Original Article

The effects of eel biscuits on nutritional intake of hospitalized children

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Background and Objectives: Support from fortified food during hospitalization is an important factor to increase nutritional intakes of patients to meet nutritional needs and nutritional status. The objective of the study was to analyze the effects of eel biscuits on the nutritional intake of sick children. **Methods and Study Design:** The study had an experimental post-test design, and included 40 hospitalized children at Dr. Hasan Sadikin Hospital, Bandung, who were selected by consecutive sampling. The inclusion criteria were children aged from 1 to 18 years old who received standard hospital food. The exclusion criteria were patients with fish allergies and those undergoing special diet therapy. The intervention was conducted for 5 days, in which the intervention group was given eel biscuits while the control group was given standard hospital snacks. The food intake was assessed using the food record and 24-hour recall methods. Unpaired t-test and Mann-Whitney test were used in data analysis. **Results:** There was an increase in nutritional intake from snacks in the intervention group, namely energy (p<0.001), protein (p<0.001), fat (p<0.001), carbohydrate (p=0.005), zinc (p=0.012), and vitamin A (p=0.046) intake. There was also a positive impact on the main meal intake, especially in protein (p=0.037), fat (p=0.032), and zinc (p=0.037) intake. **Conclusions:** Consumption of eel biscuits to hospitalized children could increase their nutrient intake. Eel biscuits could be given as a snack to fulfill the nutritional requirements for sick children.

Key Words: effects, eel biscuits, nutritional intake, hospitalized, children

INTRODUCTION

The prevalence of malnutrition among pediatric patients who are admitted to the hospital is around 15% to 30%, and can lead to morbidity, and even mortality.[1] There is a considerable difference in the prevalence of malnutrition in hospitalized pediatric patients in developed countries such as Germany (6.1%), and developing countries such as Vietnam (19%).[2,3] More alarmingly, the patients who are in pediatric intensive care units have a higher prevalence of malnutrition of about 15% to 55%.[4] Nevertheless, recent studies in developed countries estimate the prevalence of malnutrition in children who are hospitalized to be from 12% to 24%.[3,5] Yet, despite many medical advances over the past 20 years, the level of malnutrition among hospitalized children has not declined.

According to Sayyari et al the nutritional status of children who are hospitalized has not improved, but has, in fact, declined.[6] This could result in a longer length of stay, and a negative response to treatment.[7] This is concerning because the length of stay is a risk factor associated with weight loss during hospitalization. Furthermore, there is also a greater incidence of infection along with a longer length of stay, which then leads to the emergence or worsening of a poor nutritional status. Children who are at risk of malnutrition have either been malnourished previously, or they experience an imbalance between the energy requirements and intake.

Pediatric patients are more susceptible to malnutrition compared to adult patients. Malnutrition in hospitalized children is directly associated with their illness, and can result in delayed physical and neurocognitive growth.[1] Malnutrition is defined as an imbalance between the nutritional requirements and intake, which can cause a cumulative deficit of energy, protein, or micronutrients, which negatively affects the children's growth and development. Malnutrition can be classified based on its etiology, which are: disease-related, nondisease-related, or both.[8] Aurangzeb's study states that malnutrition is a state in which the deficiency (or excess) of energy, protein, and other nutrients causes measurable adverse effects on the

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body, and can affect the child's growth and clinical outcomes. The term "nutritional decline" has been used to describe significant weight loss in children who are hospitalized,[9] and malnutrition is widely known to have a detrimental effect on clinical outcomes.[1] Therefore, it is very important that the doctor, as a healthcare provider, is aware of a child's risk for malnutrition when he/she is admitted to the hospital.[10] This is because nutritional interventions are not only given to malnourished children at the time of admission, but also to those who are at risk of malnutrition.[10]

Children with chronic diseases, such as cystic fibrosis and cancer, have less appetite and nutrient absorption impairment.[11] Hence, stunted growth and nutritional deficiencies can occur. In consequence, pediatric patients require high calorie intake. Calorie and protein supplementation in the form of milk and juice can improve nutritional status and weight gain.[11] Ward et al supported that malnutrition was a common problem in children who suffered from cancer as a result of the natural history of the disease, and the side effects of therapy.[12] Accordingly, it can weaken their responsiveness to various treatments, increase the risk of complications, and reduce survival ratess.[13] Children who have had chemotherapy treatment need proper nutritional support to increase their tolerance to treatments.

