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The Relationship between Energy, Nutrition, and Dietary Fiber Intake with the Nutritional Status of Down Syndrome Children

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Abstract: Down syndrome is one of the disability conditions that can reduce productivity especially if coming with nutritional problems. Overweight is a nutritional problem that often occurs on Down Syndrome children. This research was aimed to understand the relationship between energy, nutrition, and fiber intake and the nutritional status of Down syndrome children. The design of this study was a cross-sectional study. As many as 50 samples were selected using purposive sampling from five extraordinary schools in Magetan East Java. Structured interviews and a 2x24 hour recall questionnaire were conducted with mothers of Down Syndrome children. According to the z-score of BMI for age, 40.0% of children in this study were overweight and obese, 52.0% was normal, and 8.0% was found to have thin and severely thin nutritional status. Based on the bivariate analysis, energy intake, carbohydrate intake, and fiber intake were not significantly associated with the nutritional status of children with Down syndrome ($p>0.05$). Protein intake ($p=0.018$) and fat intake ($p=0.027$) were significantly associated with the nutritional status of children with Down syndrome.

1 INTRODUCTION

Disability is one of the conditions that may reduce productivity. Down syndrome is one of the disability due to a genetic disorder that occurs during fetal growth (on chromosome 21/trisomy 21). The symptoms might greatly vary, from mild to severe that was mental retardation with the IQ level of less than 70, facial profile (Mongoloid), and typical palm line (simian crease) (Ministry of Health, 2013).

The global number of patients with Down syndrome indicated an increased trend of 30% in 1979-2003 (Shin et al., 2009). According to the data of Basic Health Research, the percentage of children with Down syndrome increased from 0.12 in 2010 to0.13 in 2013 (Ministry of Health, 2013). Furthermore, data of the National Socio-economic Survey 2003 issued by the Central Bureau of Statistics 2003 indicated that East Java had the most patients with mental retardation in Indonesia with 17 550 patients with Down syndrome (Central Bureau of Statistics, 2003). The high prevalence requires special attention to improve their life quality.

Nutritional status is one of the factors affecting an individual life quality. The study that was conducted by Nursilmi et al. (2017) showed that there is a positive correlation between nutritional status and the life quality of physical health and the environment. The better the nutritional status, the better the individual life quality. Overweight is a nutritional problem that often occurs in children with Down syndrome. The study that was held by Oosterom et al. (2012) showed that children with Down syndrome are more potential for suffering from overweight and obesity than other children. In addition to that, based on Marin and Graupera (2011), most children with Down syndrome have both overweight and obese nutritional status.

Overnutrition on children with Down syndrome shall be prevented as it may deteriorate their health. Besides, overweight and obesity suffered by children with Down syndrome will restrict their opportunities to participate in social, recreational, and sports activities significantly contributing to their physical and emotional development (Marin and Graupera, 2011).

Factors directly influencing nutritional status are food intake and infection (Supariasa et al., 2002).

Yulni (2013) in her study on elementary school children found a correlation between energy intake and carbohydrate and nutritional status. Based on the studies above, we are interested in the correlation between nutrient intake and nutritional status on children with Down syndrome. The research is conducted to examine the correlation between energy, nutrition, and dietary fiber intake with the nutritional status of Down syndrome children.

2 MATERIALS AND METHODS

2.1 Study Design and Subjects

The research used a cross-sectional study design and conducted in April-June 2015. The research subjects were 50 students with Down syndrome from five extraordinary schools in Magetan. They were selected using purposive sampling and based on inclusion criteria i.e. 1) aged 6-8 years old, 2) having no chronic disease, 3) currently living with their biological mothers, and 4) with mothers willing to participate in the research.

2.2 Data Collection and Analysis

Data collected comprised of characteristics, nutritional status, and nutrient intake of subjects. Data collection of the subject characteristics were conducted through structural interviews using questionnaires with mothers of Down Syndrome children. Nutritional status data were gathered using an anthropometric measurement of body weight and body height. Bodyweight was measured using a body scale; while body height was measured using a microtome. Nutrient intake data were collected through interviews with the mothers of Down Syndrome children using 2×24 recall questionnaires. Data collected were analyzed using SPSS for Windows verse 16. Univariate analysis was conducted to investigate the distribution of each variable. To observe the correlation between energy, nutrition, and fiber intake and nutritional status of the subjects, we conducted Spearman correlation test. The odds ratio was calculated based on the 95% confidence interval (CI).

3 RESULTS

3.1 Characteristics of Subjects

From 50 subjects, 33 (66.0%) were males and 17 (34.0%) were females. Distribution of the subject age was 29 (58.05) subjects aged ≤12 years old, 21 (42.0%) others were aged >12 years old.

