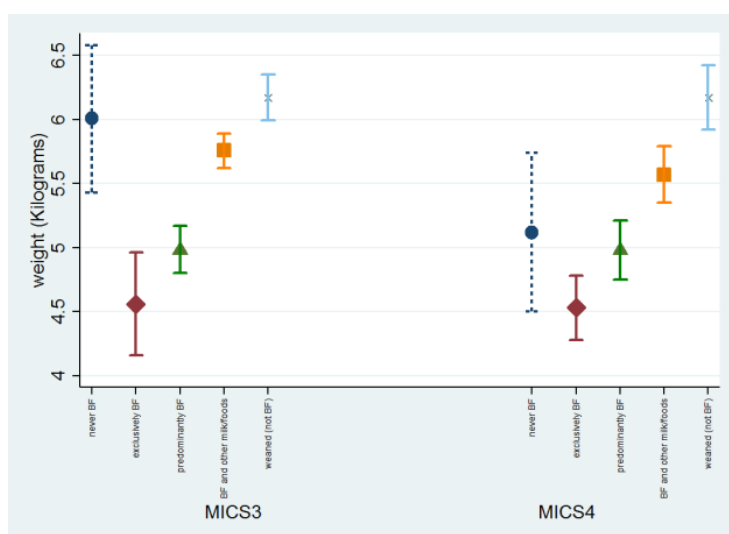


Figure 1: Body weight in kilograms of children aged 0-5 months by breastfeeding types, Thailand 2005 and 2012.

For children older than 5 months, the duration of breastfeeding effect to their body weights as shown in Figure 2. We use the answer from question of “how many months has he/she ever been breastfed continuously?” as the duration of breastfeeding, which only available in MICS4 dataset. It's clear from Figure 2 that infant with breastfeeding are heavier than who never been breastfed during the

first year of life. For children aged between 1-4 years old, children who has been continuously breastfed more than 6 months are smaller than the other two groups (never been breastfed and breastfed for less than 6 months). At the fifth year of life, there are no different in body weights of children who never been breastfed and who ever been breastfed for 6 months and over.

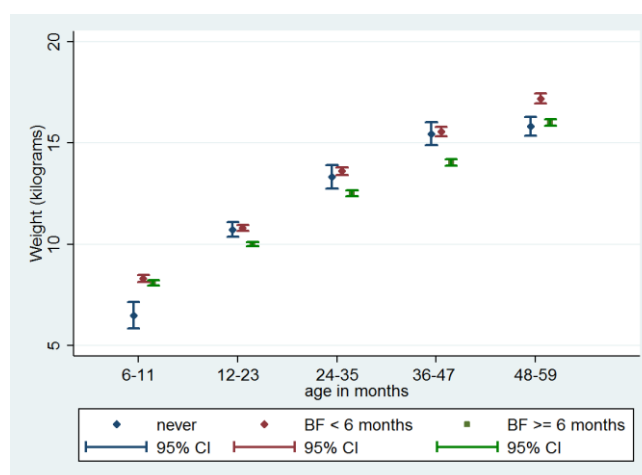


Figure 2: Body weight in kilograms of children aged 6-59 months by age group and breastfeeding types, Thailand, 2012.

Weight-for-age is a measure of both acute and chronic malnutrition. Children whose weight-for-age is more than two but less than three standard deviations below the median of the reference population are considered moderately underweight while those whose weight-for-age is more than three standard deviations below the median are

classified as severely underweight [1]. We compare the mean weight-for-age z-score of children aged 0-5 months from two rounds of the survey as shown in Figure 3. During the first 6 months of life, infant with exclusively and non-exclusively breastfed are not different in weight-for-age z-scores.

