Residential and socio-economic difference in protein intake of children aged 6-35 months in Indonesia: The national individual food consumption survey 2014

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Abstract. Consumption of protein by young children is known to support children's growth and weight gain and thus may help prevent stunting. This study aimed to investigate variation in protein consumption between age groups, socioeconomic status (SES), and residential type among children aged 6-35 months in Indonesia. We analyzed data from the National Individual Food Consumption Survey (SKMI) 2014, which included 3,449 children. Our findings revealed that protein intake increased with children's age in both urban and rural, ranging from 14.9 to 42.5 g/d in urban areas and 12.6 to 40.3 g/d in rural areas. In both urban and rural settings, protein intake increases significantly with better SES, from 33.4 to 37.8 g/d and 31.6 to 39.5 g/d, respectively. More younger children (6-11 months) had protein inadequacy than older age (73.9 vs 17.6% in urban and 82.8 vs 24.4% in rural areas). Conversely, older children from all SES had mean protein intake higher than the RDA. The primary protein sources were cereals (i.e. rice, plant protein), followed by offal, fish, and meat. This suggests that nutrition education along with improving protein consumption by younger children is crucial for growth and development as well as preventing stunting.

1 Introduction

The latest national nutrition survey *Survei Status Gizi Indonesia* (SSGI) 2023 showed that the prevalence of stunting in children under five in Indonesia was 21.5% [1]. Stunting is one of the nutritional challenges emphasized in the Sustainable Development Goals (SDGs) and the National Medium-Term Development Plan of Republic of Indonesia 2020-2024 [2]. Higher protein intake has been associated with accelerated growth and weight gain in young children, which can help prevent stunting [3].

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As reported by the World Health Organization (WHO), stunting is characterized by insufficient stature for a given age, resulting from unfavorable environmental factors across multiple domains, such as inadequate nutrition [4]. This condition impacts children's physical growth, brain maturation, and mental capabilities [2]. The initial 1000 days of life are a critical window to avert disruptions in metabolic programming due to the heightened adaptability of development during this phase [5]. Adverse environmental influences during this time can hinder the pace of growth [6].

One of crucial factor for enhancing linear growth for young children is the consumption of sufficient energy and high-grade protein. Essential amino acids, including lysine, leucine, and tryptophan, play a vital role in supporting growth and brain development [5]. Unfortunately, these protein requirements are often unmet due to financial constraints or impoverished living conditions [2]. Therefore, it is essential to explore the protein consumption of young children, since early intervention can potentially compensate for any linear development deficits before the age of three during adolescence [7]. Protein intake may vary among children residing in urban and rural areas, different age groups, and across different SES [8,9]. The objective of this study is to analyze the protein intake at early aged of children (6-35 months) in different residential settings, age groups, and SES categories, as well as identify the primary protein sources in their diets.

2 Materials and methods

2.1 Materials

We utilized data from the national survey SKMI 2014, which is a cross-sectional national household survey conducted in 2014 [10]. Although the survey had been conducted years ago, the information is still relevant and currently there is no such large nationwide study on food consumption with hundreds of thousands of samples. The survey involved interviews with approximately 45,802 households and 145,360 individuals. For this analysis, we focused on a subset of the data, specifically 3,449 children aged 6-35 months who had complete information for all variables included in the analysis.

2.2 Methods

The SKMI employed an individual food recall questionnaire to gather data on the food and beverages consumed by individuals within the 24 hours preceding the survey (24-hour food recall). Food consumption is one of the strengths of this survey, which is not regularly obtained in other national surveys. The enumerators were selected with a minimum of bachelor's in nutrition or health educational background. Training for enumerators were conducted before data collection. During data collection, all the enumerators were equipped with food photo book to guide respondent estimates the type and amounts of food consumed. In addition, researchers from National Institute of Health Research and Development Ministry of Health (NIHRD) supervised the data collection process to ensure data validity [10]. Wealth quintiles and SES levels were calculated from 12 standard household ownership variables and then grouped into five quintiles: lowest (quintile 1), lower (quintile 2), middle (quintile 3), higher (quintile 4), and highest (quintile 5). The Indonesian Recommendation Dietary Allowance (RDA) for children aged 6-11 months is 18 g/day and 26 g/day for children aged 12-35 months [11].

Differences in protein intake across socio-demographic groups were tested using one-way ANOVA, while differences in proportion below RDA were tested using the chi-square test. Data analysis was conducted using SPSS version 27. Ethics approval for SKMI 2014 was

obtained from the Health Research Ethics Committee of the National Institute of Research and Development, Ministry of Health Republic of Indonesia (No: LB.02.01/5.2/KE. 189/2014).