Early identification of malnutrition risks by the doctors in charge is necessary, on account of allowing them to order appropriate interventions to prevent the deterioration of the patients' nutritional status and to accelerate their recovery.[8] In the context of clinical care, the administration of proper food intake is critical in pediatric patients, regardless of the illness suffered when admitted to the hospital.[14] Providing adequate nutrition contributes to reducing the prevalence of malnutrition and improving the clinical prognosis.[15] Therefore, sufficient nutritional support is essential for children who are suffering from illness to maintain or improve their nutritional status, physical conditions, and survival, and to support optimal healing as well as development and growth. Consequently, the need to provide increased macronutrient and micronutrient intake according to the children's needs is also crucial because of the metabolic changes caused by their illnesses.

In Kondrup's study, among the 22% malnourished pediatric patients, only 25% received adequate energy and protein intake, while only 30% had their food intake and body weight monitored at all. The main causes of insufficient nutritional care were the lack of instructions to overcome this issue, the lack of basic knowledge of nutritional requirements, and poor practicality in providing food for this group of patients in the hospitals.[16]

The food service provided to inpatient children typically includes 3 main meals a day and snacks twice a day with additional enteral supplementation if needed. The snacks that are usually served include sponge cake, bread, and others. These snacks tend to have a short shelf life due to high water content and have high fat and carbohydrate content but are low in protein and micronutrients.[17]

Therefore, diet modification is needed to fulfill the patients' requirements in the form of food which is accessible as well as easy to digest and consume in a sitting or lying position and has a long shelf life, yet is high in energy, protein, zinc, and vitamin A content.[18] The results of Widodo's research with biscuits fortified with cork fish showed that there were improvements in energy and protein intake, body weight, nutritional status, and serum albumin levels in the children who consumed them.[19] The addition of cork fish also increased the bioavailability of the biscuits.

Dr. Hasan Sadikin Hospital is a third-level referral hospital. In this hospital, the most common diseases suffered by the children who are admitted are tuberculosis (TB), pneumonia, diarrhea, and cancer. Considering their symptoms of nausea, vomiting, and loss of appetite (anorexia), meeting the nutritional requirements of these children is challenging, which can cause inadequate nutritional intake.

To assist the hospital in providing adequate nutrition for these children, in the present study, the researchers made modified biscuits which incorporated eel head and taro flour to increase the nutritional content of the snack. Adding eel head and taro flour improves the biscuits' nutritional composition, and increases the bioavailability, hence making them functional food.[20] The aim of this study was to determine the effects of eel biscuits on the nutritional intake of children who are suffering from illness.

METHODS

Study design

This research had an experimental post-test design. It was conducted from February to March 2018 in the inpatient pediatric ward of Dr. Hasan Sadikin Hospital, Bandung. The intervention was performed for 5 days, because the average length of stay of pediatric patients in the hospital was only 5 days. Patients in the pediatric ward of Dr. Hasan Sadikin Hospital who met the inclusion criteria were selected for participation in this study. The inclusion criteria were pediatric patients aged from 1 to 18 years old who received standard hospital food. Patients with a history of fish allergies, those who had a liquid food diet, whether orally or via naso-gastric tube (NGT), and those undergoing special diet therapy were excluded. This study fulfilled Helsinski's declaration, and received ethical clearance from the Ethics Committee of the Faculty of Medicine Universitas Padjadjaran No.1294/UM.6.C/PN/2017. Informed consent was obtained from all subjects before participating in this study.

