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Seasonal Change, Fishing Revenues, and Nutrient Intakes of Fishers' Children in Davao Gulf, Philippines

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Monsoons affect the Philippines' weather and climate in different regions during the year, which leads to significant changes to coastal ecosystems. Specifically, while the northeast monsoon (NEM) season brings less rainfall the succeeding dry summer season becomes relatively hotter and drier. Maintaining a healthy coastal habitat is critical because it is the main source of income, food, and nutrition for many households, especially children. Hence, this study examined 270 fishing households – including 315 children – to assess if there were significant changes in fish catch and revenues during the NEM and summer seasons and how these changes affected food consumption and nutrient intakes of children in a marine protected area (MPA) in Davao Gulf. The study found that catch per unit (CPUE) effort levels and fishing revenues were higher in the NEM as compared to the summer season. Moreover, food consumption and nutrient intakes of children were significantly reduced from NEM to the summer season and were also insufficient in both seasons, according to the Philippine Dietary Reference Intakes (PDRI) standards. Thus, while issues regarding micro and macronutrient deficiencies of children in the coastal areas should be addressed, more focused intervention is needed during the summer season. Furthermore, tourism-based services such as recreational and site-seeing activities can be an option to provide more livelihood and income opportunities for fishers. However, if possible, such activities should be intensified during the summer season because children are more vulnerable due to their relatively more inadequate food and nutrient intakes.

Keywords: CPUE, food consumption, marine protected area, monsoon, nutrient intakes

INTRODUCTION

The Philippines' changing weather and climate in different regions during the year are due to its geographic location and the prevailing winds or monsoons (FAO 1980). The monsoon is a seasonal change in the direction of the prevailing winds of a region and has its distinct pattern of prevailing winds each year (Kumar *et al.* 2007). The big winds that make the weather pattern in the Philippines unpredictable include the NEM, southwest monsoon (SWM), and the North Pacific trade winds (Deppermann 1954). These winds blow from cold to warm regions and often determine the climate, which leads to having wet and dry seasons in the tropical continents (Matsumoto *et al.* 2020).

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In the Philippines, the prevailing winds from the northeast are referred to as NEM or locally known as *amihan* and it ranges from November–March (Abesamis and Russ 2010; Matsumoto *et al.* 2020). On the other hand, the prevailing winds coming from the southwest are referred to as *habagat* or SWM and the monsoon's scope is from July–September but it starts early in the southern part of the Philippines (Abesamis and Russ 2010; Matsumoto *et al.* 2020). The NEM season is succeeded by the summer season, which ranges from March–June and the weather eventually becomes warmer and drier (PAGASA 2017). The presence of El Niño during the summer season usually results in variability in the extreme precipitation in the Philippines (Lyon *et al.* 2006). As the sea surface temperature warms, especially during El Niño, the tropical catch is also expected to decline due to the reduction of nutrient inputs (Kwiatkowski *et al.* 2017). The future projections of climate indicate that the Philippines is expected to experience a significant rise in temperature, which will lengthen dry periods and – as a result – it poses threats to the country's food security, particularly in agriculture and fisheries sectors (Trócaire 2014). Thus, sustaining a coastal habitat is crucial because communities rely on food and income from the harvest of marine fauna.

In 2015, Filipino fishers were considered among the poorest as 34% of them lived below the poverty threshold, thus making the poverty incidence in the coastal areas relatively higher compared to the national poverty rate of 21.6% (PSA 2017). Moreover, households in the Philippines have inadequate nutrient consumption especially with regards to micronutrient intakes which is a major indicator of a significant hunger problem (FNRI 2014). And this is most prevalent in children where malnutrition has been identified as one of the major public health concerns since it places a heavy burden on already disadvantaged communities in most developing countries (Abubakar *et al.* 2012). In fact, in Uganda and Tanzania, there is a high prevalence of malnutrition in fishing communities compared to the national average (Geheb *et al.* 2008). Moreover, monsoon season affects the fish catch level (Abesamis and Russ 2010; Villanoy *et al.* 2011) and when it results in flooding and disruption of livelihood activities, it can also have an adverse impact on the nutrition of children (Choudhury and Bhuiya 1993). A study by the Food and Agriculture Organization (2000) in Zambia found that during the wet season when there is fishing closure, children experienced a deficiency in total calorie intake while during the dry season, they have excessive intakes of carbohydrates and protein but are deficient in fat, iron, and calcium. This implies that children experience varying nutrition levels and this can significantly alter their health outcomes (Hautvast *et al.* 1999; Martins *et al.* 2011).

The literature regarding the impacts of NEM and summer season on the livelihood of fishers is relatively new, especially when it attempts to determine the implications on children's food consumption and nutrient intakes. Thus, this research aims to determine the effects of the NEM and the summer seasons on the catch levels and revenue of fishers and assess its implications on the food consumption and nutrient intakes of children in an MPA in Mabini, Davao de Oro.

MATERIALS AND METHODS

Study Area

The study area of this research is located in the municipality of Mabini, Davao de Oro (Figure 1). Mabini has a total of 6,106 hectares of mangrove forests, white sand beaches, and coral reefs that are covered by the Mabini Protected Landscape and Seascape (DENR RXI 2020). The Philippine Clearing House Mechanism for Biodiversity has stated that Mabini has 45.5 ha of developed fishponds and 36 ha of swamplands.

Sampling Technique

A stratified random sampling technique was used to determine the respondents for each village (*barangay*). From the master list provided by the Municipal Agricultural Office, we surveyed a total of 270 respondents composed of 66 from *Barangay* Cuambog, 66 from *Barangay* Cadunan, 55 from *Barangay* Pindasan, 44 from *Barangay* San Antonio, 20 from *Barangay* Tagnanan, and 19 from *Barangay* del Pilar across NEM and summer seasons. These villages are the *barangays* of Mabini, which are located in the coastal areas of the Davao Gulf.

Survey Instrument

Primary data were utilized in this study. Fishers were surveyed regarding their household socio-demographic and economic information and children's food consumption. These include data on catch levels, fishing operations, revenue, food consumption, and nutrient intake of children. Information such as gender, years of experience in fishing, and educational attainment was likewise collected. Also, fishing-related data such as fishing gear and the costs associated with equipment, tools, and materials used were obtained as well.

The Food and Nutrition Research Institute (FNRI 2015) classifies children as those in the age group of 1–18 yr old. The children's consumption data was assessed using a three-day diet recall questionnaire. The nutrient intakes were computed using the FoodData Central's National Nutrient Database for Standard Reference of the United

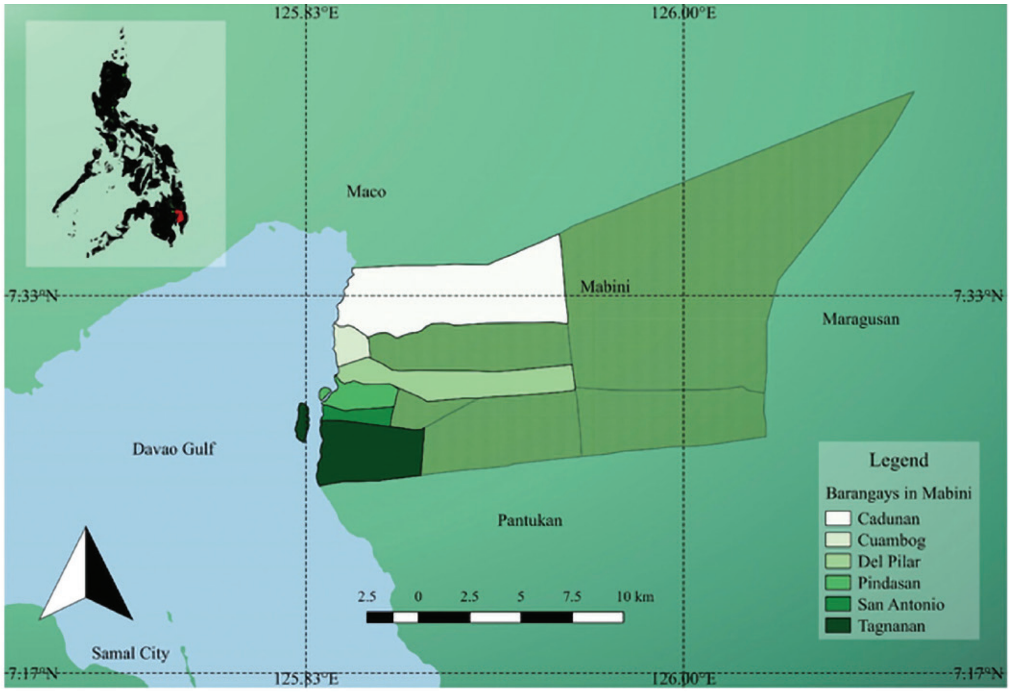

Figure 1. Map of Mabini, Davao de Oro, Philippines.

