Maternal Characteristics and Weight-for-length Status of Young Children Aged 0–23 Months in the Philippines

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ABSTRACT

Introduction. Malnutrition in the forms of wasting and overweight among children ages 0 to 23 months is a continuing public health concern in the Philippines. Childhood malnutrition has lifelong consequences. For young children aged 0-23 months, maternal influences play a significant role in the realization of optimal nutritional status.

Objective. This study aimed to identify maternal characteristics that may influence the nutritional status of children aged 0–23 months.

Methods. This study utilized data from the 2015 Updating Survey from Department of Science and Technology-Food and Nutrition Research Institute. The association of maternal characteristics with the nutritional status of a child was determined using the Rao-Scott Chi-squared test statistic. Multinomial logistic regression was used to model a child's nutritional status using weight-for-length as an indicator.

Results. A child whose mother was educated was less likely to be wasted. The odds of a child being wasted was observed to increase with underweight mothers, longer duration of lactation and higher wealth quintile. Alternatively, the odds of a child to be overweight is reduced if the mother had formal education, was in late lactation stage, and availed tetanus toxoid vaccine. The likelihood that a child will be overweight increased with higher family wealth quintile and obesity of the mother.

Conclusion. Maternal nutritional status, education, duration of lactation, wealth quintile, and availment of prenatal services were found to be associated with the weight-for-height status of children 0–23 months. Incorporating the identified maternal factors when planning new interventions and policies is recommended to address wasting in young children.

Keywords: maternal characteristics, nutrition survey, overweight, wasting, young children

INTRODUCTION

The double burden of malnutrition is characterized by the coexistence of undernutrition along with overweight and obesity, or diet-related non-communicable diseases within individuals, households and populations, across the life course.[1] Pelletier and Frongillo observed child mortality cases in 59 developing countries and found that mortality in children was often preceded by malnutrition.[2] Since over-nourishment is commonly observed in high-income countries, overweight/obesity is often an overlooked aspect of studies in malnutrition in many countries. A study concerning 200 countries conducted by the Non-Communicable Disease Risk Factor Collaboration (NCD-RisC) in 2016 revealed that the prevalence of overweight children increased ten-

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fold from 1975 to 2014.[3] Although overweight/obesity is more prominent in high-income countries, the study showed that even developing countries like the Philippines also experienced the double burden of malnutrition. In the 2013 National Nutrition Survey (NNS) conducted by the Food and Nutrition Research Institute (FNRI), it was observed that the double burden of malnutrition exists among adults, young children and adolescents.[4]

The national prevalence rate of wasting in the Philippines is 8%, according to the 2013 NNS for children aged 0–60 months.[4] Wasting is a form of malnutrition defined as a reduction or loss of body weight in relation to height, and is classified as severe or moderate according to the World Health Organization (WHO) growth reference for weight-for-height.[5] Wasting is recognized by WHO as a major health problem because of the increased risk of disease and death for children who are suffering from it.[6] The United Nations Emergency Children's Fund (UNICEF) also reported that wasting affects more than 49 million children worldwide.[7] These figures corroborate with the worrying fact that health issues associated with undernutrition are responsible for 52.5% of child mortality worldwide.[8]

In 2015, around 7% of children aged 0–60 months in the Philippines were moderately or severely wasted.[7] On the other hand, around 34.5% of the Philippine population in 2015 were obese or overweight with the highest rates of obesity/overweight recorded in the northern provinces of the country.[9] Similarly, UNICEF reported that 3.90% of children in the Philippines aged 0–60 months in 2015 were moderate to severely overweight.[7]

Maternal characteristics were used as determinants in the assessment of the nutritional status of children in various research across countries due to the innate relationship between a mother and her children.[10,11] Related studies, like Kandpal et al. and McNamara et al. used maternal characteristics such as physical attributes and demographic information, which are usually available through national surveys to determine the relationship with child nutritional status.[11]

Boah et al. studied young children in Ghana and determined that the main factors for malnutrition in children are food intake, birth weight, diseases, and sex. These factors are mostly related to maternal influence like feeding and nurturing practices, since mothers are the primary caregivers of their children. They also noted that maternal nutritional status (BMI as reference) affects the nutritional status of fetuses, not just young children, since underweight mothers may result in intrauterine growth limitations for their babies. Birth weight was mentioned as a direct factor for malnutrition, which denotes that pregnancy practices of mothers may also play a vital role in child nutrition. The study also mentioned that household and socio-economic factors also influence child undernutrition to a certain extent.[12]

Investing in children is often associated with human capital. Evidence from DiPietro et al. showed that a child's nutritional status has a lasting effect on one's development, physically and mentally, as an adult; hence, it is only fitting that resources should be allotted to the improvement of child nutrition.[13]

