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**Special Topic****Professional Work and Rewards for Dietitians  
A History of Dietitians in Japan: No. 1 in a Series**

Teiji Nakamura

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Today, Asia is a highly active region with remarkable economic development. Agriculture, food processing and distribution have progressed, nutritional deficiency has been decreasing, food is abundant, and non-communicable diseases (lifestyle-related diseases) have become social problems. On the other hand, 20 to 30 years ago, in the developed countries of Europe and America, inpatient malnutrition appeared to be due to problems in the nutritional management of hospital food, which adversely affects the treatment of diseases and was related to the increase in medical costs. As a consequence, the importance of clinical nutrition management has been recognized. Enteral nutrition and central parenteral nutrition have been developed as nutritional supplements, and advanced medical technology has become necessary. This situation is spreading to Asia, and the establishment and reform of the dietitian system are progressing in each country.

About 150 years ago, Japan was the first country in Asia to introduce nutrition science, and over the past 100 years, it has developed the current dietitian system. Based on that experience, I have examined methods for further developing nutrition in Asia.

The most important aspect of nutrition improvement is to train dietitians who are specialists in nutrition improvement in the region or country and to establish nutrition as a profession in society. For nutrition to become a profession, it is necessary to clarify that nutrition is a profession and that the work of dietitians should be adequately compensated. The reason why the dietitian system is immature in some Asian countries is that "professional work and reward" as a dietitian are often not established and recognized.

For example, in the latter half of the 20th century, when the importance of clinical nutrition was widely accepted, there were proposals in Europe and the United States to train medical doctors to become specialists in clinical nutrition. The International Confederation of Dietetic Associations (ICDA) stated that 'nutrition improvement cannot be solved only by medical doctors who have medical education centered on physiology and biochemistry but dietitians who have knowledge and technology in food science, cooking science, life science, education and guidance theory as well as physiology, biochemistry, microbiology, public health, pharmacology and others are required. The ICDA worked on these matters through various international organizations and currently countries in Europe and North America do not train medical doctors as nutrition specialists. In Japan, not only medical doctors but also nurses, pharmacists, clinical technologists, physiotherapists, and many other specialists who are interested in

nutrition for team medical care currently study nutrition; however nutritional education, guidance and management are tasks of dietitians.

If this "clarification of professional work and rewards" is established, for example, in medical care, it will be inevitably incorporated into the medical system, and hospital income will increase due to the fees for dietitians. Therefore, hospitals actively employ dietitians. For example, in Japan, if a registered dietitian at a hospital gives "nutrition and dietary guidance" to inpatients who are admitted to the hospital, the usual charge will be 2600 yen (about 24 US \$) for the first consultation, 2000 yen (about 18 US \$) for the second and subsequent times, and 1800 yen (about 16 US \$) for remote instruction using IT, and for home visit instruction 5300 yen (about 50 US \$) will be paid as a medical treatment fee. Such nutritional dietary guidance is paid for in the same way even if it is conducted for outpatients in a clinic. In addition, medical fees will be added if a registered dietitian participates in a convalescent rehabilitation ward, nutrition support team, palliative care, cancer chemotherapy, intensive care unit, or bed sores countermeasure team. It means that by hiring a registered dietitian, the labor costs of a hospital can be sufficiently supplemented by the contribution of rewards for dietitians.

However, in Japan, it took about 30 years to reach such a situation. The initial nutritional dietary guidance fee was only ¥50 (about half of one US \$). The current system is the result of efforts made step by step in cooperation with administrative nutrition specialists in the central government, politicians, and the Japan Dietetic Association (JDA).

In Japan, when dietitian training started and the Dietetic Association was established, the leaders of JDA were medical doctors. However, the goal of the association was the independence and development of dietitians. As the roles of dietitians become highly specialized and dietitians grew in number and became independent, medical doctors moved away from the Dietetic Association, and nutritional dietary education and hospital meal management became the duties of dietitians.

Recently, I published a book that clarified the history and actual state of nutrition in Japan (1) hoping to encourage the development of Asian dietitians and dietetic associations and to benefit people in other Asian countries.

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**Original****School Lunch Program Could Control Snacking Habits and Decreased Energy and Lipid Intakes of 11-year-old Students in Jakarta**Indri Kartiko Sari <sup>1\*</sup>, Diah Mulyawati Utari<sup>2,3</sup>, Sumiko Kamoshita<sup>3</sup>, Shigeru Yamamoto<sup>1,3</sup><sup>1</sup>*International Nutrition, Graduate School of Human Life Science, Jumonji University*<sup>2</sup>*Public Health Nutrition Department, Faculty of Public Health, Universitas Indonesia*<sup>3</sup>*Asian Nutrition and Food Culture Research Center – Jumonji University*

**ABSTRACT** There is currently no school lunch program implemented in Indonesian public schools. Under current conditions, children are likely to be susceptible to lifestyle-related diseases as indicated by the increasing prevalence of childhood overweight and obesity year by year due to uncontrollable dietary habit. The purpose of this study was to evaluate the implementation of a school lunch program in a Jakarta public school and its effect on students' nutrition and food intake and habitual patterns. A total of 50 students, 11-year-old 5th graders from two classes, participated in this study. In a crossover study design, the intervention was a school lunch program providing a school lunch meal for one week (5 days), termed School Lunch Week. The control was one week of five regular days (Regular Week). Outcome parameters were the nutrition intake and changes in habits during Regular Week and School Lunch Week for all the children. The results showed a significant decrease in energy and lipid intakes ( $p < 0.05$ ) and snacking frequency/day ( $p < 0.001$ ) during School Lunch Week. The energy contribution from snack was decreased by 192 kcal/day ( $p < 0.001$ ) during School Lunch Week. The implementation of a school meal program could control snacking habits and decrease energy and lipid intakes in schoolchildren. In conclusion, the establishment of a school meal program should be considered in order to foster beneficial dietary habits in Indonesians.

**Keywords:** Jakarta, snacking habit, school lunch, school meal, childhood nutrition

**INTRODUCTION**

School life is the beginning of a lifetime health investment for schoolchildren. There are many challenges to establish an early healthy lifestyle in children. Dietary habits that last a significant part of a human life are critically established during childhood. However, unhealthy dietary habits such as high energy and lipid intakes are commonly found in children, which can lead to lifestyle-related disease later in life. According to national basic health research, it was found that 19% of children in Indonesia suffer from overweight and obesity, with Jakarta children having the highest prevalence of 30% (1).

Currently there is no school lunch program implemented in Indonesian public schools, even though school is a perfect place to promote healthy lifestyle and dietary habits through nutrition education and healthy lifestyle modeling (2). Indonesian public elementary schools usually start at 7AM and finish at 2PM with a short first break at 9AM and a longer second break at 12AM. These break times are meant not only to take a rest between learning periods, but also to let the children have their time, for playing or eating to satisfy hunger. With a proper nutrition intervention, children's growth can be boosted and

their health status eventually improved (3,4). A school lunch program, as one nutrition intervention, can help in solving health and nutrition problems in school-age children (5,6). The purpose of this study is to evaluate the implementation of a school lunch program in a Jakarta public school and its effect on children's food habits and nutrition intakes.

**METHODS**

This study was conducted with a monocentric, controlled, crossover design to assess the efficacy of a school meal program in students at a public school. The study was done in accordance with the Helsinki Declaration and was approved by the Ethical Committee of the Faculty of Medicine, Universitas Indonesia. The study was conducted at a public school in Jakarta in which regular activities of the students were maintained (no special intervention during break time). The location was purposively selected based on the local district education committee's permission: no similar intervention had been conducted at the school and the selected school agreed to be the study site. The subjects were 11-year-old 5th graders who had already been assigned to two classes, with 25 students in each

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class, for a total of 50 students. Inclusion criteria included healthy children of 5th grader who had obtained signed informed consent from their parents. Exclusion criteria were 5th grader suffers any chronic diseases.

The intervention was a school meal program providing school lunch meals during break time for a week (5 days) designated as School Lunch Week. Another week without intervention and with normal activities during break was designated as Regular Week. The lunch menu provided on average 600kcal, about 30% of total energy RDA. School lunch menus were created by the researchers. The menus are shown in Figure 1 and included rice as the staple food, a side dish of plant protein (tempeh, tofu), animal protein (egg,

chicken, beef), and a vegetable dish. Data collection was conducted on students' characteristics and food habits with question items shown in Table 1, anthropometric measurement, and nutrition intakes with 3-day/24-hour recall methods in both Regular Week and School Lunch Week. During School Lunch Week, there was no restriction on what could be consumed on during afternoon break. However, there was a requirement of eating the school lunch meal together in the classroom first before the children could spend the rest of break time as they liked. During Regular Week, the rest of the break time was spent in the students' regular activities. Statistical analysis were conducted with paired Student's *t*-Test ( $p < 0.05$ ).



**Figure 1. School lunch menus for one week**

**Table 1. Questions for student's characteristics and food habits**

Question items	
1.	Who does meal preparation at home?
2.	Is your mother living with you? If yes, what does she do? (Occupation)
3.	Who influences you to buy snacks? (Multiple answers)
4.	Do you usually bring a lunch box from home?
5.	Do you eat breakfast every day?
6.	What do you eat for breakfast?
7.	How many times do you buy snacks in one day? (Frequency)
8.	What kind of snacks do you usually buy/eat? (Multiple answers)
9.	What kind of beverages do you usually buy/drink? (Multiple answers)
10.	Let's review what you had to eat yesterday! (Food recall)

## RESULTS

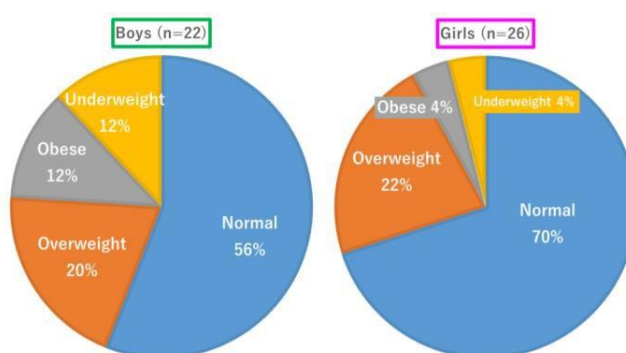
There were 48 children who completed the study. Data for two children were dropped due to their absences during the study and incomplete data collection. The school lunch program was conducted during the second break, the last break before the children finish the school day and then go home or go for extra-curricular activities. The subjects were 11-year-old students (5th graders in two classes, 5A and 5B) of one Jakarta public school with a total of 50 students. Of the total, two students dropped out due to incomplete data. Table 2 shows the BMI information of the subjects. The average BMI ( $\text{kg}/\text{m}^2$ ) of all students was  $18.1 \pm 2.9$  with average BMI of boys and girls were  $17.9 \pm 2.9$  and  $18.4 \pm 3.2$ , respectively. Figure 2 shows subjects' BMI categories percentages (%) whereas in boys and girls were 56 and 70 normal, 20 and 22 overweight, 12 and 4 obese, and

12 and 4 underweight, respectively. Table 3 shows the results of the subjects' basic characteristics and food habits in percentage. For question "Who does meal preparation at your home?", the percentages were 87.5% mother, 2.1% grandparents, 8.3% housekeeper, and 2.1% take-out food. For question "What is your mother's occupation?", the percentage of their occupations were 36% stayed-home housewives and 64% working mothers (entrepreneur, private employee, government official, etc). For question "Who influences you to buy/have snacks?", the multiple answers show 68.4% came from friends, 35% siblings or relatives, 28.9% TV commercials, 28.1% parents, and 7% from online advertisements. For question "Do you usually bring a lunch box to school?", 58% responded No and 42% responded Yes.

**Table 2. BMI information of the subjects (n=48)**

BMI information	BMI ( $\text{kg}/\text{m}^2$ )	
	mean	$\pm$ SD
All student (n=48)	18.1	$\pm$ 2.9
Boys (n=22)	17.9	$\pm$ 2.9
Girls (n=26)	18.4	$\pm$ 3.2

Data are shown in mean  $\pm$  SD



**Figure 2. Subject's BMI categories percentage**

**Table 3. Subject's basic characteristics and food habits in percentage (n=48)**

No	Subjects' characteristics and food habits	Percentage (%)
1.	Who does meal preparation at your home?	
	- Mother	87.5
	- Grandparents	2.1
	- Housekeeper	8.3
	- No one, eating take-outs	2.1
2.	What is your mother's occupation?	
	- Stay-home housewives	36
	- Working mothers (entrepreneur, private employee, government official, etc)	64
3.	Who influences you to buy/have snacks? (Multiple answers)	
	- Friends	68.4
	- Siblings, relatives	35.1
	- Parents	28.1
	- TV commercials	28.9
	- Online advertisements	7
4.	Do you usually bring a lunch box to school?	
	- Yes	42
	- No	58

Table 4 shows the results of food related habits during Regular Week and School Lunch Week in percentages. For question “Do you eat breakfast every morning?” was separated into three categories of having breakfast every morning, some mornings, and no breakfast, with results during Regular Week and School Lunch Week were 58.3% and 62.5% have breakfast every morning, 37.5% and 35.4% some mornings, and 4.2% and 2.1% no breakfast, respectively. For question “What do you eat for breakfast?” shows the breakfast food patterns, which

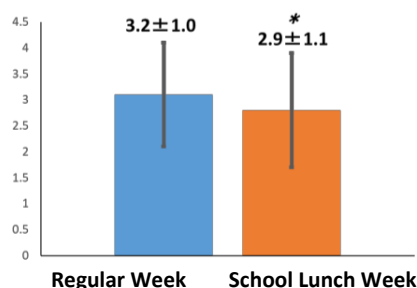
were separated into categories of milk + bread, porridge, and rice + dish(es). During Regular Week, students’ breakfast was 67.3% rice + dish(es), 27.2% milk + bread, and 5.5% porridge. During School Lunch Week, breakfast was 60.7% rice + dish(es), 30.4% milk + bread, and 8.9% porridge. For question “How many times do you buy/have snacks in a day?” was separated into categories of snacking frequency from 1 – 6 times. Further analysis of snacking frequency is shown in detail on Figure 3.

