Original Article

Dietary diversity score as an indicator of micronutrient intake in Filipino children and adolescents

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Background and Objectives: The study objective was to assess if Dietary diversity score (DDS) based on counting 10 food groups consumed can be used as an indicator of adequacy of micronutrient intake in Filipino children and adolescents. **Methods and Study Design:** Dietary data of 7448 Filipinos age 3 to 18 years old included in the National Nutrition Survey in 2013 were used to assess the adequacy of intake of iron, vitamin A, vitamin C, thiamin, riboflavin and niacin. Nutrient adequacy ratio (NAR) for each micronutrient was computed and these were used to calculate the mean adequacy ratio (MAR) for each individual. Linear association for MAR and the different scores of DDS was verified using Pearson's correlation. Sensitivity and specificity were analyzed through the receiver operating characteristics curve to determine the DDS cut-off point that can be used to ascertain adequacy of micronutrient intake. **Results:** The mean DDS is 6 and the mean MAR is 0.69. There was significant positive correlation between MARs and NARs ($p<0.0001$), as well as between MAR and DDS ($r=0.29$; $p<0.0001$). A DDS of 6 showed the highest sensitivity (74.2%) and specificity (44.6%) for achieving MAR of 0.5, while a DDS of 7 had the highest sensitivity (54.9%) and specificity (67.6%) in achieving MAR of 0.75. **Conclusions:** DDS is significantly correlated with micronutrient intake and a score of 6 or 7 can be used as a cutoff in screening for those with possible dietary micronutrient inadequacy in Filipino children and adolescents.

Key Words: dietary diversity score, micronutrient, Filipino, children, adolescents

INTRODUCTION

Dietary micronutrient intake in growing children remains a public health concern especially in settings of limited food security. In the Philippines, more than half of children and adolescents are documented to be inadequate for most micronutrients.[1-4] The cost-effective identification of individuals who are at risk for these deficiencies is necessary given that further diagnostic tests and empiric supplementation are expensive and not without risks. Although existing assessment tools are used for this purpose, most are complicated, time-consuming and would require technical skills.[5,6] Therefore, there is need for simple tools that can be used efficiently in evaluating micronutrient status.

Dietary Diversity Score (DDS) is a quantitative tool used to evaluate the diversity of food intake across populations. It relies on the premise that dietary diversity is a useful indicator of dietary quality,[7] and that a variety of food intake supports better health outcomes.[8] Although there is no accepted standardized DDS, it is generally a list of food groups which assesses the diversity of food intake depending on the number of food groups consumed. The scores are used to predict nutrient adequacy, with cutoffs based on studies comparing DDS and nutrient intake approximations. DDS can also be used in monitoring micronutrient status before and after interventions, as well as during acute changes as in cases of famine and disasters.[6] As food variety is dependent on biodiversity, with the mutual effects between food and health being best expressed in terms of achieving dietary diversity, DDS can also be a surrogate measure of the efficient utilization of available environmental resources in achieving food security and proper nutrition.[9] Thus, the use of DDS encompasses not only the understanding of the relationship between food and the human body, but also the larger interactions between the environment, food supply and human health.

Numerous studies have used different DDS systems in assessing dietary micronutrient intake with results supporting the validity of DDS.[7,8,10,11-14] However, these were limited to certain ethnicities and age groups which may have caused variations in the validity and recommended cut-offs for screening.[13] This prompts the need to explore the validity of DDS across larger, more specific populations. This study aims to validate DDS as an indicator of micronutrient intake in Filipinos 3 to 18 years old and come up with the cutoff points that can be used in screening for possible micronutrient deficiencies to this specific group which could be helpful in settings where there is need to screen and monitor for those who would require further diagnostics, monitoring, and interventions.

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METHODS

This study is a secondary analysis of data derived from the 2013 Philippine National Nutrition Survey (NNS) to develop a DDS by establishing the cutoff scores with the best sensitivity and specificity in assessing the adequacy of micronutrient intake among Filipino children and adolescents age 3 to 18 years old. Necessary data from the NNS were acquired with permission from the Food and Nutrition Research Institute (FNRI) through proper channels. The protocol of this study was submitted for review to the University of the Philippines Manila Research Ethics Board (UPMREB) and was approved for implementation. A waiver of informed consent was requested from and was approved by the UPMREB since the FNRI already acquired informed consent from its participants prior to the data gathering for NNS in 2013, and the data involved is available for public use. In addition, the study satisfied the provision of the Philippine National Ethical Guidelines for Health and Health-Related Research 2017 for waiving the informed consent process.

