Individual and Environmental Factors are Important Predictors of Overweight and Obesity among 0 to 60 Months Old Children in the Philippines: 2013 NNS Data

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Abstract The rising prevalence of overweight is a result of multi-faceted factors at the individual and environmental levels. This study aims to identify the predictors of overweight and obesity among children aged 0 to 60 months old in the Philippines. The respondents were 13,021 children who participated in the 2013 National Nutrition Survey (NNS): 2,392 infants (0 to < 12 months); 4,732 toddlers (12 to < 36 months); and 5,897 pre-schoolers (46 to 60 months). In this study, individual factors are birth information, feeding practices, nutritional status, and macronutrient intake while environmental factors include socio-demographic characteristics and government program participation like vitamin A supplementation and deworming. A face-to-face interview was conducted using structured pre-tested questionnaires. Weight and height were measured using standard techniques. Chi-square test for association and Odds Ratio (OR) at 5% level of significance were used to determine the factors associated with overweight/obesity among children. The predictor of overweight/obesity among infants is nutritional status while among toddlers and pre-schoolers the common predictors are urbanity, wealth quintile, mother’s working status, type of delivery, birth size, and household type. Additionally, other predictor among toddlers is Vitamin A supplementation while among pre-schoolers are family size, deworming, and nutritional status. Overweight and obesity among infants is predicted by individual factor while among toddlers and pre-schoolers, the factors are dominated by environmental factors. Identification of these drivers of overweight and obesity during childhood will aid program planners and policy makers in crafting appropriate nutrition interventions per targeted physiological groups.

Keywords: childhood obesity, environmental, individual, predictors

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1. Introduction

Childhood overweight and obesity is a global problem as a result of imbalance between calorie intake and calories utilized. This problem is on the rise in low- and middle-income countries particularly in urban settings. In 2016, an estimated 41 million children under the age of 60 months were overweight or obese. In the last decade, determinants of the behaviour related to childhood overweight and obesity were focused mainly on individual factors such as gender, genetic background, physical activity and dietary intake. On the other hand, scientific researches also suggested that environmental factors including socio-demographic characteristics, access to health services, infrastructures, pollution, and social connections influence the adopted health habits of children. However, these evidences provided inconclusive findings about the associations of both individual and environmental factors on childhood overweight and obesity.

Overweight and obese children are more likely to stay obese into adulthood and more likely to develop non-communicable diseases such as dyslipidemia, hyperinsulinemia, diabetes, hypertension, cardiovascular diseases and arthritis at a younger age [1] hence, adversely affecting the quality of life. And since eating habits are developed during childhood, this age is considered to be the critical period for emergent long-term diet related conditions such as overweight and obesity [2].

In the Philippines, childhood overweight and obesity is already a public health concern. In the 2013 National Nutrition Survey overweight among children was 5.0%. While the causes of childhood overweight and obesity are multifactorial, limited research has focused on identifying the predictors that may play a role in the rising prevalence of this problem among children. This study aims to identify the predictors of overweight and obesity among children aged 0 to 60 months old in the Philippines.
2. Methodology

2.1. Study Population and Setting

This study uses data extracted from the 2013 National Nutrition Survey (NNS) which employed a cross-sectional survey. The NNS adopted the 2003 Master Sample developed by the Philippine Statistics Authority which utilized the 2009 Labor Force Survey (LFS) Households. The survey employed a stratified three-stage sampling design.

The first stage of sampling is the selection of Primary Sampling Units, consisting of one barangay or a combination of contiguous barangays with at least 500 households each. From these PSUs, enumeration areas with 150 to 200 households were identified, from which housing units were randomly selected. The third stage was the random selection of the households, which is the ultimate sampling unit. The NNS used four replicates of the Master Sample to obtain the national, regional, and provincial estimates for measurements of anthropometry, and interview schedule based information. Overall, there were 3,114 identified enumeration areas. There were a total of 35,825 sample households and 172,323 individuals covered. A total of 13,021 0 to 60 months old children were included in the study wherein 2,392 are infants (0 to less than 12 months), 4,732 are toddlers (12 to less than 36 months), and 5,897 are preschoolers (36 to 60 months) [3].

This study is focused on analyzing the individual and environmental factors of overweight and obesity among children aged 0-60 months. Environmental factors include the household’s socio-demographic profile, as well as participation in government programs while individual factors include gender, ethnicity, birth information, feeding practices, nutritional status, and macronutrient intake.

2.1.1. Weight

The weight of the study children were measured using a Detecto platform beam balance scale with 160-kilogram capacity. Children below 2 years of age and those not able to stand independently were weighed together with the mother or caregiver or any adult companion without the child and was subtracted from the weight of the child with the mother/caregiver. Weight was recorded to the nearest 0.1 kilograms.

2.1.2. Height

Standing height of children 2 years and above was measured using a Seca microtoise while recumbent length was measured among children less than 2 years using an infantometer or a wooden length board. Height and length were recorded to the nearest 0.1 centimeters.

2.1.3. Nutritional Status

The nutritional status of infants and children was determined using the World Health Organization-Child Growth Standards (WHO-CGS, 2006). Overweight are children with weight-for-height greater than 2 standard deviations (~2SD) above WHO Child Growth Standards median, while obese children have weight-for-height greater than 3 standard deviations (~3SD).

2.1.4. Interview

A face-to-face interview was done to gather data on the socio-economic and government program participation variables. These included Vitamin A supplementation, deworming, newborn screening, and iron supplementation.

2.1.5. Food Intake

To estimate the day-to-day variation in energy and nutrient intakes, two 24-h dietary recalls were conducted by registered dietitians with the parents and children face-to-face using structured questionnaires. The first 24-h dietary recall was collected for all sampled households, and a second 24-h dietary recall was repeated in 50% of randomly selected households on a non-consecutive day. The second 24-h dietary recall was typically collected 2 days after the first 24-h recall. All food and beverages that the child consumed on the previous day were recorded during dietary recalls. The amount of each food item or beverage was estimated using common household measurements, such as cups, tablespoons, by size, or number of pieces. The information was then converted to grams using a portion to weight list for common foods compiled by FNRI or through actual weighing of food samples.

2.2. Statistical Analysis

Chi-square test for association was used to determine if there exists an association between the prevalence of overweight/obesity among children with the individual and environmental variables.

