RESEARCH ARTICLE

Dietary diversity score and its association with anemia status among selected nonpregnant women in Pasay City, Philippines

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ABSTRACT
Background and Objective: Iron deficiency anemia, the most common type of anemia, is a disease of public health significance that leads to negative economic and health implications. Dietary diversity is one of the recommended strategies in combating micronutrient deficiency such as anemia and may be measured through Dietary Diversity Score (DDS). The study aimed to determine whether DDS is associated with anemia status among nonpregnant women of reproductive age (WRA) in Pasay City, Philippines. Specifically, the study aimed to determine the: (1) prevalence of anemia, (2) mean DDS, and (3) association between DDS and anemia status among the study population.
Methodology: The study was analytic and cross-sectional that included 121 nonpregnant WRA who were selected using stratified random sampling with proportional allocation. Data collection methods included anthropometric assessment, hemoglobin determination, and 24-hour food recall as basis for calculating the dietary diversity score.
Results and Conclusion: Results of the study found that the prevalence of anemia was 21.49% and mean DDS was 4.46 (between low and moderate DDS). A statistical association was found between DDS and anemia status ($p<0.001$) such that the odds of having anemia was 25.47 times higher among women with low DDS compared to women with moderate/high DDS. Therefore, nutrition education and promotion awareness is needed on dietary diversity to prevent anemia among women of reproductive age.

Keywords: *dietary diversity score, anemia status, women of reproductive age*

Introduction

Anemia is a public health disease that affects 1.62 billion people in both developed and developing countries [1]. There are several causes of anemia but the most common is iron deficiency. Its presence during pregnancy increases the risk for adverse health effects including maternal and infant mortality [2]. Anemia can affect all age groups but is more prevalent in vulnerable populations, particularly children (6-59 months), pregnant women (15-49 years of age), and nonpregnant women of reproductive age (15-49 years of age) [3].

Anemia has the highest prevalence in low-income countries among all age groups, particularly among infants and pregnant women. As of 2019, the prevalence of anemia among children 6 months to <1 year of age and pregnant women is 43.1% [4] and 23.0% [5] respectively. According to the Department of Nutrition for Health and Development (NHD) of WHO (2011), these prevalence rates are considered severe and moderate, respectively, when classified according to public health significance [6].

There is an increased need for iron to support the growth of the fetus during pregnancy, hence, women who are anemic or have depleted iron stores before pregnancy will have a higher nutrient requirement of iron, which also puts them at risk of anemia and the adverse health effects that it brings [7]. Thus, decreasing the prevalence of anemia among nonpregnant women of reproductive age can consequently lead to its decreased prevalence during pregnancy.

In 2019, the global prevalence of anemia that is attributed to iron deficiency can be estimated at 29.9% in women and 39.8% in children aged 6 to 59 months [8]. To effectively reduce iron deficiency anemia (IDA), it is recommended to focus on interventions that promote dietary diversification, improve access to iron-rich sources of food, food fortification, and iron supplementation [3]. Emerging interventions for anemia now realize the importance of a variety of micronutrients in the diet as a better solution instead of targeting the amount of iron intake alone. Dietary diversification is a sustainable strategy that can be used to address multiple micronutrient deficiencies, including iron deficiency anemia [9].

Dietary Diversity Score (DDS) is one of the indices measuring dietary diversity. The DDS measures the number of food groups a household or an individual consumes over a given time[10]. A comparison of studies of the different indices of dietary diversity shows that the dietary diversity score is the best predictor of nutrient adequacy [11].

Although dietary diversification is a promising strategy in combating micronutrient deficiencies and the diseases related to it, there are only a few studies on the association of dietary diversity and micronutrient deficiency outcomes. Focusing on diet intake as a whole has to be given more importance compared to the previous notion of taking a specific food in order to address a nutrient deficiency. Food contains different nutrients which necessitate the utilization of dietary indices rather than a single nutrient approach [12]. Therefore, there is a need to study the association of dietary diversity as measured by the DDS on micronutrient deficiency outcomes such as anemia.

Methodology

The research utilized an analytic cross-sectional study design to determine the association of the DDS on anemia status among nonpregnant women of reproductive age. The study comprised a representative and randomly selected sample of 121 nonpregnant women of ages 18 – 49 who are residents of Pasay City. Respondents were randomly selected from the health records of the *barangay.* Stratified sampling method with proportional allocation among the total population was employed in the study. The study respondents were stratified according to the six sectors of the community and were named Sectors 1 to 6. Simple random sampling method was done per stratum. Prior to data collection, informed consent was obtained from the respondents.