The data analyzed was from the Individual Dietary Consumption component of the NNS focusing on the dietary data of Filipinos aged 3 to 18 years old. The NNS is a nationwide survey including all 17 regions and 80 provinces of the Philippines which used a multi-stage stratified three-stage sampling design. Households, instead of individuals, were included in the sampling to come up with 35,825 households with 7,448 individuals age 3 to 18 years old. Informed consent was acquired from the legal guardians of the participants from the same household prior to participation. The details of the methodology of the NNS is published online.[15-17] The food consumption survey was done through 24-hour food recall for all members of the sample households. From the data gathered, dietary evaluation was done through Individual Dietary Evaluation System using the Philippine Food Composition Library to determine the nutrient content of food items consumed.

DDS is a set of 10 food groups adapted from the food groupings prescribed by FAO for DDS validation.[18]These food groups are (1) *cereals, rice, corn and tubers*; (2) *meat, poultry and fish*; (3) *dairy*; (4) *eggs*; (5) *dried beans, nuts and seeds*; (6) *green leafy and yellow vegetables*; (7) *other vegetables*; (8) *fruits*; (9) *oils and fats*; and (10) *other foods*. In the original FAO guideline, however, three food groups were assigned different labels: *cereals, rice, corn and tubers* were labeled as just *cereals and tubers*; *dried beans, nuts and seeds* as only *pulses and nuts*; and *green leafy and yellow vegetables*, *other vegetables and fruits* were grouped as either *vitamin-A rich fruits* and *vegetables, other fruits, or other vegetables.* These changes were based on the food groups used in the NNS which were culturally considerate of the usual Filipino dietary patterns and would not require complicated categorization. DDS was calculated by adding the food groups consumed by a person in two 24-hour periods out of the 10 food groups of interest. No minimum amount of consumption was required for each food group to be considered consumed.

Age- and sex-specific Philippine Dietary Reference Intakes 2015 (PDRI 2015) values were used to assess the adequacy of the micronutrient intake of the subject population and the analysis was done individually per age group.19 Three age groups were used based on developmental stages and as these groups differ in their recommended nutrient intake for calcium, iron, vitamin A, vitamin C, thiamin, riboflavin and niacin. The groupings are: (1) *preschool children* (3 to 5 years), (2) *school-age children* (6 to 12 years) and (3) *adolescents* (13 to 18 years).

Statistical analysis was done using Stata/IC 15.1. Data was reported as mean ± standard deviation (SD). Nutrient analysis was done by computing for the Nutrient Adequacy Ratio for each micronutrient of interest using the formula:

NAR = actual micronutrient intake per day/daily reference intake for the micronutrient based on PDRI 2015

NAR for each nutrient for every individual was calculated and the resulting NARs were used to compute for the Mean Adequacy Ratio (MAR) per individual using the formula:

$MAR = \sum NAR/7$

Pearson's correlation was used to verify the linear association for MAR and the different points for DDS, from a score of 1 to 10. Sensitivity and specificity were analyzed using the Receiver Operating Characteristics (ROC) curve which was also be used to determine the DDS cut-off points with the best sensitivity and specificity using the computed MAR as the standard. The DDS scores with the best sensitivity and specificity in achieving MAR of at least 0.5 and 0.75 were used to delineate the minimum cut-off point for achieving micronutrient adequacy, as used in another large-scale study on DDS among Filipino children.[14]

RESULTS

Demographics

Preschoolers comprise the smallest group with a total of 1262, followed by adolescents at 2800, while school-age children is the biggest group with 3386 subjects. Distribution by sex are comparable on all age groups (p=0.73). The age and sex characteristics of the subjects are summarized in Table 1.

Consumption of food groups

The food group *cereals, rice, corn and tubers* is consistently included across all DDS point and is the only food group consumed among those with DDS score of 1. *Green leafy and yellow vegetables* was the second most consumed food group among Filipino children, making it the only other food group consumed by children having DDS score of 2. On the contrary, *fruits* are the least consumed food group across the pediatric age groups. However, among specific age groups, *fruits* are shown to be least consumed only among school-age children and adolescents, while the food group *meat, poultry and fish* is least eaten by preschoolers. A DDS of 6 is shown to be the most common DDS across all Filipino children and adolescents, and even among each age group. Table 2 shows the percent consumption of different food groups among Filipino children and adolescents for every DDS.