**Table 4. Food related habits during Regular Week and School Lunch Week in percentage (n=48)**

No	Food related habits	Regular Week (%)	School Lunch Week (%)
1	Do you eat breakfast every morning?		
	- Yes, every morning	58.3	62.5
	- Sometimes	37.5	35.4
	- No, no breakfast habit	4.2	2.1
2	What do you eat for breakfast?		
	- Milk + bread	27.2	30.4
	- Porridge	5.5	8.9
	- Rice + dish(es)	67.3	60.7
3	How many times do you buy/have snacks in a day?		
	- 1 times	4.1	8.3
	- 2 times	18.8	31.3
	- 3 times	43.8	29.2
	- 4 times	25	20.8
	- 5 times	6.3	10.4
	- 6 times	2.0	0

Figure 3 shows the average daily snacking frequency. During Regular Week, snacking frequency for one day was  $3.2 \pm 1.0$  times and it was decreased to  $2.9 \pm 1.1$  in School Lunch Week ( $p < 0.05$ ). Figure 4 shows the snack patterns for question “What kind of snacks do you usually buy/eat?”. Snack patterns during Regular Week include 44% fried foods, 14% coconut rice, 8% noodles, 7% sweet bread, 7% meatballs, 4% seblak, 5% macaroni, 4% soto, 3% porridge, 2% shumai, and 2% other. Snack patterns during School Lunch Week include 52% fried foods, 15% coconut rice, 8% noodles, 5% meatballs, 3% seblak, 4% macaroni, 2%

soto, 4% porridge, 4% cilok, and 3% others. Figure 5 shows beverages patterns for question “What kind of beverages do you usually buy/drink?”. Beverages patterns during Regular Week include 33% sweet tea, 22% milkshake powder, 10% flavored milk, 10% ice sweet milk, 7% mixed ice, 7% ice cream, 3% tea beverages, 3% jelly drink, 3% juice powder, and 2% other. Beverages patterns during School Lunch Week include 33% sweet tea, 22% milkshake powder, 4% flavored milk, 17% ice sweet milk, 10% mixed ice, 5% ice cream, 3% tea beverages, 2% jelly drink, 2% juice powder, and 2% other.



**Figure 3. Daily snacking frequency (mean  $\pm$  SD) (n=48)**

\*Significantly different at  $p < 0.05$



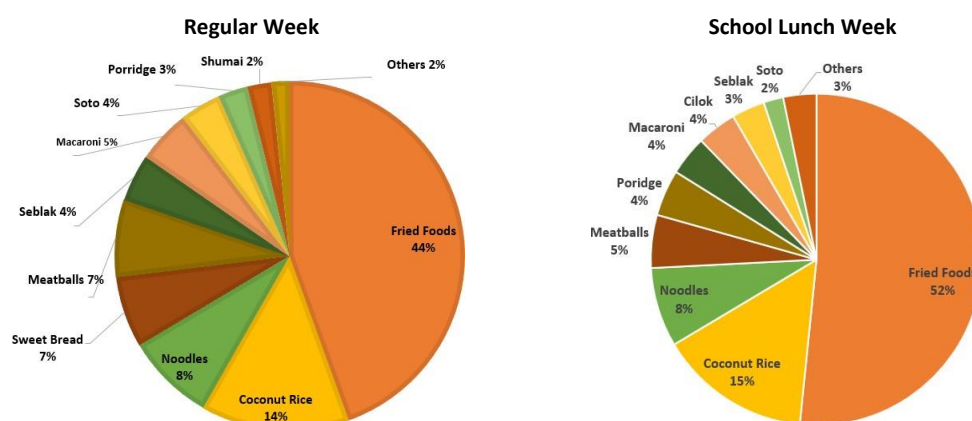


Figure 4. Snack patterns during Regular Week and School Lunch Week

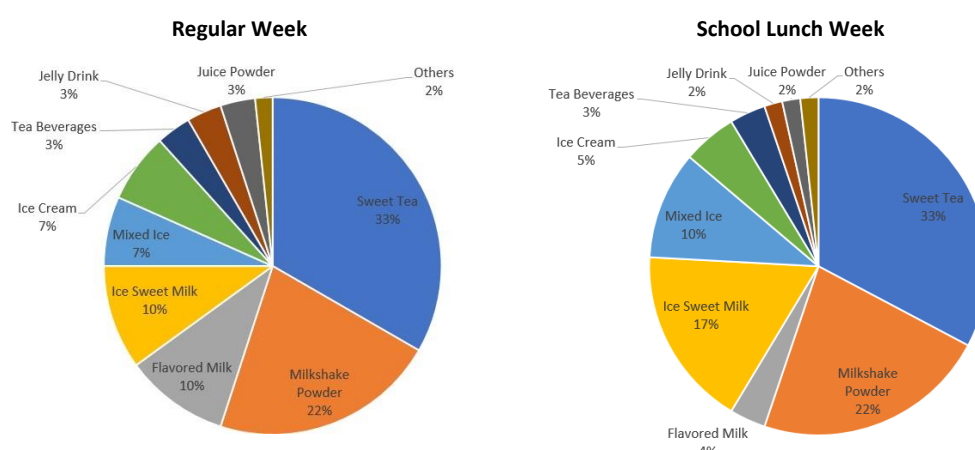


Figure 5. Beverages patterns during Regular Week and School Lunch Week

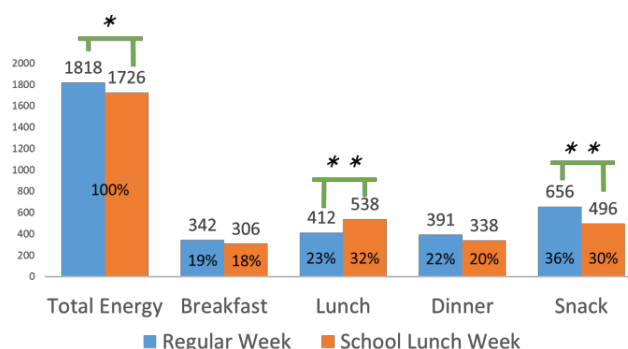
Table 5 shows energy and nutrient intakes per day during Regular Week and School Lunch Week. There were significant decreases in both energy and lipid intakes during School Lunch Week ( $p<0.05$ ). Protein, carbohydrate, and fiber intakes remained unchanged.

Figure 6 shows calorie contribution from breakfast, lunch, dinner, and snack. There was a significant increase in calorie contribution from lunch ( $p<0.001$ ), also a significant decrease in calorie contribution from Snack ( $p<0.001$ ) during School Lunch Week.

**Table 5. Nutrient intakes during Regular Week and School Lunch Week (n=48)**

Nutrient Intakes (per day)	Regular Week (mean $\pm$ SD)	School Lunch Week (mean $\pm$ SD)
Energy (kcal)	1852 $\pm$ 328	1709 $\pm$ 297*
Protein (g)	55 $\pm$ 16.5	53 $\pm$ 13.6
Lipid (g)	74 $\pm$ 18.6	67 $\pm$ 16*
Carbohydrate (g)	240 $\pm$ 66	223 $\pm$ 47
Fiber (g)	6 $\pm$ 2.7	6.4 $\pm$ 2.5

\*Significantly different at  $p<0.05$



**Figure 6. Daily calorie contribution from breakfast, lunch, dinner, and snack (n=48)**  
Significantly different at  $*p<0.05$  and  $**p<0.001$ , respectively

## DISCUSSION

The study results show that 32% boys and 26% girls were overweight and obese, which was close to national basic health research data (1). This indicates that the data from this study are representative of the actual population. There were study results which can show that school meal program have favorable impacts in schoolchildren.

Food habits of the children in terms of bringing a lunch box was that more than half of the children didn't bring one have the habit, which explains the habit of buying food during break time. From the mother's occupation result, assuming that one third of mothers are working at home and the remaining two thirds are working mothers, it is understandable that meals may not always be prepared at home and that bringing a lunch box to school is less prevalent. Bringing a lunch box meal from home usually tended to provide adequate daily nutrition for the children (7). A lunch box meal can also become one good tool to prevent excessive intake of sugar, lipids, and sodium from fast foods (7-9). For both reasons, a lunch box meal is an option to establish favorable dietary habits which is effective if a school meal program remains unimplemented.

The habit of having breakfast might be related with the habit of bringing lunch meal box. Once breakfast is skipped, easy to develop the habit of skipping breakfast, and it is very likely to have a correlation with more frequent snacking during the day (10). Another study on skipping breakfast in children and adolescents found that skipping breakfast was associated with overweight/obesity and highly associated in children with working mothers (11). However, in our study it was found that having breakfast at home was already a regular habit. This might be another reason why the children didn't have the habit of bringing a lunch box from home aside from the mothers' occupation status, because the children were already eating breakfast at home before school. In other words, the snacking frequencies might be influenced by something other

than breakfast habits, which is likely due to the fact that there is no school meal program to satisfy children's hunger during the school day.

Since bringing lunch from home is an option and there is no school meal program, children satisfy their hunger by buying foods and drinks from the food stalls in the area around the school. There are many factors that affect snacking habits. About 70% of snacking influence comes from friends, which also explains the impact that peer pressure can have on snacking habits. Despite no difference found in snacking patterns, the snacking frequency showed a significant decrease during School Lunch Week. Seventy percent of the children were snacking 3-4times on a usual day. This became less frequent, dropping to 1-3times on a School Lunch Week. This shows that the school lunch can help in controlling the snacking habit and in reducing daily snacking frequency. Studies in countries like Vietnam show the effectiveness of a school lunch in reducing snacking frequencies and total energy from snacks (12).

As for the snacking patterns, half of the snack patterns was fried foods. It doesn't matter that the size of fried foods had changes. Although fried foods was 10% higher during School Lunch Week, the decrease of total energy and lipid intake during the day of School Lunch Week could be marked by lower fried foods intake. Fried foods itself are easy to prepare, in terms of food safety and efficiency, and can be served as quickly as possible (13-15). This means that anybody can prepare fried foods, including meal prepper at home, much likely that the source of fried foods during School Lunch Week came from home. For the beverages patterns, the most popular drink was sweet tea, followed by milkshake powder drink. These drinks are also fast and easy drinks to prepare and are accessible to the children. The classification of snack can be separated into quality and composition (13-15). Higher quality snacks has richer nutrients than low quality snacks, for example an apple and a glass of milk compared with

fried foods and sweets (13-15). Children usually consume lower or no quality foods because the foods are easily accessed either in the school or at home (13-15).

A previous study found that school meal programs and nutrition education for school – children can provide adequate intake of energy, protein, carbohydrate, and fiber (16). In our study, it was found that energy and lipid intakes were decreased during School Lunch Week. Moreover, when the energy contribution from breakfast, lunch, dinner, and snacks were compared, it was found that during School Lunch Week, energy from lunch was increased and energy from snacks was decreased. These results show the favorable effects of school lunch in controlling energy and lipid intakes and also the energy contribution especially from snacks. School-based nutrition intervention programs are effective in establishing favorable dietary habits in children (16–18). In this case, a school meal program was proven effective even though it was conducted for only one week.

A school lunch program can improve the daily nutrition contribution based on the RDA of children 11 years old. One third of the RDA intake can be provided by the school lunch and our lunch meal provided on average 600kcal/day. The energy contribution from Lunch was increased to 32% because there is a lunch meal to provide adequate energy despite there was common picky eater problem of some of the children didn't finish the provided lunch meal, not finishing the vegetable or not liking the tofu or tempeh we provided for them. School lunch was served at break time and it was mandatory to eat the school lunch meal first before students could go on to other activities such as playing with friends or even buying additional snacks. As for the additional snacks the children might buy after eating the school lunch meal, it can be assumed that the children didn't buy fried foods as snacks, by the reason of the decrease in their lipid intake. Excess energy intake in school – children mostly results from snacking habits, despite its one purpose to satisfy hunger and eventually to meet energy and nutrient intakes (12, 19). With no school meal program, during the longer break time children will satisfy their hunger through uncontrolled snacking. Some of the children usually consumed fast food from fast food restaurant chains with their family outside school time or during weekends.

There was no significant difference in protein intake. It already met the protein recommendation for daily protein intake. The recommendation for protein intake in Indonesia includes three portions of animal protein like fish, meat, egg, milk, etc and three portions of plant protein like beans, bean products like tofu, tempeh, and fermented soybean like oncom (20). The lunches in this study included either one portion of animal protein or one portion of plant protein, which contributed at least 30% of RDA.

There is a reason why a school meal program is not established yet. Ninety percent of Indonesian schools are public schools. The school management is under the Ministry of Education. Even now, the government is still struggling to provide universal education in all areas of Indonesia. Inequality and social disparities are still high. Funding for education is one of the problems, not to mention funding for a school meal program. However, if a school meal program is provided/introduced at targeted area like Jakarta at the beginning, other areas may follow this example and may start school meal programs as well. There are methods on how to establish a school meal program, one example being the Japanese school meal program. The Japanese school meal program includes the employment of at least one licensed registered dietitian/nutrition teacher to help create 200 different menus/year that meet the dietary reference intakes and have high consideration and give priority to locally sourced food and introduce national food culture and tradition (21–22). The dietitian will work in the school kitchen or work at a district kitchen to serve several schools simultaneously (21–22). On the stakeholder level, it might be necessary to have legal developments for a school meal program in Indonesia. In Japan, Shokuiku Basic Act involves the promotion of nutrition education throughout the life cycle, including the school lunch program (22). Since it starts at an early age, it may also be a positive force in instilling healthy food habits during childhood (22).

This study has the limitation that the school meal program could be implemented for only one week (five days). It was not possible to see the longer-term effects of the school meal program like changes in breakfast habits, snacking influence resources, the timely period of snacking, and the nutritional status of the children themselves: their BMI status. A longer period such as one month or two months might change on these variables, especially when a decline in overweight and obesity is the target. In conclusion, a school meal program could control the snacking habits and decrease energy and lipid intakes in Jakarta school-children and the establishment of school meal program should be considered.

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# **CONFLICT OF INTEREST**

There is no conflict of interest in this study.

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**Original**

## Vietnam's New Food Culture with Textured Soybean Protein Can Save the Earth

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**ABSTRACT** *Background and purpose.* Raising livestock to meet the demand of meat for human being exerts detrimental pressure on the environment and natural resources. With the view of saving the Earth by eating less meat, meat analogs are gaining popularity worldwide. Among these foods, Textured Soybean Protein (TSP), a by-product of the oil extracting process, is rich in fiber (13.6g/100g) and a good protein source (about 56g/100g). Substituting TSP for meat in the diet may have beneficial effects in preventing lifestyle-related diseases as well as in preserving the Earth. *Purpose.* To establish a new food culture with Textured Soybean Protein and to assess the palatability of TSP dishes. *Method.* There were two phases in the study. Phase 1: The research group created new menus using TSP. From the traditional recipes, meat was replaced with TSP to make 16 menus. Menus that were considered to be the tastiest and that contained 20g of TSP were selected for use in the next phase. Phase 2: The acceptability of new dishes using TSP was assessed in comparison with the control dishes (cooked with meat). 24 ordinary people were randomly selected from the community. A sensory test was conducted, and the score for each dish was established by using a Hedonic 5-point scale. Subjects (n=24) were asked to eat 2 dishes with 40g of TSP every day for 4 weeks consecutively to evaluate their tolerance of new food in their daily dietary pattern. A questionnaire was created to elicit the subjects' opinions after 4 weeks. *Results.* The average evaluations of the 10 TSP dishes and control dishes were 3.9 and 4.2 points for overall taste. Evaluations of the TSP dishes were close to those of the control dishes, with no significant difference ( $p>0.05$ ). The results from the questionnaire indicated that 75% of the subjects were pleased with the amount of 40g TSP in 2 dishes per day; the suggestion of having TSP dishes for 3-4 days was considered reasonable and the digestive status was acceptable for 79% of subjects. There was no significant difference in total energy intake, but lipid intake and animal protein significantly decreased ( $p<0.001$ ). Fiber was significantly increased, by 6g ( $p<0.001$ ). *Conclusion.* We found that TSP dishes were highly acceptable for Vietnamese people. TSP can be a good non-meat food source and provide adequate fiber and protein, which may create beneficial health effects as well as preventing detrimental effects to the environment caused by meat consumption.