The Barangay Health Workers (BHWs) assisted the research team in locating the randomly selected participants and inviting them to the assembly area. The research team then administered the respondents' informed consent in the assembly area. After which, anemia status was determined, sociodemographic data, and anthropometric data were measured.

Anthropometry

Anthropometric assessment was conducted by taking each respondent's height (in meters) and weight (in kilograms) and computing for the Body Mass Index (BMI). The procedure was standardized based on Gibson's (2005) recommended guidelines for anthropometry. WHO BMI classification cutoff points (in kg/m^2) were used namely, <18.5 for underweight, 18.5-24.9 for normal weight, 25.0-29.9 for overweight, and ≥30.0 for obesity [13].

Dietary Intake

The information on dietary intake of women (18-49 years old) included in the study was collected using a dietary diversity questionnaire involving a single 24-hour dietary recall. According to FAO's Guidelines for Measuring Household and Individual Dietary Diversity (2010), a single 24-hour dietary recall does not assess the individual's habitual intake but it does provide an assessment of the diet at the population level [14]. To ensure internal validity, the data collectors underwent pre-training in conducting 24-hour dietary recall and the processing and analysis of dietary data. Food involving multiple components or mixed dishes were separated into their components (when assigning to designated food groups) and were further probed by the interviewer [14]. Food obtained from the questionnaire were then categorized into the nine aggregated food groups as recommended by the FAO of the UN in the computation of the Women's Dietary Diversity Score (WDDS) as discussed further below.

Dietary Diversity Score

Dietary Diversity Score (DDS) is the number of food groups consumed within 24 hours. The evaluation of DDS was based on the method of the Food and Agriculture Organization (FAO) of the United Nations. The respondents' diet was classified according to the 16 food groups recommended by FAO (2013): (1) cereals, (2) white roots and tubers, (3) vitamin A-rich vegetables and tubers, (4) dark green leafy vegetables, (5) other vegetables, (6) vitamin A-rich fruits, (7) other fruits, (8) organ meats, (9) flesh meats, (10) egg, (11) fish and seafood, (12) legumes, nuts, and seeds, (13) milk and milk products, (14) oil and fats, (15) sweets, and (16) spices, condiments, and beverages. A minimum of 15 grams of consumption of a certain food group is needed in order to count the respondent as a "consumer." A minimum cut-off of 15 grams for food group consumption showed that dietary diversity scores more strongly correlated with micronutrient adequacy [14].

Although the original DDS utilizes 16 food groups, FAO recommends aggregation based on the purpose of the study. There are 12 food groups for Household DDS which describe a household's economic access and food insecurity. On the other hand, there are nine food groups for WDDS which focus more on micronutrient intake. For this study, WDDS was utilized. The said type of DDS only makes use of nine food groups because groups 1 & 2, 3 & 6, 5 & 7, and 9 & 11 were aggregated and named as "Starchy staples", "Other Vitamin A-rich vegetables and tubers", "Other fruits and vegetables", and "Meat and fish" respectively. The maximum DDS that the respondents may obtain is 9 wherein for every consumption of a food group over a period of 24 hours, "1" point is given. On the other hand, respondents who are non-consumers of a certain food group were given a "0" for that group [14].

Hemoglobin Determination

Hemoglobin levels in the study were determined using HemoCue Hb 201+ System. The study team hired experienced and licensed medical technologists who executed the standard blood microsampling method. The first drop of blood was wiped first with cotton or tissue and the succeeding drop was placed into the Hemocue Cuvette for hemoglobin determination [15]. Women who had hemoglobin concentration of 120 g/L or higher was classified as non-anemic according to the WHO standards in 2011 for nonpregnant women ages 15 and above, while women who had hemoglobin concentrations lower than 120 g/L were classified as anemic [16]. Those who were considered as anemic were referred for intervention in the Barangay Health Center. Blood specimens were disposed of upon reading the blood samples in the machine. Blood specimens placed on HemoCue cuvettes as well as lancets were collected by the medical technologist in puncture-proof containers while in the community.

Socio-demographic Variables

Socio-demographic variables (age, highest educational attainment, civil status, employment status, and monthly household salary) were collected using pre-tested and structured questionnaires. Maternal outcomes were collected by determining the parity of the respondents.

