Determination of protein content in cooked foods consumed by toddlers aged 1-2 years in Sri Lanka

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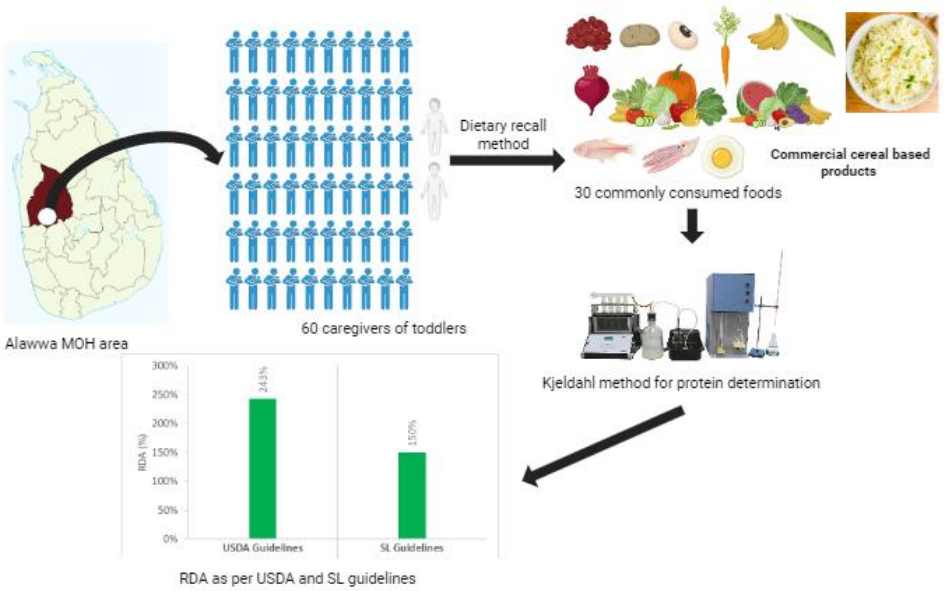

Abstract

In early life, protein deficiency as well as heavy protein intake cause adverse conditions. Therefore, the present study aimed to assess the protein adequacy of diets in 1-2-year-old toddlers in the Alawwa Medical Officer of Health (MOH) area, Kurunegala, Sri Lanka. Data on food consumption was obtained by 24-hour dietary recall method from selected caregivers (n=60) and commonly consumed foods (n=30) were cooked using household preparation protocols practiced in the area. They were homogenized and analyzed for protein. The majority of toddlers among the selected population consumed rice-based meals (73%) as the main meal (cooked rice with vegetable accompaniments), while 27% preferred mixed diets (a mixture of vegetables, pulses, leafy vegetables and fish along with rice). A serving of commercial cereal products provided the highest estimated daily intake (EDI) of protein (10.70 ± 0.40 g). The average EDI of protein of all categories of foods per portion (rice, vegetables, pulses, green leaves, fish, eggs, rice mixtures and cereal products) was 31.55 ± 0.88 g, contributing to the recommended dietary allowance (RDA) of 242.64% and 150.17% for 1-2 year toddlers as defined by the Department of Agriculture, United States (USDA) and Sri Lankan RDA defined by Medical Research Institute (MRI), respectively. In conclusion, the cooked foods prepared according to local recipes fulfilled the dietary requirements of protein for toddlers aged 1-2 years in the Alawwa MOH area following USDA and Sri Lankan nutrition guidelines.

Keywords: *Estimated Daily Intake, Protein, Recommended Dietary Allowance, Toddlers*

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1. Introduction

The first two years of a child's life is an important phase of the child's life cycle, because during this period the child grows, develops rapidly, and affects future health (Anater et al., 2018). As per the definition of childhood, an infant is a child from birth to one year old, while a child between the ages of one and three years old can be considered a toddler (Allen and Mayers, 2006). Therefore, infancy and toddlerhood represent significant periods in which rapid and important changes happen in a child's brain, as well as social-emotional functions. During this period, toddlers' nutritional habits become independent in terms of food consumption (Anater et al., 2018; Allen and Mayers, 2006). Thus, complementary feeding is important for the development of toddlers when breast milk is insufficient to satisfy the altering energy and nutrition demands of toddlerhood compared to the early stage (Anater et al., 2018; Rosales et al., 2009).