States Department of Agriculture (USDA) and the FNRI's Philippine Food Composition Tables (PhilFCT). These were then compared with the recommended values set by the FNRI on its 2015 Philippine Dietary Reference Intakes (PDRI) to obtain the percentage recommended energy and nutrient intake (%RENI). In this procedure, we followed the approach of Ricalde *et al.* (2018) and Alviola *et al.* (2016) in the conduct of the three-day diet recall survey and conversion of the food intakes into nutrient equivalents. Moreover, the three-day diet recall is a standard instrument and is judged as more superior among other food frequency record assessments such as 24-h recall or five-day food frequency (Crawford *et al.* 1994; Schroder *et al.* 2001; Yang *et al.* 2010).

Data Collection

In conducting the surveys for each of the research sites, courtesy calls and coordination were made to concerned offices in the local government unit of the municipality of Mabini. Free, prior, and informed consent was also secured from the survey respondents.

We collected panel data for the three-day diet recall with the season as the time index. Thus, interviews were conducted with the same set of respondents in both NEM and summer seasons. The data collection was conducted from November 2017–February 2018 for the NEM and from March–April 2018 for the summer season. We hired survey enumerators who are *barangay* nutrition scholars affiliated with the Municipal Nutrition Office. These enumerators are already trained in the data collection of food intakes because they are the point-persons in the implementation of local feeding programs. Moreover, we conducted additional orientation activities regarding the research project, which utilizes a three-day diet recall approach.

The food diet recall questionnaire, which was participated by parents, was used to determine the food items that were consumed by children during breakfast, lunch, dinner, and snacks for the past three consecutive days. The food items were measured on a per-serving basis by bowl, by cup, by piece, or by slice. To have a uniform standard of measurement, the food intakes were converted into grams. The *barangay* nutrition scholars used the appropriate measuring utensils to guide the respondents in estimating their food consumption. Then, the USDA (2020) FoodData Central and FNRI (2020) PhilFCT were used to convert food items into its nutrient values such as macronutrients, vitamins, and minerals.

Data Analysis

We posit that the change in seasons may likely impact the catch level of fishers. Moreover, if the catch levels vary, then the revenue of the fishers would be affected as well. Further, varying income levels implies that food consumption of children may change and this would affect their nutritional intakes. The FNRI (2015) classifies individuals aged 1–18 yr as children. In this study, children were classified into six age groups: 1–2 yr old, 3–5 yr old, 6–9 yr old, 10–12 yr old, 13–15 yr old, and 16-18 yr old.

The nutrients that were considered in the study include energy, protein, total fat, carbohydrate, total dietary fiber, sugars, calcium, iron, magnesium, phosphorus, potassium, sodium, zinc, vitamin C, thiamin, riboflavin, niacin, vitamin B-6, folate, vitamin B-12, vitamin A (RAE), vitamin E, vitamin D (D2+D3), and vitamin K (FNRI 2015). The nutrient level intakes were assessed if the children have insufficient, adequate, or excessive levels. The paired t-test was used to compare means of food consumption and nutrient intakes of children across NEM and summer seasons. Also, we calculated the difference between the means and t-test on the fishing trips, catch levels, and revenue for both NEM and summer seasons. The paired t-tests were performed using Stata v.15.1.

Limitations

The study only focused on the effects of NEM and summer seasons. The SWM season was not considered due to the declaration of martial law in Mindanao (Proclamation 216), which started in May 2017. We had difficulty in conducting surveys in the research sites due to unstable security during the survey period.

RESULTS AND DISCUSSION

Profile of Respondents

The study was conducted in six *barangays* in Mabini, Davao der Oro – namely, Cadunan, Cuambog, Pindasan, San Antonio, Del Pilar, and Tagnanan (Table 1). There were a total of 270 households that were sampled in the study. Cuambog (25%) and Cadunan (25%) are the biggest *barangays* that accounted for the majority of the total samples. Pindasan is next with 20% of the total distribution of households, while San Antonio accounted for 16% of the total sample households. Finally, Tagnanan (7%) and Del Pilar (7%) had the least distribution of respondents. Likewise, the majority of the household heads were males that were also the fishers; in the sample, there were 9% female fishers relative to 91% male fishers. As for education, 31% had elementary level education and 21% had completed their elementary education. About 28% went to high school level and 14% had graduated from high school. Lastly, there were 6% who attended college but only less than 1% had obtained a college degree. In terms of fishing experience, the majority of the fishers from Cadunan and Del Pilar garnered the highest level of 11–20 yr. On the other hand, most fishers from Cuambog, San Antonio, Tagnanan, and Pindasan have a relatively lower fishing experience of 1–10 yr.

Out of the 270 households, there were a total of 315 children (154 females and 161 males) sampled in the study, which were classified into six age groups: 1–2 yr old, 3–5 yr old, 6–9 yr old, 10–12 yr old, 13–15 yr old, and 16–18 yr old. Around 49% were females and 51% were males. Cadunan (27%) and Cuambog (24%) had the majority of the children respondents. San Antonio accounted for 20% of the children and Pindasan accounted for 15%. Lastly, the least number of children were located in Tagnanan (8%) and Del Pilar (6%).

Fishing Gears

Fishing gears are materials used to harvest different types of fishes and other aquatic and marine resources (Selgrath *et al.* 2018). Table 2 presents the top 15 fishing gears that were used by respondents and the corresponding frequency of usage during the NEM and summer seasons. Among the two seasons, the majority of the fishers use the drift net (*pukot*), with 34% of fishers using it during the NEM season and 32% during the summer. The drift net is one of the oldest fishing gears, and it operates by entangling the fish with the net as they swim to the drift net (Northridge 1991). This gear is usually chosen during night fishing because the fishes are unable to detect the net and, as a result, more catches are expected. However, the drift net approach is an indiscriminate technique

Table 1. Distribution of household and children respondents by locality.

	Number of household respondents	Number of female children	Number of male children	Total number of children
Cadunan	68	43	43	86
Cuambog	67	35	40	75
Pindasan	54	25	22	47
San Antonio	43	31	32	63
Del Pilar	19	10	8	18
Tagnanan	19	10	16	26
Total	270	154	161	315

Table 2. Frequency of use of top 15 fishing gears per season.

Fishing gears	NEM	Summer
Drift net (*Pukot*)	34%	32%
Hook and line (*Undak*)	25%	21%
Handline (*Pasol*)	18%	24%
Ring net (*Panamban*)	20%	18%
Fish corral (*Bunsod*)	5%	5%
Fishing spear (*Pamana*)	6%	4%
Troll line (*Subid*)	9%	1%
Hook and line (*Pahawin*)	4%	4%
Handline (*Ton-ton*)	3%	3%
Woven traps (*Panggal*)	2%	3%
Fishing spear (*Sapang*)	4%	< 1%
Fishing spear (*Ganta-aw*)	< 1%	4%
Scoop net (*Sibot*)	2%	0%
Bottom set gill net (*Palugdang*)	2%	0%
Gleaning (*Manginhas*)	0%	1%

because it catches non-target species such as juvenile fishes (Northridge 1991). According to the Southeast Asian Fisheries Development Center (2001), the drift net catches multiple fish species such as scad, mackerel, flying fish, tuna, and other tuna-like species.