Data Analyses

All data were encoded in Microsoft Excel before it was analyzed in STATA. Qualitative and quantitative data were organized using tables and figures for better data visualization. The point estimate and interval estimate for the proportion of anemia and mean dietary diversity score among women were calculated. Logistic regression was used for determining the association of dietary diversity score and anemia status. A two-step analysis was used to determine the strength of association between DDS and anemia status. First, Wald's test was done to screen for potential confounders in the full model. Second, the confounding effect of a variable was determined by computing the percent change in estimate. The confounder variable was retained in the model if the percent change estimate was at least 10%. Otherwise, this variable will be removed from the model. This technique was described in the study of Weng, *et al.* (2009) [17] and has been utilized by several studies in determining the confounders of the reduced model [18,19]. The adjusted model includes the exposure and outcome variables with the confounders. The crude odds ratio, adjusted odds ratio, the 95% confidence interval (CI), and the resulting p-values are also presented.

Ethical Considerations

The ethical clearance of the research protocol (UPM-REB 2017 501-01) was obtained from the University of the Philippines Manila (UP Manila) Research Ethics Board (REB) Review Panel 1. A letter of consent for conducting the research study was sent first to the City Health Office of Pasay as well as the health centers and the barangay health officials of Pasay City.

A printed consent form, both written in English and Tagalog for the participants to understand, was obtained from the participants before the data collection process. The informed consent contained the objectives, purpose, methodology, possible risks and benefits to participants and the community, duration and extent of the individual's participation, and the right of participants to withdraw at any point in time of the study.

Results

Socio-demographic Characteristics

A total of 121 respondents were selected after applying the inclusion and exclusion criteria. Table 1 shows the socio-demographic characteristics of the respondents.

Table 1. *Distribution of Socio-demographic Characteristics among Nonpregnant Women of Reproductive Age in Barangay 145, Pasay City (n=121), 2018.*

Characteristic	Frequency (%)*
Age	
18 – 29 years old 30 – 49 years old	47 (38.84) 74 (61.16)
Mean ± s.d. Median Range	32.72 ± 9.16 33 18 - 49
Highest Educational Attainment	
No formal Education Pre-school Primary Education Secondary Education Technical-Vocational Education Baccalaureate Education Post-Graduate Education	0 (0.00) 0 (0.00) 23 (19.01) 72 (59.50) 5 (4.13) 21 (17.36) 0 (0.00)
Civil Status	
Unmarried Married Separated/Widowed	50 (41.32) 68 (56.20) 3 (2.48)
Employment Status	
Employed Unemployed	44 (36.36) 77 (63.64)
Monthly Household Salary	
< Php 6,000.00 Php 6,000.00 - <15,000.00 Php 15,000.00 – 25,000.00 > Php 25,000.00	19 (15.70) 54 (44.63) 31 (25.62) 17 (14.05)

*unless descriptive statistics are presented

Table 2. *Maternal Outcomes among Nonpregnant Women of Reproductive Age in Barangay 145, Pasay City, (n=121), 2018.*

Parity	Frequency (%)
Nulliparous Primiparous Multiparous	23 (19.01) 19 (15.70) 79 (65.29)

Table 3. *Anthropometric Measurements of Nonpregnant Women of Reproductive Age in Barangay 145, Pasay City, (n=121) 2018.*

Anthropometric Measure	Value
Height (cm)	
Mean ± s.d Median Range	152.00 ± 5.41 152.00 136.03 - 165.17
Weight (kg)	
Mean ± s.d Median Range	56.33 ± 12.38 56.60 30.9 - 93.47
Body Mass Index	
Mean ± s.d Median Range	24.37 ± 5.16 24.37 13.83 - 38.56

Table 4. *BMI Status among Nonpregnant Women of Reproductive Age in Barangay 145, Pasay City (n=121), 2018.*

BMI Status (Range)	Frequency (%)
Underweight (<18.5)	17 (14.05)
Normal (18.5 – 22.9)	34 (28.10)
Overweight (23 – 24.9)	16 (13.22)
Pre-Obese (25 – 29.9)	38 (31.41)
Obese (≥ 30)	16 (13.22)

Table 5. *Summary Statistics for Hemoglobin Count among Nonpregnant Women in Barangay 145, Pasay City, (n=121), 2018.*

Variable	Value (g/dL)
Hemoglobin Count	
Mean ± s.d Median Range	12.88 ± 1.21 13 9- 16.2

Maternal Outcomes

Table 2 shows that majority of the respondents had at least two children and were considered as multiparous (65.29%).