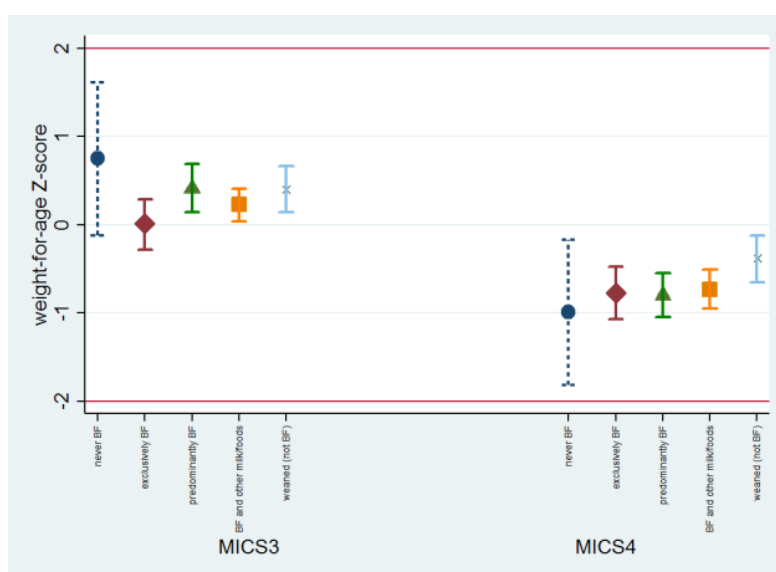


Figure 3: Weight-for-age of children aged 0-5 months by breastfeeding types, Thailand 2005 and 2012.

For children aged 6-59 months in MICS4, the mean weight-for-age z-scores and their 95% confidence interval by age group and breastfeeding categories are shown in Figure 4. During ages 6-11 months, infants who never been breastfed are moderately

underweight and much smaller than who ever been breastfed. For children aged 1-4 years old, children who [13] ever been breastfed at least 6 months are significantly smaller than who never been breastfed and who ever breastfed for less than 6 months.

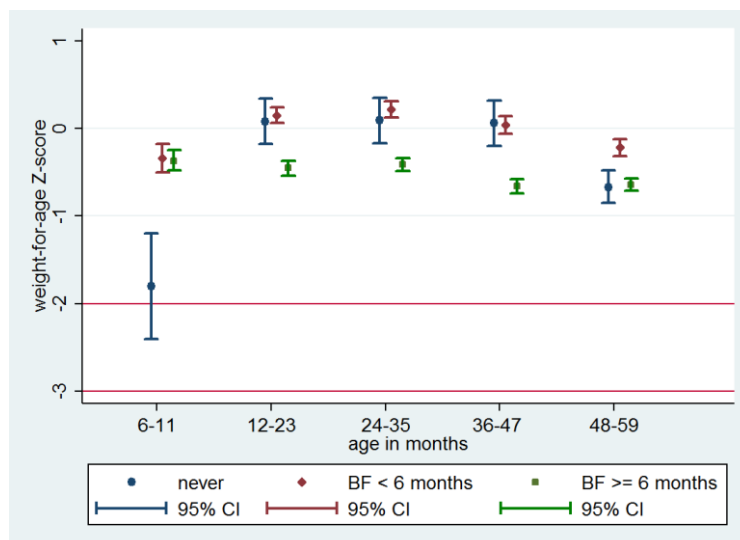


Figure 4: Weight-for-age of children aged 6-59 months by age group and breastfeeding types, Thailand, 2012.

Height-for-age is measure of linear growth. Children whose height-for-age is more than two but less than three standard deviations below the median of the reference population are considered short for their age and are classified as moderately stunted. Those whose height-for-age is more than three standard deviations below the median are classified as severely stunted. Stunting is a reflection of chronic malnutrition as a result of

failure to receive adequate nutrition over a long period and recurrent or chronic illness [1].

Figure 5 shows mean of height-for-age z-scores for children aged 0-5 months, compare five groups of population during two periods. There were no different in height-for-age z-score for children who are breastfeeding or not.