Individual variables include gender, ethnicity, birth information, child feeding practices, nutritional status, and sugar intake. Under birth information are the type of delivery, birth weight, gestation, and birth size. The feeding practices include breastfeeding, formula feeding, complementary feeding, regular feeding, and their various combinations. And for the nutritional status, presence of stunting was analyzed.

 Macronutrient intake for carbohydrates, protein, total fat, and total sugar were also determined, with adjustment on sex, urbanity and wealth status.

On the other hand, environmental variables pertain to socio-economic and demographic characteristics as well as participation in government programs. Under the socio-economic and demographic characteristics are locale, family size, wealth quintile, household type, parents’ educational status and parents’ working status. The government programs participation includes newborn screening, iron supplementation, vitamin A supplementation, and deworming.

Once an association was observed, Logistic regression was used to obtain Odds Ratio. Odds can be defined as the probability that the outcome of interest will occur over the probability that it will not occur for a particular group while Odds Ratio (OR) is the ratio of the probability that the outcome of interest will occur over the probability that it will not occur for one group relative to the other. An OR = 1 indicates that the probability that the outcome of interest will occur over the probability that it will not occur for one group relative to the other.

An OR > 1 suggests the probability that the outcome of interest will occur for one group is higher than that group 2. Lastly, if OR < 1, the probability that the outcome of interest will occur for group 1 is lower than group 2.
2.3. Ethical Review

The study was submitted and reviewed by the FNRI Institutional Ethics Review Committee (FNRI-IERC) for clearance. However, since it is a legal mandate of FNRI to define the nutritional status of Filipinos, ethical clearance is not really necessary. Nevertheless, FNRI adhered to the code of ethics and practices during the implementation of the survey [3].

2.4. Conflict of Interest

The authors declare no conflict of interest with the conduct of the study. The conduct of the National Nutrition Survey is government – funded.

3. Results

3.1. Profile of Respondents

A total of 13,021 0 to 60 months old children were included in the study wherein 2,392 are infants (0 to less than 12 months), 4,732 are toddlers (12 to less than 36 months), and 5,897 are pre-schoolers (36 to 60 months). In this study children were mostly male (51.5%), majority dwells in rural areas (57.0%), with children coming from families with more than 5 members (84.7%), with extended families (50.1%); from households belonging to the rich wealth quintile (32.4%). Majority of the parents had completed secondary education; most mothers are non-working (74.3%) while most fathers are working (90.1%). Among these study children, 632 were overweight while 12,389 (74.3%) while most fathers are working (90.1%). Among pre-school children, 632 were overweight while 12,389 (74.3%) of whom 12,389 (74.3%) were of working status, type of delivery, birth size and vitamin A supplementation were the significant predictors of overweight and obesity. Children in the urban areas were likely to become overweight/obese by 42% higher than for toddlers from rural areas. Toddlers who belong to the rich quintile were 76% more likely to become overweight while those who belong to the richest quintile were 3.23 times higher to become overweight/ obese. Moreover, the odds of being overweight among toddlers was 34% higher on those who belong to extended type of household, 85% higher among those with working mothers, 80% higher on those who were born via caesarean delivery, 113% among toddlers who were born large in size. On the other hand, toddlers who participated in Vitamin A supplementation were 30% less likely to become overweight than those who did not participate.

As for the factors affecting overweight and obesity among pre-schoolers, include locality, family size, wealth quintile, household type, mothers’ working status, type of delivery, birth size, deworming, and nutritional status were significant predictors. The odds of being overweight/ obese were higher by 59% among pre-schoolers from urban areas, 57% among pre-schoolers who belonged in extended type of household, 67% among pre-schoolers with working mothers. The odds of being overweight/ obese was 0.76 higher in the poorest quintile than in the poor quintile; while about 1.5; 4; 8.8 times higher among the middle, rich, and richest quintile. Moreover, children who were born through caesarean delivery were 1.88 times more likely to become overweight/ obese as compared to those who were born through normal delivery and 2.5 times higher on those who had larger birth size. On the contrary, the odds of being overweight/ obese was lower by 37% among those who belong to a family of 5 or more members, and 27% among those who participated in deworming.

In terms of nutritional status, stunted pre-schoolers were found to be 46% less likely to become overweight/ obese. This is contradicting with the results of the infants wherein those who were stunted were more likely to become overweight/ obese.

3.4. Predictors of Overweight/Obesity

Table 5 presents the results of logistic regression to determine the factors affecting overweight and obesity among the different agegroups. Results show that the only significant factor affecting overweight and obesity among infants was the presence of stunting. Stunted infants were 176% more likely to become overweight/obese than those who were not stunted.

Among toddlers, wealth quintile, household type, mothers’ working status, type of delivery, birth size and vitamin A supplementation were the significant predictors of overweight and obesity. Children in the urban areas were likely to become overweight/obese by 42% higher than for toddlers from rural areas. Toddlers who belong to the rich quintile were 76% more likely to become overweight while those who belong to the richest quintile were 3.23 times higher to become overweight/ obese. Moreover, the odds of being overweight among toddlers was 34% higher on those who belong to extended type of household, 85% higher among those with working mothers, 80% higher on those who were born via caesarean delivery, 113% among toddlers who were born large in size. On the other hand, toddlers who participated in Vitamin A supplementation were 30% less likely to become overweight than those who did not participate.

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3.5. Macronutrients Associated with Overweight/ Obesity

Results of logistic regression (Table 6) showed that carbohydrate, protein, total sugar intakes were not associated to the prevalence of overweight among infants. Among toddlers, the odds of being overweight decreases by 0.02 (p=0.013) as total sugar intake increases. As for pre-schoolers, as total fat intake increases by one 1 gram the likelihood of becoming overweight increases by 0.02.
Table 1. Socio-demographic Profile of Respondents