The Sustainable Development Goals (SDG), which are set to be completed in 2030, aim to eliminate poverty, malnutrition, and environmental issues in order to preserve the world for future generations.[14] Goal 3 of the 17 SDGs aims to provide people of all ages a healthy lifestyle, and it pays close attention to maternal and infant health.[15] The target is to reduce neonatal mortality (death within the first 28 days of life), under-5-year-old and maternal mortality in all countries. Regardless of day and age, malnutrition remains rampant; but particularly, childhood malnutrition had always been given a lot of attention because of its effect on future nutritional status and mental capacity. Moreover, the Philippine Plan of Action for Nutrition for 2017 to 2022, which embodies the country's commitment to the global community, aims to reduce wasting among children under five years old from 7.0% in 2015 to less than 5% by 2022.[16]

Literature suggests that adequate nutrition during infancy is essential for the achievement of lifelong health and well-being. Children aged 0–23 months have limited exposure to the environment outside their houses and family; therefore, maternal influence is particularly significant for children of this age. Thus, this study aimed to identify maternal characteristics that could be determinants of the nutritional status of children aged 0–23 months. The maternal characteristics were limited to socio-economic status, fertility and health status, pregnancy practices, and maternal knowledge and practices.

MATERIALS AND METHODS

Dataset

Data on the Maternal Health and Nutrition (MHN), Infant and Young Child Feeding (IYCF), Demographic and Socio-Economic and Anthropometric Surveys from the 2015 Updating Survey of the Food and Nutrition Research Institute – Department of Science and Technology (FNRI-DOST) were utilized in this study. The 2015 Updating Survey adopted the Master Sample (MS) created by the Philippine Statistics Authority (PSA). The sampling design employed was stratified multi-stage sampling covering all regions and provinces in the country. The barangays with at least 500 households served as the primary sampling Units (PSUs), enumeration areas (EAs) from barangays with 150-200 households from PSUs as the secondary sampling units (SSUs), and households from EAs as the ultimate sampling units. This study considered respondents of the MHN-IYCF with their youngest biological child aged between 0–23 months with no missing information on their measurements and their mother's characteristics.[9] With all these considerations, anthropometric measurement of the 5,356 sampled children aged 0-23 months and their

mothers' maternal characteristics were subjected to data analysis in order to address the goal of this study.

The response variable of interest in this study was the nutritional status of children aged 0–23 months based on their weight-for-length *z*-scores (WLZ). Though some studies claim that body mass index (BMI) for children is a more accurate measure of infant overnutrition, the WLZ is more commonly used to assess overnutrition in infants and young children around the world (Roy et al. 2016). The *z*-scores were computed using the WHO Anthro Survey Analyser.[17] Based on the WHO-Child Growth Standards, a child with z-score of <-2SD, -2SD to +2SD, and >+2SD, was classified as wasted, normal, and overweight, respectively.[18] The analyzer flagged measurements of children with z-scores for WLZ that are either <-5SD and >+5SD and they were not included in the estimates generated. Furthermore, the magnitude and severity of wasting in country was said to be acceptable if the prevalence group of wasting was less than 5 percent, poor if 5 to 9 percent, serious if more than 9 to 14 percent and critical if more than 14 percent.[19] The children were categorized under the age groups 0–5, 6–11, and 12–23 months following the nutrition reports published by WHO and DOST-FNRI.

Maternal characteristics of the mothers of the children were considered as the explanatory variables in the study and were grouped into four domains, namely: socio-demographic, fertility and health, pregnancy practices, and maternal knowledge and practices. Socio-demographic characteristics included age (<20 years old [teens], ≥ 20 years old), ethnicity (indigenous people, not part of indigenous people/no foreign blood, with foreign blood), educational attainment (no formal education, elementary, high school, college and above), employment status (aggregated as employed/not employed), and wealth quintile (in lieu of maternal income since the survey lacks income as a variable; poorest, poor, middle, rich, richest). Fertility and health included nutritional status (using BMI as indicator), vitamin intake, and the physiological status of the mothers (lactating). Pregnancy practices included prenatal care/lack of prenatal care (pertaining to prenatal services availed), taking/failure to take pregnancy supplements, and post-natal practices. Maternal knowledge and practices included breastfeeding, complementary feeding and vaccine knowledge.

The data obtained from the different components of the NNS survey was merged using the household number and member code which are unique identifiers of individuals that participated in the survey. The MHN survey data which lists all mothers with children under 36 months of age was used in order to identify the mothers. In order to merge the children's data with the maternal data, aside from matching the household number, the member code of the child must be of a higher number since mothers were listed first in the survey. This is to ensure that households with multiple families (and multiple mothers listed) will correctly match mother and child data.

There was no funding used for the analysis since data used for the survey is listed as a public use file and was sent electronically after requesting through the website eNutrition.com, the data warehouse of National Nutrition Survey managed by DOST-FNRI.