3 Results and discussion

3.1 Protein intake

On the average, children aged 6-11 months in both urban and rural areas had mean protein intake of 14.9 g/d and 12.6 g/d respectively, while children aged 12-35 months had mean protein intake of 42.5 g/d in urban and 40.3 g/d in rural (Table 1). Consistent with previous study [3], protein intake increased with children's age.

In terms of socioeconomic status (SES), children from lower SES backgrounds had lower protein intake compared to those from higher SES backgrounds in both urban and rural areas (Table 1). These differences were statistically significant across all age groups and residential settings.

Table 1. Mean protein intake (g/day) of children aged 6-35 months by age group and SES in urban and rural.

Age Group	Q1	Q2	Q3	Q4	Q5	Total	p
	Urban						
6-11 months	11.5	12.4	12.5	16.9	15.7	14.9	0.038*
12-35 months	39.5	39.4	41.2	42.8	44.5	42.5	0.014*
Total 6-35 months of urban	33.4	34.9	36.8	38.0	39.8	37.8	0.010*
	Rural						
6-11 months	11.2	13.9	12.7	12.3	13.6	12.6	0.016*
12-35 months	37.0	39.5	41.2	42.8	45.1	40.3	<0.0001*
Total 6-35 months of rural	31.6	34.0	36.0	36.4	39.5	34.8	<0.0001*
Total 6-35 months all	31.9	34.3	36.4	37.4	39.7	36.2	<0.0001*

Note: SES=Socioeconomic Status; Q1-Q5=lowest-highest; * One-way-ANOVA test, p<0.05

Study in Ethiopia [12] analyzed the association between socioeconomic and spatial inequality in iron-loaded animal food intake among 1,461 children under two using Wagstaff decomposition analysis. Only 24.2 percents (95% CI: 22.1-26.5) of the children ate protein particularly iron-loaded animal-derived foods the day before, according to the data collection survey. Children from low-income families eat disproportionately less iron-contained animal-derived food than children from prosperous families, which results in an index of wealth concentration (C) of 0.25 (95% CI: 0.12-0.37). This indicates that people in higher socioeconomic classes consume more protein particularly high in iron from animal sources. Approximately 70% of the projected socioeconomic inequality was explained by the decomposition model. The investigation also found that twenty-one percents of the wealth-associated disparity in children's intake of iron-loaded animal-derived food is attributable to those whose moms have completed basic school or above. According to the elasticity, the intake of iron-contained foods might rise by 21.5% and 9%, respectively, if the percentage of women with primary school education or higher increased by 1%. A study in Surakarta Indonesia among 113 elementary school children [13] which used the education level of mothers as a proxy indicator for socioeconomic level showed mothers with low educational background had 1.2 times higher risk of protein deficiency in their children compared to those with high educational background.

A community's purchasing power has been linked to socioeconomic status, which includes factors like income, parental education, and occupation. It has also been demonstrated that socioeconomic status influences schoolchildren's nutritional status and the

amount and quality of food they consume. While children from low-income families are more likely to eat inexpensive, high-carbohydrate foods, children from high-income families are more likely to eat pricy foods that are high in fat and protein [14]. Another study in Indonesia showed a relationship between families with middle to lower socioeconomic conditions and food shortages/higher food insecurity. It revealed that families with food insecure conditions had more children with insufficient levels of protein adequacy [13].

3.2 Proportion below RDA

The percentage of children below the RDA for protein intake decreased notably with higher SES (Table 2). However, this trend was only found to be significant among children aged 12-35 months. The same result was found in another study [9]. In Indonesia and Malaysia, individuals with limited financial resources were more likely to eat plant-derived proteins regularly. Conversely, eating poultry and red meat more often was tied to city living, advanced development, and improved economic conditions. It was challenging for children from lower socioeconomic backgrounds to meet their protein needs since their families could not afford protein sources which are usually more expensive [9].

Based on the data, most children aged 6-11 months in both rural (82.8%) and urban (73.9%) areas had protein consumption below the RDA, indicating that they were facing challenges in meeting their protein needs. In contrast, protein intake of older children aged 12-35 months from all SES exceeded the RDA (Table 1). These findings support a previous study that reported a low prevalence of inadequate protein intake among children over 12 months old in six low-income countries [7]. In Australia, children above one year old consumed two to three times as much protein than the country's recommended dietary intake (RDI) [3].