| Socio-demographic profile | 0-1 yo | 1-3 yo | 3-5 yo | Total n (%) |
|---------------------------|--------|--------|--------|-------------|
| **Gender**                |        |        |        |             |
| Male                      | 1196 (50.0) | 2494 (52.7) | 3014 (51.1) | 6704 (51.5) |
| Female                    | 1196 (50.0) | 2238 (47.3) | 2883 (48.9) | 6317 (48.5) |
| **Total**                 | 2392 (100.0) | 4732 (100.0) | 5897 (100.0) | 13021 (100.0) |
| **Locale**                |        |        |        |             |
| Rural                     | 1330 (55.6) | 2654 (56.1) | 3441 (58.4) | 7425 (57.0) |
| Urban                     | 1062 (44.4) | 2078 (43.9) | 2456 (41.6) | 5596 (43.0) |
| **Ethnicity**             |        |        |        |             |
| non-indigenous people     | 2196 (92.5) | 4374 (92.9) | 5398 (92.2) | 11968 (92.5) |
| Indigenous people         | 174 (7.3) | 324 (6.9) | 449 (7.7) | 947 (7.3) |
| Had foreign blood         | 5 (0.2) | 10 (0.2) | 8 (0.1) | 23 (0.2) |
| **Family size**           |        |        |        |             |
| less than 5 members       | 278 (11.6) | 689 (14.6) | 1027 (17.4) | 1994 (15.3) |
| more than 5 members       | 2114 (88.4) | 4043 (85.4) | 4870 (82.6) | 11027 (84.7) |
| **Wealth quintile**       |        |        |        |             |
| Poorest                   | 635 (26.8) | 1299 (27.8) | 1739 (29.8) | 3673 (28.5) |
| Poor                      | 535 (22.6) | 1045 (22.3) | 1291 (22.1) | 2871 (22.3) |
| Middle                    | 478 (20.2) | 967 (20.7) | 1152 (19.7) | 2597 (20.1) |
| Rich                      | 409 (17.3) | 755 (16.1) | 924 (15.8) | 2088 (32.4) |
| Richest                   | 310 (13.1) | 613 (13.1) | 737 (12.6) | 1660 (12.9) |
| **Household type**        |        |        |        |             |
| Single                    | 955 (40.3) | 2270 (48.4) | 3215 (54.9) | 6440 (49.9) |
| Extended                  | 1417 (59.7) | 2421 (51.6) | 2639 (45.1) | 6477 (50.1) |
| **Mother’s Education**    |        |        |        |             |
| No grade completed        | 32 (1.4) | 67 (1.5) | 115 (2.3) | 214 (1.8) |
| Elementary education      | 414 (17.9) | 894 (20.4) | 1166 (22.8) | 2474 (0.3) |
| Secondary education       | 1182 (51.2) | 2158 (49.2) | 2383 (46.7) | 5723 (48.5) |
| College/Higher/Post-secondary education (VOC/TECH) | 678 (29.4) | 1262 (28.8) | 1436 (28.1) | 3376 (28.6) |
| Others                    | 1 (0.0) | 5 (0.1) | 8 (0.2) | 14 (0.1) |
| **Mother’s working status** |    |        |        |             |
| No work                   | 1953 (84.5) | 3326 (75.6) | 3505 (68.6) | 8784 (74.3) |
| Working                   | 359 (15.5) | 1072 (24.4) | 1608 (31.4) | 3039 (25.7) |
| **Father’s education**    |        |        |        |             |
| No grade completed        | 40 (2.0) | 64 (1.7) | 114 (2.5) | 218 (2.1) |
| Elementary education      | 538 (26.5) | 1135 (29.4) | 1511 (32.9) | 3184 (30.4) |
| Secondary education       | 912 (45.0) | 1584 (41.0) | 1769 (38.6) | 4265 (40.7) |
| College or Higher/Post-secondary education (VOC/TECH) | 537 (26.5) | 1075 (27.8) | 1191 (26.0) | 2803 (26.8) |
| Others                    | 0 (0.0) | 3 (0.1) | 3 (0.1) | 6 (0.1) |
| **Father’s working status** |    |        |        |             |
| No work                   | 230 (11.3) | 382 (9.9) | 423 (9.2) | 1035 (9.9) |
| Working                   | 1799 (88.7) | 3489 (90.1) | 4170 (90.8) | 9458 (90.1) |
| **Nutritional status**    |        |        |        |             |
| Not overweight            | 2219 (92.8) | 4520 (95.5) | 5650 (95.8) | 12389 (95.1) |
| Overweight                | 173 (7.2) | 212 (4.5) | 247 (4.2) | 632 (4.9) |
### Table 2. Environmental and Individual Factors Associated With Being Overweight of Children 0 to Less than 1 Year Old