The NNS used new digital weighing scale, with strict compliance to the standard procedures in measuring weights of all the subjects. Weight measurements were collected twice and recorded to the nearest 0.1 kg. Moreover, a third measurement was considered if the difference between the first two measurements was more than 0.3 kg. Meanwhile, a 2-in-1 function key was employed for the determination of the body weight of infants and restless young children, wherein the mother or caregiver (without the child) was initially weighed and then the digital weighing scale was deducted by pressing the function key to reveal the weight of the child. The height/length measurement, children aged two years old and older were measured with a stadiometer while a medical plastic infantometer was used for infants and children who could not stand without help. The obtained measurements were recorded to the nearest 0.1 cm following standard procedures. Similar to weight measurement, height/length of a subject was measured twice, and thrice for those measurement giving a difference of higher than 0.5 cm. Moreover, all the maternal characteristics considered in the study were generated through a personal interview using a pre-tested structured questionnaires developed for the Maternal Health and Nutrition, Infant and Young Child Feeding and Anthropometric Surveys.[9]

Ethics Approval

The 2015 Updating of Nutritional Status of Filipino Children and Other Population Groups was approved by the FNRI Institutional Ethics Review Committee (FNRI-IERC). As a standard procedure, an informed consent form was provided to the subjects prior to data collection, explaining the objectives of the survey, the procedure, the risks and benefits of participation, confidentiality, and option to renounce participation at any point of the survey. A clearance to conduct such survey was bestowed to the project by the Philippine Statistics Authority (PSA) on July 15, 2015.[9]

Data Analyses

The children were characterized in terms of their age, sex, weight, height, and their feeding practices by constructing weighted percentage distributions. Similarly, the weighted distribution of the children according to nutritional status (wasted, normal, and overweight) was constructed. The association of maternal characteristics with the nutritional status of a child was determined by employing the Rao-Scott Chi-squared test statistic – an adjusted Pearson Chi-square to incorporate the complexity of the sampling design of NNS. Moreover, Cramer's V coefficient was calculated to determine the degree of association. The possible values of Cramer's V coefficient are between 0 and 1, and interpreted

as weak if less than 0.1, moderate if between 0.1 and 0.30, and strong if more than 0.3.[20] Correspondence analysis for maternal characteristics found associated with the child's nutritional status (based on weight-for-length indicator) was generated for a graphical representation of the relationship between these variables. It graphs the absolute residuals from the contingency table generated between the row categories (nutritional status of children) and the column categories (maternal characteristics). The larger the value of the absolute residuals, the higher the association between the row and column categories. Each dimension for the correspondence analysis has a corresponding percentage of variance explained between the categories. Higher variance explained denotes fewer possible conclusions that will be left out. The distances of the categories of each variable from each other shown in the plot reflected the relationships of the categories.

The data set formed in the study was partitioned into two, in which 70% of it was used to fit a model and the 30% was used to assess the predictive ability of the constructed model. The 70-30 ratio was employed as one of the most common ways of partitioning data sets from empirical studies.[21] To generate a viable model, the partitioning of data is necessary to avoid overfitting where the generated model is overly specific for a particular data set and will have low predictive ability when applied to updated or different data sets. Multinomial logistic regression was used to model child's nutritional status using WHZ indicator with three categories, namely: 0 - normal, 1 - underweight, 2 - overweight. The assumption that each child belongs to one of the three mutually exclusive categories (0, 1, or 2) holds. The normal category (Y = 0) served as the reference category. The two logit equations which are linear functions of the response variable are:

$$L_{WLZ1} = \ln \ln \frac{P(Y = 1)}{P(Y = 0)} = \propto_1 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_k X_k \text{ ; and}$$

$$L_{WLZ2} = \ln \ln \frac{P(Y = 2)}{P(Y = 0)} = \propto_2 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_k X_k$$

where $\propto$ is regression coefficient of the dependent variable (child nutritional status) and β is the increase or decrease in log odds of a child to be malnourished based on the outcome of factor X, holding other factors constant. Moreover, the odds ratio for significant predictors were computed to assess the odds that a child will be malnourished (wasted or overweight) given the maternal characteristics.

To evaluate the goodness of fit of the estimated models, Hosmer-Lemeshow test was also generated. A high p-value from the test would give support to the estimated model. Furthermore, the overall classification rate or accuracy was considered for the proportion of correctly classified observations (true positives and true negatives). The weighing variable used was the sampling weight indicated in the survey data which was the product of the base weight, non-response and population weight adjustments. By applying the sampling weights, which was adjusted after conducting the survey with respect to the population obtained from PSA, the analysis was able to produce national level estimates. Statistical analysis was performed using the software StataSE 13.