Anthropometric Measurements

Table 3 shows that the mean and median BMI of the target population were both 24.37 kg/m^2. Moreover, the BMI of the target population ranged from a minimum of 13.83 kg/m^2 to a maximum of 38.56 kg/m^2. On the other hand, Table 4 shows that majority of the women were pre-obese (31.41%) while more than a quarter (28.1%) had normal BMI status. Conversely, there were also underweight women (14.05%) and fairly the same proportion of obese women (13.22%).

Anemia Status

Blood samples obtained were placed in microcuvettes and analyzed by the Hemocue Hb 201+ photometer to determine the hemoglobin count. The results are shown in Table 5. Hemoglobin values of the nonpregnant women (n=121) ranged from 9 to 16.2 g/dL. The mean hemoglobin count was 12.88 g/dL with a standard deviation of 1.21 while the median hemoglobin level was 13 g/dL. Table 6 shows that among the 121 respondents, 26 of the women were anemic (21.49%) while 95 were classified as normal (78.51%).

Table 6. *Proportion of Anemic and Non-anemic in Barangay 145, Pasay City (n=121), 2018.*

Anemia Status	Frequency	Percent (%)
Non-Anemic	95	78.51
Anemic	26	21.49
Total (n)	121	100

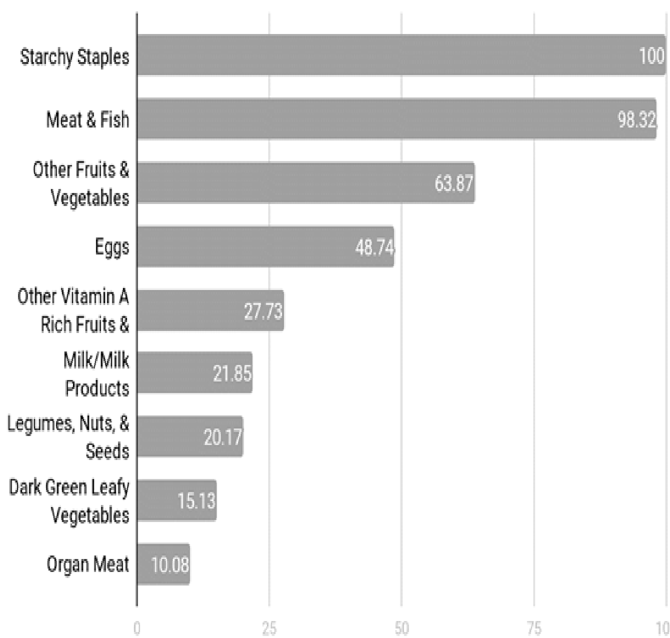

Figure 1. *Frequency of food consumption of the nine food groups*

Table 7. *Distribution of Respondents According to DDS Categories in Barangay 145, Pasay City, (n-121), 2018.*

Dietary Diversity Score Category	Frequency
Very Low (≤3)	27 (22.69)
Low (4)	30 (25.21)
Moderate (5)	42 (35.29)
High (≥6)	20 (16.81)

Dietary Diversity Score

One hundred twenty-one responses were gathered from the target population. However, two were excluded from the analysis as the food intake obtained from the respondents were implausible, making the estimates of their food intake non-representative of their usual diet. Figure 1 shows the distribution of intake of the various food groups. All respondents consumed Starchy Staples (100%) followed by Meat and Fish (98.32%) and Other Fruits & Vegetables (63.87%). On the other hand, the food groups that were consumed less were Organ Meat (10.08%), Dark Green Leafy Vegetables (15.13%), and Legumes, Nuts, & Seeds (20.17%).

The dietary diversity scores ranged from a minimum of two (2) to a maximum of 7. The mean DDS of the respondents was 4.46 (CI: 4.26- 4.70) with a median of five (5). The scores were categorized into quartiles with the first quartile consisting of those who had a DDS score of less than or equal to three (3), second quartile with those who had a DDS of four (4), third quartile with those who had a DDS of five (5), and fourth quartile with those who had a DDS of greater than or equal to six (6). Data from Table 7 shows that the high category had the lowest proportion of respondents (16.81%) while the moderate category had the greatest proportion of respondents (35.29%).