NARs, MARs and DDS

The mean DDS, nutrient intake and NAR across all age groups are summarized in Table 3. Distribution across

Table 1. Summary of age and sex characteristics (n=7448)†

Sex	Preschoolers (3 to 5 years old) n= 1262	School-Age (6 to 12 years old) n= 3386	Adolescents (13 to 18 years old) n= 2800	Total n=7448
Male	4.55 (0.87) (n=625)	9.65 (2.01) (n=1737)	15.77 (1.76) (n=1438)	11.13 (4.41) (n=3800)
Female	4.56 (0.87) (n=637)	9.57 (2.01) (n=1649)	15.77 (1.70) (n=1362)	11.01 (4.44) (n=3648)

†Values expressed as mean (standard deviation).

types of residence are also shown, with those from areas with more than 50% urban population labeled as Urban. All nutrient intakes and NARs are high in those from urban areas except for Vitamin C, where intake in rural areas is higher at 25.6 mg compared to 23.8 mg in urban areas.

The MARs for Filipino children and adolescents across age groups is listed on Table 4. The average MAR was 0.69, with preschoolers having the highest MAR of 0.84, while adolescents having the lowest at 0.60. MAR was shown to have an increasing trend with higher DDS as shown in Figure 1. There was significant correlation between MARs and NARs of all the sample and within each age group based on Pearson product-moment correlation coefficients (p<0.0001) as seen on Table 5. Spearman rank-order correlation coefficients between MAR and DDS among all age groups summarized in Table 6 showed significant positive linear correlation (p<0.0001).

Sensitivity and specificity of DDS

Figure 2 and 3 show the nonparametric receiver operating characteristics (ROC) curve analysis for DDS against MAR ≥0.5 and ≥0.75, respectively, for Filipino children and adolescents age 3 to 18 years old. The area under the ROC curve for DDS against MAR ≥0.5 across all age groups is 0.654, while that among each age group are similar with values more than 0.6. Similarly, the area under the ROC curve for DDS against MAR ≥0.75 across all age groups is 0.623, while the that among each age group are comparable with values more than 0.6.

Specificity is shown to be directly proportional to DDS, while the inverse is true for sensitivity. Using <0.5 MAR as a cut-off for sensitivity and >0.5 MAR as a cut-off for specificity, a DDS of 6 shows the highest sensitivity and specificity of 74.2% and 44.6%, respectively, with Positive Likelihood Ratio (PLR) of 1.34 and Negative Likelihood Ratio (NLR) of 0.580. A similar pattern is evident in all age groups, with DDS of 6 exhibiting the highest sensitivity and specificity. Using <0.75 MAR as a cut-off for sensitivity and >0.75 MAR as a cut-off for specificity, a DDS of 7 show the highest sensitivity and specificity of 54.9% and of 67.6%, respectively, with PLR of 1.51 and NLR of 0.709. This observation is also comparable in all age groups, with DDS of 7 having the best sensitivity and specificity.

DISCUSSION

Diversity of food intake is necessary in the acquisition of nutrients for proper health. To ascertain proper dietary nutrient intake, a tool such as DDS that measures diversity in the diet can be used. In this study, it was shown that MAR is significantly correlated with both NAR and DDS. Thus, it can be inferred that DDS can be used as a proxy indicator of intakes of micronutrients among Filipino children and adolescents. This inference is likewise supported by similar studies done among Filipino adolescents[20] and elderly Filipinos.[21]