RESULTS

Nutritional Status

The double burden of malnutrition can be seen in children 0 to 23 months, with highest co-existence of wasting and overweight in children 0 to 5 months. For every 100 children aged 0 to 23 months, around 10 were classified as wasted. The prevalence rate of wasted male children at 10.5% (95% CI 9.5, 11.7) was slightly higher than the overall prevalence at 9.7% (95% CI 8.9, 10.6). Wasting was more prevalent for children aged 6 to 11 months – with males having a prevalence rate of 13.5% and females with 9.5%. On the contrary, female children aged 0 to 5 months had a higher prevalence rate of 12.2% (95% CI 9.5 , 14.9) (serious severity) than males with a rate of 9.6% (95% CI 7.4, 11.8) (poor severity). On the other hand, three for every 10 Filipino children aged 0–23 months (3.4%, 95% CI 3.0, 4.0) were observed to be overweight. This time, those aged 0 to 5 months posted the highest rate of overweight, which constituted 6.9% (95% CI 5.6, 8.2) of the population in this age group. Similar to the results presented earlier, the percentage of male overweight children was higher than that of females. The prevalence of overweight in children aged 0 to 5 months was almost twice higher as compared to those in the 6–11 and 12–23 months age group which is 4.2% (95% CI 3.2, 5.2) and 3.1% (95% CI 2.1, 3.3), respectively (Figure 1).

A total of 6.9% of Filipino children aged 0–23 months had never been breastfed.[22] Also, a large portion were dependent on milk other than breast milk, comprising 39.15% of Filipino children younger than two years of age. Around 5.2% did not even incorporate any kind of milk in the diet of children aged 12–23 months. Majority (71.06%) of children under 2 years of age had complementary foods and milk in their diet, most of which were children aged 6–11 months and 12–23 months (Figure 2).

Association between Maternal Characteristics and Child's Nutritional Status

The maternal characteristics significantly associated (p-value <0.05) with the nutritional status of children aged 0–23 months using WLZ indicator are presented in Table 1. Among the explanatory variables considered from the survey, factors such as mother's months of lactation, nutritional status, age-appropriate breastfeeding practices, highest educational attainment were weakly associated with a child's nutritional status. Similarly, having tetanus toxoid vaccine, vitamin supplementation during prenatal period and being knowledgeable of child vaccines had a weak relationship with the nutritional status of a child. Other variables considered

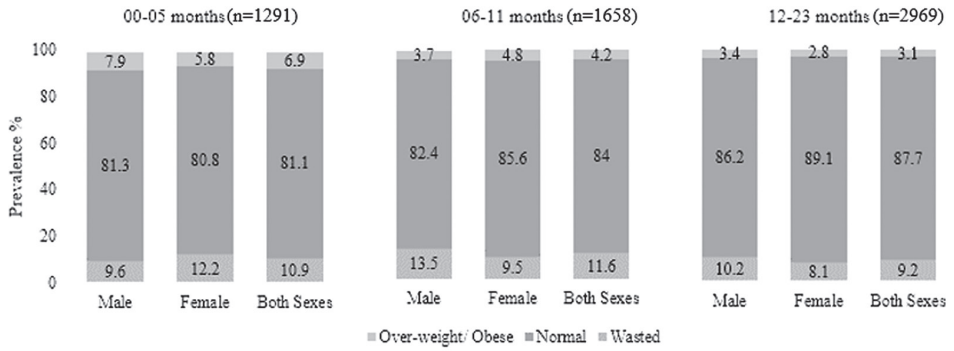

Figure 1. Weighted percentage distribution of children aged 0–23 months based on WLZ indicator, by age group and sex in the Philippines, 2015.

Table 1. Association of maternal characteristics and nutritional status of children aged 0-23 months using WLZ indicator, Philippines, 2015

Maternal Characteristics	Test Statistic	Cramer's V Coefficient	p-value
Highest Educational Attainment	16.75	0.057	0.033*
Duration of Lactation	36.15	0.082	<0.001***
Nutritional Status	29.07	0.074	0.001**
Age-appropriate Breastfeeding Practices	21.93	0.064	<0.001***
Wealth Quintile	20.54	0.031	0.040*
Prenatal service: Tetanus Toxoid Vaccine	17.10	0.058	0.001**
Prenatal service: Vitamin Supplementation	7.68	0.039	0.048*
Knowledge of Child Vaccine	4.41	0.029	0.043*
Age	2.86	0.023	0.294
Employment Status	3.70	0.026	0.252
Ethnicity	1.27	0.015	0.584
Availed Prenatal Check-up	3.79	0.019	0.499
Prenatal Service: Urinalysis	4.04	0.028	0.190
Prenatal Service: Ultrasound	6.36	0.035	0.072
Prenatal Service: Nutrition Counseling	4.40	0.029	0.187
Had Health Problems Related to Current/Last Pregnancy	0.45	0.009	0.836
Pregnancy Supplement: Single Vitamin/Mineral	1.59	0.019	0.537
Pregnancy Supplement: Folic Acid	1.54	0.018	0.571
Pregnancy Supplement: Ferrous Sulfate	0.04	0.003	0.981
Pregnancy Supplement: Iron-Folic Acid	1.87	0.020	0.465
Pregnancy Supplement: Multivitamins	2.96	0.025	0.350
With Postnatal Check-up	2.19	0.020	0.371
Practice Postnatal Check-up	18.80	0.027	0.140
Knowledge of Number of Months when to give other food other than Breast Milk	9.83	0.031	0.095

**significant at p<0.05; **significant at p<0.01; ***significant at p<0.001*

but were not found associated with the nutritional status of children using WLZ indicator are also listed in Table 1.