The next fishing gear with the highest usage frequency is the hook and line (*undak*) with 25% and 21% usage during NEM and summer seasons, respectively. The hook and line is one of the most common fishing gears and is the second most efficient gear in municipal fishing (SEAFDEC 2001). The hook and line harvest species such as sardine (*tamban*), Indian mackerel (*karabalyas*), tuna (*anduhaw*), big-eyed scad (*matambaka*), and goatfish (*timbongan*). Likewise, the fishing gear with the third-highest usage frequency is the handline (*pasol*) with 18% usage during NEM and 24% usage during the summer season. The common species that are harvested with *pasol* are tuna and tuna-like species (SEAFDEC 2001). Ring net (*panamban*) ranks fourth with 20% users in the NEM season and 18% users in the summer season. *Panamban* is a ring net specifically designed for catching sardines (*tamban*). Other gears such as the barriers and traps (*bunsod and panggal*) catch species such as billfish (*balo*), Indian mackerel *(karabalyas*), big-eyed scad (*matambaka*), squid (*nokos*), crabs (*lambay*), jacks (*talakitok)*, goatfish (*timbongan*), and angelfish (*pata*).

There was a noticeable change in the frequency of fishing gear usage between the two seasons. Most gears experienced the same or lower usage in the summer season except for handline (*pasol*), woven traps (*panggal*), fishing spear (*ganta-aw*), and gleaning (*manginhas*).

CPUE per Species

Seasons play a role in the movement and dispersal of fish species and a change in season may indicate changes in the abundance of species caught (Abesamis and Russ 2010; Villanoy *et al.* 2011). Table 3 reports the top species caught in both NEM and summer seasons along with its corresponding CPUE and average selling price. The CPUE is an indicator of fish abundance and in this study, it is defined as total catch (kg) normalized by effort as measured in hours (Petrere *et al.* 2010). From the table, we find that the CPUE during the NEM season is 5.83 kg/h, which is higher than the summer CPUE equal to 3.88 kg/h. This implies that the abundance levels during the NEM season are higher relative to the summer season.

By examining the CPUE at the species level, we also find that the CPUE in mixed-species catches were significantly higher in the NEM season compared to the summer season. Likewise, the same observation can be deduced for the CPUE for sardines where it is relatively higher for the NEM as compared with the summer season. The total CPUE reported in Table 3 is the sum of all the species CPUE for both the NEM and summer seasons. Note that the major drivers of the total CPUE come from the mixed species and sardines CPUEs. Also, the average selling

Table 3. CPUE per species per season.

Species	NEM		Summer	
	CPUE (kg/h)	Average selling price (PHP/kg)	CPUE (kg/h)	Average selling price (PHP/kg)
Mixed fish species (unclassified)[1]	4.09		2.18	
Bali/ white/ goldstripe sardinella (*tamban*)	1.02	110	0.51	61
Yellowstripe scad (*karabalyas*)	0.20	221	0.30	189
Bigeye/ oxeye scad (*matambaka*)	0.06	138	0.13	132
Agujon needlefish (*balo*)	0.04	223	0.13	260
Total/ average[2]	5.83	147	3.88	129

[1]Mixed species are unclassified catches by fishers. [2]Total refers to total CPUE while average refers to the average price.

price of fish during the NEM season is relatively higher than in the summer season (see Appendix I for complete enumeration of species caught with corresponding CPUEs).

Catch and Revenue Levels

Table 4 reports the trips per week, hours per week, hours per trip, total catch per week, total catch per trip, CPUE, revenue per week, revenue per trip, and revenue per unit effort across the two seasons. During the NEM season, the fishers had a lower number of trips per week with 4.93 trips compared to 9.02 trips during the summer season. However, there were higher average hours of fishing trips per week in the NEM season compared with the summer season. More specifically, fisherfolks spent an average of 43 h/wk during the NEM season while fishing during the summer season had an average of 30 h/wk. In terms of hours per trip, fishers spent 8 h per trip during the NEM season, while for the summer, it was 5 h per trip.

The total catch per week and the total catch per trip levels had also negatively changed by 116 kg and 25 kg from NEM to summer, respectively. The CPUE during NEM was 5.83 kg/h while the CPUE during the summer season was 3.88 kg/h. This suggests that fishers had relatively higher fish catch during NEM season and this also indicates relatively higher fish abundance compared to the summer. The revenue per week and the revenue per trip were relatively lower by PHP 18,534 and PHP 3,891 from NEM to the summer season, respectively. Lastly, the revenue per unit effort declined by PHP 357/h from NEM to the summer season. The role of fish trading is crucial in achieving food security in coastal areas as there is a need to buy non-fish commodities for household food consumption (Fabinyi *et al.* 2017).

Food Consumption

A total of 315 children samples were utilized in this study. Table 5 reports the key consumed food items for both the NEM and summer seasons (see Appendix II for the top 15 consumed food per season). Rice consumption was slightly lower from the NEM to summer, but this change was not statistically significant. Next to rice, fish products and dishes were the most consumed among the food items. It is because fishing is the main source of livelihood of the household. Six food items are from the fish and fish products group – namely, fried fish, fish stew (*sinabawang isda*, *tinola*), fish cooked in vinegar sauce (*paksiw*), dried fish, and canned sardines. Fried fish was the most consumed with 199.11 g/d in the NEM

Table 4. Catch and revenue levels per season.

	NEM	Summer	Difference	*p*-value
Trips per week (trips/wk)	4.93	9.02	–4.09	0.00
Hours per week (h/wk)	43.18	30.05	13.13	0.00
Hours per trip (h/trip)	8.31	5.14	3.17	0.00
Total catch per week (kg/wk)	196.58	80.34	116.25	0.00
Total catch per trip (kg/trip)	34.20	8.81	25.40	0.00
CPUE (kg/h)	5.83	3.88	1.96	0.00
Revenue per week (PHP/wk)	28897.66	10363.54	18534.12	0.00
Revenue per trip (PHP/trip)	5027.68	1136.07	3891.61	0.00
Revenue per unit effort (PHP/h)	857.62	500.35	357.27	0.00

Table 5. Average daily consumption of key food consumed per season.

Food item	NEM (g)	Summer (g)	Difference (g)	*p*-value
Rice	1738.60	1704.07	34.53	0.30
Fried fish	199.11	124.40	74.71	0.00
Fish stew (*tinola*)	120.21	117.13	3.08	0.41
Fish stew (*sinabawang isda*)	170.46	54.38	116.08	0.00
Vegetable stew (*law-uy*)	111.59	78.11	33.48	0.00
Fish cooked in vinegar sauce (*paksiw*)	63.28	70.60	–7.32	0.08
Dried Fish (*bulad*)	38.15	47.05	–8.90	0.02
Canned sardines	25.78	54.18	–28.40	0.00
Sauteed vegetables (*ginisang gulay*)	41.38	31.44	9.94	0.00

season and 124.40 g/d in the summer season. There was a significant difference in the average daily consumption of fried fish between the two seasons. It was followed by fish stew (*sinabawang isda*) with 170.46 g/d in the NEM season and 54.38 g/d in the summer season. Fish stew consumption had a lower intake of 116.08 g/d between the two seasons. For dried fish, consumption was relatively higher from 38.15 g/d in the NEM season to 47.05 g/d in the summer season. Lastly, canned sardine consumption posted a significant difference in the two seasons. Its consumption changed from 25.78 g/d in the NEM season to 54.18 g/d in the summer season.

On the other hand, bread consumption during the summer season was higher with 81.84 g/d as compared to 49.52 g/d during the NEM season. For milk, the average daily consumption changed from 334.04 g/d in the NEM season to 163.10 g/d in the summer season. As for coffee, average daily consumption also changed from 236.40 g/d in the NEM season to 174.37 g/d in the summer season. For juice, average daily consumption also changed from 30.07 g/d in the NEM season to 56.65 g/d in the summer season.

For vegetable dishes, vegetable stew (*law-uy*) and sautéed vegetables were the most consumed. *Law-uy* significantly changed from 111.59 g/d in the NEM season to 78.11 g/d in the summer season. For sautéed vegetables, average daily consumption changed from 41.38 g/d in the NEM season to 31.44 g/d in the summer season.