**KEY WORDS:** Textured Soybean Protein, meat analog, livestock, environment.

### INTRODUCTION

Meat-Free Monday (2009) is an international campaign which aims to raise awareness of the significant consequences of global meat consumption. Raising livestock for meat is responsible for about 14.5% of total anthropogenic greenhouse gas (GHG) emissions, including methane gas (a gas which has an effect on global warming 28 times higher than carbon dioxide) and nitrous oxide (a

molecule with a global warming potential 265 times higher than carbon dioxide) (1). Meat production currently adds 0.15 giga-metric tons of methane and 0.0065 giga-metric tons of nitrous oxide to the atmosphere annually. If the climate system is allowed to reach equilibrium with this level of GHG emission and decay (which would take about a decade for methane and about a century for  $N_2O$ ), then the earth would be 0.44°C warmer. Animal agriculture is also a sector which requires a significant amount of natural resources like water and landmass when compared with other foods as

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a protein source (2). In addition, excessive consumption of meat and meat products is often associated with overconsumption of energy and fat, resulting in excess weight, obesity and an increased risk of chronic diseases, such as cardiovascular disease and type 2 diabetes. Besides, according to the Vietnamese general nutrition survey 2009-2010, the average vegetable consumption in Vietnam was about 190g/day (3). This amount was less than the RDA for adults (300g/d). There was a similar situation for fiber intake; Vietnamese consumed about 9g/day, which meets only half of the RDA recommendation at 20g/day (4). The role of fiber in controlling metabolic disease is well documented (5). Therefore, dietary treatment increasing fiber intake, decreasing meat consumption in the Vietnamese dietary pattern can be important factors in making a positive difference in slowing climate change, preserving Earth's irreplaceable natural resources, and an improving health. Textured Soybean Protein (TSP) is a meat analog which is produced through an extrusion process. The defatted thermoplastic protein is heated to 150–200°C, which denatures it into a fibrous, insoluble, porous network that can soak up as much as three times its weight in liquids. As the pressurized molten protein mixture exits the extruder, the sudden in pressure causes rapid expansion into a puffy solid that is then dried. The dried matter is called Textured Soybean Protein, which







rich in fiber (13.6g/100g) and plant protein (about 56g/100g). These features of the product are expected to have health effects and become a meat substitute. In addition, many foods made from soybeans are popular and it is a common ingredient in many Vietnamese recipes, for example: soybean sauce, tofu. Therefore, TSP, with a taste quite similar to traditional soybean foods in Vietnam is expected to have high acceptability for palatability among Vietnamese people.

## METHODS

There were two phases in the study. **Phase 1: Creating new menus using TSP.** The research group conducted a pilot study to find the best cooking methods for 16 types of traditional dishes with TSP replacing the meat ingredient. These dishes were familiar to Vietnamese and did not require special cooking skills. For all dishes, the ingredients, seasoning, and sauce were kept the same, the only difference was that the meat in the recipes was replaced with TSP. We explored how much TSP could be added to the dishes and the proper amount was 20g of TSP for each dish. The 16 TSP menus were tasted and evaluated by research group members to assess palatability. Then the 10 tastiest menus were chosen to implement in the next phase of the study. Details of the cooking methods for the 10 TSP dishes are listed below.

### Best 10 menus with textured soybean protein

Dishes	Instruction	Dishes	Instruction
	TSP is soaked in water for 5 mins then squeezed as dry as possible. All ingredients are washed and cut into small pieces, then mixed together with sauce added to make a mixture. Spread a rice sheet on a flat surface, put a spoonful of mixture onto the sheet and wrap it. Pre-heated oil in a pan for 3 mins, then fry the spring until they turn brown.		TSP is soaked in water for 5 mins then squeezed as dry as possible. All ingredients are washed and cut into small pieces, then mixed together with sauce added to make a mixture. Spread a rice sheet on a flat surface, put a spoonful of mixture onto the sheet and wrap. Pre-heated oil in a pan for 3 mins, then fry the spring until they turn brown.
<b>Ingredients:</b> TSP (20g), Rice paper (5g), Tree ear (5g), Cellophane noodle (7g), Mushroom (3g), Carrot (20g), Onion (20g), Duck egg (10g), Oil (5g).		<b>Ingredients:</b> TSP (20g), Spinach(80g), MSG (2g).	
	TSP is soaked in water for 5 mins then squeezed as dry as possible. Stir-fry Katuk in a pot for 3 mins, add TSP, MSG. After 5 mins, add 500ml water and boil the soup.		TSP is soaked in water for 5 mins then squeezed as dry as possible. Stir-fry sliced gourd in a pot for 3 mins, add TSP, MSG. After 5 mins, add 500ml water and boil the soup.
<b>Ingredients:</b> TSP (20g), Katuk (80g), MSG (2g)		<b>Ingredients:</b> TSP (20g), Gourd (100g), MSG (3g).	

	<p>TSP is soaked in water for 5 mins then squeezed as dry as possible. Chop carrot, onion into cubes. Leave the peel of tomato and fry it for 5 mins to make a tomato sauce. Add carrot, onion to the sauce and continue cooking the mixture for 5 mins. When the vegetables become tender, add TSP. To finish, stir the mixture for about 5 mins.</p>		<p>TSP is soaked in water for 5 mins then squeezed as dry as possible. Stir-fry bean sprouts with oil in a pan for 3 mins then add loofah. Cook the vegetables well for about 3 mins. Add TSP, MSG to the pan, continue to stir the mixture for 3 mins.</p>
<p><b>Tomato Sauce mixed vegetables</b></p>		<p><b>Bean Sprouts with Loofah Gourd</b></p>	
<p><b>Ingredients:</b> TSP (20g), Tomato (30g), Western onion (40g), Carrot (40g), Soybean oil (2g), Fish sauce (3g)</p>		<p><b>Ingredients:</b> TSP (20g), Bean sprout (30g), Loofah gourd (100g). Oil (3g).</p>	
	<p>TSP is soaked in water for 5 mins then squeezed as dry as possible. Stir-fry mustard greens in a pot for 3 mins, add TSP, MSG. After 5 mins, add 500ml water and boil the soup.</p>		<p>Fry TSP in a pan without oil for 5 mins. Soak cabbage and carrot in salt water for 10 mins, then slice cabbage, carrot. Mix vegetables and fried TSP. Add Kewpie sauce to the mixture before eating.</p>
<p><b>Mustard Green Soup</b></p>		<p><b>Salad</b></p>	
<p><b>Ingredients:</b> TSP (20g), Mustard green (80g), MSG (2g).</p>		<p><b>Ingredients:</b> TSP (20g), Cabbage (80g), Carrot (15g), Kewpie sauce.</p>	
	<p>TSP is soaked in water for 5 mins then squeezed as dry as possible. Boil a pot of water then put morning glory into it for 3 mins. Take the well-cooked morning glory out. Fry garlic in a pan with oil, add morning glory, salt, and stir for 3 mins before add TSP. Continue to stir the mixture for 5 mins.</p>		<p>TSP is soaked in water for 5 mins, then squeezed as dry as possible. Stir-fry loofah in a pot for 10 mins, add jute plant, TSP, MSG. After 5 mins, add 500ml water and boil the soup.</p>
<p><b>Stir-fry Water Morning Glory</b></p>		<p><b>Jute Plant Soup</b></p>	
<p><b>Ingredients:</b> TSP (20g), Morning glory (80g), Garlic (5g), Soybean oil (3g)</p>		<p><b>Ingredients:</b> TSP (20g), Jute plant (80g), Loofah (50g) MSG (3g)</p>	

**Phase 2: Assessing the palatability and tolerance of new dishes using TSP:** There were 24 ordinary people who participated in this phase. The subjects were randomly selected in a community near Hanoi. We prepared two kinds of food samples, including 10 menus with TSP and 10 menus with meat (control dishes), each TSP dish and its parallel control dish were placed on the same table for the subjects to taste. The score for each dish in terms of appearance, aroma, taste, texture, overall was recorded by using the Hedonic 5-point scale (1. Dislike very much, 2. Dislike moderately, 3. Neither like nor dislike, 4. Like moderately, 5. Like very much). After finished the sensory test, all subjects were asked to eat 2 dishes with 40g of TSP every day for 4 weeks consecutively. The two TSP dishes were prepared and delivered daily to the subjects to eat at lunch and dinner. A nutrition survey (3 non-consecutive days) was conducted one week before and throughout the 4-week intervention period, using a food diary record. From the record, parameters including total energy, total protein, animal protein/total protein, carbohydrate, lipid, and fiber were analysed to assess the change in daily diet after adding the TSP dishes. At the end of the study, a questionnaire was created to interview the subjects about their tolerance for the new foods. Statistical analyses were conducted by paired

Student t-test using SPSS software version 20

QUESTIONNAIRE	
<p><i>Q1. Could you describe how did you feel about the amount of 40g TSP in 2 dishes which were delivered to eat daily for 4 weeks?</i></p> <p>A. Too much. B. Enough. C. Too little.</p>	<p><i>Q3. What would you suggest for frequency of using TSP product in your diet per week?</i></p> <p>A. 1-2 days per week B. 3-4 days per week C. 5-6 days per week D. 7 days per week</p>
<p><i>Q2. What would you suggest as a proper amount of TSP in each dish?</i></p> <p>A. Higher than amount served B. The same as amount served C. 3/4 served amount D. Half of amount served</p>	<p><i>Q4. After 4 weeks eating TSP dishes, how was your digestive status?</i></p> <p>A. Non-ulcer dyspepsia B. Digest comfortably C. Feel hungry faster D. Others</p>
<p><i>Thank you very much for completing the questionnaire!</i></p>	

## RESULTS

Table 1 shows the number of subjects and average age by gender. There were 24 subjects (9 males and 15 females) who participated into the study. The average age was about 63 years old. Table 2 shows the comparison of the sensory test between 10 TSP dishes and 10 control dishes. The average score of the 10 TSP dishes and control dishes were 3.9 and 4.2 points for overall taste, 4.1 and 4.4 points for appearance, 3.9 and 4.3 points for aroma and 3.8 and 4.4 points for basic taste, and 3.9 and 4.4 points for texture, respectively. The palatability of TSP dishes was close to that of the control dishes (cooked with meat) with no significant difference

( $p>0.05$ ) among the 10 dishes of each kind of food sample. Among the 10 TSP dishes, spring roll and stir-fry bean sprouts with loofah were the two dishes the highest overall taste scores.

**Table 1. Baseline characteristics of the subjects**

	Number	Age (Mean $\pm$ SD)
Male	9	60.3 $\pm$ 3.6
Female	15	64 $\pm$ 6.8
Total	24	62.7 $\pm$ 6.0

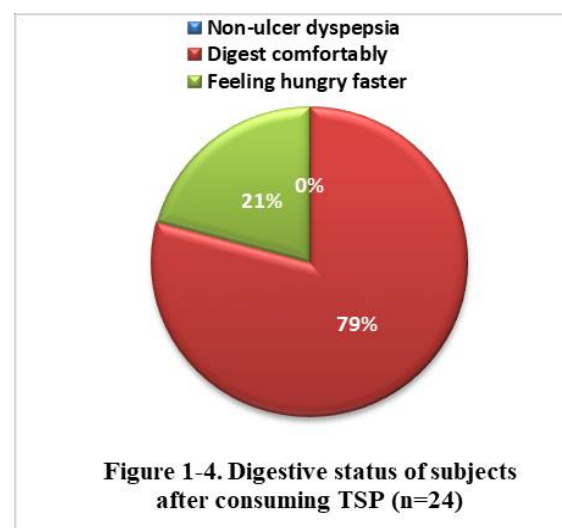
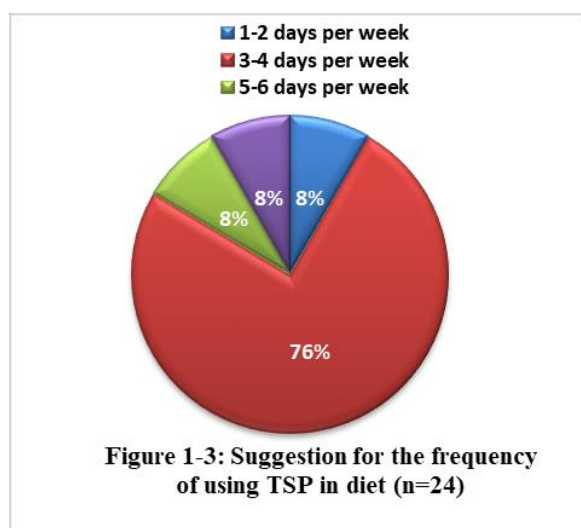
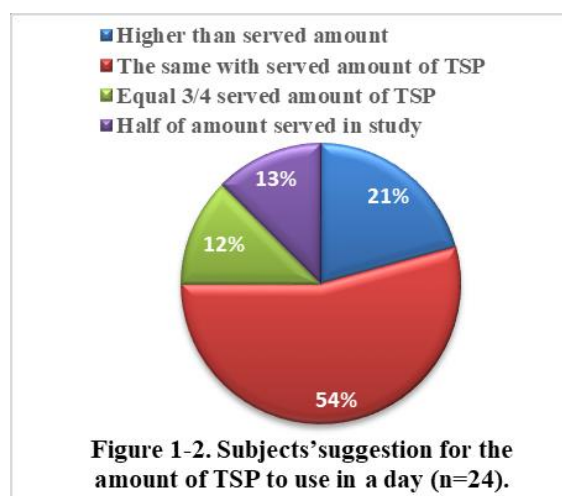
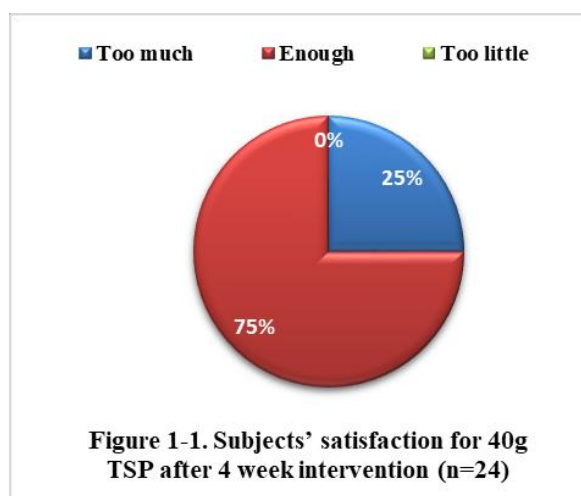
**Table 2. The comparison of sensory test between TSP dishes and control dishes in 10 different menus.**