To better explain the association found between child's nutritional status and some maternal characteristics, a correspondence plot was generated. Children with normal nutritional status formed a cluster near the origin with mothers who had normal nutritional status and had been lactating between 1–6 months (Figure 3). This indicates that a child tended to have a normal nutritional status if a mother possessed the aforementioned characteristics. Meanwhile, wasted children were plotted nearest mothers that were underweight, lactating for 7 to 12 months and over 1 year and had a family wealth quintile that was considered poor. Mothers with the previously stated characteristics were likely to have wasted children. Overweight children were clustered nearest mothers that were obese, had at least college

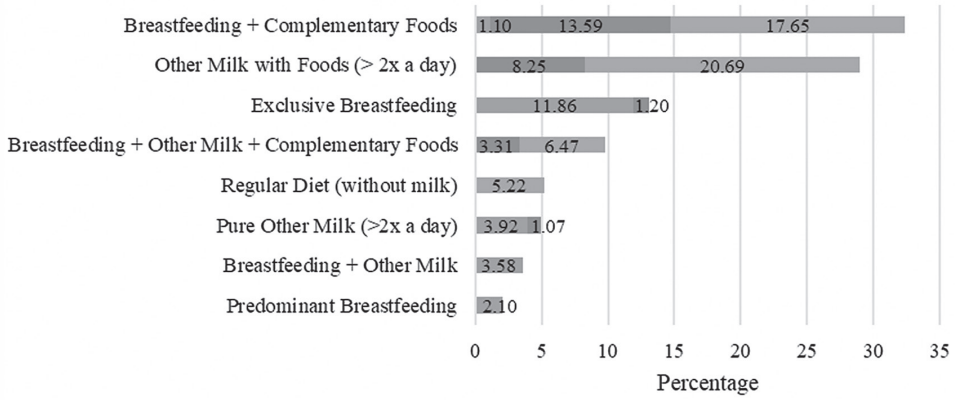

Figure 2. Weighted percentage distribution by current feeding practices for children aged 0–23 months in the Philippines, 2015.

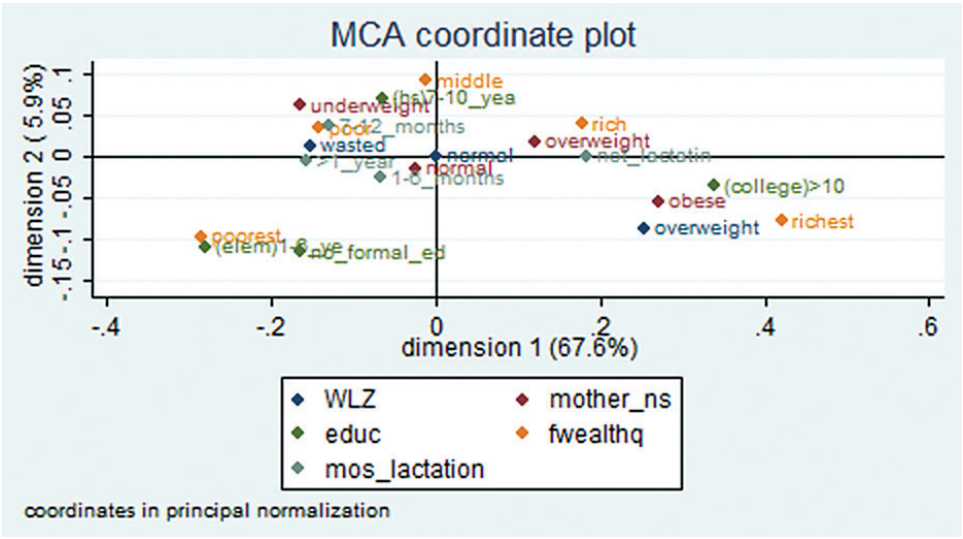

Figure 3. Multiple correspondence analysis plot of the nutritional status of children based on WLZ indicator and significant maternal characteristics, Philippines, 2015.

level of education (> 10 years) and had a family wealth quintile considered as richest. Dimension 1 (y-axis) already represented 67.6% of the variation among the categories, so that categories plotted on opposite sides of dimension 1 had a great distinction or negative association with each other. This means that overweight children, and the maternal characteristics surrounding it, had great distinction with wasted children and the cluster of maternal characteristics surrounding it.