| ENVIRONMENTAL FACTORS                      | Not OW | %   | 0W | %   | Total | p-value |
|--------------------------------------------|--------|-----|----|-----|-------|---------|
| **Socio-demographic profile and economic status** |        |     |    |     |       |         |
| Gender                                     |        |     |    |     |       |         |
| Male                                       | 1109   | 46.54 | 87 | 3.72 | 1196  | 0.937   |
| Female                                     | 1110   | 46.13 | 86 | 3.61 | 1196  |         |
| Locale                                     |        |     |    |     |       | 0.505   |
| Rural                                      | 1238   | 44.88 | 92 | 3.5  | 1330  |         |
| Urban                                      | 981    | 47.79 | 81 | 3.83 | 1062  |         |
| Ethnicity                                  |        |     |    |     |       | 0.904   |
| non-indigenous people                      | 2038   | 87.55 | 158| 6.94 | 2196  |         |
| Indigenous people                          | 160    | 4.39  | 14 | 0.37 | 174   |         |
| Had foreign blood                          | 5      | 0.25  | 0  | 0.25 | 5     |         |
| Family size                                |        |     |    |     |       | 0.228   |
| less than 5 members                        | 253    | 10.37 | 25 | 1.08 | 278   |         |
| more than 5 members                        | 1966   | 82.29 | 148| 6.26 | 2114  |         |
| Wealth quintile                            |        |     |    |     |       | 0.97    |
| Poorest                                    | 589    | 21.44 | 46 | 1.7  | 635   |         |
| Poor                                       | 499    | 20.34 | 36 | 1.42 | 535   |         |
| Middle                                     | 444    | 18.51 | 34 | 1.48 | 478   |         |
| Rich                                       | 379    | 17.75 | 30 | 1.42 | 409   |         |
| Richest                                    | 285    | 14.66 | 25 | 1.29 | 310   |         |
| Household type                             |        |     |    |     |       | 0.1     |
| Single                                     | 876    | 36.2  | 79 | 3.31 | 955   |         |
| Extended                                   | 1325   | 56.5  | 92 | 3.97 | 1417  |         |
| Mother’s Education                         |        |     |    |     |       | 0.911   |
| No grade completed                         | 30     | 1.1   | 2  | 0.1  | 32    |         |
| Elementary education                       | 385    | 15.3  | 29 | 1.17 | 414   |         |
| Secondary education                        | 1089   | 48.1  | 93 | 4.2  | 1182  |         |
| College/Higher/Post-secondary education(TECH) | 632    | 27.9  | 46 | 2.06 | 678   |         |
| Others                                     | 1      | 0     | 0  | 0    | 1     |         |
| Father’s Education                         |        |     |    |     |       |         |
| No grade completed                         | 35     | 1.5   | 5  | 0.19 | 40    | 0.37    |
| Elementary education                       | 496    | 22.5  | 42 | 1.92 | 538   |         |
| Secondary education                        | 840    | 42.4  | 72 | 3.79 | 912   |         |
| College or Higher/Post-secondary education(TECH) | 504    | 25.9  | 33 | 1.75 | 537   |         |
| Others                                     | 0      |      |    | 0    |       |         |
| Government programs                        |        |     |    |     |       | 0.838   |
| New born screening                         |        |     |    |     |       |         |
| Did not participate                        | 1058   | 43    | 72 | 3.01 | 1130  | 0.074   |
| Participated                               | 1120   | 48.42 | 100| 4.32 | 1220  |         |
| Iron supplementation                       |        |     |    |     |       |         |
| Did not participate                        | 894    | 76.06 | 52 | 4.3  | 946   |         |
| Participated                               | 215    | 18.76 | 9  | 0.88 | 224   |         |
| Vit. A supplementation                     |        |     |    |     |       |         |
| Did not participate                        | 6      | 0.44  | 0  | 0    | 6     |         |
| Participated                               | 407    | 17.16 | 15 | 0.69 | 422   |         |
| Deworming                                  |        |     |    |     |       |         |
| Did not participate                        | -      | -     |    | -    | -     |         |
| Participated                               | -      | -     |    | -    | -     |         |
| Individual factors                  | Not OW | 0W | Total | p-value |
|------------------------------------|--------|----|-------|---------|
| n       | %  | n   | %   |         |
| Gender                           |        |    |       | 0.937   |
| Male                             | 1109   | 46.54 | 87   | 3.72   | 1196 |
| Female                           | 1110   | 46.13 | 86   | 3.61   | 1196 |
| Birth information                |        |    |       |         |
| Type of delivery                 |        |    |       | 0.69    |
| Normal delivery                  | 1520   | 80.97 | 119  | 6.41   | 1639 |
| Caesarian section                | 207    | 11.59 | 18   | 1.03   | 225  |
| Birth size                       |        |    |       | 0.121   |
| Small or less (< 2500 g)         | 392    | 21.07 | 29   | 1.44   | 421  |
| Average (> 2500g; < 4000g)       | 1017   | 54.01 | 73   | 4.06   | 1090 |
| Large or more (> 4000 g)         | 318    | 17.47 | 35   | 1.94   | 353  |
| Gestation                        |        |    |       | 0.423   |
| Full term                        | 60     | 3.36  | 3    | 0.14   | 63   |
| Pre mature                       | 1667   | 89.2  | 134  | 7.31   | 1801 |
| Birth weight                     |        |    |       | 0.135   |
| Normal                           | 1499   | 80.09 | 125  | 6.84   | 1624 |
| Low                              | 228    | 12.47 | 12   | 0.61   | 240  |
| Feeding practices                |        |    |       |         |
| Exclusive breastfeeding           | 602    | 23.69 | 71   | 2.86   | 673  |
| Predominant breast feeding       | 74     | 3.16  | 6    | 0.26   | 80   |
| Breastfeeding + complementary foods | 428   | 16.92 | 23   | 0.94   | 451  |
| Breastfeeding + other milk       | 169    | 7.42  | 15   | 0.62   | 184  |
| Breastfeeding + other milk + complementary milk | 150 | 6.58 | 8 | 0.42 | 158 |
| Regular meals + breastfeeding    | 147    | 6.42  | 3    | 0      | 150  |
| Regular meals + breast feeding + other milk | 45 | 2.01 | 3 | 0 | 48 |
| Pure milk formula                | 185    | 8.6   | 15   | 0.8    | 200  |
| Other milk + complementary foods | 294    | 13.6  | 16   | 0.76   | 310  |
| Regular meals + other milk (2x a day) | 87    | 4.24  | 9    | 0.46   | 96   |
| Regular diet (without milk)      | 6      | 0.23  | 0    | 0      | 6    |
| Nutritional status               |        |    |       |         |
| Stunting                         |        |    |       | 0.000*  |
| No                               | 1920   | 80.26 | 121  | 5.03   | 2041 |
| Yes                              | 299    | 12.41 | 52   | 2.3    | 351  |

* p-value computed using χ² test of association, significant at p-value <0.05.
**proportion was computed using survey weights.
OW - Overweight.

Table 3. Environmental and Individual factors associated with being overweight of children 1 to less than 3 years old