Name of dishes	Food samples	Sensory test									
		Appearance (Mean $\pm$ SD)	P	Aroma (Mean $\pm$ SD)	P	Taste (Mean $\pm$ SD)	P	Textured (Mean $\pm$ SD)	P	Overall (Mean $\pm$ SD)	P
Spring roll	TSP dish	4.2 $\pm$ 0.4	ns	4.3 $\pm$ 0.4	ns	4.3 $\pm$ 0.4	ns	4.2 $\pm$ 0.4	ns	4.3 $\pm$ 0.4	ns
	Control	4.5 $\pm$ 0.4		4.4 $\pm$ 0.4		4.4 $\pm$ 0.4		4.5 $\pm$ 0.4		4.4 $\pm$ 0.4	
Malabar Soup	TSP dish	3.8 $\pm$ 0.4	*	3.8 $\pm$ 0.4	ns	3.6 $\pm$ 0.5	*	3.9 $\pm$ 0.6	ns	3.7 $\pm$ 0.4	*
	Control	4.3 $\pm$ 0.4		4.2 $\pm$ 0.3		4.3 $\pm$ 0.4		4.3 $\pm$ 0.4		4.1 $\pm$ 0.3	
Tomato Sauce with vegetables	TSP dish	3.8 $\pm$ 0.4	ns	3.3 $\pm$ 0.5	*	3.6 $\pm$ 0.4	ns	3.6 $\pm$ 0.4	ns	3.6 $\pm$ 0.4	ns
	Control	4.4 $\pm$ 0.4		4.3 $\pm$ 0.4		4.4 $\pm$ 0.4		4.3 $\pm$ 0.4		4.2 $\pm$ 0.3	
Green Mustard Soup	TSP dish	4.2 $\pm$ 0.5	ns	4.1 $\pm$ 0.5	ns	3.9 $\pm$ 0.5	ns	3.9 $\pm$ 0.5	ns	3.9 $\pm$ 0.5	ns
	Control	4.4 $\pm$ 0.4		4.3 $\pm$ 0.4		4.4 $\pm$ 0.4		4.4 $\pm$ 0.4		4.2 $\pm$ 0.3	
Stir-fry Morning Glory	TSP dish	4.3 $\pm$ 0.3	ns	3.9 $\pm$ 0.4	ns	3.9 $\pm$ 0.4	ns	4.0 $\pm$ 0.3	ns	3.9 $\pm$ 0.3	ns
	Control	4.5 $\pm$ 0.5		4.3 $\pm$ 0.4		4.5 $\pm$ 0.4		4.3 $\pm$ 0.5		4.4 $\pm$ 0.4	
Katuk	TSP dish	4.1 $\pm$ 0.3	ns	3.8 $\pm$ 0.5	ns	3.7 $\pm$ 0.5	*	4.2 $\pm$ 0.5	ns	3.9 $\pm$ 0.4	ns
	Control	4.7 $\pm$ 0.4		4.5 $\pm$ 0.4		4.5 $\pm$ 0.4		4.6 $\pm$ 0.4		4.5 $\pm$ 0.4	
Stir-fry Bean Sprouts, Loofah	TSP dish	4.2 $\pm$ 0.4	ns	4.2 $\pm$ 0.4	ns	4.2 $\pm$ 0.4	ns	4.2 $\pm$ 0.4	ns	4.2 $\pm$ 0.4	ns
	Control	4.5 $\pm$ 0.4		4.4 $\pm$ 0.4		4.4 $\pm$ 0.4		4.5 $\pm$ 0.4		4.4 $\pm$ 0.4	
Gourd Soup	TSP dish	4.1 $\pm$ 0.4	ns	3.8 $\pm$ 0.5	ns	3.7 $\pm$ 0.3	ns	4.2 $\pm$ 0.5	ns	3.9 $\pm$ 0.4	ns
	Control	4.6 $\pm$ 0.3		4.4 $\pm$ 0.4		4.4 $\pm$ 0.4		4.6 $\pm$ 0.4		4.4 $\pm$ 0.4	
Salad	TSP dish	3.8 $\pm$ 0.4	ns	3.6 $\pm$ 0.4	ns	3.7 $\pm$ 0.5	*	3.6 $\pm$ 0.5	ns	3.6 $\pm$ 0.4	ns
	Control	4.4 $\pm$ 0.4		4.1 $\pm$ 0.2		4.2 $\pm$ 0.3		4.1 $\pm$ 0.2		4.2 $\pm$ 0.3	
Jute Plant Soup	TSP dish	4.2 $\pm$ 0.3	ns	3.9 $\pm$ 0.3	ns	3.7 $\pm$ 0.3	ns	3.9 $\pm$ 0.3	ns	3.8 $\pm$ 0.2	ns
	Control	4.2 $\pm$ 0.3		4.1 $\pm$ 0.3		4.4 $\pm$ 0.4		4.1 $\pm$ 0.3		4.2 $\pm$ 0.3	
Average		4.1 $\pm$ 0.4	ns	3.9 $\pm$ 0.4	ns	3.8 $\pm$ 0.5	ns	3.9 $\pm$ 0.4	ns	3.9 $\pm$ 0.4	ns
		4.4 $\pm$ 0.4		4.3 $\pm$ 0.2		4.4 $\pm$ 0.4		4.4 $\pm$ 0.4		4.2 $\pm$ 0.3	

\* Significant difference by paired Student t-test between TSP dishes and Control dishes at  $p<0.05$ .

Figure 1 illustrates the tolerance of TSP dishes after 4 weeks consumption. Each pie chart stands for one question in the questionnaire. For 40g TSP in the diet, 75% of subjects could tolerate it, the remaining subjects answered that it was too much for them. There was 54% who suggested 40g of TSP as a reasonable amount to eat and 21% wanted the amount of TSP increased to more than 40g, 12% suggested  $\frac{3}{4}$  of the amount served in the study. Almost all subjects (76%) answered that they would like to have TSP dishes 3-4 days per week. There were about 80% of subjects whose digestive status was normal without any problems of constipation, diarrhoea and or non-ulcer dyspepsia.

Using TSP dishes in the daily diet for 4 weeks did not cause significant changes in total energy intake, total protein, or carbohydrate ( $p>0.05$ ) (Shown in Table 3). Although the amount of total protein was slightly increased (no significant different) but animal protein was dramatically decreased from 29 g to about 17g ( $p<0.001$ ), which changed the ratio of animal protein/total protein from 51% to 28%. In addition, subjects' lipid intake was also reduced significantly with  $p=0.001$ . The data indicated that fiber intake was significantly increased (6g) when compared with the diet without TSP dishes.



**Figure 1. Assessing the acceptability of TSP dishes among subjects after 4 weeks.**

**Table 3. Comparison of the changes in daily diet before and after using TSP dishes for 4 weeks.**

Variables	Baseline (n=24)	Final (n=24)	P
Energy (kcal/day)	1223±174	1182±151	0.2
Total protein (g/day)	57.6±13.8	62.4±9.3	0.08
Protein (%E)	(18.8%)	(21.1%)	
Animal protein	29.2±11.8	17.3±8.1	<0.001*
Protein animal/Total protein (%)	50.6%	27.7%	
Lipid (g/day)	37.8±15.6	26.5±9.2	0.001*
Lipid (%E)	27.8%	20.2%	
Carbohydrate (g/day)	174.9±35.2	160.5±30.8	0.09
Carbohydrate(%E)	57.2%	54.3%	
Fiber (g)	6.0±2.5	11.9±3.5	<0.001*

\* Significant difference by paired Student t-test at p <0.05.

## DISCUSSION

The study found that the 10 new TSP dishes were highly evaluated by the subjects scores comparable to the meat recipes ( $p>0.05$ ). In addition, by using dishes with 40g of TSP for each day substituted for meat in the traditional Vietnamese recipes for 4 weeks, subjects can significantly increase their fiber intake (by 6g) compared with their normal diet. It is interesting to note that, although the total energy, total protein and carbohydrate were not significantly changed after consuming TSP in the daily diet, animal protein and lipid witnessed a strong decrease ( $p<0.001$ ).

Vietnam has recently been facing problems of nutrition transition, which negatively affect the meal structure such as increased meat, saturated fat, sweetened beverages and decreased vegetable consumption. According to the Vietnamese general nutrition survey 2009-2010, the average vegetable consumption was about 190g/day (3). This amount was less than the Vietnamese RDA for adults (300g/d) (6). With the same situation for fiber intake, Vietnamese consumed about 9g/day which meets only half of the RDA recommendation of 20g/day (4). Considerable evidence has shown the effectiveness of increasing fiber intake in controlling lifestyle-related diseases. Meta-analysis studies have proved that increasing fiber intake in patients with DM decreased glucose levels (7). From another angle, meat consumption in Vietnam 2015 was 33.2kg per capita, but dramatically surged to 46.8kg per capita in 2019 (8). Eating red meat is increasingly being viewed as a guilty pleasure which may lead to adverse effects on consumers as well as on the environment. Components in meat that might be carcinogenic include heme iron, N-nitrous compounds in many processed meats, and heterocyclic aromatic amines and polycyclic aromatic hydrocarbons, which are formed when meat is cooked at high temperatures; red and processed meats might increase risk because they are usually rich in saturated fatty acids, which raise low-density lipoprotein cholesterol, and processed meat might also raise blood pressure because it is usually high in salt (2). A 4-year observational study in the US showed that subjects who consumed the highest levels of both unprocessed and processed red meat had the highest risk of all causes of mortality, cancer mortality and cardiovascular disease mortality. After adjusting for other risk factors, the researchers calculated that 1 additional serving per day of unprocessed red meat over the course of the study raised the risk of total mortality by 13%. An extra serving of processed red meat (such as bacon, hot dogs, sausage and salami) raised the risk by 20%. The researchers estimated that substituting 1 serving per day of other foods like fish, poultry, nuts, legumes, low-fat dairy and whole grains for red meat could lower the risk of mortality by 7% to 19%. If the participants had all consumed fewer than half a serving per day (about 42g) of red meat, the scientists calculated, 9.3% of the deaths in men and 7.6% of the deaths in women could have been prevented (9). Lifestyle-related diseases such as diabetes, dyslipidemia, cardiovascular diseases have been reaching alarming proportions as a result of these above dietary risk factors. Dietary treatment plays an essential role in controlling these diseases.

Regarding sources, fiber comes mainly from vegetables, but most vegetables in Vietnam are low in

fiber with less than 2 g fiber/100g of vegetable. So, it is really difficult to supply sufficient fiber only from vegetables.

Textured Soybean Protein (TSP), a soy product which is rich in fiber (13.6g/100g) and can provide interest in the daily diet. Hence, we wanted to take advantage of TSP products in Vietnam to make various menus which would help to increase fiber intake. There were new 16 dishes using TSP as a replacement for meat that were created in Vietnamese cooking style. After adjusting the taste, the 10 tastiest dishes were chosen to use in an intervention study. Evaluations of TSP dishes were close to those of the control dishes with no significant difference ( $p>0.05$ ) with 3.9 and 4.2 points for overall taste. These results were compared with a study conducted in Japan about a sensory test of Indonesian fermented soybeans (Tempeh) (10). In this study, 10 new dishes were made by replacing main ingredients like meat, fish, dairy product with Tempeh. The average evaluations of tempeh dishes and 10 control dishes were 3.5 and 3.7 points for overall taste. In this present study, the consumption of TSP dishes in the diet resulted in an increase in dietary fiber of 6g/day, which was higher than the fiber increase in the study using Tempeh (2g/day) (10). There was a similar result in increasing the amount of fiber in our study and a study using Okara (6g/day) (7) and as well as a study using pre-germinated brown rice (about 7g) (11).

Another implication from the results of this study is that by using TSP dishes, subjects can reduce their meat consumption by nearly half, from 29g/day to 17g/day. Although meat consumption decreased significantly after consuming TSP dishes, the total amount of protein and total energy in the diet remained unchanged. This change in the structure of the diet is recognized as a positive change which helps preserve the environment. To be specific, when livestock digest food, the bacteria in their digestive tract will ferment plants and release a huge amount of methane gas ( $\text{CH}_4$ ). When the animals burp, this gas is emitted into the air. The emissions from livestock, largely from burping cows and sheep and their manure, currently make up almost 15% of global emissions, which accelerates global warming more than cars, planes and all other forms of transport put together. In a study, Mekonnen and Hoekstra (2010) showed that the water footprint of any animal product is larger than the water footprint of a wisely chosen crop product with equivalent nutritional value. They calculated that the water footprint of a 150g soy burger produced in the Netherlands appears to be about 160 liters, whereas the water footprint of an average 150g beef burger is nearly 15 times larger (12). It is obvious that consumers can reduce their water footprint by reducing their volume of meat consumption.

To conclude, there is a strong relationship between eating meat, health and the environment. People should understand the effects of what they chose in their daily diet in order to make a wise choice. TSP product could be accepted as an edible ingredient which can be included in the daily diet for many good health purposes and to protect the environment as well.



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**Original****Factors in Low Prevalence of Child Obesity in Japan**

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**ABSTRACT** *Background and Objectives:* Sugars, as well as lipids, are tasty and likely to be consumed in excess. Since until recently there was no sugar composition table for Japan, therefore few reports about sugar intake have been existed. Lipid intakes in children are inconsistent. Since a dietary pattern of high sugar and high lipid intakes can become habitual and a factor for life-style-related diseases in adulthood, knowing the facts of dietary intakes of sugars and lipid is important. To determine the sugar and lipid intakes in children as factors in the low obesity prevalence in Japanese children. *Method:* A 3-day nutrition survey was conducted by the weighing and 24-hour recall method at a school in Tokyo, involving 58 children aged 8 and 10 years from average families. Sugars and lipid were calculated using the Japanese sugar composition and food composition tables. *Results and Conclusion:* Sugar and lipid intakes were not different among the ages and genders ( $p < 0.05$ ). Average sugar intake was 25.7 g/day was within World Health Organization recommendation (less than 10% of energy; about 45g) for more than 90% of the children and within the newly proposed World Health Organization guideline (less than 5% of energy intake; 22.4g) for almost 43% of them. Lipid and saturated fatty acid intakes were within normal levels for about 75% of the children. Sugar and lipid intakes were normal at a school in Tokyo. Low sugar and lipid intakes may be considered as factors for a low prevalence of obesity.

**Key words:** Sugar, lipid, obesity, school children, nutrition survey

**INTRODUCTION**

The principal sugars are sucrose, glucose, fructose, lactose, and maltose. For growing children, such sugars are particularly important as readily absorbed energy sources. However, sugar is tasty and can easily be consumed in excess. According to Japanese school statistics for 2012, the prevalence of obesity in school-age children was 4.1~10% which was relatively low among countries world-wide (1). Since excess sugar intake in childhood can become habitual and play a role in life-style related diseases in adulthood, a dietary habit of low sugar intake is important, especially in childhood. The World Health Organization (WHO) has recommended that sugar (excluding fruits and milk) intake should make up less than 10 % of total energy intake per day. This is based on the idea of chronic diseases prevention; 23 countries use this recommendation as a goal, and various countries use it as a guideline (2). WHO also further suggests that a reduction to below 5 % of total energy intake per day would have additional benefits, even though they have recommended sugar intake should stay at below 10 % of total energy intake a day (3). Until recently a sugar composition for Japan was not available and consequently there have been few reports on sugar

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intake by Japanese. Likewise, even the annual nationwide health and nutrition surveys in Japan have not included sugar intakes (4).