Maternal Characteristics as Determinants of Child's Nutritional Status

Among the associated maternal characteristics, education, nutritional status, months of lactation, and availing tetanus toxoid vaccine pre-natal service were found as significant influencing factors of a child's nutritional status (Table 2). Maternal education greatly reduced the likelihood of a child being wasted. The chance of a child being wasted was reduced by 41% (OR 0.59, 95% CI 0.57, 0.59), 32% (OR 0.68, 95% CI 0.64, 0.70), and 54% (OR 0.46, 95% CI 0.45, 0.48), if the mother's highest educational attainment was elementary, high school, and college level, respectively. The fitted model also showed that the nutritional status of a mother influenced the chance of a child to have low weight-for-length. An underweight mother increased the chance of a child being wasted by 1.57 times (95% CI 1.54, 1.59). On the other hand, an overweight or obese mother decreased the likelihood of wasting by 34% (OR 0.66, 95% CI 0.64, 0.67) and 52% (OR 0.48, 95% CI 0.46, 0.50), respectively. The odds of wasting increased by 1.14 (95% CI 1.12, 1.16), 1.28 (1.25, 1.30), and 1.48 (1.45, 1.50) times if the mother was lactating for a duration of between 1–6 months, 7–12 months, and more than 1 year, respectively. A mother who availed tetanus toxoid vaccine during pregnancy lowered the odds of a child being wasted by 13% (OR 0.87, 95% CI 0.86, 0.89]. A mother whose family wealth quintile

Table 2. Estimated logistic regression model for wasting and overweight/obese among children aged 0–23 months. Philippines. 2015 (weighted n=2160543)

Maternal Characteristics	Coefficient	Odds Ratio	95% CI	p-value
Wasting				
Constant	-2.462	0.09	[0.08, 0.09]	<0.001*
Education[1]				
Elementary	-0.525	0.59	[0.57, 0.59]	<0.001*
High School	-0.389	0.68	[0.64, 0.70]	<0.001*
College and above	-0.769	0.46	[0.45, 0.48]	<0.001*
Nutritional Status[2]				
Underweight	0.450	1.57	[1.54, 1.59]	<0.001*
Overweight	-0.420	0.66	[0.64, 0.67]	<0.001*
Obese	-0.743	0.48	[0.46, 0.50]	<0.001*
Duration of Lactation[3]				
Between 1 to 6 months	0.133	1.14	[1.12, 1.16]	<0.001*
Between 7 to 12 months	0.244	1.28	[1.25, 1.30]	<0.001*
Over a year	0.390	1.48	[1.45, 1.50]	<0.001*
Prenatal Service: Tetanus Toxoid Vaccine[4]				
Availed	-0.137	0.87	[0.86, 0.89]	<0.001*
Wealth Quintile[5]				
Poor	-0.280	0.76	[0.74, 0.77]	<0.001*
Middle	-0.090	0.91	[0.90, 0.93]	<0.001*
Rich	0.220	1.24	[1.22, 1.27]	<0.001*
Richest	-0.186	0.83	[0.81,0.85]	<0.001*
Overweight				
Constant	-1.607	0.20	[0.19, 0.21]	<0.001*
Education[1]				
Elementary	-1.616	0.20	[0.19, 0.21]	<0.001*
High School	-1.350	0.26	[0.25, 0.27]	<0.001*
College and above	-1.175	0.31	[0.30, 0.32]	<0.001*
Nutritional Status[2]				
Underweight	-2.185	0.11	[0.10, 0.12]	<0.001*
Overweight	-0.714	0.49	[0.48, 0.50]	<0.001*
Obese	0.085	1.09	[1.05, 1.12]	<0.001*
Duration of Lactation[3]				
Between 1 to 6 months	0.085	1.09	[1.07, 1.11]	<0.001*
Between 7 to 12 months	-0.618	0.54	[0.52, 0.56]	<0.001*
Over a year	-1.042	0.35	[0.34, 0.37]	<0.001*
Prenatal Service: Tetanus Toxoid Vaccine[4]				
Availed	-0.858	0.42	[0.42, 0.43]	<0.001*
Wealth Quintile[5]				
Poor	0.114	1.12	[1.07, 1.16]	<0.001*
Middle	0.124	1.13	[1.10, 1.17]	<0.001*
Rich	0.382	1.47	[1.42, 1.51]	<0.001*
Richest	0.401	1.49	[1.44, 1.52]	<0.001*

*Base Category: [1]No formal schooling, [2]Normal, [3]Not lactating, [4]Did not avail, [5]Poorest; *significant at p<0.001*

was considered poor, middle or richest had decreased odds of having a wasted child by 21% (OR 0.79, 95% CI 0.74, 0.77), 9% (OR 0.91, 95% CI 0.90, 0.93) and 17% (OR 0.83, 95% CI 0.81, 0.85), respectively. On the contrary, the odds of wasting increased by 1.24 times (95% CI 1.22, 1.27) if the mother had a family that was considered rich.