Study participants

There were a total of 40 children who were in the intervention and control groups. Consecutive sampling technique was used in this study. The participants who met the inclusion criteria were randomized into the intervention group (which was given the eel biscuits) and the control group (which was given the standard snacks from the hospital).

Sample size was calculated for the comparison of two means with power of 80% and significance level of 5%, resulted in 20 children per group. Participants in the intervention and control group were recruited from ward for 3rd level patients. Every ward consists of 6 beds with curtain as boundaries between the beds. Based on obser-

vations, there were no envy, questions or curiosity for the different snacks given between the intervention and control groups.

The intervention group was given 8 pieces of eel biscuit/day, 4 pieces in the morning and 4 pieces in the afternoon. Weight per eel biscuit was 6.25 g, resulted in total of 50 g/day. This amount was considered ideal for children aged 1-18 years. Following the recommendation, diet of children over 1 year of age was not different from adult and should consist of 3 main meals and 2 snacks, with ad libitum breast milk for children up to 2 year of age. The control group was given hospital snacks, which were green bean porridge in the morning and cakes (such as: Nagasari, Brownies, Pastel, Bread etc). Based on hospital policy, patients should receive snacks which contained 100-150 calories (100 gr/day) and did not contain harmful ingredients. Cakes were purchased from a store, while green bean porri were locally made at the hospital. The intervention group was given 3 main meals and 2 snacks in the form of eel biscuits a day. The control group was also given the 3 main meals but with standard hospital snacks twice a day.

Development of eel biscuit and acceptability test

The research team made 3 formulas, namely: F1 with the addition of 20% eel fish; F2 with the addition of 25%; and F3 with the addition of 30%. Total 30 participants were recruited for acceptability test, consisting of 13 pediatric patients and 17 adults with various backgrounds such as: food presenters, nutritionists, and nurses. Biscuits with the addition of 25% eel fish were well-accepted among adults in terms of color, texture, taste, and aroma. Pediatric patients were a bit disturbed by the smell of fish, but the color, texture, and taste were well received. In addition, pediatric patients preferred eel biscuits to hospital snacks, because of the variety of flavors and shapes of eel biscuits.

The nutritional content of the eel biscuits/100 g was 516.79 kcal of energy, 11.4 g of protein, 27.55% of fat, 55.67 g of carbohydrate, 80.94 mcg of vitamin A, and 3.55 mg of zinc. These eel biscuits had fulfilled the food safety requirements of the SNI (Indonesia National Standard), number 2973-2011. The biscuits have been tested at the Saraswanti Indo Genetech Laboratory, Bogor and were free from heavy metal and bacterial contamination. The nutritional composition of the eel biscuits was in accordance with the regulation of the Ministry of Health of the Republic of Indonesia, No. 51 of 2016 regarding the standard of nutritional supplementation products (for toddlers).

Data collection

The primary data regarding the patients' food intake for 5 days were recorded using the food record method for the standard hospital food and 24-hour recall for food other than the hospital food. In the food record form, the list of the food in the main meals consumed by the participants was included according to the hospital daily menu. Thus, it was easier for the participants or their caregivers to fill in the form with the amount of food consumed. Meanwhile, for the snacks, the intervention group was given the eel biscuits while the control group was given the standard snacks from the hospital. We calculated total nutrition intakes for main meals and snacks, which included energy, fat, carbohydrate, protein, vitamin A and zinc. Single 24-hour recall interviews to record the food consumed aside from the hospital food were also conducted. The food intake measurement data were converted into nutritional values using NutriSurvey 2007. The secondary data, including age, sex, diagnosis, and initial nutritional status were obtained from the medical records of the patients.

Statistical analysis

The data were analyzed descriptively using univariate analysis for the characteristics of the participants, such as age, gender, diagnosis, and initial nutritional status. Bivariate analysis was performed to determine the relationship between the administration of eel biscuits and the nutritional intake using the t-test and Mann-Whitney test. All analysis was conducted using SPSS version 22, licence.unpad.ac.id.