| ENVIRONMENTAL FACTORS                      | Not OW | 0W | Total | p-value |
|--------------------------------------------|--------|----|-------|---------|
| n      | %  | n   | %   |         |
| Socio-demographic profile and economic status |        |    |       |         |
| Locale                                      |        |    |       | 0.011*  |
| Rural                                       | 2553   | 47.76 | 101  | 1.84   | 2654 |
| Urban                                       | 1967   | 47.62 | 111  | 2.79   | 2078 |
| Ethnicity                                   |        |    |       |         |
| non-indigenous people                       | 4175   | 90.33 | 199  | 4.45   | 4374 |
| Indigenous people                           | 313    | 4.51  | 11   | 0.14   | 324  |
| Had foreign blood                           | 8      | 0.16  | 2    | 0      | 10   |
| Family size                                 |        |    |       |         |
| less than 5 members                         | 651    | 14.11 | 38   | 0.77   | 689  |
| more than 5 members                         | 3869   | 81.27 | 174  | 3.85   | 4043 |
| Wealth quintile                             |        |    |       |         |
| Poorest                                     | 1263   | 23.56 | 36   | 0.65   | 1299 |
| Poor                                        | 1012   | 20.83 | 33   | 0.71   | 1045 |
| Middle                                      | 928    | 20.51 | 39   | 0.79   | 967  |
| Rich                                        | 719    | 16.99 | 36   | 0.77   | 755  |
| Richest                                     | 547    | 13.49 | 66   | 1.7    | 613  |
|                                   | Not OW | OW | Total | p-value |
|-----------------------------------|--------|----|-------|---------|
|                                   | n      | %  | n     | %      |
| **Household type**                |        |    |       |        |
| Single                            | 2183   | 45.81 | 87 | 1.77 | 2270 | 0.039* |
| Extended                          | 2298   | 49.58 | 123 | 2.84 | 2421 |
| **Mother's Education**            |        |    |       |        |
| No grade completed                | 65     | 1.18 | 2 | 0 | 67 | 0.000* |
| Elementary education              | 868    | 18.53 | 31 | 0.75 | 894 |
| Secondary education               | 2084   | 48.5 | 74 | 1.76 | 2158 |
| College/Higher/Post-secondary     | 1174   | 27.21 | 88 | 2.15 | 1262 |
| education (VOC/TECH)              |        |    |       |        |
| Others                            | 5      | 0   | 0 | 0 | 5 |
| **Mother’s working status**       |        |    |       |        |
| No work                           | 3205   | 72.14 | 121 | 2.81 | 3326 | 0.000* |
| Working                           | 1002   | 23.36 | 70 | 1.69 | 1072 |
| **Father’s education**            |        |    |       |        |
| No grade completed                | 63     | 1.32 | 1 | 0 | 64 | 0.000* |
| Elementary education              | 1104   | 26.44 | 31 | 0.75 | 1135 |
| Secondary education               | 1527   | 40.96 | 57 | 1.51 | 1584 |
| College or Higher/Post-secondary  | 1005   | 26.92 | 70 | 2.02 | 1075 |
| education (VOC/TECH)              |        |    |       |        |
| Others                            | 3      | 0   | 0 | 0 | 3 |
| **Father’s working status**       |        |    |       |        |
| No work                           | 365    | 9.84 | 17 | 0.5 | 382 |
| Working                           | 3346   | 85.84 | 143 | 3.82 | 3489 |
| **Government programs**           |        |    |       |        |
| New born screening                |        |    |       |        |
| Did not participate               | 2522   | 52.88 | 82 | 1.77 | 2604 |
| Participated                      | 1825   | 39.87 | 116 | 2.63 | 1941 |
| **Iron supplementation**          |        |    |       |        |
| Did not participate               | 3422   | 73.71 | 156 | 3.55 | 3578 |
| Participated                      | 1008   | 21.7 | 51 | 1.05 | 1059 |
| **Vit. A supplementation**       |        |    |       |        |
| Did not participate               | 801    | 17.2 | 50 | 1.27 | 851 |
| Participated                      | 3672   | 78.17 | 160 | 3.36 | 3832 |
| **Deworming**                     |        |    |       |        |
| Did not participate               | 2750   | 61.11 | 133 | 3.08 | 2883 |
| Participated                      | 1724   | 34.26 | 77 | 1.55 | 1801 |
| **INDIVIDUAL FACTORS**            |        |    |       |        |
| Gender                            |        |    |       |        |
| Male                              | 2375   | 50.15 | 119 | 2.6 | 2494 |
| Female                            | 2145   | 45.22 | 93 | 2.02 | 2238 |
| **Birth information**             |        |    |       |        |
| Type of delivery                  |        |    |       |        |
| Normal delivery                   | 2757   | 83.65 | 118 | 3.62 | 2875 |
| Caesarian section                 | 376    | 11.9 | 29 | 0.84 | 405 |
| **Birth size**                    |        |    |       |        |
| Small or less (< 2500 g)          | 700    | 21.25 | 30 | 0.89 | 730 |
| Average (> 2500g; < 4000g)        | 1820   | 55.18 | 61 | 1.92 | 1881 |
| Large or more (> 4000 g)          | 613    | 19.12 | 56 | 1.64 | 669 |
| Gestation                         |        |    |       |        |
| Full term                         | 86     | 2.58 | 8  | 0.21 | 94 |
| Pre mature                        | 3047   | 92.97 | 139 | 4.25 | 3186 |
| **Birth weight**                  |        |    |       |        |
| Normal                            | 2764   | 84.27 | 134 | 4.07 | 2898 |
| Low                               | 369    | 11.28 | 13 | 0.38 | 382 |
| **Nutritional status**            |        |    |       |        |
| Stunting                          |        |    |       |        |
| No                                | 2943   | 63.43 | 138 | 3.01 | 3081 |
| Yes                               | 1576   | 31.94 | 74 | 1.62 | 1650 |

* p-value computed using χ2 test of association, significant at p-value <0.05
**proportion was computed using survey weights
OW- Overweight.
Table 4. Environmental and Individual Factors Associated with being Overweight of Children 3 to 5 Years Old