In Japanese food composition tables, mono- and disaccharides are included as carbohydrates and not shown as separate categories (5). The National Health and Nutrition Survey in Japan for 2010 showed a sugar intake of 5.3 g for children 7-10 years old, but this figure was for sugar used in cooking at home only. And for beverages and snacks, only weight was indicated (6). A standard individual bottle of a sweetened beverage contains approximately 50 g of various sugars. Intake of Sugar-Sweetened Beverages (SSBs) increased from 196 g per day in 2001 to 294 g per day in 2007 (7,8). Isomerized sugars are used in many SSBs. Isomerized sugar was developed in 1969 in Japan; it is produced enzymatically from starch to form glucose, part of which is converted to fructose (9). The ratio of the two sugars is approximately 1:1. The taste of isomerized sugar is high in sweetness but not long-lasting; in addition, it is cheaper than sweeteners obtained from other sources. For these reasons isomerized sugar is used in large quantities in beverages, ice cream and chilled snacks. One study regarding the sugar intake of Japanese

children has been conducted by Takeichi et al (17). Its results showed that the sugar intake of Japanese school children was about 25g/d. This is quite low compared to other countries. Given this background, the aim of the current study is to investigate whether sugar intake is a factor for the low prevalence of obesity in elementary school students in metropolitan Tokyo.

According to the Japan National Health and Nutrition Survey, in the ten years from 2001 to 2010, seafood consumption decreased from 94.0 g per day to 72.5 g, while meat consumption increased from 76.3 g to 82.5 g (10). Since 2008, consumption of meat has been greater than that of seafood. Since food habits originating in childhood can persist in later life stages, it is crucial to establish healthy habits in the early years. However, with regard to children's lipid intake, interpretations vary. Some maintain that lipid intake has increased because of the Westernizing of the diet, while others claim that it has not changed or has even decreased. However, the proportion of lipids to total energy intake is increasing because of a decrease in carbohydrate intakes (11, 12). Therefore, in addition to sugar intakes, a second purpose of this study was to investigate lipid intakes through a 3-day nutrition survey.

Although informative labeling is important in selecting food products, it is not legally required to list mono- and di-saccharides or fatty acids explicitly on food labels. Because of this, full nutrition information is still not readily available to consumers. It would be preferable to have better information on which mono- and di-saccharides and fatty acids we are consuming and in what quantities in order to assist nutrition professionals in formulating reliable advice. Therefore this study seeks to investigate intakes of sugars and fatty acids by children.

## METHODS

### Subjects

A nutrition survey was conducted in children of grade 2 (boys 17, girls 14) and grade 5 (boys 15, girl 12) in an elementary school in Tokyo.

### Design

The 24-hour recall method on 3 days (2 weekdays and 1 weekend day) was used; however during weekdays, subjects were given school lunch, therefore the school lunch was studied by the weighing method. The subjects were given record forms for three days and all the meals (breakfast, lunch, dinner and snacks such as between meal and bed time snack) were recorded by students' guardians; in some cases, older students did this by themselves. The following day, in the case of incomplete items or unclear descriptions on the form, the investigators confirmed details with the students directly or asked their guardians to fill out the items. Regarding school lunch, their meals were weighed before and after eating by investigators. An investigation of height and weight was used from students' health check-up data.

### Estimation of mono- and di-saccharide and lipid intake

Calculations of sucrose, glucose, fructose and lactose intakes from foods were done by using the sugar composition tables that were reported previously (13, 14).

Calculations for the lipid intakes were made in accordance with the data listed in "Standard Tables of Food Composition in Japan, 5 revised and enlarged Version" (5) and "Standard Tables of Lipid Composition in Japan, 5 revised and enlarged Version" (15).

### Ethical consideration

These studies were conducted with the approval of the Ethics Committee in the Kagawa Nutrition University in accordance with the Declaration of Helsinki (1964) (revision Tokyo (1975), Venice (1983)): Ethical principles for research involving human subjects, with special attention paid to the following: to prevent the identification of individuals, each subject's personal information was carefully coded and obtained data were strictly managed. A statement that participation in the research was by free will on the part of the participants was obtained from participants' parents and guardians; explanations were provided about the objectives and details of the investigation and the intention to use the results for oral and written presentations. Even after commencement, explanations were provided whenever subjects dropped out of the study, either of their own volition or at the guardian's behest; no subjects were penalized in any way.

### Statistical analysis

Statistical analysis of the data was carried out with Excel Statistics. Data were assessed by unpaired Student t-test and p values less than 0.05 were considered statistically significant. Correlation between body weight and sugar intake was also assessed.

## RESULTS

### Sugar Intake

Table 1 shows that the energy proportion of Protein, Fat and Carbohydrate intake and their percentage against energy (PFC ratio). Total energy were 1596 kcal, 1689 kcal, and PFC ratios were 15:30:54, 16:30:53 for the second grade boys and girls respectively, 2050 kcal, 1869 kcal, and PFC ratios were 16:29:53, 15:28:55 for the fifth grade boys and girls respectively. The mean for all was 1792 kcal, and the PFC ratio was 16:29:54. Ratios of protein, lipid and carbohydrate against energy intakes (%) in the second grade were 15.8, 29.6, 53.5 and in the fifth grade, 15.6, 29.1, 53.9 %. There was no significant difference among genders and grades ( $p > 0.05$ ).

Table 2 shows intakes of sugars (glucose, sucrose, fructose, lactose and the total) by grade. Total sugar intake by grade was  $25.9 \pm 13.7$ g (boys  $26.8 \pm 17.7$ g, girls  $25.1 \pm 6.9$ g) for the second grade, and  $25.4 \pm 12.9$ g (boys  $27.3 \pm 13.9$ g, girls  $23.1 \pm 11.8$ g) for the fifth grade. There were no significant difference among the 4 groups (grade and gender) and total sugar intake of all the children was  $25.7 \pm 13.2$ g.

**Table 1. Energy and major nutrient intakes**

Grade	Gender	Energy (kcal)	Protein (%energy)	Lipid (%energy)	Carbohydrate (%energy)
2	Boy (n=17)	1596±183	15.3±1.4	29.6±3.7	53.8±4.1
	Girl (n=14)	1689±180	16.3±1.4	29.6±2.9	53.1±4.2
	Mean		15.8±1.4	29.6±3.3	53.5±4.1
5	Boy (n=15)	2050±244	15.9±1.5	29.9±3.7	52.9±3.5
	Girl (n=12)	1869±214	15.4±1.5	28.3±2.1	54.9±3.4
	Mean		15.6±1.5	29.1±3.1	53.9±3.5
All (n=58)		1792±270	15.8±1.5	29.2±3.2	53.8±3.8

Mean±SD, No significant deference was observed among boys and girls in the second and fifth grade children by Turkey ( $p>0.05$ ).

**Table 2. Intake of mono- and di-saccharides**

Grade	Gender	Glucose (g)	Sucrose (g)	Fructose (g)	Lactose (g)	Total (g)
2	Boy (n=17)	3.4±4.3	17.5±11.2	3.2±4.0	2.7±3.0	26.8±17.7
	Girl (n=14)	2.6±1.6	17.4±4.2	2.7±1.6	2.4±1.6	25.1±6.9
5	Boy (n=15)	2.9±2.6	19.2±10.5	3.2±3.0	2.0±1.7	27.3±13.9
	Girl (n=12)	2.6±2.8	15.3±8.5	3.0±3.4	2.2±2.2	23.1±11.8
All (n=58)		2.9±3.0	17.4±9.0	3.0±3.1	2.3±2.2	25.7 ± 13.2

Mean±SD, No statistical differences in 4 subject groups and total sugars were observed among the 4 subject groups by Turkey ( $p>0.05$ )

Figure 1 shows that the proportion of mono- and di-saccharide intake for all subjects. Sucrose was 67.8 %, fructose was 11.9 %, glucose was 11.3 %, and lactose was 9.0 %; therefore sucrose was the highest.

Figure 2 shows contributions of 8 food groups to total sugars intake (except sugars for cooking) per day in both the second grade and the fifth grade. The food group contributing the most was dairy snacks such as yoghurt and lactated drinks. The second food group was SSBs such as carbonated drinks and soft drinks. The third food group was baked snacks. In addition from these results sucrose that was using for cooking was  $5.9 \pm 2.6$ g. Mean sucrose using for cooking by grade was  $5.4 \pm 2.6$ g (boys  $4.5 \pm 1.5$ g, girls  $6.1 \pm 2.5$ g) for the second grade, and  $6.6 \pm 2.5$ g (boys  $6.8 \pm 2.9$ g, girls  $5.8 \pm 1.8$ g) for the fifth grade.

The degree of obesity which is used as a Japanese standard was calculated using the following equation following equation.

Degree of obesity (%) = (Actual measured weight (kg) – Weight for height standards (kg)\*) / Weight for height standards (kg)\*100.

\*weight for height standards (kg) =  $a \times \text{Actual measured weight (kg)} - b$ , “a” is 0.513, 0.508 in 7 year olds, 0.752, 0.730 in 10 year old boys and girls respectively. “b” is 38.878, 38.867 in 7 years old, 70.461, 68.091 in 10 years [no –s] old boys and girls respectively (16).

In addition, the correlation between mono- and di-saccharide intake and body weight was calculated (Fig.3). We could not observe any relationship between sugar intake and body weight.

#### Lipid intake

The lipid intake of a day (mean ± SD) was  $53.6 \pm 9.9$ g (boys  $52.0 \pm 9.1$ g, girls  $55.6 \pm 9.6$ g) in the second grade, and  $65.6 \pm 12.1$ g (boys  $71.0 \pm 13.0$ g, girls  $58.8 \pm 5.0$ g) in the fifth grade. There was no significant difference among genders and grades ( $p>0.05$ ). Mean saturated fatty acid intake of total energy a day was  $9.8 \pm 1.6$  %,  $9.6 \pm 2.0$  %, in the second grade and fifth grade, respectively (Table 3).



(%)

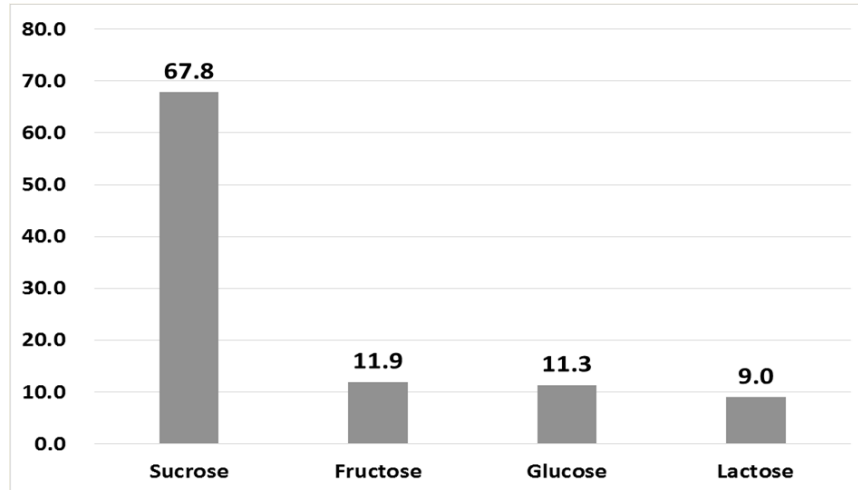


Figure 1. The proportion of mono- and di-saccharide intake for all subjects.

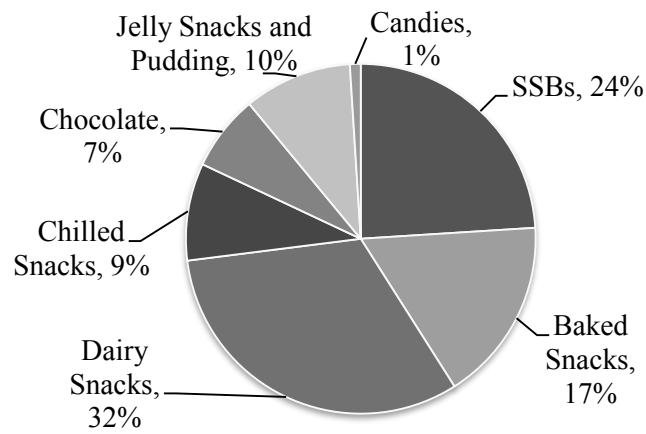


Figure 2. Contribution of various food groups on sugar intake

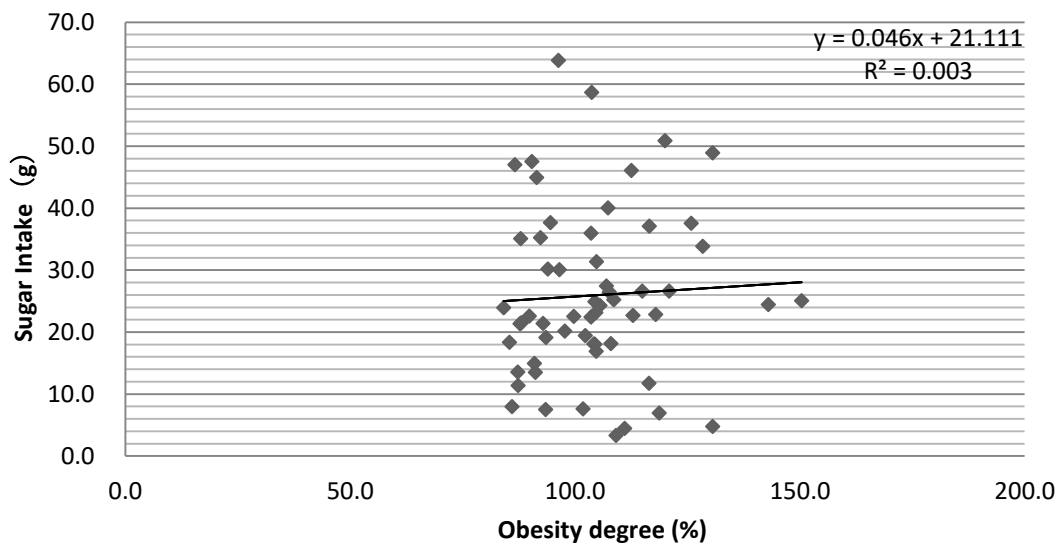


Figure 3. Correlation between body weight and sugar intake

**Table 3. Lipid intake (g/d)**

Grade	Gender (n)	Lipid (g)	Saturated fatty acid (g)	Mono-Unsaturated fatty acid (g)	n-3 Polyunsaturated fatty acid (g)	n-6 Polyunsaturated fatty acid (g)
2	Boy N=17	52.0±9.8	10.0±1.8	16.8±3.5	1.3±0.4	7.1±0.9
	Girl N=14	55.6±9.6	9.7±1.3	18.7±3.2	1.6±0.4	9.2±2.0
	Mean	53.6±9.9	9.8±1.6	17.2±4.6	1.6±1.0	8.1±1.8
5	Boy N=16	71.0±13.0	10.0±2.1	22.7±4.4	1.8±0.6	10.0±1.7
	Girl N=12	58.5±5.0	9.1±1.9	19.6±2.2	1.8±0.5	10.0±2.1
	Mean	65.6±12.1	9.6±2.0	21.3±3.9	1.8±0.5	10.0±1.9
All (n=59)		59.2±12.4	9.7±1.8	19.1±4.7	1.7±0.8	9.0±2.1

Mean±SD, No statistical differences in 5 and total lipid intake were observed among the 4 subjects groups by Turkey ( $p>0.05$ )

### DISCUSSION

We conducted a 3-day nutrition survey in second and fifth grade students at a school in Tokyo and found that sugar and lipid intakes were low compared to those of other countries. The average daily intakes of mono- and di-saccharides by the second grade and the fifth grade children showed no statistical differences; the combined average was  $25.7 \pm 13.2$  g, including sugar used in cooking (5.9 g). WHO recommends that sugars (excluding fruits and milk) intake should make up less than 10 % of total energy intake per day (2). WHO also further suggests that a reduction to below 5 % of total energy intake (3). In the current study, the energy intake of the second grade boys was  $1683 \pm 361$  kcal, for girls  $1686 \pm 173$  kcal, for the fifth grade boys it was  $2050 \pm 235$  kcal and for girls  $1869 \pm 205$  kcal. Ten percent of energy for second grade children was about 169 kcal, which was equivalent to 42 g of sugar; for fifth grade students it was about 197 kcal, which was 49 g of sugar.