A sufficient provision of healthy protein and important amino acids from complementary foods is essential for normal growth and neurodevelopment as well as for the long-term health and wellness of children (Michaelsen and Greer, 2014). The deficiency of healthy protein and high protein intake in early childhood can contribute to some health problems such as childhood obesity (Peiris and Wijesinghe, 2010). Furthermore, Peiris and Wijesinghe, (2010) revealed that 2.4% of children under the age of five were obese in Sri Lanka. As primary caregivers of toddlers in Sri Lanka lack adequate knowledge, this figure is likely to increase (Seram and Punchihewa, 2017; Wikramanayake, 1997). Therefore, it is necessary to identify the causes of overweight and the higher protein intake may be a major possible cause of childhood overweight.

Not only childhood obesity, but low-income countries are also prone to stunting of child growth, possibly because of inadequate protein intake. Public health should be concerned about the potential risks of stunting including the increased risk of infant mortality, infectious disease morbidity, improved neurocognitive development, and metabolic diseases in late life (Arsenault and Brown, 2017). According to the study conducted by Kandeepan, Balakumar, and Arasaratnam, (2016), stunting prevalence among children under five years old was 26.4% in the northern part of Sri Lanka.

Furthermore, although previous studies have identified the iron content in cooked foods consumed by school-age children in Sri Lanka, there are no similar studies conducted to determine protein content in diets given to toddlers under the age of 1-2 years in Sri Lanka. Thus, it is a timely important study to analyze the protein content in cooked foods that are prepared for toddlers according to Sri Lankan cooking protocols. Considering the importance of this subject, this study aimed to assess the protein adequacy of the diets of toddlers aged between 1-2 years in Sri Lanka.

2. Materials and methods

2.1 Sample selection and dietary survey

A descriptive cross-sectional study was carried out using randomly selected 60 primary caregivers (25% caregivers out of 231) of toddlers aged between 1-2 years in the Medical Officer of Health (MOH) area of Alawwa, Kurunegala, Sri Lanka. Ethical approval for the study was granted by the Ethics Review Committee of the Faculty of Applied Sciences, Rajarata University of Sri Lanka, Anuradhapura, Sri Lanka. A 24-hour dietary recall method was used to obtain data on toddlers' food consumption by their caregivers. During the two months from December 2019 to February 2020, a total of five consecutive days per person were recalled capturing weekdays and weekends. All necessary details about main meals (type of food and beverages, average portion sizes, preparation method with approximate amount of ingredients) consumed on the previous day (midnight to midnight) were recorded during the field visits. Laboratory analyses were performed on commonly consumed foods with the average number of ingredients.

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2.2 Sample preparation

All the raw materials and ingredients were obtained from the retail outlets in Alawwa area and cooked in the most common preparation protocol practiced in that area. The weighed sample was dried in an air-drying oven (UF 55, Memmert, Schwabach, Germany) at 65 ^{o}C for 12 h. Then the dried food sample was ground using a grinder to get the fine homogeneous powder and stored in properly labelled glass bottles. All the chemicals used were in Analytical grade.

Table 1 shows the popular food consumed in main meals and the method of preparation of food items. Table 2 shows that the popular rice mixers are prepared using different ingredients consumed as main meals and the method of preparation. Table 3 shows the popular cereal product and the method of preparation.

Table 1: Popular foods consumed in main meals and the method of preparation of food items.

Food Category	Food Type	Preparation Method
Rice	Parboiled large rice (*Naadu*)	Cook with water
Vegetable	Pumpkin curry	Cook 100 g of small cut pieces using coconut milk (50 g of coconut kernels and 1 cup of water), ¼ teaspoon (tsp) of curry powder (1 g), ½ tsp of chili powder (5 g), ½ tsp of turmeric powder (5 g), ¼ tsp of black pepper powder (1 g), 5g of garlic, ¼ tsp of a piece of cinnamon, 5 g of red onion, 3 leaves of curry leaves
Vegetable	Potato curry	Cook 120 g of small cut pieces using coconut milk (60 g of coconut kernels and ½ cup of water), ¼ tsp of curry powder (1 g), ¼ tsp of chili powder (1 g), ¼ tsp of turmeric powder (1 g), 5 g of red onion, 3 g of green chili, 3 leaves of curry leaves
Vegetable	Winged bean curry	Cook 120 g of small cut pieces using coconut milk (50 g of coconut kernels and ½ cup of water), ¼ tsp of curry powder (1 g), ¼ tsp of chili powder (1 g), ¼ tsp of turmeric powder (1 g), 5 g of red onions, 3 leaves of curry leaves
Vegetable	Bean curry	Cook 120 g of small cut pieces using coconut milk (60 g of coconut kernels and ½ cup of water), ¼ tsp of curry powder (1 g), ½ tsp of chili powder (5 g), ¼ tsp of turmeric powder (1 g), 3 g of green chili, 3 g of red onion, 3 leaves of curry leaves
Vegetable	Carrot curry	Cook 100 g of small cut pieces using coconut milk (60 g of coconut kernel and ½ cup of water), ¼ tsp of chili powder (1 g), ¼ tsp of curry powder (1 g), ¼ tsp of turmeric powder (1 g), 5 g of red onions, 3 g of green chili, 3 leaves of curry leaves
Vegetable	Radish curry	Cook 120 g of small cut pieces using coconut milk (50 g of coconut kernels and ½ cup of water), ¼ tsp of curry powder (1 g), ¼ tsp of chili powder (1 g), ¼ tsp of turmeric powder (1 g), 3 g of green chili, 3 g of red onions, 3 leaves of curry