| ENVIROMENTAL FACTORS | Not OW | OW | Total | p-value |
|-----------------------|--------|----|-------|---------|
| n                     | %      | n  | %     |         |
| Socio-demographic profile and economic status |        |    |       |         |
| Locale                |        |    |       |         |
| Rural                 | 3324   | 49.48 | 117 | 1.73   | 3441 |
| Urban                 | 2326   | 46.02 | 130 | 2.77   | 2456 |
| p-value               | 0.000* |    |       |         |
| Ethnicity             |        |    |       |         |
| non-indigenous people | 5162   | 89.83 | 236 | 4.37   | 5398 |
| Indigenous people     | 440    | 5.02  | 9   | 0.11   | 449  |
| Had foreign blood     | 8      | 0.16  | 0   | 0      | 8    |
| p-value               | 0.099  |    |       |         |
| Family size           |        |    |       |         |
| less than 5 members   | 966    | 16.41 | 61  | 1.17   | 1027 |
| more than 5 members   | 4684   | 79.09 | 186 | 3.34   | 4870 |
| p-value               | 0.002* |    |       |         |
| Wealth quintile       |        |    |       |         |
| Poorest               | 1715   | 25.22 | 24  | 0.33   | 1739 |
| Poor                  | 1260   | 20.68 | 31  | 0.51   | 1291 |
| Middle                | 1113   | 19.83 | 39  | 0.71   | 1152 |
| Rich                  | 860    | 16.48 | 64  | 1.24   | 924  |
| Richest               | 648    | 13.24 | 89  | 1.75   | 737  |
| p-value               | 0.000* |    |       |         |
| Household type        |        |    |       |         |
| Single                | 3106   | 52.07 | 109 | 1.96   | 3215 |
| Extended              | 2501   | 43.39 | 138 | 2.58   | 2639 |
| p-value               | 0.000* |    |       |         |
| Mother's Education    |        |    |       |         |
| No grade completed    | 110    | 1.66  | 5   | 0      | 115  |
| Elementary education  | 1148   | 20.54 | 18  | 0.35   | 1166 |
| Secondary education   | 2304   | 46.44 | 79  | 1.75   | 2383 |
| College/Higher/Post-secondary education (VOC/TECH) | 1321 | 26.67 | 115 | 2.39 | 1436 |
| Others                | 6      | 0     | 2   | 0      | 8    |
| p-value               | 0.000* |    |       |         |
| Father's Education    |        |    |       |         |
| No grade completed    | 109    | 1.74  | 5   | 0      | 114  |
| Elementary education  | 1485   | 29.81 | 26  | 0.56   | 1511 |
| Secondary education   | 1716   | 38.75 | 53  | 1.26   | 1769 |
| College or Higher/Post-secondary education (VOC/TECH) | 1084 | 25.15 | 107 | 2.58 | 1191 |
| Others                | 3      | 0     | 0   | 0      | 3    |
| p-value               | 0.000* |    |       |         |
| Father's working status |   |    |       |         |
| No work               | 3379   | 64.93 | 126 | 2.68   | 3505 |
| Working               | 1514   | 30.47 | 94  | 1.92   | 1608 |
| p-value               | 0.000* |    |       |         |
| Government programs   |        |    |       |         |
| New born screening    |        |    |       |         |
| Did not participate   | 3668   | 60.92 | 105 | 1.92   | 3773 |
| Participated          | 1661   | 39.08 | 128 | 2.41   | 1789 |
| p-value               | 0.000* |    |       |         |
| Iron supplementation  |        |    |       |         |
| Did not participate   | 3214   | 74.6  | 128 | 3.29   | 3342 |
| Participated          | 904    | 25.4  | 50  | 1.16   | 954  |
| p-value               | 0.054  |    |       |         |
| Vit. A supplementation|        |    |       |         |
| Did not participate   | 965    | 16.75 | 48  | 0.88   | 1013 |
| Participated          | 4618   | 83.25 | 195 | 3.12   | 4813 |
| p-value               | 0.32   |    |       |         |
| Deworming             |        |    |       |         |
| Did not participate   | 2126   | 38.66 | 111 | 2.26   | 2237 |
| Participated          | 3457   | 61.34 | 132 | 2.74   | 3589 |
| p-value               | 0.017* |    |       |         |
| INDIVIDUAL FACTORS    |        |    |       |         |
| Gender                |        |    |       |         |
| Male                  | 2874   | 48.23 | 140 | 2.61   | 3014 |
| Female                | 2776   | 47.77 | 107 | 1.9    | 2883 |
| p-value               | 0.074  |    |       |         |
### Birth Information

#### Type of delivery

| Type              | OR    | SE    | 95% CI Lower limit | 95% CI Upper limit | p-value |
|-------------------|-------|-------|--------------------|--------------------|---------|
| Normal delivery   | 1539  | 86    | 56                 | 3.36               | 1595    | 0.000* |
| Caesarian section | 162   | 9.68  | 17                 | 0.96               | 179     |        |

#### Birth size

| Size               | OR    | SE    | 95% CI Lower limit | 95% CI Upper limit | p-value |
|--------------------|-------|-------|--------------------|--------------------|---------|
| Small or less (< 2500 g) | 321   | 17.57 | 6                  | 0.39               | 327     | 0.018* |
| Average (> 2500 g; < 4000 g) | 1043   | 58.46 | 45                 | 2.81               | 1088    |        |
| Large or more (> 4000 g)    | 337   | 19.65 | 22                 | 1.11               | 359     |        |

#### Gestation

| Stage             | OR    | SE    | 95% CI Lower limit | 95% CI Upper limit | p-value |
|-------------------|-------|-------|--------------------|--------------------|---------|
| Full term         | 34    | 2.05  | 2                  | 0.1                | 36      | 0.66   |
| Pre mature        | 1667  | 93.63 | 71                 | 4.21               | 1738    |        |

#### Birth weight

| Category          | OR    | SE    | 95% CI Lower limit | 95% CI Upper limit | p-value |
|-------------------|-------|-------|--------------------|--------------------|---------|
| Normal            | 1540  | 86.9  | 70                 | 4.11               | 1610    | 0.122  |
| Low               | 161   | 8.79  | 3                  | 0.21               | 164     |        |

#### Nutritional status

| Status       | OR    | SE    | 95% CI Lower limit | 95% CI Upper limit | p-value |
|--------------|-------|-------|--------------------|--------------------|---------|
| No           | 3598  | 62.43 | 189                | 3.51               | 3787    | 0.000* |
| Yes          | 2052  | 33.07 | 58                 | 0.01               | 2110    |        |

* p-value computed using χ2 test of association, significant at p-value <0.05
**proportion was computed using survey weights

OW- Overweight.

Table 5. Factors Affecting Prevalence of Overweight/ Obesity Among Children (0 to less than 1 year old, 1 to less than 3 years old, and 3 to 5 years old)

| Factors                          | OR    | SE    | 95% CI Lower limit | 95% CI Upper limit | p-value |
|----------------------------------|-------|-------|--------------------|--------------------|---------|
| 0 to less than 1 year old        |       |       |                    |                    |         |
| Stunting                         |       |       |                    |                    |         |
| No (reference)                   | -     | -     | -                  | -                  | -       |
| Yes                              | 2.76  | 0.49  | 1.95               | 3.9                | 0.000*  |
| 1 to less than 3 years old       |       |       |                    |                    |         |
| Locale                           |       |       |                    |                    |         |
| Rural (reference)                | -     | -     | -                  | -                  | -       |
| Urban                            | 1.42  | 0.2   | 1.08               | 1.88               | 0.012*  |
| Wealth Quintile                  |       |       |                    |                    |         |
| poorest (reference)              | -     | -     | -                  | -                  | -       |
| poor                             | 1.14  | 0.28  | 0.71               | 1.85               | 0.582   |
| middle                           | 1.47  | 0.35  | 0.93               | 2.34               | 0.099   |
| rich                             | 1.76  | 0.42  | 1.1                | 2.81               | 0.019*  |
| richest                          | 4.23  | 0.9   | 2.79               | 6.43               | 0.000*  |
| Household type                   |       |       |                    |                    |         |
| Single (reference)               | -     | -     | -                  | -                  | -       |
| Extended                         | 1.34  | 0.19  | 1.01               | 1.78               | 0.039*  |
| Mother's working status          |       |       |                    |                    |         |
| No work (reference)              | -     | -     | -                  | -                  | -       |
| Working                          | 1.85  | 0.29  | 1.37               | 2.5                | 0.000*  |
| Type of delivery                 |       |       |                    |                    |         |
| Normal delivery (reference)      | -     | -     | -                  | -                  | -       |
| Caesarian                        | 1.8   | 0.39  | 1.18               | 2.74               | 0.006*  |
| Birth size                       |       |       |                    |                    |         |
| Small or less (reference)        | -     | -     | -                  | -                  | -       |
| Average                          | 0.78  | 0.18  | 0.5                | 1.22               | 0.28    |
| Large or more                    | 2.13  | 0.5   | 1.35               | 3.36               | 0.001*  |
| Vit. A Supplementation            |       |       |                    |                    |         |
| Did not participate (reference)  | -     | -     | -                  | -                  | -       |
| Participated                     | 0.7   | 0.12  | 0.5                | 0.97               | 0.031*  |
| 3 to 5 years old                 |       |       |                    |                    |         |
| Locale                           |       |       |                    |                    |         |
| Rural (reference)                | -     | -     | -                  | -                  | -       |
| Urban                            | 1.59  | 0.21  | 1.23               | 2.05               | 0.000*  |
| Family Size                      |       |       |                    |                    |         |
| >= 5 members                     | 0.63  | 0.1   | 0.47               | 0.85               | 0.002*  |
Table 6. Macronutrient Intake Affecting Overweight/Obesity Among Children 0 to 5 years old