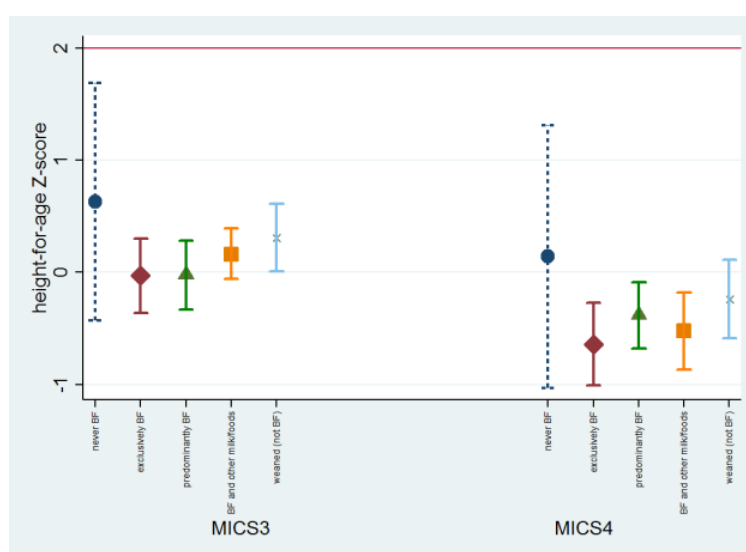


Figure 5: Height-for-age of children aged 0-5 months by breastfeeding types, [14] Thailand 2005 and 2012.

Figure 6 show means and their 95% confidence intervals of height-for-age for children aged 6-59 months by their breastfeeding duration. In children ages 6-11 months, never been breastfed infants are significantly shorter than who ever been breastfed,

and classified as moderately stunted. During aged 1-2 years old, infant who ever been breastfed for more than 6-10 months are shorter than the other two groups, but no different in height-for-age when they get older, aged 24-59 months.

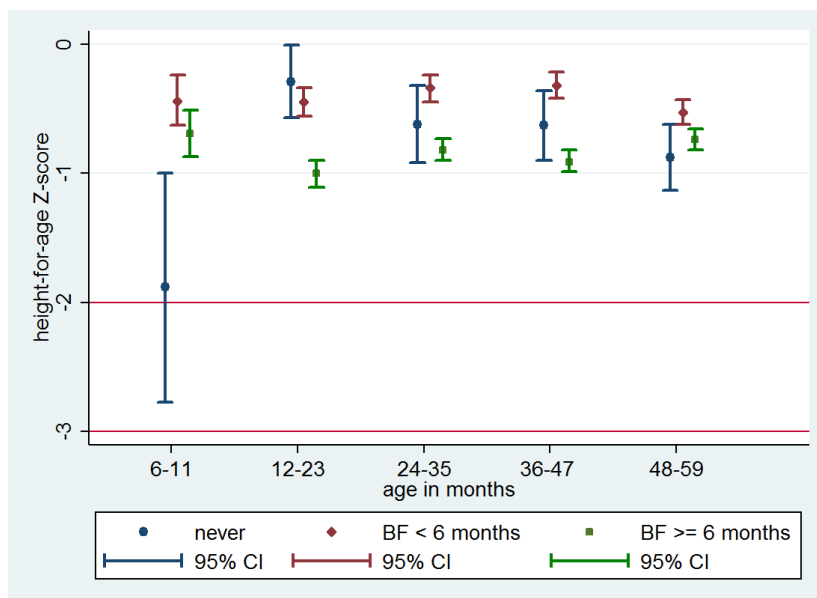


Figure 6: Height-for-age of children aged 0-5 months by breastfeeding types, [14] Thailand 2005 and 2012.

Children whose weight-for-height is more than two but less than three standard deviations below the median of the reference population are classified as moderately wasted, while those who all more than three standard deviations below the median are

classified as severely wasted [1]. For children aged 0-5 months, children who never been breastfed are classified as over-weight while other breastfeeding categories are in the standard as shown in Figure 7.