Table 8 shows the distribution of food group consumption according to the different categories of dietary diversity score. Data from the table shows that among the respondents with high DDS, the three most consumed food groups were Starchy Staples (100%), Meat & Fish (95%), and Other Fruits and Vegetables (95%) while the three least consumed food groups were Organ Meat (15%), Legumes, Nuts, & Seeds (30%), and Dark Green Leafy Vegetables (45%). Among respondents with medium DDS, the three most consumed food groups were Starchy Staples (100%), Meat & Fish (100%), and Other Fruits & Vegetables (85.71%) and the three least consumed food groups were Organ Meat (21.43%), Legumes, Nuts, & Seeds (23.81%), Dark Green Leafy Vegetables (26.19%). Among respondents with a low DDS, the three most consumed food groups were Starchy Staples (100%), Meat & Fish (100%), and Other Fruits & Vegetables (56.67%) while the three least consumed food groups were Dark Green Leafy Vegetables (10%), Organ Meat (16.67%), and Legumes, Nuts, & Seeds (20%). Among respondents with a very low DDS, the three most consumed food groups were Starchy Staples (100%), Meat & Fish (96.30%), and Eggs (37.03%) while the three least consumed

Table 8. *Distribution of Food Group Consumption According to the Different Categories of Dietary Diversity Score, 2018.*

Food Groups	Characteristic			
	High(≥6) n=20	Medium(5) n=42	Low(4) n=30	Very Low(<4) n=27
Starchy Staples	20 (100%)	42 (100%)	30 (100%)	27 (100%)
Dark Green Leafy Vegetables	9 (45%)	11 (26.19%)	3 (10%)	1 (3.70%)
Other Vitamin A Rich Fruits & Vegetables	16 (80%)	19 (45.24%)	7 (23.33%)	3 (11.11%)
Other Fruits & Vegetables	19 (95%)	36 (85.71%)	17 (56.67%)	10 (37.04%)
Organ Meat	3 (15%)	9 (21.43%)	5 (16.67%)	0
Meat & Fish	19 (95%)	42 (100%)	30 (100%)	26 (96.30%)
Eggs	17 (85%)	17 (40.48%)	15 (50%)	10 (37.04%)
Legumes, Nuts, & Seeds	6 (30%)	10 (23.81%)	6 (20%)	1 (3.70%)
Milk/Milk Products	13 (65%)	24 (57.14%)	7 (23.33%)	1 (3.70%)

Table 9. *Distribution of Anemia Status According to DDS Category*

Dietary Diversity Score Category	Anemia Status	
	Anemic (n=26) No. (%)	Non-Anemic (n=93) No. (%)
Very Low (≤3)	15(57.69)	12(12.90)
Low (4)	9(34.62)	21(22.58)
Moderate (5)	2(7.69)	40(43.01)
High (≥6)	0 (0.00)	20(21.51)

food groups were Organ Meat (0%), Legumes, Nuts, & Seeds (3.7%), and Dark Green Leafy Vegetables (3.7%). Starchy staples, Meat & Fish, and Other Fruits & Vegetables were consistently the most consumed food groups among the different categories of dietary diversity score while Organ Meat and Legumes, Nuts & Seeds were consistently the least consumed food groups.

It is shown in Table 9 that most of the anemics (57.69%) had a very low DDS while most non-anemics (43.01%) had a moderate DDS. It can also be seen that there were no anemics among those with a high DDS and there was an increase in the number of anemics as the DDS category decreases. On the other hand, there was an increase in the number of non-anemics as the DDS category increases, peaking at the moderate category.

Table 10 shows the distribution of food group consumption according to anemia status. Data shows that all anemic and non-anemic respondents consumed starchy staples. Among anemics, the percent consumption of Dark Green Leafy Vegetables, Other Vitamin A-rich Fruits & Vegetables, Other Fruits & Vegetables, Organ Meat, and Legumes, Nuts, & Seeds was lower than 50%. Among non-anemics, the percent consumption of Dark Green Leafy Vegetables, Other Vitamin A-rich Fruits & Vegetables, Organ Meat, Eggs, and Legumes,

Table 10. *Distribution of Food Group Consumption According to Anemia Status, 2018.*