Sugar intake of second grade children was  $25.9 \pm 13.7$  g, with the result that mean + 1 SD was 39.6 g and mean + 2SD was 53.3 g. Mean + 1SD covers 84 percent of subjects, while mean+2SD covers 97.5 percent. Ten percent of energy would be equivalent to 42 g of sugar for 2nd grade children and to 49 g for 5th grade children, which falls between 1SD and 2SD. Therefore, about 90 % of subjects were within the range of the WHO recommendation (10% of total energy). The results of the current study were similar to those of the study done in Japanese Children by Takeichi et al (17). Furthermore, sugar intake of 5% of total energy intake would be 22.4g in the case of the current study. Almost 43% of the children were within this WHO new recommendation. Sugar intakes of Japanese children might be one of the lowest among children in the developed world; even given that, fewer than half of these children would be within 5%. In reality, it would be difficult for other countries to meet the new WHO guideline/recommendation.

Sugar intakes in some other countries are: The U.K 85 g (18), Holland 135 g (19), and the US 142g (20). Compared to these data, the sugar intake of Japanese children was low.

According to the National Health and Nutrition Examination Survey (NHANES) in the U.S. 2005-2008, energy intake from SSBs for 6- to 11-year old children was 125kcal (boys:141 kcal, girls:112 kcal)(21). This mean that sugar intake from SSBs was approximately 30 g in the U.S. To compare to the results of the current survey, sugar intake from SSBs in Japan was 4.9 g for students in grade 2, 5.2 g for students in grade 5. The result of a previous study (Takeichi et al (16)) was also 6.7g of sugar in the form of SSBs.

In the current study, fructose intake was 11.9 % of the sugar intake, while glucose was 11.3 %, and the proportion of intakes for both sugars was almost the same, which suggests that these sugars came from isomerized sugar. Isomerized sugar, called high-fructose corn syrup (HFCS) in the U.S., is made from starch and contains roughly equal amount of glucose and fructose. According to Putnam et al (22), use of HFCS went from 0.5 pound per person in 1970 to 62.4 pounds in 1997. In the same year, beverages accounted for 72 percent of total HFCS deliveries for domestic food and beverage use, compared with 36 percent in 1980. The portion of HFCS in the caloric sweetener market in the 1980s was rapidly growing. Commercial products such as SSBs and chilled/frozen snacks use mainly HFCS rather than ordinary sugar because HFCS is cheaper and its taste is more suitable for them. As a result of that, one quarter of the calories available from the 1994 per capita food supply came from sugars (22).

It has been said that mono- and di-saccharide, such as HFCS, intake leads to obesity (23); however the result in the current study did not show such a tendency, nor did the other surveys was there only one other or more in Japan (17). Therefore, childhood obesity in Japan is

not caused mainly by sugar intake but the data suggest that other factors may be involved.

Some articles in The Washington Post discussed the Japanese school lunch and commented that the Japanese school lunch helped slow the rise of childhood obesity (26, 27). This is a unique point of view. Actually, it is obvious that sugar intake in Japan has been significantly lower than in the countries such as the U.S. However, in the current study, there are some limitations that we have to mention. Especially when we discuss beverages, we first of all have to consider the season/climate. There is the possibility that the reason for decreased intake of drinks was caused by the weather; in November, when the survey was conducted, the weather typically becomes cooler in Japan. We need further research in different seasons. The second point is the school environment: in the U.S, vending machines are available in most of schools, thus children can have soft drinks anytime they want (21). On the other hand, Japanese public elementary schools do not allow access to any vending machines; in addition, the most public school children are not allowed to bring money when they go to school. They have no chance to have beverages or other snacks, at least until they go home. Therefore to compare Japanese to U.S. children, it seems that U.S. children have easier access to SSBs and other snacks.

Regarding lipid intake, the mean lipid intake as energetic ratio (%) was  $29.2 \pm 3.2\%$  a day. While mean lipid intake as energetic ratio (%) is  $29.2 \pm 3.2\%$ , the value from SD to +1 SD is 32.4 %, to +2 SD is 35.6 %, DRI for lipid is from 20 to 30 %. From these results, it seems that almost 65 % of [the children took their lipid within the recommendation.

While the mean saturated fatty acid intake as energetic ratio (%) is  $9.7 \pm 1.8\%$ , the value from SD to +1 SD is 11.5 %, to +2SD is 13.3 %. There is no recommended value for saturated fatty acids in the guidelines in Japan; however in the U.S. it is recommended that should be less than 10 % of total energy intake (24). From these results, almost half of the children consumed lipids within the recommended values.

With regard to such low lipid and sugar intakes, we would like to mention school lunch. As an article of The Washington Post (25, 26) stated, school lunch in Japan may be unique and is definitely unusual for Westerners. In Japan, most of public schools have a school nutrition teacher/dietitian (12,036 school dietitians for whole country) and lunch is provided at 99.3% of elementary schools and 79.3% of junior high schools (27). The school nutrition teacher/dietitian are not only manages the school lunch to provide an interesting menu with the best balance of nutrients and adequate energy, but also learning food culture etc. Therefore meals are often termed useable nutrition education materials, as we discussed above with regard to the environmental differences between the US and Japan, Japanese children have fewer opportunities to have SSBs and empty foods such as high lipid and sugar-containing snacks.

Dietary habits formed in childhood can become permanent and play a role in adulthood. Therefore, a school lunch that provides one third of daily energy and nutrients for school age children is important, and it may help to form children's habits. This may help maintain a/the low rate of obesity in Japan. Low sugar and lipid

intake from food with daily habit as a daily habit may be considered as a factor of in the low prevalence of obesity among Japanese school-age children. Hence, school lunch may play a role in particular in controlling the intake of sugar and lipids. However to support this hypothesis, further study is necessary.

In conclusion, sugar and lipid intakes were normal for more than 90 % and 75% of children, respectively, at a school in Tokyo. It is also supported the low prevalence of obesity in Japanese children.

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**Original**

## Nutritional Assessment Tools in Patients with Pulmonary Tuberculosis: A Cross-Sectional Study

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**ABSTRACT** Background: Nutritional counseling is a highly recommended part of the treatment plan for Pulmonary Tuberculosis (PTB), as predominantly patients present clinically with malnourished status. However, scarce evidence exists on the prevalence of malnourishment among patients with PTB, particularly in Pakistan. This study therefore aims to report on the prevalence of malnutrition status, as documented using universal nutritional assessment tools on patients with PTB, receiving first-line drug (FLD) and second-line drug (SLD) therapies. Methods: A cross-sectional study enrolled 315 participants diagnosed with PTB, receiving FLD or SLD treatment, recruited from a tertiary-care hospital and clinic in Karachi, Pakistan. Inclusion criteria encompassed both genders, 18 to 55 years of age, with either new or relapsed PTB cases. A structured questionnaire composed of various methods for assessing nutritional parameters was conducted by a registered dietitian. The statistical analysis was carried out using SPSS, with data expressed as percentages, mean and standard deviation (SD), and statistically significant associations using p-value. Results: From 312 patients, 54.2% (n=169) were females and 61.2% (n=191) patients were on FLD therapy. Average Body Mass Index (BMI) (kg/m<sup>2</sup>) of the patients was  $17.72 \pm 3.15$  (SD), whereas average calorie intake (kcal) of the patients was  $1321.77 \pm 506.19$  (SD). Patients who received FLD had lower average BMI and MAMC (mm) in comparison to those on SLD. Mean differences were found to be statistically significant between both treatment groups for BMI (p-value=0.044) and MAMC (p-value= <0.001). Average BMI (p-value <0.001) and calorie intake (p-value=0.030) were significantly different when compared with the duration of treatment. Conclusion: The study reveals that patients diagnosed with PTB are presented with varying degrees of malnourishment, despite being on either drug therapy as indicated through data collected using validated tools specific for nutritional assessment. Based on the results, the extent of time on drug therapy is associated with the outcome of improvement in nutritional status in the patient.

**Keywords:** pulmonary tuberculosis, nutritional assessment, malnutrition, anthropometric measurements, Pakistan

### INTRODUCTION

Tuberculosis (TB) has been featured as a health emergency globally over the last two decades according to World Health Organization (WHO), along with being one of the major community health concerns weighing on the developing country of Pakistan (1,2). Pakistan presently ranks 6th among 22 countries with the highest reported burden of TB worldwide, with incidence drastically escalating, of which approximately 44% of the tuberculosis burden in the Eastern Mediterranean region (1, 3). Within developed or high-income countries, patients with TB have been linked with

poverty and low socioeconomic status (4). Low-income neighborhoods are negatively impacted from overcrowding and malnutrition, therefore, are prone to develop TB (5, 6). Pakistan has a spectrum of urbanization ranging from affluent to low-income neighborhoods with minimal access to healthcare services and treatment (6).

Studies have reported that patients with TB are malnourished as indicated by reduction in visceral proteins, anthropometrics indexes and macronutrients status (7). Strong evidence shows underweight body mass index (BMI) is exclusively a risk factor in developing TB (8). Although body weight has been seen to decrease during TB treatment, recovery can be slow and significant wasting can persist for months

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after the start of effective tuberculosis treatment (9, 10). The breakdown of protein and other reserves due to fever may also worsen nutrition parameters and weaken resistance against the infection (11). There is strong evidence that underweight body mass index (BMI) is exclusively a risk factor in developing TB (12). Wasting, or loss of bodily weight, has long been recognized as a main feature of tuberculosis, owing to a combination of decrease in appetite, loss of fat and lean tissue, as a result of decreased energy intake, complicated by altered metabolism as part of the bodily inflammatory responses.

Presently, international guidelines identify two treatment pathways to overcome TB: First-line drug (FLD) and second-line drug (SLD) therapy. To inhibit the resistant or slow-growing strains of TB, the continuation phase of the treatment is effectively controlled by using first-line drugs (FLD) (13). However, FLD therapy often fails to cure TB, causing further spread of the disease, leading to the emergence of drug-resistant bacteria. The emergence of multi-drug resistant TB (MDR-TB) is on the rise and a serious concern within the healthcare community (17). As a result, SLD drugs are utilized, however, they are more toxic and expensive than FLDs (14).

Nutritional assessment is fundamental in the management of Pulmonary TB (PTB) patients, requiring clinical expertise in history-taking and physical assessment, with the duties ideally being fulfilled by a registered dietician (RD), as the evaluation is multifaceted (15). Bhargava et al. (2017) simplified the tools comprising the nutritional evaluation, through abbreviation of tools utilized in the form of "ABCD," with "A" standing for anthropometry, "B" signifying biochemical assessment, "C" being clinical assessment, and "D" comprising of dietary assessment.

Anthropometry involves measurements such as height, weight, and BMI of patients. Biochemical, or laboratory, assessment involves evaluation of serum hemoglobin and complete blood count (CBC), and serum electrolytes to further evaluate for undernutrition status in patients of PTB. Clinical evaluation is often performed by a healthcare professional with expertise to identify signs of nutritional abnormalities, often represented as pallor, oedema, muscle wasting, flaky skin, and loss of buccal pad of fat along with numerous other clinical indicators of malnutrition (15). Lastly, a significant component of nutritional assessment includes the dietary assessment, involving gathering data based on the patient's dietary recall of food intake within the past 24 hours (15). All these tools are important to aid in determining the prevalence of malnutrition of an individual with PTB on drug therapy.

There is limited and lack of relevant data documented on the prevalence of nutritional status gathered using proper nutritional assessment tools specifically on TB patients within indigenous society of Pakistan. Therefore, this study is designed to provide a perspective on the prevalence of nutritional status of malnutrition among pulmonary TB patients. The aim of the study is to assess the nutritional status of pulmonary TB patients on FLD and SLD treatment utilizing universally recognized tools of nutritional assessment for patients receiving both types of drug therapy.

## METHODS

The research design involves a cross-sectional study, by enrolling 315 patients admitted for treatment of PTB, with either FLD or SLD, between December 2018 to March 2019. Setting of study was a public-sector, tertiary-care hospital located in Karachi, an urban city in Pakistan. A structured questionnaire was verbally administered by a registered dietician in the official language of Urdu, taking approximately 20-30 minutes to administer.

The inclusion criteria for the study subjects was as follows: patients of either gender giving informed consent, between the ages of 18-55 years, who are admitted & diagnosed with pulmonary TB, either as new or relapsed cases. The exclusion criteria were participants who were either pregnant, lactating, or on oral food supplements. Furthermore, if the patients were undergoing any other treatment or were diagnosed with other cross-infections, such as HIV, were excluded. The sample size for this study was calculated by a statistician, which encompasses an incremental 5% for participants to account for loss of follow-up and unwilling to participate in the study.

## Data collection

A quantitative, structured questionnaire with physical assessment parameters was conducted by a trained, registered dietitian (R.D.). Demographics such as age, gender, type of treatment, educational level, ethnicity, and occupational level was documented upon consent. After consent, anthropometric measurements were assessed and the participant's blood samples were withdrawn and sent for laboratory biochemical analysis. For anthropometric measurements of weight were measured to the nearest 0.1 kg without shoes using an electronic platform on a model weighing scale. For height, data was documented to the nearest 0.1 cm. Body mass index (BMI) was calculated ( $\text{kg/m}^2$ ) and the patients will be classified into categories of BMI based on the WHO population cut-offs for Asians (16). Mid-upper Arm Muscle Circumference (MAMC) were measured with a flexible, measuring tape. Triceps and sub-scapular skin folds aided in determining Mid-upper Arm Muscle Circumference (MAMC) by a skin fold tool and was calculated (17). Blood samples were collected to determine Hemoglobin (Hgb) and Albumin levels of each participant. Nutritional clinical assessment was conducted to evaluate for physical signs of malnutrition. Dietary history was documented by interviewing the participant about recalling their 24-hour dietary intake to calculate energy in kilocalories and protein in grams from Diabetic Exchange list (18). Based on the PTB treatment international guidelines, data related to nutritional assessment was collected at initial visit (<1 month), at an interval where treatment regimen was followed-up (<2 months), after the treatment was completed (<6 months), and a follow-up visit (<6 months) (19).