|                      | Unadjusted OR (95% CI) | Unadjusted p-value | Adjusted*** OR (95% CI) | Adjusted*** p-value |
|----------------------|------------------------|--------------------|-------------------------|---------------------|
|                      |                        |                    |                         |                     |
| **0-11 months**      |                        |                    |                         |                     |
| Carbohydrates        | 0.93 (0.83, 1.04)      | 0.199              |                         |                     |
| Protein              | 1.01 (0.99, 1.02)      | 0.29               |                         |                     |
| Total Fat            | 1.04 (0.99, 1.09)      | 0.109              |                         |                     |
| Total Sugar          | 1.01 (0.97, 1.04)      | 0.784              |                         |                     |
| **1-2 years old**    |                        |                    |                         |                     |
| Carbohydrates        | 1 (1, 1.01)            | 0.449              | 1 (1, 1.01)             | 0.219               |
| Protein              | 1.02 (0.99, 1.05)      | 0.098              | 1.02 (0.99, 1.05)       | 0.114               |
| Total Fat            | 1.01 (0.98, 1.03)      | 0.52               | 1 (0.97, 1.02)          | 0.777               |
| Total Sugar          | 0.98 (0.97, 1)         | 0.013*             | 0.99 (0.97, 1)          | 0.034*              |
| **3-5 years old**    |                        |                    |                         |                     |
| Carbohydrates        | 1 (1, 1.01)            | 0.757              | 1 (1, 1.01)             | 0.429               |
| Protein              | 1.01 (0.99, 1.02)      | 0.451              | 1 (0.99, 1.02)          | 0.732               |
| Total Fat            | 1.02 (1.01, 1.04)      | 0.001*             | 1.02 (1, 1.03)          | 0.851               |
| Total Sugar          | 1 (0.99, 1.01)         | 0.354              | 1 (0.99, 1.01)          | 0.69                |

***adjusted for sex, urbanity & wealth quintile.

4. Discussion

Childhood obesity can profoundly affect children’s physical health, social, and emotional well-being and self-esteem. It is also associated with poor academic performance and a lower quality of life. Many co-morbid conditions like metabolic disorders, cardiovascular, orthopedic, neurological, hepatic, pulmonary, and renal disorders were also observed to be associated with childhood obesity [4].

Obesity is the result of complex interactions of multiple factors that have gradually led to enduring lifestyle changes which created global epidemic of major health concern. It is imperative that we should understand the major causes of obesity to provide better prevention and intervention strategies. It has been postulated that the basic causes of malnutrition are human and environmental resources, economic systems and political and ideological factors; the underlying causes include the inadequate access to food, inadequate care for children and women, and insufficient health services and unhealthy environment; and for the immediate causes, these are the inadequate dietary intake and occurrence of disease [4]. Our study focused on evaluating the predictors of overweight and obesity among infants, toddlers, and pre-schoolers in 2013.

The present study reveals that stunted infants were more likely to become overweight/obese than those who were not stunted (OR 2.76). This individual factor predicting overweight and obesity among infants in this
study is supported by previously published study which revealed that stunting causes a series of important long-lasting changes such as lower energy expenditure, higher susceptibility to the effects of high-fat diets, lower fat oxidation, and impaired regulation of food intake [8]. This is suggestive of an increase in the efficiency of dietary fat utilization that could lead to increased body fat content over time. Another study observed that stunted children showed significantly higher fasting respiratory quotient, and fasting fat oxidation was significantly lower, than normal children who had normal resting energy expenditure relative to body composition and normal post-prandial thermogenesis. This study concluded that childhood nutritional stunting was associated with long-term impairment of fat oxidation, a factor that strongly predicts obesity which is not observed among normal children [9]. Contrasting to these results, the findings of a prospective study which revealed that stunting in early childhood is associated with decreased BMI or body fat in childhood [6]. Another study also found that children stunted in early childhood had less fat and lower BMI than non-stunted children but had a more central fat distribution that was partially explained by their lower birth weights [7]. Given these contradicting results, more researches must be conducted to understand the physiologic mechanisms that underlie the relation between early-life stunting promote physiologic changes that influence adiposity in later life.

Among toddlers and preschoolers, common environmental predictors of overweight/obesity include those in the urban areas, rich to richest wealth quintile, extended type households, and working mothers. These environmental factors relate more to socio-economic characteristics of the households. Generally, the relationship between socio-economic factors and being overweight mainly results from the access that the population has to healthier and less energy-dense foods. In urban areas, access to unhealthy foods, and proximity to fast-food stores and food service establishments characterized as obesogenic environment could promote weight gain [10]. The predictor on mother’s working status wherein most mothers in this study are working may indicate an additional income to the family. Higher income and better wealth status have been founded to be significantly associated with diets rich in animal fats, predisposing children to excess weight gain [11]. Working mothers have less quality time spent with their children at home, thus, they do not have enough time to prepare healthy meals and encourage and motivate children to do physical activities.