Dietary diversity score

Micronutrient adequacy is related to higher dietary diver-

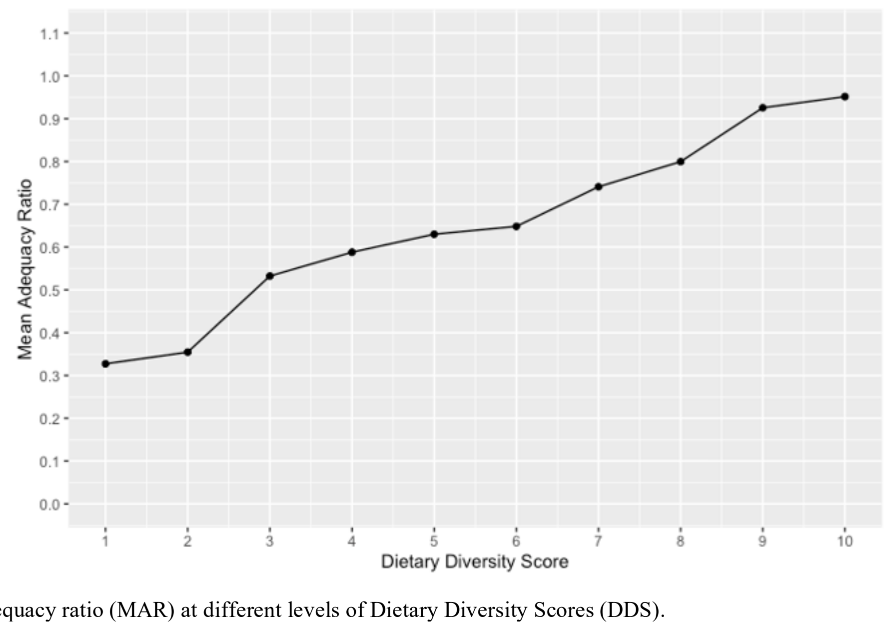

Figure 1. Mean adequacy ratio (MAR) at different levels of Dietary Diversity Scores (DDS).

Table 2. Percent consumption of different food groups of subjects for every DDS point (n=7448)[†]

DDS	Number of children	Food group									
		Cereals, rice, corn and tubers	Meat, poultry and fish	Dairy	Eggs	Dried beans, nuts and seeds	Green leafy and yellow vegetables	Other vegetables	Fruits	Oils and fats	Others
1	2 (0.03)	2 (100)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
2	50 (0.67)	50 (100)	3 (6.00)	0 (0.00)	1 (2.00)	1 (2.00)	39 (78.00)	0 (0.00)	0 (0.00)	1 (2.00)	5 (10.0)
3	268 (3.60)	268 (100)	16 (5.97)	28 (10.5)	49 (18.3)	11 (4.10)	206 (76.9)	11 (4.10)	11 (4.10)	78 (29.1)	126 (47.0)
4	709 (9.52)	709 (100)	91 (12.8)	106 (15.0)	195 (27.5)	47 (6.63)	624 (88.0)	82 (11.6)	58 (8.18)	442 (62.3)	482 (68.0)
5	1400 (18.8)	1400 (100)	288 (20.6)	461 (32.9)	734 (52.4)	167 (11.9)	1328 (94.9)	367 (26.2)	203 (14.5)	1015 (72.5)	1037 (74.1)
6	1867 (25.1)	1867 (100)	543 (29.1)	1020 (54.6)	1431 (76.7)	374 (20.0)	1820 (97.5)	690 (37.0)	335 (17.9)	1586 (85.0)	1536 (82.3)
7	1674 (22.5)	1674 (100)	672 (40.1)	1201 (71.7)	1528 (91.3)	586 (35.0)	1646 (98.3)	868 (51.9)	466 (27.8)	1546 (92.4)	1531 (91.5)
8	1029 (13.8)	1029 (100)	648 (63.0)	871 (84.7)	997 (96.9)	516 (50.2)	1017 (98.8)	714 (69.4)	448 (43.5)	1004 (97.6)	988 (96.0)
9	374 (5.02)	374 (100)	281 (75.1)	344 (92.0)	374 (100)	299 (80.0)	373 (99.7)	313 (83.7)	264 (70.6)	372 (99.5)	372 (99.5)
10	75 (1.00)	75 (100)	75 (100)	75 (100)	75 (100)	75 (100)	75 (100)	75 (100)	75 (100)	75 (100)	75 (100)

DDS: dietary diversity score.
[†]Values expressed as number of children (percentage).