Food Group Consumption	Anemia Status	
	Anemic (n=26) No. (%)	Non-Anemic (n=93) No. (%)
Starchy Staples	26(100)	93(100)
Dark Green Leafy Vegetables	3(11.54)	21(22.58)
Other Vitamin A Rich Fruits & Vegetables	6(23.08)	39(41.94)
Other Fruits & Vegetables	6(23.08)	76(81.72)
Organ Meat	3(11.54)	14(15.05)
Meat & Fish	26(100)	91(97.85)
Eggs	14(53.85)	45(48.39)
Legumes, Nuts, & Seeds	3(11.54)	20(21.51)

Nuts, & Seeds was lower than 50%. However, the percent consumption of Dark Green Leafy Vegetables, Other Vitamin A-rich Fruits & Vegetables, Organ Meat, Legumes, Nuts, & Seeds was higher among non-anemics compared to anemics.

Association of Dietary Diversity Score with Anemia Status

Table 11 below shows the cross-tabulation of DDS and anemia status as well as the corresponding row percentages. Among those with medium to high DDS, only 3.23% of the women were anemic and 96.77% were non-anemic. On the other hand, 42.11% of the women were anemic and 57.89% were non-anemic among women with low DDS.

There were two steps involved in the analysis of data to determine the association of dietary diversity and anemia status. The first one involved the screening of potential confounders (Wald's test) by using simple logistic regression between each confounder and the outcome variable, anemia status. A p-value of less than 0.25 was initially used. The two initial confounders, BMI and monthly salary, however, were not included in the final model. Since no confounders were included in the final model when the p-value was less than 0.25, the researchers decided to increase the cutoff for Wald's test. A confounder with a p-value less than 0.60 was used as the criteria for inclusion in the next step. Table 12 below shows the confounders that were included as probable confounders in the multiple logistic regression model.

The second step involved running a full model between the exposure variable and the outcome variable as well as the confounders. Confounders included in the final model

Table 11. *Cross Tabulation of DDS and Anemia Status and Row Percentages*

Dietary Diversity Score Category	Anemia Status		Total No. (%)
	Anemic (n=26) No. (%)	Non-Anemic (n=93) No. (%)	
Medium/High (≥5)	2 (3.23)	60 (96.77)	62 (100)
Low (<4)	24 (42.11)	33 (57.89)	57 (100)

Table 12. *Screening of Confounders for Logistic Regression*

Confounder/Characteristic	Odds Ratio (95% CI)	p-value
Age (years)	1.004311 (0.96 - 1.05)	0.859
Highest Educational Attainment		
Post-Graduate Education / Bachelor's Education /Technical-Vocational Education	1.00	
Secondary Education	0.7344633 (0.25 - 2.19)	0.580
Primary Education / Pre-School	1.458333 (0.41 - 5.21)	0.561*
Employment		
Employed	1	
Unemployed	1.372881 (0.54 - 3.48)	0.504*
Salary		
> Php 25,000.00	1	
Php 15,000.00 - 25,000.00	1.857143 (0.67 - 5.13)	0.232*
< Php 15,000.00	2.703297 (0.77 - 9.49)	0.121*
Parity		
Nulliparous (0)	1	
Primiparous (1)	0.675 (0.14 - 3.28)	0.626
Multiparous (≥2)	1.062295 (0.35 - 3.26)	0.916
Body Mass Index	0.9219721 (0.84 - 1.01)	0.081*

*probable confounder based on p<0.6

were determined by running reduced logistic regression models with respect to the confounding variables (reduction order was based on decreasing p-values of possible confounding variables). A possible confounder was considered included in the final logistic regression model if at least one of the percent change in estimate of the odds ratio in the reduced model with respect to the odds ratio of the full model is greater than 10 percent. Table 13 below shows the percent change in estimates of the reduced models with respect to the following confounding variables: educational attainment, employment status, salary, and body mass index. Among the possible confounders included from the first step, only one was included in the final logistic regression model which is educational attainment.

Table 14 below shows both the crude and adjusted odds ratio for the association of dietary diversity score and anemia status. After controlling for educational attainment, there was a significant statistical association between dietary diversity score and anemia status (p<0.05).

Table 13. *Identification of Confounders Included in the Final Model*

Potential Confounders	Odds Ratio	% Change in Estimate
Full model		
Low DDS	28.06	
Highest Educational Attainment		
Low DDS	22.21	-20.85*
Employment		
Low DDS	27.19	-3.11
Salary		
Low DDS	27.53	-1.87
Body Mass Index		
Low DDS	25.51	-9.07

*confounder included in the final model

Table 14. *Crude and Adjusted Odds Ratio: Association of DDS and Anemia*

DDS Category	Crude OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Medium to High	1	-	1	-
Low	21.82 (4.85-98.14)	p<0.001	25.47 (5.43-119.59)	p<0.001

Adjusting for the confounding effect of educational attainment, the odds of having anemia among non-pregnant women with a low DDS was 25.47 times higher compared to women with a medium to high DDS (Table 4.14).