## Statistical Analysis

The statistical analysis was carried out using SPSS version 21.0. Percentage and frequency were reported for categorical variables whereas mean and standard deviation were reported for continuous variables.

Assumption of normality was checked by using Shapiro-wilk test of the continuous variables. Chi-square test was run to check association between categorical variables and type of treatment. Mann-Whitney U-test and Kruskal-wallis test were applied to check mean differences between type of treatment and duration of treatment. All test results having p-values less than or equal to 0.05 level of significance were considered statistically significant.

#### Ethical Issues

The study was conducted with the highest respect and dignity for participants. This study underwent ethical review through institutional review committee of Dow University at the beginning of the

study and data collection being initiated upon IRB approval.

#### RESULTS

A total of 312 pulmonary tuberculosis patients were included in the study and 3 patients had loss of follow-up during the study. Among all the patients 45.8% (n=143) were males and 54.2% (n=169) were females. Patients who were married were 56.4% (n=176). There were 44.6% (n=139) patients who were uneducated. Majority of the patients were Urdu speaking (31.7%, n=99) and then those who belonged to Sindhi ethnicity (26.9%, n=84). There were 61.2% (n=191) patients who were on FLD and 38.8% (n=121) patients who received SLD. None of the demographic variable showed any significant association with the type of treatment. See Table 1.

**Table 1. Socio-Demographic characteristics of pulmonary tuberculosis patients by type of treatment (n=312)**

Variables	Total	Type of Treatment		p-value*
		FLD (n=191)	SLD (n=121)	
		n (%)	n (%)	
<b>Gender</b>				
Male	143	92 (64.3)	51 (35.7)	0.299
Female	169	99 (58.6)	70 (41.4)	
<b>Marital status</b>				
Unmarried	136	91 (66.9)	45 (33.1)	0.070
Married	176	100 (56.8)	76 (43.2)	
<b>Education level</b>				
Uneducated	139	79 (56.8)	60 (43.2)	0.353
Up to secondary	135	88 (65.2)	47 (34.8)	
Intermediate and above	38	24 (63.2)	14 (36.8)	
<b>Ethnicity</b>				
Sindhi	84	49 (58.3)	35 (41.7)	0.083
Punjabi	44	31 (70.5)	13 (29.5)	
Balochi	10	8 (80.0)	2 (20.0)	
Pashto	29	16 (55.2)	13 (44.8)	
Urdu	99	66 (66.7)	33 (33.3)	
Others	46	21 (45.7)	25 (54.3)	
<b>Number of family members</b>				
≤ 4	66	46 (69.7)	20 (30.3)	0.056
5 – 9	196	110 (56.1)	86 (43.9)	
≥ 10	50	35 (70.0)	15 (30.0)	

\*p-value has been calculated using Chi-square test.

Anthropometric measurements were assessed of all patients. Average age of the patients was 34.91 years with SD  $\pm 14.62$  years and ranged between 18 and 60 years. It was found that in all patients average BMI ( $\text{kg/m}^2$ ) was 17.72 with SD  $\pm 3.15$  and ranged between 11.03 and 31.92. It was evaluated in biochemical characteristics and dietary history that average hemoglobin (g/dl) was 10.34 with SD  $\pm 1.02$  whereas average calorie intake (kcal) of the patients was 1321.77 with SD  $\pm 506.19$  which was ranged between 365 and

2550. It was reported that patients who received FLD had lower average BMI ( $\text{kg/m}^2$ ) and MACU (mm) in comparison with those who were on SLD. Mean differences were found to be statistically significant between both treatment groups for BMI (Mean difference=0.73, p-value=0.044) and MACU (Mean difference=18.22, p-value= <0.001). It was found that on average calorie (kcal) and protein (grams) intake was also lower in those patients who received FLD. See Table 2.

**Table 2. Comparison of nutritional status of pulmonary tuberculosis patients stratified in first-line drug (FLD) and second-line drug (SLD)**

Characteristics	Overall Mean	SD	Range
<b>Anthropometric measurements</b>			
BMI ( $\text{kg/m}^2$ )	17.72	3.15	11.03 - 31.92
MACU (mm)	220.49	40.6	127.0 - 330.2
<b>Biochemical characteristics</b>			
Hemoglobin (g/dl)	10.34	1.02	7.8 - 13.6
Albumin (g/dL)	2.33	0.52	1.0 - 3.6
<b>Dietary history (24-hour recall)</b>			
Calories (kcal)	1321.77	506.19	365 – 2550
Protein (grams)	49.91	23.68	10 – 112

	FLD (n=191)	SLD (n=121)	p-value*
	Mean $\pm$ SD	Mean $\pm$ SD	
<b>Age (years)</b>	35.56 $\pm$ 15.25	33.89 $\pm$ 13.56	0.377
<b>BMI (<math>\text{kg/m}^2</math>)</b>	17.44 $\pm$ 3.15	18.17 $\pm$ 3.12	0.044
<b>MAMC (mm)</b>	21.34 $\pm$ 3.95	23.16 $\pm$ 3.96	< 0.001
<b>Hemoglobin (g/dl)</b>	10.33 $\pm$ 1.04	10.35 $\pm$ 1.00	0.826
<b>Albumin (g/dL)</b>	2.35 $\pm$ 0.52	2.31 $\pm$ 0.53	0.334
<b>Calories (kcal)</b>	1298.71 $\pm$ 515.19	1358.16 $\pm$ 491.56	0.347
<b>Protein (grams)</b>	48.59 $\pm$ 22.32	51.98 $\pm$ 25.65	0.451

\*p-value has been calculated using Mann-Whitney U Test.

Mean differences were also calculated among four different durations of treatment. A clear increment in BMI was seen as the duration of treatment increases and highest significant mean BMI difference was found in between the patients who received treatment for less than a month and those whose duration of treatment was more than six months (Mean difference=3.79, p-value= <0.001). Calorie intake (p-value=0.030) was also found to be statistically significantly different among the groups of duration of treatment. See Table 3.

Clinical examination data pertaining to nutritionally deficiencies in PTB patients were also gathered. Out of all the patient participants, a mere 1.3% reported night-blindness, dry with yellow or white spots

in eyes was reported in 7.7% of the participants. Dry, dull, or rough appearance of eyes was observed in 21.8%, while pale conjunctive was stated in 19.6%. Softening of cornea was reported in 2.6%, while 10.6% were examined to have cracked and reddened cornea of eyes. Bilateral cracks or redness of lips was observed in 9.9%, vertical cracks (cheilosis) were assessed in 13.1% of participants. In clinical examination of tongue features, magenta was observed in 28.5%, smooth or slick or loss of papillae was observed in 19.6%. Beefy, red-color or red/swollen mucosa was observed in 23.1%, while decreased taste was reported by 18.9% of patients. Clinical data observed for nails included the observation of spoon-shaped nails was seen in 43.9%, dull or lack-

luster was seen in 30.8%, pale or mottled appearance was observed in 21.2%. Clinical assessment of pallor appearance was seen in 33% out of total patient participants. Muscle-wasting was seen in 26.0%, difficulty in walking was reported by 26.6% of

participants. Musculoskeletal problems, such as pain in calf or thighs were reported in 18.3%, joint pain or swelling was reported in 37.8%, while a mere 10.9% of total participants stated difficulty in walking. (See Table 4).

**Table 3. Nutritional status of pulmonary tuberculosis patients by duration of FLD treatment (n=312)**

Variables	During Drug Treatment		After Drug Treatment		p-value*
	< 1 month (n=191)	< 2 months (n=191)	< 6 months (n=191)	> 6 months (n=191)	
	Mean ± SD				
BMI (kg/m <sup>2</sup> )	16.15 ± 1.89	17.53 ± 2.82	18.86 ± 3.31	19.94 ± 4.05	<0.001
MAMC (mm)	21.74 ± 3.65	22.195 ± 4.51	22.21 ± 3.9	22.06 ± 3.86	0.826
Hemoglobin (g/dl)	10.27 ± 1.02	10.33 ± 1.12	10.39 ± 0.98	10.42 ± 0.83	0.828
Albumin (g/dL)	2.34 ± 0.47	2.27 ± 0.51	2.37 ± 0.54	2.43 ± 0.59	0.484
Calories (kcal)	1264.24 ± 491.16	1420.53 ± 525.12	1327.92 ± 508.70	1167.10 ± 436.52	0.030
Protein (grams)	46.88 ± 21.35	53.71 ± 24.06	50.70 ± 26.69	44.85 ± 21.13	0.119

\*p-value has been calculated using Kruskal-wallis test.

**Table 4. Nutrition based clinical assessment of pulmonary tuberculosis patients (n=312)**

Physical Signs	N		%	
Eyes	Yes	No	Yes	No
Night Blindness	4	308	1.3	98.7
Dry with yellow or white spot	24	288	7.7	92.3
Dry, dull, rough appearance	68	244	21.8	78.2
Pale conjunctive	61	251	19.6	80.4
Softening of cornea	8	304	2.6	97.4
Cracked and reddened corners of eyes	33	279	10.6	89.4
Lips				
Bilateral cracks or redness of lip	31		9.9	
Vertical cracks (cheilosis)	41		13.1	
N/A*	240		76.9	
Tongue				
Magenta	89		28.5	
Smooth, slick or loss of appetite	61		19.6	
Beefy red color mucosa, red and swollen	31		9.9	
Decreased taste	72		23.1	
N/A*	59		18.9	
Nails				
Spoon-shaped	137		43.9	
Dull, lackluster	96		30.8	
Pale, mottled	66		21.2	
N/A*	13		4.2	
Pallor				
Yes	103		33.0	
No	209		67.0	
Muscle Wasting				
Yes	81		26.0	
No	231		74.0	
Difficulty in Walking				
Yes	83		26.6	
No	229		73.4	
Musculoskeletal				
Pain in calves or thighs	57		18.3	
Joint pain or swollen	118		37.8	
Difficulty in walking	34		10.9	
N/A*	89		28.5	

\*N/A=Not Available

## DISCUSSION

Nutritional assessment is a core component, yet an often rarely applied aspect, of a pulmonary tuberculosis patient's treatment plan. This study noted there is no significant difference between gender and nutritional status in patients on either FLD or SLD. In addition, this research demonstrated that most (20-22). Newly diagnosed adult TB patients were underweight based on BMI and MAMC at the time of initiating drug therapy, with majority of the participants being moderate to severely malnourished. Numerous evidence-based researches have observed malnourishment being evident in TB patients at the time of enrollment, in a spectrum of both developing and developed countries WHO (2013). This study found PTB patients had reported lower cut-offs for BMI, mid-arm muscle circumference (MAMC), and lower ranges of serum albumin, despite being maintained on FLD or SLD therapy. Similarly, a study conducted in India revealed that TB patients were 11 times more likely to have a BMI of less than 18.5, indicating a borderline underweight status (Shetty, 2006) (23).

Based on the results of this study, significantly lower serum albumin levels were noted in patients taking either treatment for PTB, which is similar to findings of an Iranian study conducted on 120 patients (Sultan et al., 2012) (24). A study by Kumar et al. (2014) (25) highlighted the necessity for protein consumption in patients with multi-drug resistant PTB as findings showed lower serum protein, serum albumin and blood hemoglobin levels. Low albumin could be attributed to hepatic production of acute phase reactant proteins due to cytokines, such as interleukin-6 and tumour necrosis factor (TNF), which inhibits the creation of serum albumin in the blood vessels, causing severe fluctuations in the plasma concentrations of certain essential micro-nutrients and albumin.

Skin-fold thickness measures the amount of fat under the skin. Patients with lower than mean averages of skin-fold thickness within this research were considered under-nourished. In comparison, a study conducted by Nthiga et al. (2017) (26) in a referral hospital in Kenya indicated the mean and percentages of skin-fold thicknesses were lower declaring undernourishment among PTB patients. Body wasting is a pronounced and characteristic feature among PTB patients, which is linked with lower caloric intake due to loss of appetite and lack of food consumption (Schwenk et al., 2000) (27). The study's findings show lower ranges of MAMC in TB patients taking either FLD or SLD. In Uganda, Mupere and colleagues (2010) (28) reported when compared to individuals negative for TB, patients with TB displayed lower body mass index (BMI), body weight, body cell mass, and fat mass, regardless of gender (29). This research showed patient's mean hemoglobin concentrations were significantly lower as compared to normal physiologic levels.

This study's results showed the caloric intake was found to be statistically significant based on the duration of treatment, with a longer duration of drug treatment being associated with greater caloric and protein intake among the PTB patients (see Table 3). According to WHO (2013) guidelines, approximately 40kcal/kg and

proteins 1.2-1.5 grams should be ideally consumed by patients diagnosed with TB diseases (30). This effort is to fill the gap in knowledge since there are few studies conducted in Pakistan previously. To the best of the authors' awareness, there have been no previous studies conducted to fill the gap in knowledge and clinical practice to best determine calories and protein consumption, specifically addressing TB patient's nutrition needs within Pakistan. Based on the results of our study, inadequate intake of calories and protein are associated with the diseased state of PTB, as the patient recovers with the disease, similarly, causing improvement in the patient's dietary intake. Inadequate dietary intake is due to patients' inability to access adequate nutritious foods, thus, causing malnutrition. The use of the 24-hour dietary recall as an instrument presents as a limitation in this study. The dietary recall tool introduces social desirability bias and recall bias, in which patients may not be able to fully recollect or under-report their past dietary intake or possibly provide responses which will be favored by the interviewer.

## CONCLUSION

The study reveals that patients diagnosed with PTB are overall nutritionally malnourished, despite treatment with either FLD or SLD therapy, due to the pathophysiological impact of the disease on the patient's body. Based on the results of this study, it is understood that the duration of the drug therapy is associated with the outcome of improvement in nutritional status. Thus, it is advised to initiate drug therapy with immediate effect to hinder the malnourished state of the PTB patient. Nutritional counseling is often undervalued as a part of the treatment regime for PTB, especially in the developing country practices of Pakistan. However, literature and research have determined that the true nutritional parameters are assessed based on validated tools, such as anthropometric measurements of BMI or muscle arm circumference, biochemical laboratory factors such as albumin, 24-dietary recall and clinical physical assessment, and have been found as strong predictors to evaluate the nutritional trajectory in patients with PTB. Majority of the patients with pulmonary TB in this study were categorized as severely underweight accompanied by low caloric intake based on the 24-hour dietary recall.