RESULTS

Table 1 showed the participants' mean ages in the intervention group and control group were similar. Likewise, the analyses on gender, diagnosis, and initial nutritional status in the intervention group and the control group

Table 1. Characteristics of the study subjects in the intervention group and the control group

Variable	Group			
	Intervention (n=20)	%	Control (n=20)	%
Age (years), mean (SD)	8.1 (4.4)		8.3 (4.3)	
<5 years	5	25	6	30
5–11 years	9	45	9	45
>11 years	6	30	5	25
Sex				
Male	10	50	12	60
Female	10	50	8	40
Diagnosis				
Infectious	4	20	6	30
Non-infectious	16	80	14	70
Initial nutritional status				
Severe malnutrition	3	15	5	25
Mild malnutrition	4	20	5	25
Normal	13	65	10	50

Table 2. Compliance of snack consumption in the intervention and the control group (%)

	Group	
Consumption of snacks	Intervention (n=20)	Control (n=20)
Not consumed	-	20 %
Consumed < half portion	35%	55%
Consumed ≥ half portion	65%	25%

Table 3. Main meal intake in the intervention group and the control group

	Group		*p*
Intake	Intervention (n=20)	Control (n=20)	
Energy, mean (SD)	1300 (336)	1180 (327)	0.286
Protein, mean (SD)	50.2 (15.4)	41.5 (13.7)	0.066
Fat, mean (SD)	40.8 (11.5)	35.3 (12.7)	0.157
Carbohydrate, mean (SD)	181 (60.9)	179 (59.2)	0.946
Zinc; median (min, max)	6.0 (3.54; 15.8)	5.10 (274; 14.5)	0.148
Vit A; median (min, max)	866 (318; 4160)	779 (228; 23700)	0.482

showed that both groups were homogeneous. The diagnoses of the participants in this study were classified into two types: infectious and non-infectious diseases. The diseases of the participants in both groups were mostly non-infectious. The percentage of participants with good initial nutritional status was 65% (13 children) in the intervention group, and 50% (10 children) in the control group. There were 4 participants (20%) with mild malnutrition in the intervention group, while there were 5 participants (25%) in the control group. On the other hand, 15% and 25% of participants respectively were severely malnourished in the intervention and control groups.

Table 2 showed compliance of both intervention and control group. In the control group, 20% of patients did not consume snacks provided from the hospital at all and tended to buy snacks from somewhere else. Proportion of patients consumed more than half of the portion size for snacks was higher in intervention group (65%) compared to control group (25%). In average, patients in intervention group consume 31.25 g of eel biscuits/day.

Table 3 compares intakes from the main meals between the two groups, which was a complete menu including rice with side dishes 3 times a day. There was no significant difference for energy, protein, fat, carbohydrate, vitamin A, and zinc intakes.

Table 4 compares intakes from the snacks between the intervention and control group. Energy, fat, carbohydrate, protein, vitamin, and zinc intakes were significantly higher in the intervention group.

The analysis of the daily food intakes of the intervention and the control group was summarized in Table 5. It appears that the intake of energy, fat, protein, zinc and vitamin A in the case group is higher than the control group. However, the differences were only significant for fat, protein, and zinc.

DISCUSSION

The results of this study indicate that the administration of the eel biscuits, with the basic ingredients of eel head and taro flour, had an increasing effect on energy, protein, fat, carbohydrate, zinc, and vitamin A intake through the snacks. This was due to the significantly higher content of protein, fat, zinc, and vitamin A in the eel biscuits than the standard snacks from the hospital. In addition, the eel biscuits were more acceptable to the sick children than the hospital snacks.

Respondents in this research were those who did not need a special diet, who received standard 1000, 1700, or 1900 calories/day based on body weight. Snacks contributed around 100-150 calories/day.