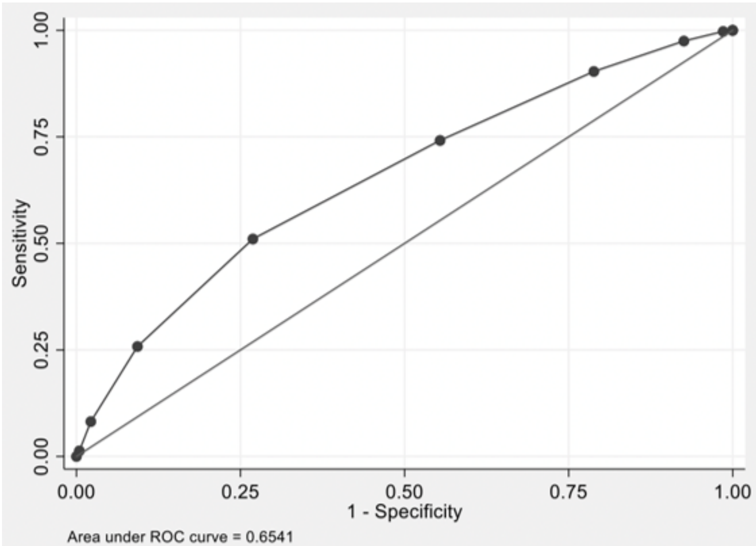

Figure 2. Nonparametric receiver operating characteristics curve (ROC) analysis for Dietary Diversity Score against Mean Adequacy Ratio ≥0.50 for Filipino children and adolescents age 3 to 18 years.

Table 3. Distribution of DDS, nutrient intake and MAR by age group and residences†

Items	Total (n=7448)	Age Groups			Residence	
		Preschoolers (n= 1262)	School-Age (n= 3386)	Adolescents (n= 2800)	Urban (n=2783)	Rural (n=4665)
DDS	6.18 (1.54)	6.05 (1.59)	6.20 (1.55)	6.21 (1.50)	6.36 (1.51)	6.07 (1.54)
Nutrient Intake						
Energy (kcal)	1397 (645)	963 (412)	1315 (546)	1691 (702)	1481 (687)	1347 (614)
Protein (g)	42.9 (21.0)	29.8 (14.3)	40.3 (18.0)	52.1 (22.9)	45.7 (22.2)	41.3 (20.1)
Vitamin A (μg RE)	366 (753)	356 (545)	337 (668)	406 (913)	426 (879)	330 (665)
Vitamin C (mg)	24.9 (37.4)	19.8 (25.3)	24.1 (40.0)	28.3 (38.4)	23.8 (39.2)	25.6 (36.2)
Thiamin (mg)	0.70 (0.45)	0.56 (0.39)	0.65 (0.40)	0.81 (0.51)	0.76 (0.50)	0.66 (0.42)
Riboflavin (mg)	0.60 (0.43)	0.59 (0.48)	0.56 (0.38)	0.65 (0.46)	0.68 (0.49)	0.55 (0.39)
Niacin (mg NE)	13.4 (7.09)	8.42 (4.19)	12.4 (5.83)	16.7 (7.83)	14.1 (7.53)	12.9 (6.79)
Iron (mg)	7.22 (3.95)	5.61 (3.44)	6.90 (3.65)	8.33 (4.18)	7.75 (4.29)	6.90 (3.69)
Calcium (mg)	293 (226)	298 (272)	273 (190)	315 (240)	302 (195)	287 (242)
NAR						
Energy	0.72 (0.29)	0.74 (0.31)	0.75 (0.30)	0.67 (0.27)	0.76 (0.31)	0.69 (0.28)
Protein	1.06 (0.53)	1.39 (0.66)	1.14 (0.52)	0.83 (0.36)	1.14 (0.57)	1.02 (0.51)
Vitamin A	0.74 (1.45)	0.89 (1.36)	0.76 (1.47)	0.64 (1.46)	0.85 (1.61)	0.67 (1.34)
Vitamin C	0.49 (0.75)	0.44 (0.56)	0.54 (0.89)	0.47 (0.64)	0.47 (0.80)	0.51 (0.72)
Thiamin	0.83 (0.56)	1.12 (0.78)	0.83 (0.51)	0.70 (0.43)	0.90 (0.59)	0.79 (0.53)
Riboflavin	0.70 (0.57)	1.08 (0.89)	0.69 (0.48)	0.54 (0.39)	0.80 (0.65)	0.64 (0.51)
Niacin	1.18 (0.55)	1.20 (0.60)	1.23 (0.57)	1.12 (0.51)	1.25 (0.58)	1.15 (0.54)
Iron	0.53 (0.34)	0.62 (0.38)	0.60 (0.34)	0.41 (0.26)	0.57 (0.36)	0.51 (0.32)
Calcium	0.36 (0.31)	0.54 (0.49)	0.33 (0.23)	0.32 (0.24)	0.38 (0.31)	0.35 (0.30)

DDS: dietary diversity score; MAR: mean nutrient adequacy ratio.
†Values expressed as mean (standard deviation).