The negative change in average daily consumption in the summer may likely be attributed to the decline in income. Since income was relatively lower, the allocation of budget for food may have declined as well. This reduction in consumption was observed in fish commodities, milk, coffee, and vegetable food preparations. On the other hand, food items that had increased consumption include canned sardines, dried fish, bread, noodles, and juice. In this case, fishers trade their catch to buy non-fish commodities (Fabinyi *et al.* 2017), particularly cheaper substitutes for food prepared at home such as processed food. For example, bread and noodles are substitutes for rice, while canned sardines and dried fish are substitutes for fish dishes such as fish stews and fried fish. Finally, juices are substitutes for milk and coffee as well.

Nutrient Intakes

After determining the food items that the children consumed during the NEM and summer seasons, the nutrient intakes were calculated accordingly. In this study, 24 nutrients were utilized to determine if children's nutrient intakes were adequate. The nutrients can be classified into two groups: macronutrients and micronutrients. Macronutrients are proximates that include energy, protein, total fat, carbohydrate, fiber, and sugars while micronutrients are essential vitamins and minerals. Table 6 summarizes the children's average daily nutrient intake per season.

For energy, the average daily intake changed from 1523.56 kcal/d in the NEM season to 1403.16 kcal/d in the summer season. However, these values in both seasons are still lower compared to the PDRI standards. Protein intakes also changed from 72.94 g/d in the NEM season to 63.54 g/d in the summer season. However, protein intakes during the NEM were slightly higher than the PDRI standards; thus, even with the lower intakes during the summer season, protein intakes were still adequate.

For total fat intake, the average daily intake changed from 32.09 g/d in the NEM season to 28.21 g/d in the summer season. In this case, the decline in fat intakes from NEM to summer resulted in inadequacy levels according to the PDRI standards. Carbohydrate intakes changed as well from 229.00 g/d in the NEM season to 217.27 g/d in the summer season. In both seasons, children were not able to meet the recommended carbohydrate intake per day. This is also true for total sugar intakes where there was an observed reduction of sugar intakes from NEM to the summer season, but the values are less than the PDRI standards.

Four minerals had a significant difference in the mean nutrient intakes across the two seasons. For calcium, potassium, and zinc, there was an observed negative change of intake for these minerals from NEM to the summer season. However, the intake values of these minerals in both seasons compared to the PDRI standards are still inadequate. On the other hand, for phosphorus – although there was also a negative change in intakes from NEM – to summer, the intakes are still within the range of the PDRI recommendations.

In terms of nutrient adequacy, all vitamin intakes were inadequate for both seasons except for niacin and vitamin B-12, which were adequate in both seasons, while riboflavin and vitamin B-6 were only adequate during the NEM season. However, for both riboflavin and vitamin B-6, the adequacy level negatively changed and, when compared with the PDRI standards, it resulted in inadequacy. The detailed nutrient intakes of male and female children across age groups are shown in Appendices III–VIII.

CONCLUSION

This research shows that fishers used a wide variety of fishing gears for catching different fish species. The usage frequency of fishing gears was relatively lower from NEM to summer seasons and the same was true for total CPUE. The results also reveal that the average

Table 6. Average daily nutrient intakes of children per season.

Nutrients	PDRI	NEM	Summer	Difference	*p*-value
Proximates					
Energy (kcal)	1816.67	1523.56[a]	1403.16[a]	120.40	0.00
Protein (g)[1]	27–69	72.94[b]	63.54	9.40	0.00
Total fat (g)[2]	32–63	32.09	28.21[a]	3.88	0.00
Carbohydrate, by difference (g)[3]	245–355	229.00[a]	217.27[a]	11.73	0.02
Fiber, total dietary (g)	13–16	4.03[a]	4.09[a]	–0.06	0.40
Sugars, total (g)[4]	< 45	25.29	21.90	3.39	0.02
Minerals (mg)					
Calcium, Ca	791–2500	675.21[a]	515.47[a]	159.74	0.00
Iron, Fe	14–42	7.62[a]	7.54[a]	0.09	0.36
Magnesium, Mg	139–234	187.41	181.41	5.99	0.19
Phosphorus, P	868–3556	1004.27	897.59	106.68	0.00
Potassium, K	1666.67	1169.59[a]	1085.72[a]	83.87	0.04
Sodium, Na	404.17	2343.65[b]	2361.32[b]	–17.67	0.45
Zinc, Zn	6–20	5.21[a]	4.61[a]	0.60	0.00
Vitamins					
Vitamin C, total ascorbic acid (mg)	50–1034	29.41[a]	38.23[a]	–8.82	0.02
Thiamin (mg)	0.82	0.58[a]	0.52[a]	0.07	0.00
Riboflavin (mg)	0.85	0.85	0.67[a]	0.18	0.00
Niacin (mg)	10–19	14.14	12.81	1.33	0.00
Vitamin B-6 (mg)	0.93–54	5.21	0.73[a]	4.47	0.01
Folate, DFE (µg)	291–534	95.53[a]	97.81[a]	–2.28	0.27
Vitamin B-12 (µg)	1.72	4.73[b]	4.75[b]	–0.03	0.47
Vitamin A, RAE (µg)	500–1523	363.02[a]	239.75[a]	123.27	0.00
Vitamin E (alpha-tocopherol) (mg)	7.33–489	3.05[a]	3.01[a]	0.04	0.37
Vitamin D, (D2 + D3) (µg)	5–50	3.10[a]	2.81[a]	0.29	0.08
Vitamin K, phylloquinone (µg)	31.67	10.23[a]	8.19[a]	2.04	0.00

Source: Recommended energy intakes per day, acceptable macronutrient distribution ranges, recommended nutrient intakes per day (macronutrients), recommended nutrient intakes per day (vitamins), recommended nutrient intakes per day (minerals), tolerable upper intake levels or upper limits per day, and additional recommendations (PDRI 2015); notes: [1]6–15% of the energy level and using 4 kcal in 1 g of protein conversion; [2]25–35% of the energy level and using 9 kcal in 1 g of fats conversion; [3]50–69% of the energy level and using 4 kcal in 1 g of carbohydrates conversion; [4]not to exceed 10% of the energy level and using 4 kcal in 1 g of sugar conversion; a – deficit; b – surplus

selling price of fish species negatively changed during the summer season. Thus, with the relatively lower CPUE and average selling price, this has resulted in lower revenue levels of fishers during the summer season as compared to the NEM season. Since the results show that there was a relatively lower income level during the summer season, the implications on the food consumption and nutrient intakes of children were also assessed as well.

For food consumption, the results indicate that the consumption of food items that are prepared at home was generally lower and this was substituted by cheaper processed food during the summer season relative to NEM. As a result, nutrient intakes negatively changed from NEM to the summer season and most of the nutrients were inadequate in both seasons when compared to the PDRI standards. Thus, the results of the study suggest that the seasonal shift from NEM to summer can impact catch levels, revenue, food consumption, and – consequently – nutrient intakes of children.

While it is imperative to address the micro- and macronutrient deficiencies of children in the coastal areas, more focused intervention is needed during the summer season. Moreover, since the municipality of Mabini is a protected site, fishing activities are constrained especially during closed fishing seasons. Alternatively, tourism-based services can potentially increase the livelihood and income opportunities of fishers. Furthermore, the local government units can expand non-fishing employment options by pursuing recreational and site-seeing ventures during the summer season where there is relatively more pronounced vulnerability of children in terms of their inadequate food and nutrient intakes.

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APPENDICES

Appendix I. CPUE per species per season.