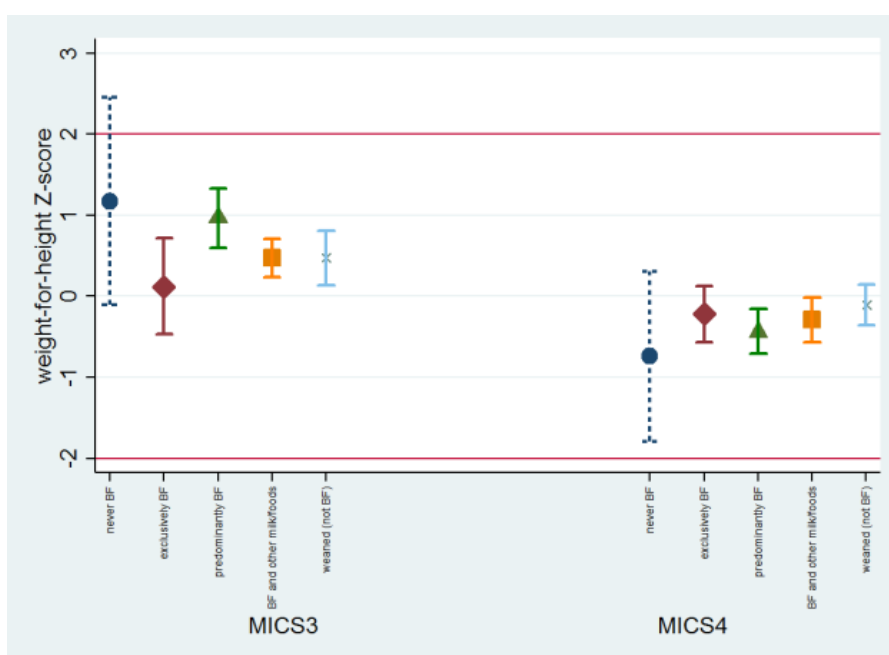


Figure 7: Weight-for-height of children aged 0-5 months by breastfeeding types, Thailand 2005 and 2012.

Children aged 6-11 months who never been breastfed are thinner than the one who ever been breastfed as shown in Figure 8. During aged 24-47 months, children who ever been breastfed at least 6

months are thinner than who never been breastfed or breastfed for less than 6 months, but they are the same shape in the fifth years of life.