Children in our study who are in an extended family have higher risk to be overweight and obese. This is consistent with the findings of a study in China which showed that children brought up in extended families had an increased risk of becoming obese than those looked after by parents mainly because grandparents might usually have more resources at their disposal that can be used to purchase more calorie-dense foods [14].

The low educational level of parents, particularly the mothers, in this study puts the child at higher risk of becoming overweight and obese. This is consistent with the study in Bazil and China where parents with low educational background have children more likely to be obese because of lack of knowledge of food selection, energy balance and weight control [13,14,15]. Educated parents may be more concerned about obesity and have higher awareness regarding the consequences of obesity. They tend to have a healthier diet, characterized by greater consumption of fruit, vegetables and lower fat milk and less consumption of fats and may also perform preventive measures better than less educated people [16].

The individual factors common among toddlers and preschoolers, like birth size and type of delivery were found to affect overweight/obesity prevalence. Based on the study results, those with high birth weight and born via Caesarean section were more at-risk to overweight than children born through normal delivery and those with small birth size. These findings are supported in an earlier published studies. It has been postulated that the intestinal flora during birth via Caesarian delays the acquisition of bifidobacterium which might be due to lack of contact of infants with the maternal vaginal flora [17]. A recent case-control study found that the composition of gut flora in infancy predicted obesity later in childhood [18]. This association between high birth weights and risk of obesity may be explained by an altered body composition at birth which persists during postnatal life [19].

In this study, although there are common individual and environmental predictors of overweight/obesity among toddlers and pre-school-aged children, there are also certain determinants unique to each. Among toddlers, the environmental factor uniquely affecting overweight/obesity prevalence was the participation in the government’s vitamin A supplementation program. Children who received Vitamin A supplements are less likely to be overweight or obese. Vitamin A supplementation is one of the mandated health programs of the government. Vitamin A is linked in the regulation of fat cells and the hormones they release could play a role in maintaining healthy body. It actively participates in the adipocyte metabolism and one of its metabolites, retinoic acid, had been found in vitro to promote adipose cell differentiation and to reduce the expression and secretion of leptin, an adipokine associated with satiety [23]. This is supported by a study which found out that dietary vitamin A has a role in regulating energy homeostasis by decreasing serum leptin levels [24].

Among the preschool children, the unique environmental factors predisposing children to overweight/obese were non-participation in deworming and family size. Children who were not dewormed are more prone to having intestinal parasitic infections which had been associated with micronutrient deficiencies and changes in gut microbiota and mucosa. Both micronutrient deficiencies and gut microbiota had been related to higher risk of obesity [25]. It was found that helminths and protozoans had a differential effect on leptin secretion which is related to inflammation, food intake and nutrient absorption and metabolism [26]. Heavy infection with E. coli, for instance, may also lead to micronutrient deficiencies in the host as E. coli might deplete the available micronutrients in the gut. Generally, an altered gut microbiota due to parasitic infections may increase caloric uptake from the diet and can modulate host genes that affect energy deposition in adipocytes and thereby increase the risk of diet-induced obesity [27].
Preschool children belonging to a family of 5 or more members showed less likelihood of being obese in this study. The number of family members may influence child weight through effects on resource allocation, the time and attention parents can devote to nurturing children, and on the nature and extent of interactions among siblings [28].

Food intake is one of the primary determinants of malnutrition apart from the presence of illness. This study also determined if the intake of macronutrients in terms of protein, carbohydrates, total fat, and total sugar increased the risk of overweight/obesity among the children. Results show that toddlers with higher sugar intake were less likely to become overweight and overweight (both unadjusted and adjusted for sex, urbanity, & wealth quintile). In terms of total sugar intake, it was found that among toddlers, the odds of being overweight decreases by 0.02 as total sugar increases. However, this is not in line with the results of current researches that reduced intake of dietary sugars was associated with a decrease in body weight while increased sugar intake was associated with a comparable weight increase which suggest that the change in body fatness which occurs with modifying intake of sugars results from an alteration in energy balance rather than a physiological or metabolic consequence of monosaccharides or disaccharides. Several studies have also linked the positive association of sugary beverages to being overweight/obese [4].

On the other hand, excessive sugar intake may displace consumption of whole foods which may result to nutritional deficiencies. In a study of 568 10-year-olds, as sugar intake increased, intake of essential nutrients decreased. And in a 1999 study, researchers from the Department of Agriculture found that when people got 18% or more of their calories from sugar, they had the lowest levels of essentials like folate, calcium, iron, Vitamin A, and Vitamin C [29]. Intake of sugary foods which is a calorie-dense food may result to feeling of fullness which may result to reduced appetite and distort the eating pattern of children to more nutrient-dense foods. If there are any adverse effects of sugar, they are due entirely to the calories it provides, and it is therefore indistinguishable from any other calorific food. Excess total energy consumption seems more likely to be the cause of obesity and diabetes [30]. Other factors such as stress, sleep, metabolic health, lifestyle, and social environment also contribute to a consistent energy surplus.

While preschool children with high total fat intake tend to be more at risk of overweight/obesity (unadjusted for sex, urbanity & wealth quintile). It was found in this study that for an increase in fat intake by 1 gram, the likelihood of becoming overweight increases by 2%. This finding corroborates with the findings of a study that energy from fat was the only macronutrient that was identified as significant predictor of body fatness among children where a significant trend for increasing fatness is observed as fat intake increased [31]. Similarly, a review of clinical trials that studied the effects of a reduction in the amount of energy from fat by 10% was associated with a reduction in weight of 16 g/d [32]. This could be because fat has a higher caloric value as compared to protein and carbohydrates will result to a positive energy balance when consumed in excess to energy expenditure.

5. Conclusion

This study showed stunting was the only factor which predict overweight/obesity among infants. The predictors of overweight and obesity among toddlers and pre-schoolers are more on environmental factors: locale, wealth quintile, household type, mother’s working status, type of delivery, and birth size. Additionally, Vitamin A supplementation and total sugar intake were unique determinants for toddlers while family size, deworming participation, and total fat intake were unique among pre-schoolers.

Although sugar intake demonstrated lesser likelihood of becoming overweight/obese, it is still prudent to conduct more in-depth studies on the association of obesity with both macro- and micronutrients along with the food sources to gain a more thorough understanding on which nutrients are linked with overweight/obesity.

Identification of the different predictors as drivers of overweight and obesity during childhood will aid program planners and policy makers in crafting appropriate nutrition interventions per targeted physiological groups.

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