Species	NEM		Summer	
	CPUE (kg/h)	Average selling price (PHP/kg)	CPUE (kg/h)	Average selling price (PHP/kg)
Mixed fish species (unclassified)[1]	4.09		2.18	
Bali/ white/ goldstripe sardinella (*tamban*)	1.02	110	0.51	61
Yellowstripe scad (*karabalyas*)	0.20	221	0.30	189
Bigeye/ oxeye scad (*matambaka*)	0.06	138	0.13	132
Agujon needlefish (*balo*)	0.04	223	0.13	260
Damselfishes *(pata)*	0.03	75	0.09	73
Whitespotted/ doublebar rabbitfish (*danggit*)	0.03	125	0.08	142
Moonfish (*bilong-bilong*)	0.07	112	0.01	53
Short/ island/ Indian mackerel (*anduhaw*)	0.05	72	0.01	140
Dusky/ whitespot parrotfish (*molmol*)	0.04	113	0.02	139
Indian threadfish/ brassy trevally/jacks (*talakitok*)	0.02	143	0.03	186
Spotted/ yellowing/ margined flyingfish (*bangsi*)	0.01	298	0.03	125
Flathead grey/ longarm/ largescale mullet (*gisaw*)	0.01	77	0.02	86
Greenback/ lobed river/ Otomebora mullet (*banak*)	0.01	172	0.02	96
Swordtip squid (*nukos*)	0.01	135	0.02	74
Cuttlefish (*kubotan*)	0.01	138	0.01	99
Sulfur/ deepwater/ cinnabar goatfish (*timbungan*)	0.01	139	0.01	137
Pinkear/ thumbprint emperor (*katambak*)	0.01	157	0.02	119
Crab (*lambay*)	0.01	248	0.01	123
Golden rabbitfish (*kitong*)	< 0.01	215	0.02	142
Goldband/ striped goatfish *(salmonete*)	0.01	119	0.01	92
Escohido/ eskuhido	0.01	214	< 0.01	150
Bullet/ frigate tuna *(pirit*)	< 0.01	127	0.01	136
Timor/ Indian/ blacktail/ emperor red snapper (*maya-maya*)	< 0.01	152	0.01	85
Shortfin/ mackarel/ roughear/ redtail scad (*moro-moro*)	0.01	105	0.01	123
Crescent grunter/ fourline terapon (*bugaong*)	0.01	109	0.01	105
Striped surgeonfish (*indangan*)	0.01	140	0.01	197
Milkfish (*bangus*)			0.09	138
Indian anchovy (*bolinao*)			0.07	200
Monocle bream *(lagaw*)			0.01	134
Largehead/ Ganges/ Savalai hairtail (*diwit*)	0.01	99		
Peacock hind/ chocolate/ tomato/ blacktip/ sixbar grouper (*lapu-lapu*)	0.01	206		
Giant trevally (*mangsa*)	0.01	163		
Starry/ queen/ masked triggerfish (*pakol*)	0.01	100		
Fourfinger/ striped/ smallmouth threadfin (*tigi*)	0.01	152		
Rainbow runner (*bangkulisan*)	< 0.01	136		
Deep-bodied mojarra (*putian*)	< 0.01	128		
Total/ average[2]	5.83	147	3.88	129

[1]Mixed species are unclassified catches by fishers. [2]Total refers to total CPUE while average refers to the average price.

Appendix II. Average daily consumption of the top 15 consumed food per season.

Food item	NEM (g)	Summer (g)	Difference (g)	*p*-value
Rice	1738.60	1704.07	34.53	0.30
Milk	334.04	163.10	170.94	0.00
Coffee	236.40	174.37	62.03	0.00
Fried fish	199.11	124.40	74.71	0.00
Fish stew (*tinola*)	120.21	117.13	3.08	0.41
Fish stew (*sinabawang isda*)	170.46	54.38	116.08	0.00
Vegetable stew (*law-uy*)	111.59	78.11	33.48	0.00
Chocolate malt drink (Milo®)	92.81	84.97	7.84	0.32
Fish cooked in vinegar sauce (*paksiw*)	63.28	70.60	–7.32	0.08
Bread	49.52	81.84	–32.32	0.00
Noodles	57.58	69.09	–11.51	0.08
Juice	30.07	56.65	–26.58	0.00
Dried fish (*Bulad*)	38.15	47.05	–8.90	0.02
Canned sardines	25.78	54.18	–28.40	0.00
Sauteed vegetables (*ginisang gulay*)	41.38	31.44	9.94	0.00

Appendix III. Average daily nutrient intake of children per season (1–2 yr old)

	Male					Female				
	PDRI	NEM	Summer	diff	*p*-value	PDRI	NEM	Summer	diff	*p*-value
Proximates										
Energy (kcal)	1000.00	1392.51[b]	1361.37[b]	31.14	0.40	920	1355.03[b]	1232.02[b]	123.02	0.27
Protein (g)[1]	15–38	83.19[b]	68.02[b]	15.17	0.14	20–51	70.40[b]	60.65[b]	9.74	0.22
Total fat (g)[2]	27–39	30.64	29.67	0.97	0.38	37–53	31.15[a]	23.73[a]	7.42	0.03
Carbohydrate, by difference (g)[3]	125–172.5	191.26	199.73	–8.47	0.36	169–234	193.78	188.15	5.63	0.43
Fiber, total dietary (g)	6–7	4.09[a]	4.93[a]	–0.85	0.27	6–7	3.56[a]	3.32[a]	0.24	0.38
Sugars, total (g)[4]	< 25	20.53	28.29[b]	–7.76	0.20	< 23	29.57[b]	18.84	10.73	0.11
Minerals (mg)										
Calcium, Ca	500–2500	967.62	734.09	233.53	0.13	500-2500	806.03	509.08	296.95	0.05
Iron, Fe	8–40	8.48	8.67	–0.18	0.44	8–40	7.49[a]	6.52[a]	0.98	0.18
Magnesium, Mg	60–65	189.72[b]	166.76[b]	22.96	0.21	60–65	147.92[b]	142.64[b]	5.28	0.42
Phosphorus, P	460–3000	1057.02	962.57	94.45	0.27	460–3000	1064.06	851.04	213.02	0.13
Potassium, K	1000	1162.13[b]	1053.20[b]	108.93	0.31	1000	1110.51[b]	1071.09[b]	39.41	0.44
Sodium, Na	w225	3118.98[b]	1946.82[b]	1172.16	0.15	225	1776.26[b]	2411.09[b]	–634.83	0.26
Zinc, Zn	4.1–7	4.71	3.94[a]	0.76	0.11	4–7	4.72	4.06	0.66	0.20
Vitamins										
Vitamin C, total ascorbic acid (mg)	45–400	18.80[a]	56.10	–37.31	0.11	45–400	12.39[a]	44.72[a]	–32.33	0.09
Thiamin (mg)	0.50	0.63[b]	0.63[b]	0.00	0.50	0.40	0.62[b]	0.46[b]	0.16	0.05
Riboflavin (mg)	0.50	0.92[b]	0.81[b]	0.11	0.25	0.40	1.22[b]	0.61[b]	0.61	0.01
Niacin (mg)	6–10	13.80[b]	15.69[b]	–1.89	0.18	6–10	13.76[b]	11.79[b]	1.98	0.15
Vitamin B-6 (mg)	0.5–30	0.96	0.64	0.32	0.07	0.5–30	0.74	0.67	0.07	0.31

	Male					Female				
	PDRI	NEM	Summer	diff	*p*-value	PDRI	NEM	Summer	diff	*p*-value
Folate, DFE (μg)	150–300	109.02[a]	119.59[a]	–10.56	0.31	150–300	106.44[a]	89.35[a]	17.09	0.14
Vitamin B-12 (μg)	0.90	4.81[b]	3.88[b]	0.93	0.32	1	4.32[b]	4.40[b]	–0.07	0.48
Vitamin A, RAE (μg)	400–600	514.61	539.95	–25.34	0.47	400–600	592.95	325.01[a]	267.93	0.05
Vitamin E (alpha-tocopherol) (mg)	5–200	2.56[a]	3.12[a]	–0.56	0.21	5–200	2.55[a]	2.42[a]	0.13	0.38
Vitamin D, (D2 + D3) (μg)	5–50	4.38[a]	3.62[a]	0.77	0.25	5–50	4.95[a]	2.61[a]	2.33	0.06
Vitamin K, phylloquinone (μg)	12	14.52[b]	7.26[a]	7.26	0.05	12	8.59[a]	9.69[a]	–1.09	0.40

Source: recommended energy intakes per day, acceptable macronutrient distribution ranges, recommended nutrient intakes per day (macronutrients), recommended nutrient intakes per day (vitamins), recommended nutrient intakes per day (minerals), tolerable upper intake levels or upper limits per day, and additional recommendations (PDRI 2015)