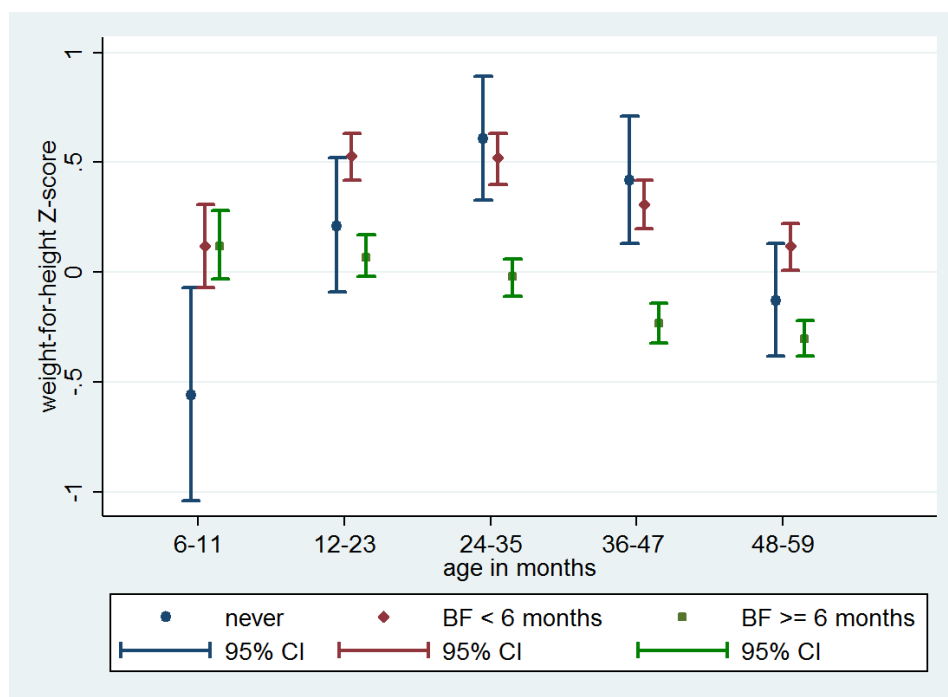


Figure 8: Weight-for-height of children aged 6-59 months by age group and breastfeeding types, Thailand, 2012.

Regression models are used to investigate the relationship between breastfeeding duration and nutritional status, including weight for age, height for age, and weight for height. Table 1-4 shows the results from these models. Body weight is significant increase by duration of breastfeeding for infants aged less than 6 months, but no significant

effect for infants aged 6-11 months. After the first year of life, when children aged 1-5 years old, children with long duration of breastfed are significantly lighter than one who shorter breastfed as shown in columns (3), (4), (5) and (6) of (Table 1).

Determinants	(1)	(2)	(3)	(4)	(5)	(6)
	< 6 months	6 - 11 months	12 - 23 months	24 - 35 months	36 - 47 months	48 - 59 months
Breastfeeding duration (months)	0.534*** (0.0508)	0.0189 (0.0290)	-0.0490*** (0.0139)	-0.0635*** (0.00877)	-0.0513*** (0.0109)	-0.0249** (0.0102)
Area (Urban is ref.)						
Rural	0.334* (0.191)	-0.115 (0.177)	0.129 (0.167)	0.247 (0.188)	-0.0249 (0.240)	-0.132 (0.244)
Region (Central+BKK is ref.)						
North	-0.188 (0.212)	0.0918 (0.246)	-0.338 (0.233)	-0.302 (0.238)	-0.178 (0.351)	-0.593* (0.322)
Northeast	-0.174 (0.251)	-0.275 (0.232)	-0.500** (0.227)	-0.174 (0.245)	-0.394 (0.307)	-1.067*** (0.376)
South	-0.606*** (0.203)	-0.113 (0.214)	-0.491** (0.237)	-0.159 (0.279)	-0.285 (0.296)	-0.666** (0.333)
Mother's education (None is ref.)						



Primary	-0.230 (0.354)	0.328 (0.372)	0.599* (0.339)	0.607** (0.258)	1.111** (0.552)	1.054** (0.430)
Secondary and above	-0.422 (0.342)	0.422 (0.339)	0.406 (0.342)	0.632** (0.266)	0.462 (0.532)	1.048** (0.444)
Wealth index quintiles (Poorest is ref.)						
Second	-0.0118 (0.274)	-0.0762 (0.277)	0.293 (0.209)	0.262 (0.276)	0.380 (0.342)	0.0108 (0.339)
Middle	0.205 (0.266)	-0.246 (0.265)	0.504* (0.261)	0.0411 (0.265)	0.838*** (0.315)	0.471 (0.450)
Fourth	0.443 (0.371)	-0.0302 (0.249)	0.770*** (0.265)	0.811** (0.342)	1.418*** (0.396)	0.332 (0.410)
Richest	0.677* (0.369)	0.689** (0.346)	1.241*** (0.322)	0.801** (0.343)	1.845*** (0.456)	1.256*** (0.449)
Constant	4.301*** (0.470)	7.907*** (0.489)	9.996*** (0.394)	12.65*** (0.352)	13.88*** (0.622)	16.09*** (0.573)
Observations	528	609	1,783	1,934	1,914	1,975
R-squared	0.320	0.077	0.092	0.077	0.090	0.064

Table 1: Regression coefficient for determinants of body weights in kilograms for children aged 0-59 months, Thailand, 2012.