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		leaves
Vegetable	Ash plantain curry	Cook 120 g of small cut pieces using coconut milk (60g of coconut kernel and ½ cup of water), ¼ tsp of curry powder (1 g), ¼ tsp of chili powder (1 g), ¼ tsp of turmeric powder (1 g), fenugreek seeds, 3 g of red onions, 3 leaves of curry leaves
Vegetable	Beetroot curry	Cook 60 g of small cut pieces using coconut milk (30g of coconut kernel with ¼ cup of water), ¼ tsp of chili powder (1 g), ¼ tsp of curry powder (1 g), ¼ tsp of turmeric powder (1 g), 3 g of red onions, 3 g of green chilli, 3 leaves of curry leaves
Leafy vegetable	*Gotukola* (*Centella asiatica*)	Mix 60 g of cut leaves with 15g of coconut scrapings along with 3 g of small pieces of green chilies, 5 g of red onions, ½ tsp of lemon juice
Leafy vegetable	Moringa leaves (*Moringa oleifera*)	Cook 60 g of cut leaves with 15g of coconut scrapings along with ½ tsp of turmeric powder (1g), 3 g of small pieces of green chilies, 5 g of red onions
Leafy vegetable	*Mukunuwenna* (*Alternanthera sessilis*)	Cook 60 g of cut leaves with 15 g of coconut scrapings along with 1/4 tsp of turmeric powder (1g), 3 g of small pieces of green chilies, 5 g of red onions
Pulse	Lentil curry	Cook 80 g using coconut milk (50 g of coconut kernel with ½ cup of water), ½ tsp of chili powder (5 g), ¼ tsp of curry powder (1 g), ½ tsp of turmeric powder (5 g), 5 g of red onions, 3 g of green chili, 5 leaves of curry leaves
Pulse	Chickpeas boiled	Cook 150 g using water
Pulse	White cowpeas boiled	Cook 150 g using water
Fish	Sail fish (*Thalapath*) curry	Cook 100 g using coconut milk (80 g of coconut scrapings with 1 cup of water), ¼ tsp of chili powder (1 g), ¼ tsp of curry powder (1 g), ¼ tsp of turmeric powder (1 g), 5 leaves of curry leaves
Fish	Yellowfin tuna (*Kelawallo*) curry	Cook 100 g using coconut milk (80g of coconut scrapings with 1 cup of water), ½ tsp of chili powder (5 g), ½ tsp of curry powder (5 g), ½ tsp of turmeric powder (5 g), 5 leaves of curry leaves
Fish	Sardinella (*Salaya*) fried marinated	Mix 100 g of fish with ¼ tsp of turmeric powder (1 g), ¼ tsp of chilli powder (1 g) and then deep-fried in coconut oil
Dried fish	Dried sprats (*Halmasso*) fried	Fry 50 g of sprats with coconut oil
Egg	Farm egg boiled	Boil 1 egg in water

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Egg	free-range egg boiled	Boil 1 egg in water
Egg	Quail egg boiled	Boil 1 egg in water

Table 2: Popular rice mixers prepared using different ingredients consumed as main meals and the method of preparation.

Mixer	Method of Preparation
A	Cook 50 g of red raw rice, 50 g of carrot, 30 g of lentils, 20 g of white cowpeas, 30 g of sailfish piece, 20 g of bean along with water
B	Cook 50 g of red raw rice, 30 g of sailfish piece, 10g of sessile joy weed, 20 g of beans, 50 g of carrot along with water
C	Cook 50 g of red raw rice, 50 g of carrot, 20 g of beans, 30 g of pumpkin, 10 g of spinach along with water

Table 3: Popular cereal product and the method of preparation.