Notes: [1]6–15% of the energy level and using 4 kcal in 1 g of protein conversion; [2]25–35% of the energy level and using 9 kcal in 1 g of fats conversion; [3]50–69% of the energy level and using 4 kcal in 1 g of carbohydrates conversion; [4]not to exceed 10% of the energy level and using 4 kcal in 1 g of sugar conversion; a – deficit; b – surplus

Appendix IV. Average daily nutrient intake of children per season (3–5 yr old)

	Male					Female				
	PDRI	NEM	Summer	diff	*p*-value	PDRI	NEM	Summer	diff	*p*-value
Proximates										
Energy (kcal)	1350	1478.84[b]	1350.70[b]	128.15	0.13	1260.00	1295.46[b]	1221.15[a]	74.31	0.28
Protein (g)[1]	20.25–202.5	77.10	63.84	13.26	0.03	18.9–47.25	60.22[b]	58.38[b]	1.85	0.39
Total fat (g)[2]	22.5–45	33.57	27.38	6.19	0.01	21–42	24.02	22.88	1.15	0.31
Carbohydrate, by difference (g)[3]	185.6–267	211.23	206.17	5.06	0.39	173.25–248.85	203.88	190.16	13.71	0.27
Fiber, total dietary (g)	8–10	4.29[a]	4.15[a]	0.15	0.42	8–10	4.40[a]	4.33[a]	0.08	0.48
Sugars, total (g)[4]	< 33.75	29.21	15.39	13.83	0.00	< 31.5	16.89	22.17	–5.27	0.25
Minerals (mg)										
Calcium, Ca	550–2500	862.69	447.07[a]	415.62	0.00	550–2500	478.404[a]	568.03	–89.63	0.29
Iron, Fe	9–40	7.85[a]	7.35[a]	0.50	0.26	9–40	6.416[a]	6.56[a]	–0.14	0.44
Magnesium, Mg	70–110	185.53[b]	167.97[b]	17.57	0.21	70–110	179.09[b]	147.46[b]	31.63	0.14
Phosphorus, P	500–3000	1018.28	930.04	88.24	0.18	500–3000	867.08	777.22	89.87	0.16
Potassium, K	1400	1188.20[a]	1010.78[a]	177.41	0.12	1400	1088.44[a]	1119.20[a]	–30.75	0.44
Sodium, Na	300	2685.95[b]	2370.19[b]	315.76	0.27	300	2016.28[b]	2186.93[b]	–170.64	0.33
Zinc, Zn	5–12	4.68[a]	4.74[a]	-0.06	0.45	4.8–12	4.22[a]	4.24[a]	–0.01	0.49
Vitamins										
Vitamin C, total ascorbic acid (mg)	45–650	29.78[a]	21.43[a]	8.34	0.22	45–650	19.84[a]	48.24	–28.84	0.10
Thiamin (mg)	0.5	0.56[b]	0.53[b]	0.02	0.38	0.50	0.51[b]	0.49[a]	0.02	0.39
Riboflavin (mg)	0.6	0.95[b]	0.72[b]	0.23	0.02	0.50	0.73[b]	0.66[b]	0.08	0.21
Niacin (mg)	7–15	13.62	13.17	0.45	0.38	7–15	11.79	10.92	0.88	0.27
Vitamin B-6 (mg)	0.6–40	0.82	0.74	0.08	0.18	0.7–40	0.85	0.70	0.16	0.14

	Male					Female				
	PDRI	NEM	Summer	diff	*p*-value	PDRI	NEM	Summer	diff	*p*-value
Folate, DFE (µg)	200–400	99.15[a]	104.82[a]	–5.67	0.65	200–400	88.89[a]	105.87[a]	–16.98	0.15
Vitamin B-12 (µg)	1.1	4.70[b]	5.18[b]	–0.48	0.70	1.20	3.75[b]	4.92[b]	–1.17	0.10
Vitamin A, RAE (µg)	400–900	510.72	207.40[a]	303.33	0.00	400–900	479.59	331.14[a]	148.45	0.23
Vitamin E (alpha-tocopherol) (mg)	5–300	2.82[a]	2.95[a]	–0.13	0.38	5–300	3.07[a]	3.08[a]	0.00	0.50
Vitamin D, (D2 + D3) (µg)	5–50	3.79[a]	3.36[a]	0.43	0.26	5–50	2.61[a]	3.26[a]	–0.65	0.15
Vitamin K, phylloquinone (µg)	18	9.87[a]	8.19[a]	1.67	0.13	17	10.87[a]	12.28[a]	–1.40	0.39

Source: recommended energy intakes per day, acceptable macronutrient distribution ranges, recommended nutrient intakes per day (macronutrients), recommended nutrient intakes per day (vitamins), recommended nutrient intakes per day (minerals), tolerable upper intake levels or upper limits per day, and additional recommendations (PDRI 2015)
Notes: [1]6–15% of the energy level and using 4 kcal in 1 g of protein conversion; [2]25–35% of the energy level and using 9 kcal in 1 g of fats conversion; [3]50–69% of the energy level and using 4 kcal in 1 g of carbohydrates conversion; [4]not to exceed 10% of the energy level and using 4 kcal in 1 g of sugar conversion; a – deficit; b – surplus

Appendix V. Average daily nutrient intake of children per season (6–9 yr old)

	Male					Female				
	PDRI	NEM	Summer	diff	*p*-value	PDRI	NEM	Summer	diff	*p*-value
Proximates										
Energy (kcal)	1600	1558.52[a]	1431.38[a]	127.14	0.06	1470.00	1441.89[a]	1362.24[a]	79.65	0.07
Protein (g)[1]	24–60	70.69[b]	61.11[b]	9.58	0.04	22–56	67.96[b]	62.39[b]	5.57	0.17
Total fat (g)[2]	26–54	34.58	28.04	6.54	0.00	24–49	30.74	28.17	2.57	0.09
Carbohydrate, by difference (g)[4]	220–316	236.02	226.69	9.33	0.25	202–291	212.25	207.51	9.74	0.13
Fiber, total dietary (g)	11–14	4.08[a]	3.59[a]	0.49	0.25	11–14	3.63[a]	4.11[a]	–0.49	0.19
Sugars, total (g)[4]	< 40	31.10	28.58	2.52	0.27	< 36	26.08	21.89	4.19	0.18
Minerals (mg)										
Calcium, Ca	700–2500	827.40	625.96[a]	202.44	0.03	700–2500	616.00[a]	516.42[a]	99.58	0.13
Iron, Fe	10–40	7.55[a]	7.18[a]	0.36	0.29	9–40	6.91[a]	7.65[a]	–0.74	0.10
Magnesium, Mg	90–350	166.95	182.96	–16.01	0.20	90–350	179.53	182.04	–2.51	0.44
Phosphorus, P	500–4000	953.02	870.85	82.17	0.13	500–4000	934.25	848.08	86.17	0.15
Potassium, K	1600	1117.76[a]	1174.32[a]	–56.56	0.32	1600	1099.38[a]	1076.04[a]	23.33	0.44
Sodium, Na	400	1753.74[b]	2019.79[b]	–266.05	0.25	400	1936.54[b]	2583.73[b]	–647.19	0.09
Zinc, Zn	5–23	4.81[a]	4.70[a]	0.12	0.37	5–23	4.92[a]	4.58[a]	0.34	0.20
Vitamins										
Vitamin C, total ascorbic acid (mg)	45–1200	43.57[a]	57.34	–13.77	0.13	45–1200	28.58[a]	38.14[a]	–9.56	0.24
Thiamin (mg)	0.7	0.55[a]	0.48[a]	0.07	0.06	0.7	0.54[a]	0.54[a]	0.00	0.50
Riboflavin (mg)	0.7	0.91[b]	0.74[b]	0.17	0.01	0.7	0.87[b]	0.67[a]	0.20	0.01
Niacin (mg)	9–20	13.32	11.80	1.52	0.03	9–20	13.27	12.23	1.04	0.17
Vitamin B-6 (mg)	0.7–60	10.74	0.72	10.02	0.13	0.8–60	0.78[a]	0.74[a]	0.04	0.32
Folate, DFE (µg)	300–600	86.14[a]	89.94[a]	–3.80	0.31	300–600	85.04[a]	99.46[a]	–14.42	0.07