The eel biscuit consumption also caused an increase in the fat, protein, and zinc intake from the main meals, but it had no impact on the carbohydrate, energy, and vitamin A intake. Improvement in the nutritional status could not be seen in this study because the mean length of stay of the patients was only 5 days.

According to Schols, energy-dense snacks increase the energy and protein intake of hospitalized patients.[21] In this study, eel biscuits increased protein, fat, and zinc intake of hospitalized patients. The Schols study was specific only to chronic obstructive pulmonary disease (COPD) patients, whereas in this study the most cases were acute lymphoblastic leukemia (ALL), idiopathic thrombocytopenic purpura (ITP), and infection.

Ingadottir et al said that the standard hospital food for inpatients failed to meet the patients' energy and protein requirements. On top of that, patients' difficulty in consuming large meals (e.g. lunch/dinner) made it more challenging for them to achieve the nutritional intake requirements.[22] By giving oral nutritional supplementations (ONS) in the form of energy-dense snacks, the energy and protein intake of patients could be enhanced.[22] Ingadotir's results are the same as Schols's, that (ONS) increases energy and protein intake, while the results of this study increased protein, fat, and zinc intake. The Ingadottir et al study compared patients who were malnourished and not malnourished in COPD patients. Whereas this study did not compare between malnourished and non-malnourished patients. Poustie's study presented that, while children's food supplementation for 6 months escalated the mean total energy intake in the intervention group, it did not increase their intake of fat and protein.[23]

Table 4. Snacks nutritional intake in the intervention group and the control group

Intake	Group		Difference (CI 95%)	*p*
	Intervention (n=20)	Control (n=20)		
Energy, mean (SD)	162 (74)	77.2 (61)	77.5	<0.001
Fat, median (min,max)	5.3 (1.2; 7.9)	1.7 (0; 6.9)	2.8	<0.001
Carbohydrate, median (min,max)	24.2 (5.4; 35.9)	12.7 (0; 30)	8.3	0.005
Protein, mean (SD)	4.7 (2.1)	2.1 (1.7)	2.6	<0.001
Zinc, median, (min,max)	27.3 (6.1; 40.5)	16.7 (0; 46.1)	11.1	0.012
Vit A, mean (SD)	25.7 (11.9)	17.3 (14.1)	8.8	0.046

Table 5. Daily food intake in the intervention group and the control group

Intake	Group		Difference (CI 95%)	*p*
	Intervention (n=20)	Control (n=20)		
Energy, mean (SD)	1470 (387)	1320 (371)	201.1	0.214
Fat, mean (SD)	46.3 (12.8)	35.6 (17.5)	12.1	0.032
Carbohydrate, mean (SD)	206 (67.9)	206 (71.2)	8.4	0.993
Protein, mean (SD)	56.0 (18.8)	44.9 (13.0)	11.2	0.037
Zinc, median (min, max)	7.7 (4.3; 17)	6.30 (2.94; 14.5)	11.6	0.037
Vit A, median (min, max)	892 (356; 4190)	784 (231; 23700)	140	0.449

According to Pausty, there were significant differences between the intervention and control groups after oral supplementation for 6 months in children suffering from cystic fibrosis.

On the other hand, the study conducted by Liang et al which provided ONS to children with cancer who were hospitalized showed that it helped to improve the children's nutritional status and reduce the incidence of complications and the cost of hospitalization. Therefore, ONS is effective for children who are at risk of malnutrition as well as those who are undergoing chemotherapy.[24] The difference between this study and Liang's research is this study did not see differences in body weight, hemoglobin levels, total protein concentration, albumin, and pre albumin between the intervention and control groups. This study only looked at the effect of ONS (eel biscuit) on nutritional intake.

Phillipson et al also reported that the administration of ONS was effective in increasing nutritional intake and improving the quality of life of cancer patients who were malnourished or at risk of malnutrition. Moreover, it reduced the likelihood of long hospital stays and medical costs.[25] The difference between this study and Phillipson et al is that this study did not conduct an assessment for the quality of life of patients, length of stay and medical costs. Other than that, VanderJagt's study further demonstrates that the provision of nutritional supplements increased body composition, especially fat, and was positively associated with decreased morbidity and mortality.[26] This study did not do a body composition assessment, only a dietary assessment in which the patient's fat intake was seen to increase.