On the other hand, the odds of a child being overweight was reduced by 80% (OR 0.20, 95% CI 0.19,0.21), 74% (OR 0.26, 95% CI 0.25,0.27), and 69% (OR 0.31, 95% CI 0.30,0.32) if the mother's highest educational attainment was at least elementary, high school, and college level, respectively, compared to a mother with no formal schooling. The fitted model also showed that although the likelihood of a child being overweight was reduced by 89%(OR 0.11, 95% CI 0.10, 0.12) if the mother was underweight and 51% (OR 0.49, 95% CI 0.48, 0.51) if the mother was also overweight, there was a 10%(OR 1.1, 95% CI 1.07, 1.14) increase in the likelihood of child overnutrition if the mother was obese compared to

mothers with normal nutritional status. Similarly, a mother lactating for a duration of 7 to 12 months and over a year lowered the chance of a child being overweight by 49% (OR 0.51, 95% CI 0.49, 0.52) and 74% (OR 0.26, 95% CI 0.25, 0.27), respectively, compared to a mother that was not lactating. A mother who was lactating between 1–6 months had increased odds by 1.09 times 95% CI 1.07, 1.11) for the child to be overweight. In addition, the odds of a child being overweight decreased by 58% (OR 0.42, 95% CI 0.42, 0.43) if the mother had a tetanus toxoid vaccine in her availed prenatal services. Compared to a mother whose family wealth quintile was considered poorest, a mother whose family was in the wealth quintile poor, middle, rich, and richest has increased odds of a child to be overweight by 1.12 (95% CI 1.07, 1.16), 1.13 (95% CI 1.10, 1.17), 1.47 (95% CI 1.42, 1.51) and 1.49 (95% CI 1.44, 1.52) times.

Both fitted models were significant with a p-value of <0.0001, hence, the overall model fitted the data both for underweight and overweight. The fitted model gave an overall accuracy of 75.03%, which shows that majority of the children's nutritional status were correctly classified. Moreover, the Hosmer-Lemeshow test revealed a test statistic of 12.598 and a p-value of 0.676 which further gives evidence the goodness of fit of the model over the data.

DISCUSSION

Different trends were observed for wasting and overweight among children ages 0 to 23 months in this study. Overnutrition was highest among children 0 to 5 months while wasting was highest for children aged 6 to 11 months. Breastfeeding and complementary feeding practices are critical within this periods. There are certain protective nutrients in breast milk that are beneficial to children and there is evidence that breast milk can ward off common infectious diseases in infants.[23] The WHO recommends that infants be exclusively breastfed for the first six months, followed by the introduction of complementary foods and beverages, with continued breastfeeding throughout until 2 years of age.[24] However, despite the recommendations of the government and private organizations, there were still a considerable number of children aged 0–23 months who were never breastfed or had been very dependent on formula than breast milk. Some of the reasons for such were lack of knowledge and the busy lifestyle of the mother.[25] It could also be because first-time mothers and those older mothers had a lower chance of producing breast milk.[26] Santo et al. also observed that some of the significant factors of low rates of exclusive breasting of infants below 6 months of age were having an adolescent mother and few prenatal visits (less than 6).[27]

A serious condition of wasting was evident for children 0–23 months of age, particularly for male children aged 6 to 11 months. It should be noted that children suffering from wasting are prone to acute infectious diseases so early detection of wasting is important to reduce the risk of more health complications.[28] Alternatively, overweight is apparent among those aged younger than five months, compared to the other age groups; among which, many were male. In the study conducted by Rossem et al. (2014), they found that the weight change of infants between birth to six months may be in the intermediate pathway and associated with breastfeeding and BMI.[29] DiPietro et al. also concluded that childhood obesity increases the risk of being overweight as an adult, which reveals how important good nutrition is in early childhood.[13]

Based on the estimated multinomial logistic model, the results suggest that the chance of a child to be wasted is greatly lowered if their mother had formal education compared to those with no formal education. The model showed that a mother with an education of at least college level had the least risk of having a child who is wasted. On the other hand, an obese or overweight mother had lesser chance to have a child with low weight-for-height z-score. Alternatively, the risk of being wasted was higher for those children whose mothers were also underweight. These results are in agreement with Babatunde et al. where they also concluded that the nutritional status of mothers (BMI index) and education are factors to malnutrition of young children.[10] Moreover, Das and Rahman showed that the lack of education in mothers would promote a high risk of malnutrition for their children.[30] Good maternal health and education translate to better health and nurturing practices which are beneficial to their children.

Length of lactation was also found to be associated with the child's nutritional outcome; the odds of the child being wasted increased as the mother progressd to late lactation. The risk of a child being wasted increased if the mother had a duration of lactation of 1 to 6 months, 7 to 12 months, or over a year; however, the risk was highest for those with mothers who have been lactating for over a year. Nutrients and growth factors needed by infants and young children are known to be found in breast milk; thus, maternal characteristics related to breastfeeding are expected to affect the nutritional status of young children.[26] Breast milk has many benefits for infants but the composition of breast milk may vary from each mother. Leghi et al. found that maternal nutrition may affect the composition of breast milk, especially fat, which is the main source of energy for infants.[31] As children reach the age of 12 months, it was also reported that bone mineral content is lower for breast-fed children compared to children fed soy milk formula.[32]

The results also suggests that a mother who availed tetanus toxoid vaccine during the prenatal period is less likely to have a child who will be thin or with low weight-for length. This is consistent with the findings of Blencowe et al. where they emphasized the possibility that tetanus toxoid vaccine can reduce neonatal mortality by at most 94%.[33] Micronutrient supplementation is needed by pregnant mothers especially those who are underweight since

deficiencies in micronutrients can lead to problems such as anemia and complications in neural tubes that can contribute to pre-term births or infant abnormalities.[34]

Family wealth quintiles is also a significant factor to wasting. Those belonging to families considered as poor, middle class and richest had lower odds of having a wasted child compared to those families considered as poorest. On the other hand, a family that was considered rich had increased odds of having a child that is wasted or thin. A study across Sub-Sahara African countries also showed that although wealth quintile is a significant factor to undernourishment of children, more than half of their observed undernourished children and women belonged to families considered middle class and above.[35] Therefore, nutrition counseling should not only be targeted to low-income families or with family wealth quintile considered as poorest.