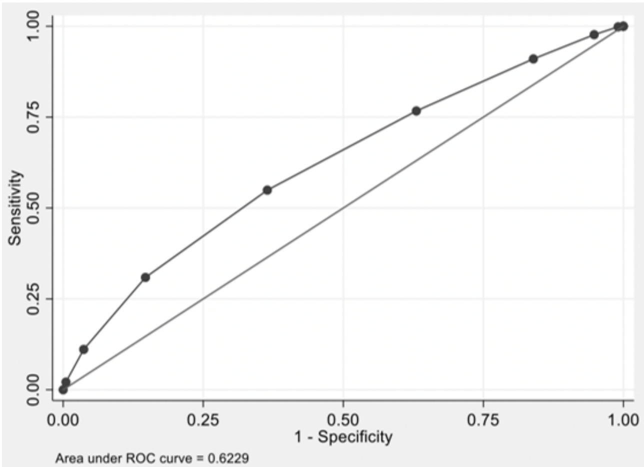

Figure 3. Nonparametric receiver operating characteristics curve (ROC) analysis for Dietary Diversity Score against Mean Adequacy Ratio ≥ 0.75 for Filipino children and adolescents age 3 to 18 years.

Table 4. MAR per age group†

	Age group		
	Preschoolers	School-age children	Adolescents (13-18 years old)
Mean Adequacy Ratio	0.84 (0.51)	0.71 (0.43)	0.60 (0.37)

MAR: mean nutrient adequacy ratio.
†Values are expressed as mean (standard deviation).

Table 5. Pearson product-moment correlation coefficients between MAR and NAR of each nutrient per age group†

Nutrient, unit	Age group			
	All age groups	Preschoolers (3-5 years old)	School-age children (6-12 years)	Adolescents (13-18 years old)
Vitamin A, μg RE	0.769*	0.750*	0.771*	0.812*
Vitamin C, mg	0.417*	0.424*	0.460*	0.398*
Thiamin, mg	0.684*	0.735*	0.667*	0.619*
Riboflavin, mg	0.839*	0.843*	0.865*	0.872*
Niacin, mg NE	0.611*	0.581*	0.631*	0.612*
Iron, mg	0.695*	0.749*	0.699*	0.613*
Calcium, mg	0.557*	0.729*	0.507*	0.415*

MAR: mean nutrient adequacy ratio; NAR: nutrient.
†Values are expressed as correlation coefficient.
*p<0.0001.

Table 6. Spearman rank-order correlation coefficients between Mean Adequacy Ratio (MAR) and Dietary Diversity Score (DDS) according to age groups†

Age group	Correlation
All age groups	0.29*
Preschoolers	0.27*
School-age children	0.33*
Adolescents	0.29*

MAR: mean nutrient adequacy ratio; DDS: dietary diversity score.
†Values expressed in correlation coefficient (p-value).
*p<0.0001.

sity,[7] making a higher DDS desirable in screening for micronutrient deficiencies. Energy, protein and micronutrients, except for thiamin, all showed an increasing trend of NARs as the DDS point increases, revealing a direct proportionality between energy, protein and micronutrient intake with DDS, favoring higher DDS as a measure of adequate energy and nutrient intake. Thiamin, on the other hand, was shown not to follow this trend as a DDS of 1 showed a higher NAR compared to a DDS of 2. This can be attributed to DDS of 1 being represented only by *cereals, rice, corn and tubers* which are known to be rich sources of this nutrient.

A DDS of 6 was shown to be the most common score among all Filipino children and adolescents in this study. This shows a relatively high DDS compared to other local studies favoring a DDS of 4.[20,21] This can be attributed partly to the smaller sample size and smaller number of food groups used in other studies, as well as the greater scope of this study in terms of sample size and age distribution. This higher DDS can also be ascribed to the greater intake of *cereals, rice corn and tubers*; *dairy*; *eggs*; *green, leafy and yellow vegetables*; *oils and fats*; and other uncategorized foods among Filipino children and adolescents. Notable is the high consumption of *green, leafy and yellow vegetables*, making it the most consumed food group next to *cereals, rice, corn and tubers*. This trend can be due to the availability, affordability and access to these food groups in the average Filipino household, in comparison with the relative expensiveness of *fruits* which was found to be the least consumed across all age groups in average. This reason may also be true for *meat, poultry and fish* which was found to be the least eaten food group among preschoolers.