Product Type	Method of Preparation
Brand A	Mix 50 g of brand A powder, 1 g of sugar, 5 g of coconut kernels with a small amount of water
Brand B	Mix 75 g of brand B powder, 1 g of sugar, 5 g of coconut kernels with a small amount of water
Brand C	Mix 50 g of brand C powder, 1 g of sugar, 5 g of coconut kernels with a small amount of water

2.3 Determination of crude protein in cooked food samples

Crude protein in cooked foods was determined by the Kjeldahl method (AOAC 995.04) using the Kjeldahl apparatus (DK 6, F30100182 Series and UDK 129 - F30200120 Series Velp Scientifica, Usmate Velate, Italy) (AOAC, 2012).

2.4 Statistical analysis

Data was analyzed using SPSS (Version 26.0, IBM, New York, United States). Categorical data were analyzed using descriptive statistics. The average protein content and estimated daily intake (EDI) of protein in each food item were recorded as the mean ± standard deviation (SD). The comparison of the average protein content of each food was performed using one-way ANOVA. Mean separation was done using Turkey's method. All the statistical analysis was designed at 95% confidence interval.

2.5 Calculation of estimated daily intake per serving (EDI)

The daily intake of a nutrient is determined by the concentration of that particular nutrient in the food sample and the amount of food consumed per day. The EDI was calculated using the following equation.

$$\mathrm{EDI} = \mathrm{C} \times \mathrm{M} \qquad [1]$$

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where C is the mean concentration of nutrient (protein) in each food sample and M is referred to as the assumed consumption rate (kg) (Perera et al., 2019; Pinto et al., 2016; Pedron et al., 2016).

2.6 Calculation of contribution of nutrients for recommended dietary allowance (RDA)

The estimated contribution of various cooked foods to the daily intake of each nutrient was therefore calculated using the following equation (Perera et al., 2019; Pinto et al., 2016; Pedron et al., 2016).

$$\text{Contribution to RDA per serving} = \frac{\text{EDI per serving}}{\text{RDA}} \times 100\% \qquad [2]$$

3. Results and discussion

It was found that there are three main meals comprised of different accompaniments for toddlers in 1-2 years as their daily diet because toddlers tend to find different tastes during these periods. The composition of their main meals was most similar to the diets of adults because toddlers at this age could eat the usual meals that were prepared for adults. Thus, the composition of breakfast, lunch, and dinner was similar with rice and curry being the most popular choice because rice is the staple food in Sri Lanka. However, 27% of toddlers still consumed mixed diets prepared as a mixture using different types of vegetables, green leaves, pulses, and non-vegetarian food items, while fruits, yogurt, cheese, ice cream, and curd were consumed as desserts. All the children consumed breast milk and only 33% of children consumed milk prepared with milk powder along with breast milk.

Even though red raw rice (*Rathu kakulu*) is popular as the most nutritious rice variety available in Sri Lanka, it was not commonly consumed among the selected study population. Instead, parboiled long grains (*Naadu*) were the most popular varieties among this population. However, mixed diets were commonly prepared with red raw rice.

The vegetables consumed were pumpkin (*Cucurbita moschata*), potato (*Solanum tuberosum*), winged bean (*Psophocarpus tetragonolobus*), common bean (*Phaseolus vulgaris*), carrot (*Daucus carota*), radish (*Raphanus sativus*), ash plantain (*Plantago lanceolata*) and beetroot (*Beta vulgaris*), while *gotukola* (*Centella asiatica*), moringa leaves (*Moringa oleifera*), and *mukunuwenna* (*Alternanthera sessilis*) were the most commonly consumed green leafy vegetables. The most popular pulse varieties among the selected population were lentils (*Lens culinaris*), chickpeas (*Pisum sativum*), and white cowpeas (*Vigna unguiculata*) which were also selected for the analysis. A considerable consumption was recorded regarding non-vegetarian foods such as sail fish (*Istiophorus platypterus*), yellowfin tuna (*Thunnus albacares*), sardinella (*Sardinella gibbosa*), and dried sprats (*Stolephorus commersonii*) were the most commonly consumed fish species while, farm eggs, free-range eggs, and quail eggs were the consumed egg types by the study population. Commonly used food items for the preparation of mixed diets were carrots, lentils, white cowpeas, sailfish, bean, *mukunuwenna* (*Alternanthera sessilis*), pumpkin, and spinach along with red raw rice. Cereal products that are in the market were also included from time to time in between the main meals except for human milk. The average crude protein contents of prepared food types consumed by toddlers (1-2 years) in the MOH area, Alawwa, Kurunegala district are given in Table 4.