The practice of complementary feeding among stunted children was studied in 2016 in East Java Indonesia. It was observed during a qualitative study that most stunted children usually consume rice porridge until the age of one year. Nutrition contained in rice porridge is mainly carbohydrate, some protein, and some vitamin minerals. The mothers argued that children's intestines are still immature and not ready to receive and digest food with coarser textures like eggs, fish, beef, and chicken. Sea fish was commonly start to be given to the children when they start/able to walk because there is a perception in the community that fish is contained with infectious parasitic worms [5].

Table 2. Proportion below RDA (%) of children aged 6-35 months by age group and SES in urban and rural.

Age Group	Q1	Q2	Q3	Q4	Q5	Total	p
	Urban						
6-11 months	81.3	81.8	80.4	69.1	71.0	73.9	0.387
12-35 months	27.6	22.0	22.3	15.8	13.7	17.6	0.003*
Total 6-35 months of urban	39.2	32.0	31.1	25.6	23.1	27.2	0.004*
	Rural						
6-11 months	87.9	78.0	81.4	88.1	74.4	82.8	0.159
12-35 months	35.4	26.9	19.2	16.2	13.1	24.4	<0.0001*
Total 6-35 months of rural	46.3	37.9	30.5	31.3	23.9	36.2	<0.0001*
Total 6-35 months all	45.4	36.0	30.8	27.7	23.4	31.8	<0.0001*

Note: RDA (Recommended Dietary Allowance):18 g/day for children aged 6-11 months and 26 g/day for children aged 12-35 months (Regulation of MoH RI Number 28 Year 2019); SES=Socioeconomic Status; Q1-Q5=lowest-highest; * Chi-square test, $p<0.05$

A study in 2019 among 200 toddlers aged 6 to 23 months in the East Nusa Tenggara area (Sumba) Indonesia found that the stunted group consumed considerably less protein. The

stunted group's median total protein consumption was 7.72 grams (IQR 6.46-11.31), while the control group's was 10.02 grams (IQR 6.53-13.95) (P=0.03). Furthermore, The amount of flesh foods (beef, fish, chicken, organ meat, and other types of meat) consumed by the stunted group was substantially lower (7 percent) than that of the non-stunted group (16 percent) [15].

3.3 Protein sources

Analysis of this study indicated that the main sources of protein for children across all age groups were similar, including cereals and its products, followed by offal and other non-meat products, fish and its products, as well as meat and its products. This result is in line with the previous studies [9,16].

A 24-hour dietary assessment from the study conducted in Malaysia (N=1604) and Indonesia (N=1665), indicated that the bulk of protein consumption originated from plant-based foods, mainly grains. Animal-sourced proteins made up more than one-third of the overall intake, with twelve percents from red meat and white meat, 12.8% from milk and eggs, and 9.8% from fish [9].

A systematic review [17] based on 1500 records and 38 Indonesian articles. According to reports, children under five years old have varying caloric and macronutrient intakes, with some consuming enough protein. There have been reports of micronutrient deficits, specifically in iron, zinc, calcium, and vitamin C. One of the likely reasons of micronutrient deficiencies in children under five is the low frequency and/or volume of consumption of fruits, vegetables, and meals derived from animals.

The superior absorption of micronutrients from animal-based foods is due to the heme protein found in meat, poultry, and fish, along with the lack of compounds such as phytate, which are prevalent in plant-based diets consisting of beans, cereals, seeds, and nuts. Furthermore, food derived from animals contains iron which the body absorbs more readily than from plants [12]. Research has demonstrated that in low-income nations, consuming more animal-based foods on a regular basis is linked to improved growth, nutritional status, cognitive function, motor development, and activity [2].

Stunted and underweight children consumed less protein from animal foods, particularly milk and dairy products, than children with good nutritional status, according to an analysis from a study [16]. Meanwhile, the protein intake from plant protein or vegetables was higher, especially cereals (i.e. rice-based). Following WHO recommendation [18], due to their higher nutrient richness than cereal grains, animal-source foods, nuts, pulses, and seeds ought to be important parts of a nutritious diet for young children.

The analysis acknowledged some limitation in the current analysis including the use of national survey where some information might be limited to the available questionnaire from the survey. However, the survey covered many respondents from all provinces which represent the national population.

4 Conclusions

Protein intake increased with the increase in children's age and socioeconomic status (SES) in both urban and rural areas. However, a significant number of infants under one year old had inadequate protein consumption. Cereals especially rice-based followed by fish, meat, and offal were identified as common protein sources of food across all age groups. Nutrition education along with improvement in protein intake among children aged 6-11 months is essential to meet the requirement and thus may minimize the occurrence of stunting.

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