MARs and NARs

The results showed an average MAR of 0.69, with subgroup MARs of 0.84, 0.71, and 0.60 for preschoolers, school-age children and adolescents, respectively. The least MAR found in adolescents can be explained by the relative stricter food preference of this age group as well as their higher dietary reference intake for micronutrients brought about by the increased demands of this stage of development. Although the use of MAR in the assessment of DDS among Filipino children is limited, a similar study among Filipino adolescents revealed a comparable MAR of 0.67.[20] MAR was noted to have the highest correlation of coefficient with NAR for riboflavin (0.84, p<0.001) and this is observed in all age subgroups. This can be a reflection of the varied source of riboflavin which include food groups such as *cereals, rice corn and tubers; dairy*; *eggs*; *green, leafy and yellow vegetables*; *other vegetables*; *dairy*; *eggs*; and *meat, poultry and fish.* On the other hand, the correlation of coefficient between MAR and NAR was lowest for vitamin C (0.42, *p*<0.0001), and this was also observed in across all age groups. This can be due to the limited sources of vitamin C in terms of food groups, which is limited mostly among *green, leafy and yellow vegetables* and *fruits*, as well as due to the observation that *fruits* is the least consumed food group. Likewise, these food groups are more available in the rural setting, making vitamin C the only nutrient to have higher intake among those coming from rural areas. The MAR was shown to be significantly correlated with each nutrient per age group (*p*<0.0001) and even across all age groups in general (*p*<0.001), making it a suitable representative of NAR for the micronutrients in study.

DDS and MARs

MAR, which was significantly correlated with NAR, can be used as an index of overall quality in the diet in terms of micronutrient content. The correlation coefficients between MAR and DDS across all age groups was measured to be 0.30, which was noted to be highly significant (*p*<0.0001). This observation was highest among school-age children (0.33, *p*<0.0001) and lowest among preschoolers (0.27, *p*<0.0001). Although relatively small, this significant and positive correlation between MAR and DDS makes DDS a relevant tool in assessing MAR and thus, the micronutrient content of the diets of Filipino children and adolescents.

Selection of cutoffs for DDS

In using DDS, a specific score should be determined in order to come up with the ideal score that could be used as a cutoff point to ascertain micronutrient adequacy in the diet. The score with the highest sensitivity and specificity is then appropriate for this purpose. To assess who achieves MAR of 0.5, a DDS score of 6 was shown to be the best cutoff, with a sensitivity of 74.2% and a specificity of 44.6%. On the other hand, those who satisfy MAR of 0.75 would have a DDS of 7 to be the best cutoff point, with sensitivity of 54.9% and a specificity of 63.6%. These are relatively higher compared to the optimal DDS cutoff noted in local studies.[20,21] A higher DDS cutoff is expected in the context of higher dietary diversity in the population, as the average DDS of 6 noted in this research is higher than those of other local studies. Nevertheless, these cutoff points are similar to those shown in a similar nation-wide study among Chinese children.[10] Although these sensitivity and specificity values are relatively small, they are comparable to values of other local researches done among elderly Filipinos and adolescents.[20,21]

This study showed that the Filipino children and adolescents have relatively low MARs which may indicate inadequacy in micronutrient intake in the diet, and their DDS supports this observation. The analysis confirmed that DDS can be used as an indicator of MAR and thus, of micronutrient intake among Filipino children and adolescents. The advantages of DDS, which include its ease of use and ability to be utilized in large-scale scenarios, makes it an efficient tool in screening those who are possibly suffering from micronutrient inadequacy in the diet. This favors DDS as a handy tool in both clinical and public health settings. However, given the limitations of this study, objective findings of correlation and validity are relatively small, prompting the need for improvements in further studies, which may include the use of other more detailed dietary tools in measuring micronutrients, investigating the use of more food groups to be included in the DDS, including more micronutrients in the analysis, as well as exploring other dietary scoring systems. In addition, this study focused on the analysis of food groups and nutrient intake through dietary approximations, without regard to different factors that could affect nutrient quality and bioavailability, such as food structures and the effects of food preparation methods, thus, pointing the need for further studies with consideration to such factors. The implications of DDS in assessing the efficiency in the use of environmental resources in achieving food security is also a potential focus of study particularly in analyzing the relationship between biodiversity, food production and utilization, and health outcomes.

Although DDS can be used in estimating micronutrient adequacy in the diet among Filipino children and adolescents, nutrient adequacy must still be subjected to more thorough assessment. Therefore, DDS should be used only as a screening tool in identifying those who would need further evaluation.

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AUTHOR DISCLOSURES

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