	Male					Female				
	PDRI	NEM	Summer	diff	*p*-value	PDRI	NEM	Summer	diff	*p*-value
Vitamin B-12 (µg)	1.3	5.09[b]	4.40[b]	0.69	0.35	1.50	3.99[b]	4.44[b]	–0.46	0.29
Vitamin A, RAE (µg)	400–1700	469.64	251.47[a]	218.17	0.00	400–1700	331.22[a]	214.58[a]	116.65	0.02
Vitamin E (alpha-tocopherol) (mg)	6–600	2.68[a]	2.74[a]	–0.06	0.42	6–600	2.61[a]	2.65[a]	–0.05	0.45
Vitamin D, (D2 + D3) (µg)	5–50	3.16[a]	3.14[a]	0.01	0.49	5–50	3.60[a]	3.14[a]	0.46	0.25
Vitamin K, phylloquinone (µg)	23	8.13[a]	6.96[a]	1.17	0.19	23	7.64[a]	8.04[a]	–0.40	0.43

Source: recommended energy intakes per day, acceptable macronutrient distribution ranges, recommended nutrient intakes per day (macronutrients), recommended nutrient intakes per day (vitamins), recommended nutrient intakes per day (minerals), tolerable upper intake levels or upper limits per day, and additional recommendations (PDRI 2015)
Notes: [1]6–15% of the energy level and using 4 kcal in 1 g of protein conversion; [2]25–35% of the energy level and using 9 kcal in 1 g of fats conversion; [3]50–69% of the energy level and using 4 kcal in 1 g of carbohydrates conversion; [4]not to exceed 10% of the energy level and using 4 kcal in 1 g of sugar conversion; a – deficit; b – surplus

Appendix VI. Average daily nutrient intake of children per season (10–12 yr old)

	Male					Female				
	PDRI	NEM	Summer	diff	*p*-value	PDRI	NEM	Summer	diff	*p*-value
Proximates										
Energy (kcal)	2060	1482.02[a]	1411.14[a]	70.87	0.19	1980	1545.31[a]	1436.86[a]	108.45	0.20
Protein (g)[1]	30–78	63.28	60.28	3.01	0.27	29–75	72.46	64.41	8.06	0.19
Total fat (g)[2]	34–69	30.30[a]	29.75[a]	0.55	0.41	33–66	32.19[a]	28.32[a]	3.87	0.11
Carbohydrate, by difference (g)[3]	283–407	233.62[a]	218.43[a]	15.19	0.13	272–392	236.96[a]	222.25[a]	14.71	0.25
Fiber, total dietary (g)	15–17	4.10[a]	3.65[a]	0.44	0.20	15–17	4.35[a]	4.16[a]	0.19	0.40
Sugars, total (g)[4]	< 51.5	27.52	27.28	0.24	0.49	< 49.5	25.17	19.12	6.04	0.20
Minerals (mg)										
Calcium, Ca	1000–2500	550.19[a]	589.91[a]	–39.72	0.36	1000–2500	545.62[a]	452.94[a]	92.69	0.21
Iron, Fe	12–40	7.04[a]	6.81[a]	0.23	0.35	20–40	8.02[a]	7.78[a]	0.25	0.39
Magnesium, Mg	150–350	189.25	171.53	17.71	0.21	160–350	213.19	201.85	11.34	0.36
Phosphorus, P	1250–4000	951.81[a]	823.86[a]	127.95	0.04	1250–4000	1046.78[a]	925.80[a]	120.99	0.18
Potassium, K	2000	1220.35[a]	1122.30[a]	98.05	0.27	2000	1281.28[a]	1126.31[a]	154.97	0.26
Sodium, Na	500	1955.38[b]	2040.49[b]	–85.11	0.36	500	2739.39[b]	2891.79[b]	–152.40	0.42
Zinc, Zn	6.6–23	5.03[a]	4.37[a]	0.66	0.03	6.1–23	5.36[a]	4.85[a]	0.51	0.15
Vitamins										
Vitamin C, total ascorbic acid (mg)	45–1200	34.27[a]	58.54	–24.27	0.09	45–1200	32.72[a]	29.44[a]	3.28	0.42
Thiamin (mg)	0.9	0.60[a]	0.45[a]	0.15	0.02	0.9	0.70[a]	0.53[a]	0.17	0.04
Riboflavin (mg)	1	0.85[a]	0.63[a]	0.23	0.01	0.9	0.84[a]	0.66[a]	0.18	0.01
Niacin (mg)	11–20	12.93	11.47	1.46	0.08	12–20	15.42	12.88	2.54	0.10
Vitamin B-6 (mg)	1–60	10.65	0.67[a]	9.98	0.16	1.1–60	20.15	0.81[a]	19.34	0.09
Folate, DFE (µg)	300–600	85.06[a]	78.70[a]	6.36	0.23	300–600	111.47[a]	102.67[a]	8.80	0.26
Vitamin B-12 (µg)	1.9	4.32[b]	4.04[b]	0.28	0.34	2.1	4.19[b]	5.14[b]	–0.95	0.23
Vitamin A, RAE (µg)	500–1700	376.77[a]	197.65[a]	179.12	0.04	500–1700	380.98[a]	233.38[a]	136.61	0.10
Vitamin E (alpha-tocopherol) (mg)	7–600	3.22[a]	2.94[a]	0.28	0.21	9–600	3.19[a]	3.35[a]	–0.16	0.36
Vitamin D, (D2 + D3) (µg)	5–50	2.84[a]	2.21[a]	0.64	0.13	5–50	2.92[a]	2.54[a]	0.39	0.28

	Male					Female				
	PDRI	NEM	Summer	diff	*p*-value	PDRI	NEM	Summer	diff	*p*-value
Vitamin K, phylloquinone (µg)	33	9.16[a]	6.40[a]	2.77	0.02	36	11.79[a]	7.21[a]	4.57	0.01

Source: recommended energy intakes per day, acceptable macronutrient distribution ranges, recommended nutrient intakes per day (macronutrients), recommended nutrient intakes per day (vitamins), recommended nutrient intakes per day (minerals), tolerable upper intake levels or upper limits per day, and additional recommendations (PDRI 2015)
Notes: [1]6–15% of the energy level and using 4 kcal in 1 g of protein conversion; [2]25–35% of the energy level and using 9 kcal in 1 g of fats conversion; [3]50–69% of the energy level and using 4 kcal in 1 g of carbohydrates conversion; [4]not to exceed 10% of the energy level and using 4 kcal in 1 g of sugar conversion; a – deficit; b – surpluss

Appendix VII. Average daily nutrient intake of children per season (13–15 yr old).