Table 1: Distribution of the characteristics of subjects.

Characteristics	n	%
Sex		
Male	33	66.0
Female	17	34.0
Total	50	100.0
Age		
≤ 12 years old	29	58.0
> 12 years old	21	42.0
Total	50	100.0

3.2 Nutritional Status of Subjects

Nutritional status was categorized based on Body Mass Index in accordance with age (BMI for Age) for children aged 5-18 years old (Ministry of Health, 2011). More than half of the subjects had a normal nutritional status (n = 26). 11 subjects (22.0%) had an overweight nutritional status, and 9 (19.0%) subjects had an obese nutritional status. Of the total subjects, 2 (4.0%) subjects had a severely thin nutritional status, and 2 (4.0%) other subjects had a thin nutritional status.

Table 2: Distribution of the nutritional status of subjects based on BMI for Age.

Nutritional Status	n	%
Severely thin	2	4.0
Thin	2	4.0
Normal	26	52.0
Overweight	11	22.0
Obese	9	18.0
Total	50	100.0

3.3 Energy, Nutrition, and Dietary Fiber Intake

Energy, nutrition, and dietary fiber intake of subjects were categorized based on the adequacy level. The mean of energy intake of subjects was 1,900 kcal. Most subjects (42.0%) had the energy adequacy level categorized as excessive (≥ 120% RDA), 34.0% had the energy adequacy level categorized as deficit (< 90% RDA), and 24.0% had the energy adequacy level categorized as normal (90-119% RDA).

Protein adequacy level was normal when in the range of 90.0-119.0% of Recommended Dietary Allowance (Gibson, 2005). The mean of protein

intake of the research subjects was 54 grams. Of 50 subjects, 10 (20%) had a protein adequacy level categorized as normal; while 40 others had a protein adequacy level categorized as deficit and excessive (20 subjects for each).

The recommended total fat intake for children aged 4-18 years old was 25.0-35.0% of calories for children (Hardinsyah et al., 2014). Of 50 subjects, 8 (16%) had a fat adequacy level categorized as normal. 42 others had a fat adequacy level categorized as deficit and excessive (22 and 20 subjects for each, respectively). The mean fat intake of the subjects was 60.7 grams.

The recommended carbohydrate intake for children aged 4-18 years old was 45.0-65.0% of calories for children (Hardinsyah et al., 2014). The mean carbohydrate intake of the subjects was 414.9 gram. Most of the subjects (64.0%) had an excessive carbohydrate adequacy level. 28.0% of subjects had a carbohydrate adequacy level categorized as normal; while 8.0% others had a carbohydrate adequacy level categorized as a deficit.

The recommended amount of fiber intake to prevent obesity and non-infectious diseases was 25 g/day (Perkeni, 2011). All research subjects (100.0%) had fiber intake categorized as inadequate. The mean of fiber intake of the subjects was 6.0 g/day.

Table 3: Distribution of subjects based on the level of energy, nutrition, and dietary fiber adequacy.

Variable	n	%
Energy		
Deficit (< 90% RDA)	17	34.0
Normal (90-119% RDA)	12	24.0
Excessive (> 120% RDA)	21	42.0
The mean of energy intake ± sd (kcal)	1900 ± 572	
Protein		
Deficit (< 90% RDA)	20	40.0
Normal (90-119% RDA)	10	20.0
Excessive (> 120% RDA)	20	40.0
The mean of protein intake ± sd (gram)	54 ± 20.3	
Fat		
Deficit (< 25% of calories)	22	44.0
Normal (25 – 35% of calories)	8	16.0
Excessive (> 35% of calories)	20	40.0
The mean of fat intake ± sd (gram)	60.7 ± 28.9	
Carbohydrate		
Deficit (< 45% of calories)	4	8.0
Normal (45 – 65% of calories)	14	28.0
Excessive (> 65% of calories)	32	
The mean of carbohydrate intake ± sd (gram)	414.9 ± 243.7	
Fiber		
Inadequate (< 25 g)	50	100.
Adequate (> 25 g)	0	0.0
The mean of fiber intake ± sd (gram)	6.0 ± 3.5	

3.4 Correlation between Energy, Nutrition, and Dietary Fiber Intake with the Nutritional Status of Subjects

Referring to Spearman correlation analysis, the protein and fat intake variables significantly related to overweight and obese nutritional status on the subjects ($p < 0.05$). Subjects with excessive protein intake (≥ 120% RDA) were potential for obesity 4.1 higher than subjects with adequate protein intake (< 120% RDA). Similarly, subjects with excessive fat intake (≥ 25% of calories) were potential for obesity

3.9 higher than subjects with adequate protein intake (< 25% of calories). However, energy, carbohydrate, and dietary fiber intake did not significantly relate to the nutritional status of the research subjects.