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

For children aged 3- 4 years old, there are significantly lower weight-for-age z-score if they have been longer breastfed as shown in column (5) of Table 2.

Determinants	(1)	(2)	(3)	(4)	(5)	(6)
	< 6 months	6 - 11 months	12 - 23 months	24 - 35 months	36 - 47 months	48 - 59 months
Breastfeeding duration (months)	2.596 (4.584)	0.154 (0.148)	-0.514 (0.344)	-0.269 (0.202)	-0.268*** (0.101)	-0.0749 (0.126)
Area (Urban is ref.)						
Rural	15.56 (22.64)	-0.401 (0.313)	4.750 (10.96)	2.987 (3.855)	1.857 (2.475)	2.306 (2.795)
Region (Central+BKK is ref.)						
North	-22.96 (17.28)	-0.655 (0.738)	-8.744 (9.638)	-7.908 (6.769)	-2.277 (3.643)	-5.069 (6.619)
Northeast	-22.89 (17.27)	-0.882 (0.636)	-10.46 (8.446)	-7.929 (7.365)	-1.409 (3.306)	-10.69 (9.240)
South	-27.11 (20.40)	-1.096 (0.915)	-7.316 (10.57)	-1.008 (8.334)	-2.179 (3.320)	-6.808 (5.435)
Mother's education (None is ref.)						
Primary	-4.579 (4.572)	-0.464 (0.364)	0.305 (1.769)	0.784 (2.544)	3.820* (1.991)	5.437 (4.107)
Secondary and above	-1.881 (2.583)	-0.252 (0.348)	5.633* (3.324)	7.384* (4.440)	-1.907 (2.304)	4.454* (2.381)
Wealth index quintiles (Poorest is ref.)						
Second	-3.476 (3.106)	-0.368 (0.277)	-0.907 (1.749)	8.493 (7.412)	6.182 (6.702)	-7.191 (7.800)
Middle	-2.104 (3.288)	-0.434 (0.344)	0.726 (3.005)	-3.882 (4.009)	1.449 (2.076)	-8.121 (9.103)
Fourth	14.15 (15.38)	-0.281 (0.319)	-6.228* (3.774)	-1.071 (6.050)	9.209** (4.616)	-9.945 (9.390)
Richest	30.61	2.062	16.87	7.668	10.22**	-7.892



	(37.37)	(1.772)	(17.65)	(9.406)	(4.959)	(9.878)
Constant	17.17 (12.57)	0.265 (0.490)	7.756 (6.018)	5.269 (7.840)	0.493 (4.212)	8.984 (10.93)
Observations	528	609	1,783	1,934	1,914	1,975
R-squared	0.036	0.005	0.020	0.010	0.007	0.010

Table 2: Regression coefficient for determinants of weight-for-age z-score for children aged 0-59 months, Thailand, 2012.

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

There are no significant relationships between duration of breastfeeding and height-for-age and weight-for-height z-scores in any age group as shown in Table 3&4. Table 5 shows the results of regression model when group duration of breastfeeding into 5 categories, 4 groups of breastfeeding and using never been breastfed as reference level. Children with less than 6 months of

breastfed are significantly higher in weight-for-age z-score than who never been breastfed. Children have been longer breastfed (24 months and over) are smaller than who never been breastfed. It's clear that longer breastfed than 12 months can effects to lower weight-for-height z-score as shown in column (3) of Table 5.