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Table 4: Average crude protein contents of prepared food types consumed by toddlers (1-2 years) in the Alawwa MOH area, Kurunegala district.

Food type	Protein content (g/kg)
Rice	
Parboiled large rice	27.97 ± 0.13
Vegetables	
Pumpkin curry	6.35 ± 0.37^{ef}
Potato curry	12.01 ± 2.14^{d}
Winged bean curry	115.45 ± 0.72^{a}
Bean curry	54.51 ± 1.15^{b}
Carrot curry	7.92 ± 0.87^{e}
Radish curry	4.95 ± 0.45^{f}
Ash plantain curry	7.21 ± 0.81^{ef}
Beetroot curry	23.56 ± 3.12^{c}
Leafy vegetables	
Gotukola (*Centella asiatica*)	20.55 ± 0.61^{c}
Moringa leaves (*Moringa oleifera*)	61.73 ± 0.87^{a}
Mukunuwenna (*Alternanthera sessilis*)	33.60 ± 2.72^{b}
Pulses	
Lentil curry	84.62 ± 3.35^{a}
Chickpeas boiled	81.17 ± 0.17^{a}
White cowpeas boiled	76.46 ± 0.79^{b}
Fish	
Sail fish (*Istiophorus platypterus*) curry	321.78 ± 0.78^{a}
Yellowfin tuna (*Thunnus albacares*) curry	291.44 ± 0.53^{b}
Sardinella (*Sardinella gibbosa*) curry	241.71 ± 1.01^{d}
Dried sprats (*Stolephorus commersonii*) fried	254.86 ± 1.71^{c}
Eggs	
Farm egg boiled	125.82 ± 0.23^{b}
Free-range egg boiled	128.45 ± 0.55^{a}
Quail egg boiled	128.88 ± 0.89^{a}
Rice mixtures	
Mixture A	40.71 ± 1.01^{a}
Mixture B	29.14 ± 1.42^{b}
Mixture C	8.85 ± 2.67^{c}
Cereal products	
Product A	233.68 ± 5.39^{a}
Product B	204.10 ± 1.59^{b}
Product C	201.73 ± 0.70^{b}

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3.1 Vegetables

Winged bean curry contained a significantly higher amount of protein ($p<0.05$) than other vegetable curries (Table 4). Raw winged beans contain less amount of protein than cooked winged beans according to the ASEAN Food Composition Database (2014), which is not compatible with the present study. Bean, beetroot and potato curry also had a significantly different protein content ($p<0.05$). Boiled beetroot contains 18 g/kg (McCance and Widdowson, 2014) of protein in general agreement with the current study, while the protein content in cooked potato prepared by the local recipe is less than the protein content in the boiled potato which had been reported by Vrdoljak et al. (2015), while values showed in McCance and Widdowson (2014) matched with the present study. No significant difference ($p>0.05$) was observed in the average protein content of other vegetable curries except the above-mentioned curries. Furthermore, the reported values for the uncooked raw carrot (7 g/kg of protein), and boiled carrot (6 g/kg) by McCance and Widdowson, (2014) are matched with the findings. Similarly, 6 g/kg of protein was contained in raw pumpkins which agreed with the values obtained in the present study. However, when comparing the values of the current study, with the protein contents in boiled vegetables shown in the USDA Food Composition Table (2020) and the protein contents in raw vegetables shown in the Sri Lankan Food Composition Table (2021), no significant difference ($p>0.05$) was observed except for bean. Therefore, the average protein contents of cooked vegetables according to local recipes were found to be generally agree with the amounts of boiled vegetables in previous studies however, less than the amounts in raw vegetables.

3.2 Green leafy vegetables

Cooked moringa leaves were found to be the best protein source (61.73 ± 0.87 g/kg) having a significantly higher average protein content ($p<0.05$) compared with the other two types of green leafy vegetables (Table 4). Cooked *mukunuwenna* (*Alternanthera sessilis*) and *gotukola* (*Centella asiatica*) also had significantly different average protein contents ($p<0.05$). The protein content of *mukunuwenna* (*Alternanthera sessilis*) in this study agrees with the values reported by Sheela et al. (2004) while not compatible with the values reported by Othman et al. (2016). The value reported by Sheela et al. (2004) of uncooked *Gotukola* was 26.9 g/kg, which is not compatible with the present study. Furthermore, the protein contents of all the leafy vegetables analyzed in the current study are not compatible with the protein contents in raw vegetables shown in the Sri Lankan Food Composition Table (2021).