Discussion

Prevalence of Anemia

The mean hemoglobin count of the respondents was 12.88 g/dL while the median hemoglobin count was 13.0 g/dL. Both values are close to the cut-off value but are still in the non-anemic classification. Among the respondents, 21.49% (n=26) were classified as anemic. This anemia prevalence is a moderate public health concern according to the WHO cut-off for public health significance of anemia [16]. This finding of anemia prevalence is typical of a depressed urban community and is consistent with previous studies done with similar community characteristics. In a study done among Indian women living in Andhra Pradesh by Bentley and Griffiths (2003), it was revealed that 48.79% (n=4031) were found to be anemic [20]. While in another similar study done in an urban area of Nagpur, the prevalence of anemia among adolescent females was found to be 35.1% (n=296) [21]. Another study done among Serbian non-pregnant women 20 to 49 years old by Rakic *et al.* (2013) found the prevalence of anemia to be at 27.7% (n=708) [22]. These results are, according to the WHO classification of public significance of anemia, either in the moderate or severe grade.

The results of the study are slightly lower than the prevalence of anemia among pregnant women in the Philippines (23.0%) [5] and the global prevalence of anemia among nonpregnant women (29.9%) [8]. The prevalence of anemia in a typical urban community as revealed by the Expanded National Nutrition Survey (ENNS) is only 11.8%, considered as mild in terms of public health severity [4], while the study revealed the prevalence to be at 21.49% which is moderate.

Dietary Diversity Score

Results of the study showed that the most consumed food groups among the respondents are starchy staples, meat and fish, and other fruits and vegetables. In relation to a study done in Metropolitan Cebu, results also showed that the most consumed food groups among the respondents are starchy staples, fish and meat, and other fruits and vegetables [22]. Consumption of all food respondents of starchy staples is likely due to rice being a staple food in the Philippines. Compared to the findings by Poorrezaeian *et al.* (2017), the common food groups consumed were starchy staples, fish & meat, and other vegetables and fruits among women 20 - 49 years in Iran [23]. On the other hand, the study by Cisse-Egbuonye *et al.* (2017) showed that starchy staples, dark green leafy vegetables, and legumes, nuts, and seeds were the most common food groups [24]. The least consumed food groups of this study were organ meat, and legumes, nuts, and seeds. These food groups are rich in iron.

The mean DDS of the respondents was 4.46 while the median was 5 ranging from a minimum of 2 to a maximum of 7. These were similar to the results of the study done by Daniels (2009) in Metropolitan Cebu which showed that women of reproductive age in the study location had a mean DDS of 4.2 and a median DDS of 4 ranging from minimum values of 2 to maximum values of 9 [22]. The mean DDS of women in Niger weas 3.5 among women ranging from a minimum of 1 to a maximum of 7 [24]. The higher mean and median DDS of this study show that women in Brgy. Sto Niño had a slightly more diverse diet and, thus, a higher probability of micronutrient adequacy compared to the target population in Metropolitan Cebu and Niger.

Data shows that 57.69% of the anemics belonged to the very low DDS category. Among those with anemia, only less than 50% consumed dark green leafy vegetables, organ meat, legumes, nuts, and seeds. This is consistent in the cross-sectional study conducted in Southern Ethiopia among pregnant women [25]. Furthermore, findings of the study conducted by Thomson *et al.* (2011) revealed that any single nutrient deficiency leads to an 18% greater risk of anemia among postmenopausal women [26]. Results of the study done by Dreyfuss *et al.* (2000) also support the association showing that women of reproductive age with Vitamin A deficiency are two times more likely to have anemia than women who do not have Vitamin A deficiency. The reason behind this is that decreased levels of Vitamin A also decrease hemoglobin synthesis [27]. Vitamin C adequacy also contributes to increased absorption of iron in the body. This is illustrated in the findings of studies that the consumption of fruit more once a week decreases the risk of anemia [28,29].