Table 4: Correlation between energy, nutrition, and dietary fiber intake with the nutritional status of subjects.

Variable	Nutritional Status				OR	p
	Overweight/ obese (n=20)		Normal/ thin (n=30)			
	n	%	n	%		
Energy						
Excessive	11	52.4	10	47.6	2.4	0.128
Adequate	9	31.0	20	69.0	CI : 0.76-	
Protein						
Excessive	12	60.0	8	40.0	4.1	0.018*
Adequate	8	26.7	22	73.3	CI: 1.24-	
Fat						
Excessive	15	53.6	13	46.4	3.9	0.027*
Adequate	5	22.7	17	77.3	CI: 1.13-	
Carbohydrate						
Excessive	14	43.7	18	56.3	1.6	0.470
Adequate	6	33.3	12	66.7	CI : 0.47-	
Fiber						
Excessive	9	31.0	20	69.0	0.4	0.128
Adequate	11	52.4	10	47.6	CI : 0.13-	

4 DISCUSSION

Although more than half of subjects evidently had a normal nutritional status, subjects with overweight and obese nutritional status also came in a high number. It was in accordance with other studies on Down syndrome (Koniuszy and Kunowski, 2013; Marin and Graupera, 2011). According to National Food Service Management Institute (2006), overweight was one of the nutritional problems majorly suffered by school-age

children with Down syndrome. The nutritional problem should be prevented to improve their health condition.

In this study energy, nutrition, and dietary fiber intake of children with Down syndrome indicated an imbalanced result. Of the total subjects, few had the recommended energy, protein, fat, and carbohydrate intake. Even no subject had met the recommended fiber intake.

Children with Down syndrome tended to excessively consume food. When interviewed, several parents complained about their children's non-stop eating habits before all of the food was eaten (especially snack eating). It triggered excessive energy, protein, and carbohydrate intake in most children with Down syndrome. It was in line with Samour and King (2012) study that children with Down syndrome tended to have higher food intake than Dietary Reference Intake (DRI). Furthermore, another study also indicated that carbohydrate intake of children with Down syndrome was considered high (Grammatikopoulou et al., 2008).

All subjects had fiber intake categorized as inadequate. Various studies on children with Down syndrome gave a similar result. Almost all children with Down syndrome had inadequate fiber intake (Marin and Graupera, 2011; Koniuszy and Kunowski, 2013; Samarkandy et al., 2012). Achieving the recommended fiber consumption was difficult for children with Down syndrome. A study that was held by Mahan and Stump (2008) showed that it was due to swallowing and chewing ability delays in their preschool age. The delays consequently restricted parents to give various types of food, especially vegetables.

Disproportional energy, nutrient, and fiber intake in most subjects were probably due to imbalanced daily meals. It was supported by the previous study concluding that daily meals of children with Down syndrome were imbalanced in terms of energy and nutrition (Koniuszy and Kunowski, 2013).

Food intake was one of the factors directly affecting an individual nutritional status. We found that protein and fat intake significantly correlated with nutritional status of children with Down syndrome ($p > 0.05$). In this study, the odds of being overweight and obesity in Down syndrome children with excessive protein intake was 4.1 (95% CI:1.24-13.78). It suited the study of Del-Mar et al. (2015). Another study also confirmed that total protein and high animal protein intake could improve body weight and IMT (Rolland-Cachera et al., 2004; Hermanussen, 2008). Some other studies correlated animal protein intake with obese nutritional status (Lin et al., 2015; Wang and Beydoun, 2009). According to the studies, animal protein intake, especially meat and processed products triggered high fat intake, saturated fat, and total calorie and reduced vegetable consumption (Nicklas et al., 1995).

Several studies indicated a significant correlation between fat intake and nutritional status (Saker et al., 2011; Mc Gloin et al., 2002). We figured out that the odds of being overweight and obese in Down syndrome children with excessive fat intake was 3.9 (95% CI:1.13-13.60). Bray et al. (2004) declared that high fat intake might indirectly increase overweight and obesity risks by increasing energy density and thus excessive energy intake.

Even though we could not find the correlation between energy, carbohydrate, and dietary fiber intake with nutritional status of Down syndrome children, most children with Down syndrome tended to not have the recommended energy, nutrient, and fiber intake. Therefore, efforts to improve the condition should be made, optimizing health condition of Down syndrome children.

5 CONCLUSION

In conclusion, in this study, the percentage of children with Down syndrome and overweight and obese nutritional status was 40%. Children with Down syndrome with excessive protein and fat intake were more potential for obesity. In general, most children with Down syndrome tended to not have the recommended energy, nutrition, and fiber intake. Therefore, efforts to improve the condition shall be made, optimizing the health condition of Down syndrome children.

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