Determinants	(1)	(2)	(3)	(4)	(5)	(6)
	< 6 months	6 - 11 months	12 - 23 months	24 - 35 months	36 - 47 months	48 - 59 months
Breastfeeding duration (months)	15.37 (13.97)	-3.756 (3.883)	-0.723 (0.578)	-0.151 (0.125)	-0.0384 (0.295)	-0.0741 (0.0763)
Area (Urban is ref.)						
Rural	28.71 (25.77)	27.12 (19.56)	2.465 (8.346)	-0.0102 (2.502)	-7.150 (6.917)	-5.121 (3.576)
Region (Central+BKK is ref.)						
North	-46.75 (29.76)	4.932 (22.82)	-23.37** (11.78)	-0.789 (1.748)	-3.683 (4.764)	1.039 (1.714)
Northeast	-6.550 (23.25)	1.522 (22.27)	-20.87 (15.75)	1.570 (1.958)	6.264 (6.274)	0.894 (1.060)
South	-38.84* (22.50)	-12.54 (19.04)	-12.51 (13.54)	5.294 (5.166)	22.20* (12.85)	6.925 (6.973)
Mother's education (None is ref.)						
Primary	12.49 (27.36)	38.96 (35.78)	8.603 (16.36)	2.877 (2.094)	-15.08 (33.03)	2.274* (1.245)
Secondary and above	3.562 (20.37)	28.13 (20.93)	14.25 (19.38)	-0.260 (1.647)	-19.49 (32.62)	2.667 (2.312)
Wealth index quintiles (Poorest is ref.)						
Second	-101.8* (58.68)	30.72 (30.62)	-16.91 (22.99)	-4.703 (4.594)	-33.62 (23.36)	-3.473* (1.884)
Middle	-86.56 (58.25)	12.77 (12.59)	-29.38 (25.25)	-3.563 (4.458)	-19.10 (22.49)	-0.524 (2.076)
Fourth	-62.09 (61.07)	27.30 (19.07)	-41.14 (26.79)	2.976 (5.120)	-31.41 (21.11)	-3.443 (3.665)
Richest	-43.22 (73.95)	57.51 (35.89)	-34.28 (28.21)	-1.070 (3.949)	-31.01 (19.90)	-2.541 (4.411)
Constant	56.92 (37.43)	-34.91 (31.85)	46.73* (26.90)	3.057 (3.692)	49.71* (30.13)	3.278 (2.813)
Observations	505	596	1,742	1,895	1,903	1,965
R-squared	0.067	0.039	0.012	0.005	0.024	0.006

Table 3: Regression coefficient for determinants of height-for-age z-score for children aged 0-59 months, Thailand, 2012.

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Determinants	(1)	(2)	(3)	(4)	(5)	(6)
	< 6 months	6 - 11 months	12 - 23 months	24 - 35 months	36 - 47 months	48 - 59 months
Breastfeeding duration (months)	16.77 (14.89)	-2.878 (2.916)	0.478 (1.174)	-0.262 (0.310)	-0.451 (0.395)	-0.275 (0.199)
Area (Urban is ref.)						
Rural	-12.33 (21.47)	-21.05 (20.12)	-0.839 (15.12)	6.412 (6.075)	10.02 (17.46)	-11.89* (6.898)
Region (Central+BKK is ref.)						
North	-49.92* (25.82)	4.174 (12.14)	-36.91** (17.38)	-11.51 (8.485)	-1.531 (19.02)	-7.165 (10.75)
Northeast	17.45 (29.22)	19.10 (25.51)	-39.00* (21.06)	-9.745 (9.734)	-10.74 (15.27)	-19.97* (11.64)
South	-12.89 (22.48)	14.00 (15.76)	-24.96 (20.81)	20.39 (17.10)	1.591 (18.16)	-1.031 (13.07)
Mother's education (None is ref.)						
Primary	22.81 (37.80)	-0.0420 (6.728)	28.37** (11.41)	6.436 (5.370)	15.53 (29.57)	13.03** (5.569)
Secondary and above	13.59 (26.96)	8.216 (10.24)	35.17** (15.95)	20.17** (9.279)	1.730 (26.07)	22.18*** (7.111)
Wealth index quintiles (Poorest is ref.)						
Second	-77.36 (69.90)	5.649 (5.974)	-18.16 (21.37)	19.95* (11.80)	-13.88 (27.28)	-0.0349 (9.672)
Middle	-86.94 (61.39)	35.12 (32.10)	-14.62 (26.94)	-8.980 (7.902)	-26.67 (24.56)	-4.697 (10.78)
Fourth	-84.62 (64.76)	4.544 (7.168)	-50.47* (27.83)	1.700 (12.42)	-17.58 (24.56)	-20.22 (12.38)
Richest	-91.12 (71.03)	11.10 (12.27)	-2.724 (39.95)	10.48 (15.21)	8.927 (31.99)	-9.861 (14.41)
Constant	67.83 46.14)	11.45 (11.57)	32.23 (27.75)	2.284 (11.46)	29.84 (26.30)	21.66 (14.05)
Observations	499	594	1,741	1,887	1,895	1,945
R-squared	0.058	0.037	0.023	0.016	0.010	0.012