3.3 Pulses

Lentil curry and boiled chickpea had no significant difference in protein contents ($p>0.05$) (Table 3). Wang and Daun, (2006) reported the protein content in uncooked lentils ranged from 243 g/kg to 302 g/kg, which was agreed with the reported values of Deraniyagala et al. (1994), but higher than the present study. Gupta and Wagle, (1988) reported much higher values for the protein content in uncooked chickpeas than in the current study. Boiled cowpeas had a significantly lower amount of protein than lentil curry and boiled chickpeas. The values reported by the USDA Food Composition Table (2020) of boiled pulses mostly agree with the present study except for chickpeas. However, pulses can be considered as a good source of protein.

3.4 Fish

There was a significant difference ($p<0.05$) in protein contents among the fish species, while sailfish curry had a significantly higher amount of protein content than other fish species (Table 4). As reported by McCance and Widdowson, (2014) fresh Sardinella contained 204 g/kg of protein which was not like the current study. Further McCance and Widdowson, (2014) reported 223 g/kg and 251 g/kg of protein in fried fresh sprats and grilled smoked sprats respectively which is generally

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agreed with the present study. USDA Food Composition Table (2020) reported much higher values for the protein content in boiled fish than in the current study.

3.5 Eggs

Protein contents in boiled free-range egg and quail egg were not significantly different ($p>0.05$), while boiled farm egg had a lower amount of protein than free-range and quail eggs (Table 4). Similarly, according to McCance and Widdowson, (2014), there was no significant difference in protein content between boiled chicken eggs and fried chicken eggs. As Thomas et al. (2016) reported, raw quail egg contains 133.0 ± 0.8 g/kg of protein, while the ASEAN Food Composition Database (2014) reported 124 g/kg of protein content in quail eggs, which is generally similar to the observed values in the present study. USDA Food Composition Table (2020) reported much higher values for the protein content in boiled eggs than in the current study, while the Sri Lankan Food Composition Table (2021) reported lower values for protein content in uncooked eggs than in the present study.

3.6 Rice mixtures

A significant difference in protein content ($p<0.05$) was obtained among each rice mixture. The most common type of rice mixture among the study population was mixture A and it had significantly higher protein content than the other mixtures (Table 4). It is difficult to find similar studies because this rice mixture is a characteristic item in Sri Lanka, especially for children in 6-18 months.

3.7 Cereal products

According to Table 4, there was a significantly higher amount of protein ($p<0.05$) in product A among other cereal products that had been tested and brand A is the most common cereal product which is provided to children by the Sri Lankan government. Brand B and brand C did not show a significant difference ($p>0.05$) in protein contents, and they are available in the Sri Lankan market, consisting of maize, soybean, rice, and green gram (Piratheepan et al., 2017).

3.8 Estimated daily intake (EDI) of crude protein per serving of each food item and its contribution to recommended dietary allowance (RDA)

Based on USDA guidelines, toddlers in the 1-3 years of age group require 13 g of RDA of protein. In contrast, based on Sri Lankan RDA, 1-2 years children require 21 g. Meanwhile, children in this age group require a larger amount of protein because children in this age range try to walk and are more active and playful. Also, brain development is undertaken during this age. Therefore, they need more energy as well as a better nutritional status not only for toddler stages but also for their future growth as well. Therefore, the nutritional status of the children in this age group is an important factor for themselves and in another perspective for the public at large because they are the future generation. The selected homemade foods for the analysis were the most popular ones among these children, and the percentage contributions of these foods to their RDAs of protein are summarized in Table 5.

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Table 5: Estimated daily intake of crude protein per serving of each food item and its % contribution to RDA.