	Male					Female				
	PDRI	NEM	Summer	diff	*p*-value	PDRI	NEM	Summer	diff	*p*-value
Proximates										
Energy (kcal)	2700	1387.73[a]	1500.73[a]	–113.00	0.18	2170	1570.35[a]	1467.91[a]	102.43	0.29
Protein (g)[1]	40–102	67.63	62.75	4.88	0.34	32–82	84.17[b]	67.93	16.25	0.06
Total fat (g)[2]	45–90	29.34[a]	26.54[a]	2.81	0.26	36–73	30.73[a]	33.31[a]	–2.58	0.32
Carbohydrate, by difference (g)[3]	371–534	216.41[a]	242.03[a]	–25.61	0.15	298–429	230.86[a]	216.56[a]	14.30	0.29
Fiber, total dietary (g)	18–20	2.16[a]	4.07[a]	–1.92	0.01	18–20	3.97[a]	4.17[a]	–0.20	0.40
Sugars, total (g)[4]	< 67.5	8.23	18.26	–10.02	0.01	< 54.25	20.59	19.85	0.75	0.44
Minerals (mg)										
Calcium, Ca	1000–2500	314.20[a]	383.02[a]	–68.83	0.16	1000–2500	778.39[a]	537.24[a]	241.16	0.12
Iron, Fe	19–45	6.89[a]	7.57[a]	–0.68	0.24	28–45	7.70[a]	8.72[a]	–1.03	0.24
Magnesium, Mg	220–350	185.05[a]	217.57[a]	–32.52	0.17	210–350	181.94[a]	189.47[a]	–7.53	0.39
Phosphorus, P	1250–4000	974.49[a]	939.44[a]	35.05	0.40	1250–4000	1056.56[a]	994.44[a]	62.12	0.32
Potassium, K	2000	954.11[a]	1041.79[a]	–87.68	0.31	2000	1116.45[a]	1087.92[a]	28.52	0.42
Sodium, Na	500	1934.80[b]	2398.35[b]	–463.56	0.22	500	3135.60[b]	2306.38[b]	829.22	0.05
Zinc, Zn	9.2–34	5.36[a]	4.90[a]	0.47	0.25	7.4–34	5.01[a]	4.76[a]	0.24	0.36
Vitamins										
Vitamin C, total ascorbic acid (mg)	60–1800	7.26[a]	14.35[a]	–7.09	0.01	55–1800	20.22[a]	36.43[a]	–16.22	0.09
Thiamin (mg)	1.2	0.56[a]	0.47[a]	0.09	0.20	1	0.50[a]	0.52[a]	–0.02	0.40
Riboflavin (mg)	1.3	0.67[a]	0.64[a]	0.03	0.39	1	0.70[a]	0.66[a]	0.05	0.28
Niacin (mg)	15–30	14.27[a]	11.90[a]	2.37	0.10	13–30	15.16	14.57	0.59	0.40
Vitamin B-6 (mg)	1.3–80	0.88[a]	0.81[a]	0.08	0.35	1.2–80	0.74[a]	0.71[a]	6.76	0.16
Folate, DFE (µg)	400–800	74.29[a]	81.33[a]	–7.04	0.29	400–800	85.49[a]	100.11[a]	–14.62	0.15
Vitamin B-12 (µg)	2.3	4.96[b]	5.38[b]	–0.42	0.40	2.2	5.37[b]	5.78[b]	–0.41	0.39
Vitamin A, RAE (µg)	700–2800	136.12[a]	387.98[a]	–251.86	0.02	500–2800	208.32[a]	187.24[a]	21.08	0.20
Vitamin E (alpha-tocopherol) (mg)	10–800	2.66[a]	3.56[a]	–0.91	0.01	9–800	3.55[a]	3.16[a]	0.39	0.25
Vitamin D, (D2 + D3) (µg)	5–50	2.27[a]	2.60[a]	–0.33	0.31	5–50	2.60[a]	2.65[a]	–0.05	0.48
Vitamin K, phylloquinone (µg)	49	6.18[a]	6.60[a]	–0.42	0.42	46	13.31[a]	13.31[a]	0.00	0.00

Source: recommended energy intakes per day, acceptable macronutrient distribution ranges, recommended nutrient intakes per day (macronutrients), recommended nutrient intakes per day (vitamins), recommended nutrient intakes per day (minerals), tolerable upper intake levels or upper limits per day, and additional recommendations (PDRI 2015)
Notes: [1]6–15% of the energy level and using 4 kcal in 1 g of protein conversion; [2]25–35% of the energy level and using 9 kcal in 1 g of fats conversion; [3]50–69% of the energy level and using 4 kcal in 1 g of carbohydrates conversion; [4]not to exceed 10% of the energy level and using 4 kcal in 1 g of sugar conversion; a – deficit; b – surpluss

Appendix VIII. Average daily nutrient intake of children per season (16–18 yr old).

	Male					Female				
	PDRI	NEM	Summer	diff	*p*-value	PDRI	NEM	Summer	diff	*p*-value
Proximates										
Energy (kcal)	3010	1742.97[a]	1440.00[a]	302.97	0.01	2280	1811.40[a]	1508.67[a]	302.74	0.00
Protein (g)	45–113	77.06	63.44	13.62	0.02	34–86	88.64[b]	68.86	19.79	0.00
Total fat (g)	50–101	33.89[a]	27.18[a]	6.71	0.00	38–76	39.13	28.86[a]	10.27	0.01
Carbohydrate, by difference (g)	413–595	275.93[a]	225.77[a]	50.17	0.02	313–451	266.99[a]	235.54[a]	31.45	0.04
Fiber, total dietary (g)	20–23	4.93[a]	3.89[a]	1.05	0.12	20–23	4.23[a]	5.05[a]	–0.82	0.11
Sugars, total (g)	< 75.25	23.06	16.31	6.74	0.12	< 57	29.28	24.90	4.38	0.14
Minerals (mg)										
Calcium, Ca	1000–2500	557.78[a]	373.34[a]	182.44	0.06	1000–2500	832.54[a]	515.76[a]	316.78	0.02
Iron, Fe	14–45	9.82[a]	7.47[a]	1.72	0.03	18–45	8.57[a]	8.35[a]	0.23	0.36
Magnesium, Mg	260–350	233.40[a]	177.22[a]	58.19	0.02	230–350	206.63[a]	204.85[a]	1.78	0.46
Phosphorus, P	1250–4000	1099.04[a]	886.10[a]	212.94	0.01	1250–4000	1148.28[a]	999.97[a]	148.32	0.04
Potassium, K	2000	1346.26[a]	952.37[a]	393.89	0.01	2000	1296.39[a]	1165.39[a]	131.00	0.18
Sodium, Na	500	2802.91[b]	2309.93[b]	492.98	0.14	500	2983.30[b]	2557.86[b]	425.43	0.22
Zinc, Zn	9–34	7.64[a]	4.69[a]	2.95	0.06	7.2–34	5.76[a]	4.79[a]	0.97	0.01
Vitamins										
Vitamin C, total ascorbic acid (mg)	70–1800	34.70[a]	26.98[a]	7.73	0.30	60–1800	35.04[a]	29.33[a]	5.71	0.28
Thiamin (mg)	1.4	0.70[a]	0.50[a]	0.20	0.01	1.1	0.62[a]	0.61[a]	0.02	0.39
Riboflavin (mg)	1.5	0.83[a]	0.58[a]	0.25	0.00	1.1	0.82[a]	0.73[a]	0.09	0.10
Niacin (mg)	18–30	15.43[a]	13.67[a]	1.76	0.12	18-30	17.49[a]	14.95[a]	2.54	0.04
Vitamin B-6 (mg)	1.5–80	1.12[a]	0.72[a]	0.40	0.00	1.5–80	0.94[a]	0.82[a]	0.16	0.06
Folate, DFE (µg)	400–800	116.38[a]	95.23[a]	21.15	0.11	400–800	108.65[a]	115.61[a]	–6.96	0.28
Vitamin B-12 (µg)	2.7	6.57[b]	4.04[b]	2.54	0.06	2.4	4.71[b]	5.14[b]	–0.43	0.36
Vitamin A, RAE (µg)	800–2800	224.16[a]	139.20[a]	84.96	0.06	600–2800	250.08[a]	222.48[a]	27.61	0.32
Vitamin E (alpha-tocopherol) (mg)	11–800	4.04[a]	3.44[a]	0.60	0.21	10–800	3.42[a]	3.23[a]	0.19	0.34
Vitamin D, (D2 + D3) (µg)	5–50	2.47[a]	1.86[a]	0.61	0.16	5	2.53[a]	2.93[a]	–0.40	0.29
Vitamin K, phylloquinone (µg)	59	13.67[a]	9.90[a]	3.77	0.07	52	12.51[a]	8.91[a]	3.60	0.06

Source: recommended energy intakes per day, acceptable macronutrient distribution ranges, recommended nutrient intakes per day (macronutrients), recommended nutrient intakes per day (vitamins), recommended nutrient intakes per day (minerals), tolerable upper intake levels or upper limits per day, and additional recommendations (PDRI 2015)

Notes: [1]6–15% of the energy level and using 4 kcal in 1 g of protein conversion; [2]25–35% of the energy level and using 9 kcal in 1 g of fats conversion; [3]50–69% of the energy level and using 4 kcal in 1 g of carbohydrates conversion; [4]not to exceed 10% of the energy level and using 4 kcal in 1 g of sugar conversion; a – deficit; b – surplus