As for the overweight model, compared to the one without a formal education, a mother who had a formal education had lesser chance to have an overweight child. The estimated overweight model gives further support to the claim that maternal education would correspond to better knowledge about health practices. Lower odds of having an overweight child were also observed for mothers who breastfed for at least 7–12 months than those who did not. In a study conducted by Mihrshahi et al., they found that breastfed infants compared to formula fed infants, gained healthier weights during the first year of life and were less likely to show rapid weight gain during infancy.[36] Motil and Duryea also identified reasons why there is poor weight gain in young children despite being breastfed, i.e., underlying health conditions such as milk protein intolerance or cystic fibrosis. These complications affect their ability to consume nutrients from the milk or any other food source that can result in undernutrition.[37] Information about milk composition of mothers or the underlying health conditions of children that may affect milk consumption were unfortunately unavailable and not included in the scope of the 2015 Updating Survey; hence, further analysis could not be conducted for this study.

Furthermore, availing tetanus toxoid vaccine lowered the risk to have an overweight child. Immunizations, in general, promote better health, especially for infants.[38] Blencowe et al. also reported that this vaccine that catered to mothers effectively reduces neonatal mortality due to tetanus. Tetanus toxoid immunization for pregnant women was reported to have the capacity to reduce neonatal mortality due to tetanus by 94%.[33] Immunization also provides evidence of the mother being health conscious that could reflect on her nurturing practices.[38]

Families that are considered poor, middle class, rich or richest were found to have increased chances of having an overweight child compared to those that were considered poorest. The results are in agreement with Bishwajit and Yaya (2019) that the risk of overweight and obesity amongst children increases as the wealth index rises.[39]

Lastly, a child was less likely to be overweight if the mother was overweight, but with increased chances if the mother was obese. Former studies also showed that children tend to mirror the nutritional status of their mothers, and maternal pre-pregnancy obesity and excessive gestational weight gain were found to be associated with higher chances of obesity in offspring during childhood.[10,30,40]

In summary, the maternal factors that were found to have influence on the nutritional status of young children are maternal education, months of lactation, nutritional status of mothers, availment of tetanus toxoid immunization during pregnancy and family wealth quintile. Crafting of new interventions and policies to address the double burden of malnutrition in young children should therefore observe the inclusion of the identified maternal factors. It is equally important to strengthen existing programs that involves behavior change among mothers specifically on infant and young child feeding practices, and participation in programs and prenatal services. Policy makers should also aim for improvement of food environment and promotion of healthy lifestyle, which have direct impact on improving the nutritional status of the mother; which in turn will improve the nutritional status of their child.

The scope of the study only considered maternal characteristics available from the 2015 National Nutrition Survey (Updating Survey) but related researches also showed that maternal mental health or prescriptions drugs tends to affect child nutrition.[41,42] Therefore, future exploration of child nutrition in the Philippines may include factors related to mental health. In addition, further studies about the possible underlying health conditions of mothers and children may be done to have a deeper understanding as to why there is little improvement in the state of malnutrition of young children in the country. Recently, there has been an increase in recorded teenage pregnancy in the Philippines which may be given focus for future studies concerning malnutrition amongst young children. Using more recent data may result in the discovery of more or different maternal characteristics associated with the nutritional status of children aged 0-23 months in the Philippines.

CONCLUSION

Wasting was common particularly among male children aged 6 to 11 months while overweight was apparent among those aged younger than five months and male.

The mother's education, nutritional status, months of lactation, availing tetanus toxoid vaccine pre-natal service and wealth quintile significantly influenced the child's nutritional status using the weight-for-length indicator.

Higher risk of wasting in children was associated with mothers with lower education, underweight, breastfeeding for more than 1 year, did not avail of tetanus toxoid vaccine, and surprisingly, from rich households. It was more likely for an obese mother to have an overweight child.

It is recommended that nutrition interventions to address wasting among children 0 to 23 months be redesigned to focus on the identified maternal factors associated with the nutritional status of young children. Healthy lifestyle, attainment of a healthy weight, and prenatal services utilization among females of reproductive age should be promoted.

Association of nutritional status of children to complementary feeding or breastfeeding practices should be further explored.

Statement of Authorship

All authors interpreted the results of analysis, read and approved the final version of the manuscript.

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