Food type	Portion size (kg)	EDI per serving (g)	Contribution to the RDA per serving (%)	
			Based on the USDA guidelines	Based on SL guidelines
Rice				
Parboiled large rice	0.100	2.80 ± 0.01	21.54	13.33
Vegetables				
Pumpkin curry	0.015	0.10 ± 0.01	0.77	0.48
Potato curry	0.015	0.20 ± 0.02	1.54	0.95
Winged bean curry	0.010	1.16 ± 0.01	8.92	5.52
Bean curry	0.015	0.64 ± 0.02	4.92	3.05
Carrot curry	0.010	0.08 ± 0.01	0.62	0.38
Radish curry	0.015	0.07 ± 0.01	0.54	0.33
Ash plantain curry	0.015	0.11 ± 0.01	0.85	0.52
Beetroot curry	0.015	0.26 ± 0.05	2.00	1.24
Mean	**0.014**	**0.36 ± 0.02**	**2.81**	**1.72**
Leafy vegetables				
Gotukola (*Centella asiatica*)	0.010	0.21 ± 0.01	1.62	1.00
Moringa leaves (*Moringa oleifera*)	0.010	0.62 ± 0.01	4.77	2.95
Mukunuwenna (*Alternanthera sessilis*)	0.013	0.70 ± 0.36	5.39	2.05
Mean	**0.010**	**0.42 ± 0.13**	**3.23**	**2.00**
Pulses				
Lentil curry	0.015	1.28 ± 0.05	9.85	6.10
Chickpeas boiled	0.080	6.50 ± 0.02	50.00	30.95
White cowpeas boiled	0.075	5.74 ± 0.06	44.15	27.33
Mean	**0.060**	**4.51 ± 0.04**	**34.67**	**21.46**
Fish				
Sail fish (*Istiophorus platypterus*) curry	0.020	6.42 ± 0.02	49.39	30.57
Yellowfin tuna (*Thunnus albacares*) curry	0.020	5.83 ± 0.01	44.85	27.76
Sardinella (*Sardinella gibbosa*) curry	0.015	3.63 ± 0.02	27.92	17.29
Dried sprats (*Stolephorus commersonii*) fried	0.010	2.55 ± 0.02	19.62	12.14
Mean	**0.020**	**4.61 ± 0.02**	**35.45**	**21.94**
Eggs				
Farm egg boiled	0.055	6.92 ± 0.01	53.23	32.95
free-range egg boiled	0.055	7.06 ± 0.03	54.31	33.62

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Quail egg boiled	0.020	2.57 ± 0.23	19.77	12.24
Mean	**0.040**	**5.52 ± 0.09**	**42.44**	**26.27**
Rice mixtures				
Mixture A	0.100	4.07 ± 0.10	31.31	19.38
Mixture B	0.100	2.92 ± 0.14	22.46	13.91
Mixture C	0.100	0.89 ± 0.27	6.85	4.24
Mean	**0.100**	**2.63 ± 0.17**	**20.21**	**12.51**
Cereal products				
Brand A	0.050	11.68 ± 0.27	89.85	55.62
Brand B	0.050	10.32 ± 0.17	79.39	49.14
Brand C	0.050	10.09 ± 0.76	77.62	48.05
Mean	**0.050**	**10.70 ± 0.40**	**82.29**	**50.94**

As shown in Table 5, the highest mean estimated daily intake (EDI) of protein can be obtained by cereal products per serving because these products are combinations of several types of pulses and legumes. Nevertheless, a considerable amount of protein requirement was provided from pulses, fish curries, and boiled eggs which were prepared according to the domestic/local recipes in Sri Lanka. Even though several spices and other condiments are added to enhance the taste to prepare these food items according to the local recipes, added protein contents from these spices/condiments can be neglected because these contain very low amounts of protein.

The total average EDI per serving of rice, vegetables, pulses, green leaves, fish, eggs, mixed diets, and cereal products was 31.55 ± 0.88 g. Based on the USDA guidelines, it contributes to 242.64%, and according to the SL guidelines, the same protein content contributed to 150.17% of the RDA of toddlers in the 1-2-year age group. Usually, they consume about one serving of them. Therefore, the protein contribution to the RDA of toddlers in this age fulfilled by these cooked food items more than their requirements. However, if that amount is taken for the long term, it is not good for their growth because it increases weight gain and causes obesity in later life.

Moreover, human milk provides a high amount of protein. According to previous studies, mature breast milk which comes after 1-2 weeks from the colostrum contains 0.12 g/kg - 0.17 g/kg of protein (Yang et al., 2018; Qian et al., 2010). However, according to the ASEAN Food Composition Database (2014), mature breast milk contains a lower amount of protein (8 g/kg) than colostrum after 6 months of lactation because protein content decreases as the lactation progresses (Yang et al., 2018). Thus, 0.36 g/kg of protein is contained in one pump of milk providing good protein content for children in this selected age group per day. Not only that but a significant amount of protein can also be obtained from milk-based products such as yogurt, cheese, etc. According to the ASEAN Food Composition Database (2014), yogurt contains 3.84 g of protein per portion (80 g), while cheese contains 21.7 g/100 g. Therefore, apart from main meals, toddlers take a better amount of protein than their requirement. Thus, it may cause childhood obesity in later life of children. Estimated Daily Intake and % contribution to RDA of protein in selected food categories are explained below.