Table 4: Regression coefficient for determinants of **weight-for-height z-score** for children aged 0-59 months, Thailand, 2012.

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.13

Determinants	(1) weight-for-age Z-score	(2) height-for-age Z-score	(3) weight-for-height Z-score
Duration of breastfeeding (Never been breastfed is ref.)			
< 6 months	0.222* (0.125)	0.254 (0.162)	0.103 (0.112)
6-11 months	0.0508 (0.128)	-0.0321 (0.170)	0.00176 (0.120)
12-23 months	-0.200 (0.128)	-0.195 (0.166)	-0.277** (0.115)
24 months and over	-0.317** (0.136)	-0.180 (0.178)	-0.384*** (0.131)
Area (Urban is ref.)			
Rural	0.00711 (0.0479)	-0.0655 (0.0553)	0.0830 (0.0547)
Region (Central+BKK)			
North	-0.0528 (0.0638)	0.0599 (0.0674)	-0.115 (0.0725)
Northeast	-0.222*** (0.0697)	-0.0167 (0.0815)	-0.224*** (0.0776)
South	-0.176*** (0.0633)	-0.0752 (0.0681)	-0.173** (0.0706)
Mother's education (None is ref.)			
Primary	0.307** (0.130)	0.485*** (0.157)	0.0353 (0.191)
Secondary and above	0.235* (0.129)	0.474*** (0.158)	-0.0219 (0.191)
Wealth index quintile (Poorest is ref.)			
Second	0.0744 (0.0756)	0.0603 (0.0989)	0.0186 (0.0904)
Middle	0.235*** (0.0792)	0.228** (0.0981)	0.129 (0.0915)
Fourth	0.454*** (0.0830)	0.498*** (0.107)	0.209** (0.0978)
Richest	0.653*** (0.0922)	0.556*** (0.119)	0.368*** (0.116)
Ethnicity of household head (Non-Thai is reference)			
Thai	-0.00294 (0.159)	-0.138 (0.205)	-0.0180 (0.204)
Constant	-0.776*** (0.197)	-1.221*** (0.252)	0.0626 (0.233)
Observations	9,178	8,988	8,851
R-squared	0.068	0.046	0.028

Table 5: Regression coefficients for durations of breastfeeding and other determinants on nutritional indicators, Thailand, 2012.

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

## Conclusion

Using the three anthropometric indices, weight-for-age, height-for-age, and weight-for-height z-scores as nutritional status indicators, we examine the relationship between breastfeeding duration and these indices of under-five children. During ages 6-11 months, infants who never been breastfed are

moderately underweight and much smaller than who ever been breastfed.

For children aged 3- 4 years old, there are significantly lower weight-for-age z-score if they have been longer breastfed. Based on weight-for-height, children aged 0-5 months who never been breastfed are classified as over-weight while other breastfeeding categories are in the standard. There

are no significant relationships between duration of breastfeeding and height-for-age and weight-for-height z-scores for children aged less than 5 years old. Children with less than 6 months of breastfed are significantly higher in weight-for-age z-score than who never been breastfed. Children have been longer breastfed (24 months and over) are smaller than who never been breastfed. It's clear that longer breastfed than 12 months can effects to lower weight-for-height z-score.

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