Campbell et al carried out a study with adult patients with malnutrition, which found that energy and protein intake was higher in the groups that were given traditional oral nutritional supplements (107 calories) and medPass (110 calories) compared to mid-meal snacks (85 calories). However, weight gain in the traditional supplements group was lower than those in the medPass and mid-meal groups, which were 0.4 kg, 1.5 kg, and 1 kg respectively. Similarly, the quality of life was found to be better in the medPass and mid-meal groups than that in the traditional supplements group, while the sensory quality was the highest in the mid-meal group.[27] The findings of Campbell et al are similar to those of Schols and Ingadottir et al that the ONS increases energy and protein intake, while this study increases fat, protein, and zinc intake. This is due to the higher content of fat, protein and zinc in eel bicuit compared to ONS.

Food fortification and supplementation have been found to be an effective and economic strategy to ensure that the nutrition provided for hospitalized patients was sufficient.[28] Stelten et al and van Til et al agreed that patients' compliance and tolerance towards fortified food were rather good.[29,30] In contrast, according to Gosney, the traditional administration of sip feeds had poor acceptability and tolerance, especially with hospitalized patients.[31] The flavors, variations, and familiarity of the fortified snacks offered significant advantages and led to higher consumption levels and patient satisfaction.[32,27] In this study, patient compliance is better for eel biscuits compared to hospital snacks. The acceptability test also showed that taste, texture, colour and aroma were well accepted by adults, although paediatric patients were somewhat disturbed by the aroma of fish. However, the variety of biscuits helped pediatric patients to like eel biscuits.

The functional eel biscuits used were a type of dense snack which was suitable for children. The energy content in 100 g of the biscuits was nearly two-fold compared to that of the functional hospital snacks. Furthermore, the protein was 1.6 times, the fat was 2.3 times, and the carbohydrate was 1.5 times higher than those of the standard hospital snacks. The zinc content in the functional biscuits was also higher than that of the hospital snacks by 1.04 times. The functional eel biscuits are considered as high-calorie/energy snacks (energy-dense food) and nutrient-dense food. Hence, compared to the hospital snacks

that were given as much as 100 g/day, giving just 50 g of the functional eel biscuits per day contributed more to an increase in the patients' food intake.

Micronutrient assessment was conducted only for vitamin A and zinc because the majority of patients had cancer. Vitamin A serves to influence the development of epithelial cells and the ability of immune system activity that is influential in preventing cancer. Zinc also plays a role in the metabolism of carbohydrates, lipids and proteins which in turn will lead to good food utilization. Children who are sick are vulnerable to zinc deficiency. In addition, the content of vitamin A and zinc in eel biscuits is quite high.

There are several limitations in this study. First, nutrition intake assessment was conducted using food records, with a possibility that patients did not write honestly. Second, there were a lot of variations of disease studied, so it could not be discussed on a case-by-case basis. Third, this study was not designed to explain the association of eel biscuits with patient nutritional status, length of stay, and medical expenses. Researchers plan to continue this research and focus more on one case of disease such as ALL and see changes in the nutritional status of patients, length of stay, and treatment costs.

Conclusion and recommendation

Fifty grams of eel biscuit/day for 5 days increases fat, protein, and zinc intake in pediatric patients who are hospitalized, compare to hospital snacks (100 g/day). During acceptability test, pediatric patients prefer eel biscuits to hospital snacks.

The hospital is expected to provide snacks that have good nutritional value and quality, not just to meet the calorie requirement. Eel biscuit can be an alternative for snacks in the hospital, because it has very good nutritional contents.

AUTHOR DISCLOSURES

All authors declare that they have no competing interests. This research was funded by Dr. Hasan Sadikin Hospital.

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