Association of DDS and Anemia Status

Before adjusting for the variable, the odds of having anemia was 21.82 times higher among women with a low DDS ($p<0.05$) as compared to women with a moderate/high DDS. Furthermore, after adjusting for educational attainment, it can be shown that the odds of having anemia were 25.47 times higher among women with a low DDS ($p<0.05$) as compared to women with a moderate/high DDS. Moreover, the association was found to be stronger after controlling for the confounder. However, the confidence interval of the odds ratio was wide. This implies that the sample size may have been too small to establish the association. Although the researchers have accurately computed for the sample, the prevalence of anemia among high DDS from literature (33.4%) was high compared to that obtained from this study (3.23%). Consequently, this may have led to the computation of a low sample size that was used for the association of the study.

The findings of this study are consistent with a prospective cohort study conducted by Zerfu *et al.* (2016) in a rural setting in Ethiopia [15]. The study showed that women with inadequate dietary diversity were 2.29 times (CI at 95%: 1.62-3.24) more at risk of having maternal anemia compared to women with adequate dietary diversity. However, it should be noted that this study utilized a longitudinal design which made use of multiple 24-hour food recalls, while this study is only cross-sectional which involved observing a specific point in time. Moreover, the cut-off used for assessing the DDS in rural Ethiopia was dichotomous with a WDDS <4 being inadequate and a WDDS ≥4 which is adequate.

On the other hand, the results of this study are not consistent with that of the findings of Kubuga *et al.* (2016) among reproductive-aged (15 to 49 years old) women in Ghana where the correlation between DDS and the hemoglobin level of women was positive (Correlation coefficient= 0.08; p=0.007) but no significant statistical association was observed between the DDS and prevalence of IDA [30]. This study differed from that of Kubuga's with the exclusion of the first three years of women's reproductive age due to ethical considerations. This may have affected the estimates of the association. This study also used the women's dietary diversity score with only 9 food groups while the latter utilized a dietary diversity scoring system with 15 food groups. The inability to get a significant statistical association might be attributed to the use of 15 food groups rather than using fewer food groups that are more directly related to the outcome.

Finally, this study is not consistent with the results of another cross-sectional study done by Saaka *et al.* (2017) whose results showed that the hematological status of pregnant women was not associated (r=-.001; p=0.9) with a dietary diversity score in a rural setting [31]. However, the study utilized a 24-hour food recall where food groups are pre-set which might have overestimated the exposure variable which is DDS. This might mask the true association of the exposure and the outcome. The study also used a minimum women's dietary diversity score (MDD-W) which consisted of 10 food groups (<5 is low DDS, ≥5 is high DDS) as compared to the women's dietary diversity score (WDDS) which consisted of 9 food groups. The MDD-W is used for the assessment at the national and subnational levels while the WDDS in this study was used to assess the quality of the individual's diet with respect to micronutrient adequacy. The researchers of the past study have recognized that the inability to establish a significant statistical association might be due to the homogeneity of the dietary diversity scores among respondents and geographic and seasonal variations. The proponents of the past study also highlighted the fact that in their study site, iron deficiency was not an important contributor to anemia in pregnancy and might be due to other reasons.

Conclusion and Recommendation

The results have shown that this group of non-pregnant women have a low dietary diversity as evidenced by the mean DDS of 4.46. The resulting prevalence of anemia among non-pregnant women in Barangay 145, Pasay City was 21.49% which is classified under the moderate category of public health significance and is typical of a depressed urban community.

The association of DDS with anemia status was ascertained in this study. After controlling for educational attainment, a significant statistical association was found between dietary diversity score and anemia status ($p<0.001$) such that the odds of having anemia was 25.47 times higher among women with a low DDS compared to women with a moderate or high DDS. Consequently, a diet comprised of five food groups or more has a protective effect on the occurrence of anemia. Therefore, efforts to increase food availability and accessibility need to be intensified by employing a multi-sectoral approach as well as complementation of appropriate nutrition-specific (*e.g.* nutrition education and promotion awareness on dietary diversity to prevent anemia among women of reproductive age) and nutrition-sensitive interventions/programs (*e.g.* gardening, livelihood programs, food fortification, and support and mobilization of the Local Government Unit (LGU).

Lastly, due to limitations in the available resources, the results of the study must be interpreted with caution because of possible influences by some factors that were not considered in the design stage, namely, the presence of existing health concerns that may be related to anemia and intake of iron-fortified foods and/or iron and vitamin C supplements.

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