3.8.1 Vegetable curries

The highest protein content per serving can be obtained from winged bean curry. The mean estimated protein intake that can be obtained through these eight vegetable curries was 0.36 ± 0.02 g per serving (Table 5). According to the USDA and SL guidelines, vegetable curries contribute to RDA at 2.81% and 1.72% respectively, in the age group 1-2 years.

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3.8.2 Leafy vegetables

The mean protein content of 0.42 ± 0.13 g can be obtained per serving from selected green leaves as shown in Table 4. Based on USDA guidelines, it contributes to 3.23% of the daily protein requirement of toddlers. Based on SL guidelines, it contributes to 2.00% of the daily requirement of 1-2 years toddlers in Sri Lanka. The total protein content of these leafy vegetables depends on the preparation method.

3.8.3 Pulses

The highest estimated average intake of protein per serving can be obtained from boiled chickpeas. The mean protein content of 4.51 ± 0.04 g per serving can be obtained from the selected cooked pulses (Table 5). Based on USDA and SL guidelines, it contributes to 34.67% and 21.46% of the recommended dietary requirement of toddlers, respectively (Table 5).

3.8.4 Fish

The highest protein content can be obtained from sailfish curry per serving (0.020 kg). A mean protein content of 4.61 ± 0.02 g per serving can be obtained from the selected fish species as shown in Table 5. Based on USDA guidelines, it contributes to 35.45% of the recommended dietary requirement of toddlers in the 1-2-year age category. According to the SL guidelines, it contributes 21.94% of the daily protein requirement of toddlers of the selected age group.

3.8.5 Egg

As shown in Table 5, a mean protein content of 5.52 ± 0.09 g can be obtained from selected egg types and the highest estimated daily protein intake can be obtained by free-range egg (7.06 ± 0.03 g). According to USDA guidelines and SL guidelines, it contributes to 42.44% and 26.27% of the daily protein requirement of toddlers of the selected age group, respectively (Table 5). Quail eggs only provide 2.57 ± 0.23 g of estimated daily protein requirement due to low portion size (0.020 kg).

3.8.6 Rice mixtures

Among prepared rice mixtures by caregivers, the highest average daily intake per serving can be obtained by mixture A (4.07 ± 0.10 g) which was prepared as shown in Table 2. The mean protein content of 2.63 ± 0.17 g per serving can be obtained from the selected mixtures as shown in Table 5. Based on the USDA guidelines, it contributes to 20.21% of the recommended dietary requirement of toddlers in the 1-2 years age category. According to the SL guidelines, it contributes 12.51% of the daily protein requirement of toddlers of the selected age group (Table 5). This can be varied according to the ingredients used to prepare the mixtures and the nutritional composition of each ingredient.

3.8.7 Cereal products

Among the selected cereal products used for analysis, brand A provides the highest estimated daily requirement of protein than other products (11.68 ± 0.27 g). The mean estimated protein intake that can be obtained through this cereal product was 10.70 ± 0.40 g per serving (Table 5). Based on the USDA and SL guidelines, the contribution was 82.29% and 50.94%, respectively, in the age group 1-2 years.

4. Conclusion

According to the dietary survey, most toddlers consumed rice-based meals with vegetable accompaniments as the main meal. Winged bean curry had the highest protein content among selected vegetable curries while *Mukunuwenna* (*Alternanthera sessilis*) provided the highest protein per serving among cooked green leafy vegetables. Boiled chickpea is the best source of protein per serving among selected cooked pulse varieties. Sail fish (*Istiophorus platypterus*) curry provides the

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highest protein compared to other fish species, while boiled free-range egg provides the highest protein per serving among tested non-vegetarian food items. Furthermore, mixed diets prepared using different types of vegetables, pulses, green leaves, and fish species and prepared commercial cereal products are reliable sources of protein. Overall, the cooked foods prepared according to local recipes fulfilled the dietary requirements of protein for toddlers in the 1-2 years age category, even by a single serving in Sri Lanka in compliance with USDA and Sri Lankan nutrition guidelines. The findings of the study will assist stakeholders and policymakers in making an evidence-based decision for the improvement of children's health by promoting better feeding practices.

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Declaration of conflict of interest

All authors of this study declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in the current work.

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