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**Original****Effects of Thinly Sliced Meat on Time, Number of Chews, and Food Intake in Elderly People with Tooth Loss**

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**ABSTRACT** *Background:* The loss of teeth in elderly people reduces their chewing ability and leads to a decrease in food intake, including meat. In Vietnam, meat is a common source of protein; most people maintain the habit of buying meat in large pieces from traditional markets and then slicing it at home with a knife. However, the thickness of meat sliced by hand is usually 3-5mm; the slices are large and irregular so they are difficult for the elderly to chew. In Japan, which has the highest proportion of elderly and the longest healthy life expectancy in the world, people generally use pre-sliced meat instead of block meat. By using a meat slicer, we can get pieces of meat of the same size, with a thickness of only 1.5mm (depending on the adjustment to the slicer). *Purpose:* To examine the effect of using thinly sliced meat compared with meat sliced by hand on time of chewing and the number of chews and food intake in older adults who have lost teeth. *Methods:* We conducted an intervention study following a cross-over design on 38 elderly subjects. After evaluating sensory characteristics and recording the time and number of chews between 2 samples of meat (thinly sliced meat and hand-cut meat), they were randomly divided into groups A and B; each group had 19 subjects. We provided subjects all the foods that they ate with either diet, using thinly sliced meat or hand-cut meat (cooked in the same way and with the same quantity) for 1 week. After a week washout, the diet was reversed. The subjects did not eat anything apart from the diets that they were served. The diets were weighed before and after eating and then the amount of food consumed was calculated. *Results:* The thinly sliced meat took less over-all time for chewing and fewer chews than the hand-cut meat (same quantity). To chew 3g of thinly sliced meat, subjects took  $53 \pm 22$  times and  $47 \pm 23$  seconds while to chew the same quantity of hand-cut meat needed  $73 \pm 35$  times and  $65 \pm 33$  seconds, both ( $p < 0.05$ ). When subjects consumed the Thinly sliced meat diet, energy, protein, lipid intakes were higher than with the Hand-cut meat diet in both moderate dentition subjects (21-27 teeth) and poor dentition subjects (20 teeth or less), and the differences were statistically significant ( $p < 0.05$ ). The average scores of the sensory test for thinly sliced meat samples were higher than for sliced by hand samples in terms of taste, tenderness, and overall acceptability ( $p < 0.05$ ). *Conclusions:* Thinly sliced meat was easier to chew and favored over meat sliced by hand in the elderly who have lost teeth.

**Keywords:** food intake, elderly people, lost teeth, thinly sliced meat

**INTRODUCTION**

The Vietnamese aging population is increasing rapidly. According to the United Nations Population Fund and General Statistic Office, the proportion of

the population aged 65 and over will increase from 7.1% in 2014 to 18.1% in 2049(1). Elderly people have many health problems, among which tooth loss has become an issue of concern in the Vietnamese elderly. Although the prevalence of complete tooth loss has declined over the last decade, edentulism remains a

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major disease worldwide, especially among older adults (2). According to Nguyen Thuy Nga and Truong Manh Dung (2017), the overall rate of tooth loss in elderly people in Hanoi in 2017 was very high (80.7%)(3). Another study showed that 27.8% of 258 elderly people aged 65-74 years in Danang often had difficulty chewing foods (4).

It is necessary to provide soft diets in hospitals and nursing homes, where the majority of elderly people have difficulty in chewing due to tooth loss. Most elderly patients commonly avoid hard foods and are provided soft and light meals like porridge, noodles, and soup, which are usually cooked with meat, particularly pork and beef. These types of meat are common sources of protein in Vietnam and are frequently present in daily meals.

However, meat sliced by hand is usually thick (3-5mm), large, and irregular in size, which causes the elderly to have some difficulties in chewing. Therefore, soft meals in Vietnam lack variety and are repetitive because of the use of finely chopped meat. This increases the feeling of anorexia. Consequently, this situation has a negative effect on nutritional status in such patients in the present and will have in the future.

In this regard, thinly sliced meat could be a feasible solution. It is a type of meat which is cut by machine, very thin (1.5mm), against the grain, so it is easy to chew and is especially suitable for the elderly with tooth loss. Sliced meat can be used daily, prepared in various ways and combined with a variety of foods, increasing the nutritional value of the dishes. Not only is this a solution for hospitals in the nutritional care of the elderly, but patients can also learn recipes using sliced meat so they can prepare their own meals at home. We expect that using sliced meat is more beneficial than the currently used hand-cut meat in helping elderly patients improve their daily meals, increase their food intake, and finally improve their quality of life through their diet.

Therefore, we decided to conduct a study "Using thinly sliced meat to improve the time, number of chews and food intake in elderly people with edentulism" with the purpose of determining whether sliced meat can improve taste and appetite for elderly people with tooth loss problems by increasing variety in their diet.

## METHOD

**Subjects:** Elderly patients ( $\geq 65$  years old) who were classified with moderate dentition (21-27 teeth) or poor dentition (20 teeth or less) by the number of remaining teeth (excluding the third molar) from the Geriatric Department, Internal Medicine Department, and Traditional Medicine Department at Dong Da General Hospital were screened. Patients with mental disorders, confusion and those with contraindications to oral nutrition or being fed by tube were not included in our study. We used the Water Swallow Test (WST) to exclude patients with

dysphagia. After screening, a total of 38 elderly patients who met the inclusive criteria were selected.

**Sensory evaluation:** To prepare for evaluation, the subjects were not hungry, had not consumed food or chewed gum within 1 hour, had not consumed liquids except water within  $\frac{1}{2}$  hour, were not wearing perfume, had not brushed their teeth within 1 hour, had not smoked within 1 hour, and were not wearing lipstick. The evaluation area was separate from the food preparation area, free of extraneous odors, with minimal noise level and no communication, visual or oral, between panelists during sensory evaluation. The subjects received 2 meat samples for comparison; one was 50g boiled thinly sliced meat (thickness 1.5mm) and the other was 50g boiled hand-cut meat (thickness 3-5mm). The subjects observed, smelled, and tasted them, and then used a Hedonic 9-point scale to score the characteristics of the two samples on color, aroma, taste, softness and overall acceptability.

**Time and number of chews:** After the sensory test, the subjects ate the same quantity (3g) of each meat sample. This process was recorded by camera. Then researchers watched that and counted the over-all time for chewing and number of chews before swallowing.

**Intervention study:** We conducted an intervention study following a cross-over design. After assessing the nutritional status of subjects by Mini Nutritional Assessment Tool (MNA), they were randomly divided into groups A and B; each group had 19 people. We provided subjects all the foods that they eat with either diet, one using thinly sliced meat and one using hand-cut meat (cooked in the same way and with the same quantity) for 1 week. After a week washout, the diet was reversed. The subjects did not eat anything apart from the diets that they were served. The diets were designed to meet the nutritional recommendations of the National Institute of Nutrition (NIN) for the elderly in Vietnam. We made the three-day cycle menus from Vietnamese traditional dishes which are commonly served at home meals. They combined a variety of locally available ingredients, also including protein-rich foods other than meat such as fish, shrimp and tofu; there was always at least one dish using meat. The two diets used the same ingredients and quantities, were cooked in the same way by the same chef, and were different only in the kind of meat they used. Despite being cut the same size, the thickness of the two types of meat was different, the Thinly sliced meat with a thickness of 1.5mm, the Hand-cut meat with a thickness 3-5mm. Snacks were provided in mid-morning and afternoon with lactose-free milk and fruits. The diets were weighed before and after eating and then the amount of food consumed was calculated. The ratio of raw and cooked food was converted according to the coefficient of NIN [5]. Energy and nutrient intakes were calculated based on the Vietnamese Food Composition Table 2016 [6].

**Meat for study:** The pork and beef used in this study were produced in Vietnam. After being frozen under the same conditions, half of the meat was sliced thinly by a meat cutter with a thickness of 1.5mm, the other half was sliced by hand after defrosting. Both kinds of meat were defrosted in a refrigerator at 5°C or lower before cooking.

**Ethics of human subject participation:** The study received permission from the ethical committee at Hanoi Medical University, Vietnam. All subjects were informed in detail about the purpose, the

advantages and disadvantages of this study, and their rights and obligations. Informed consent was obtained from all the participants.

**Statistical methods:** Data were analyzed by using STATA version 14. Values are reported as means  $\pm$  standard deviations (SD). Quantitative variables (energy and nutrient intake between 2 diets) were checked for distribution and compared by the Wilcoxon signed-rank test, *p*-values of less than 0.05 were considered statistically significant.



Photograph 1. Slicer and thinly sliced meat (left) and hand cut meat (right)

Table 1. General characteristics of subjects

	Classification	Number (n=38)	Percent (%)
Gender	Male	12	31.6
	Female	26	68.4
Age	Mean age (Mean $\pm$ SD)	73.8 $\pm$ 6.7	
	65-79 years old	29	76.3
	$\geq 80$ years old	9	23.7
Dentition	Moderate dentition (21-27 teeth)	29	76.3
	Poor dentition (20 teeth or less)	9	23.7

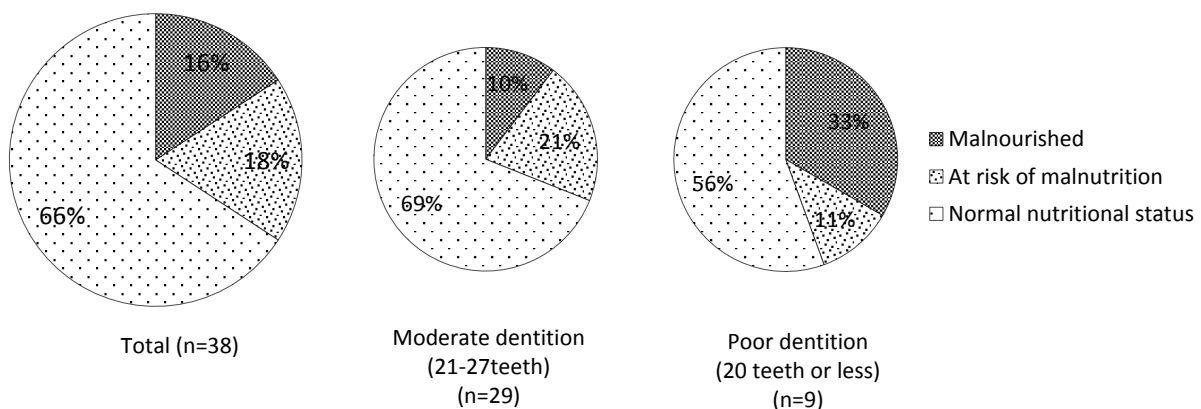


Figure 1. Nutritional status assessment based on MNA tool

## RESULTS

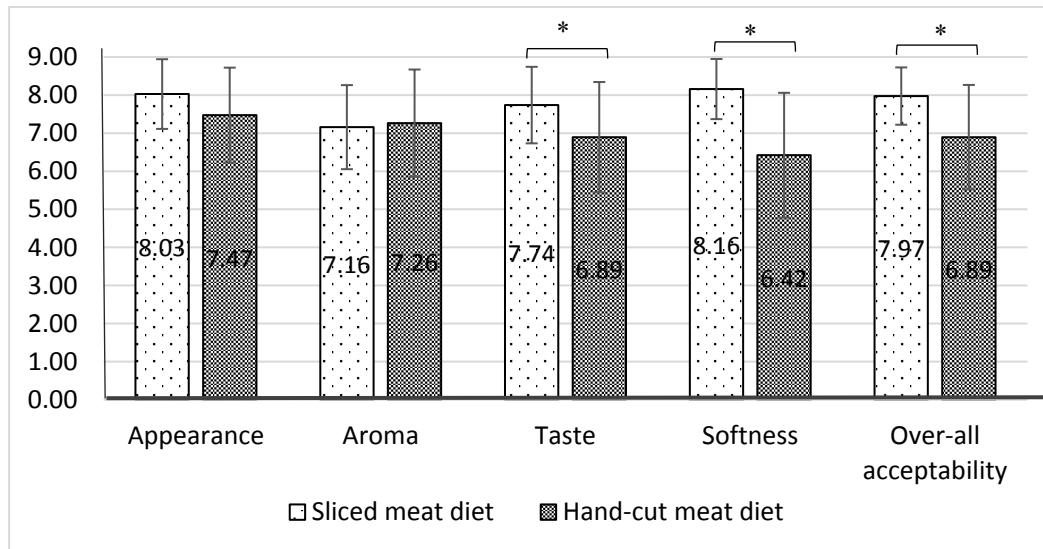
Table 1 shows the general information on study subjects (including gender, age and dentition). Data consisted of 38 subjects: 12 subjects (31.6%) were male while 26 subjects (68.4%) were female. The average age was 73.8  $\pm$  6.7 years old. There were 76.3% (n=29) patients aged 65 – 79 years old and 23.7% (n=9) aged 80 and over. There were 76.3% of

total patients who were classified with moderate dentition (the number of remaining teeth was 21-27 teeth), equivalent to 29 patients; 8 patients were in the poor dentition group (20 teeth or less), accounting for 23.7% of the total. Of the total of 38, subjects with normal nutritional status were highest, at about 66%; the percentage of patients with at risk

malnutrition was 18% while the figure for malnourished was lowest, at 16% (Fig. 1). The proportion of patients with normal nutritional status in the Moderate dentition group was higher than in the poor dentition group, 69% compared with 56%. There were 10% malnourished patients in the moderate dentition group while 1/3 patients in the poor dentition group were malnourished.

**Sensory evaluation:** Fig. 2 shows average points for characteristics of sensory evaluation. The mean

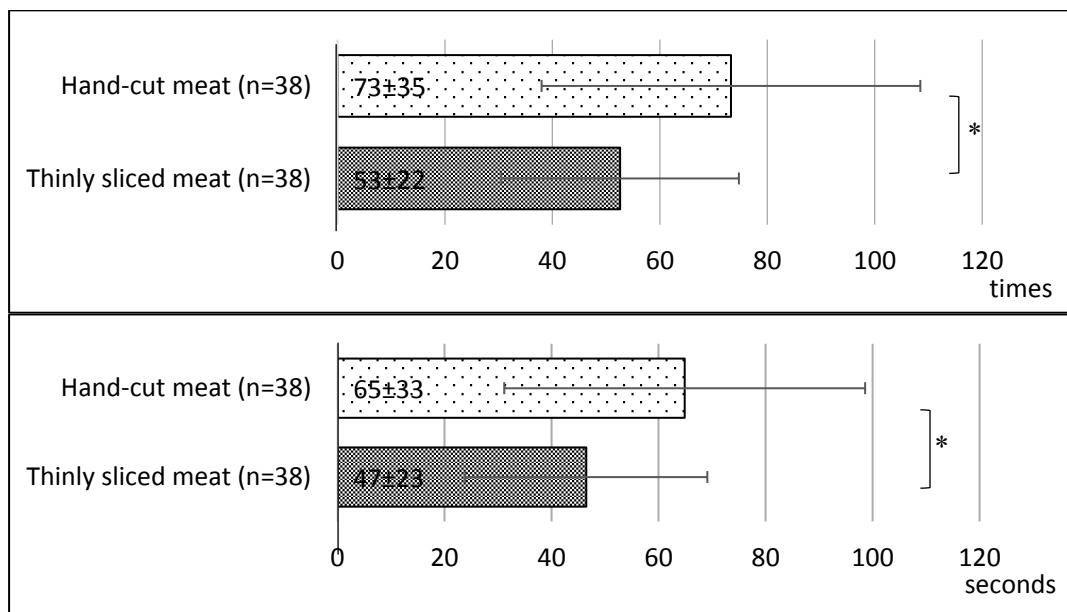
scores for the thinly sliced meat sample were higher than for the hand-cut meat sample in appearance, taste, softness and over-all acceptability in which taste, softness and over-all acceptability are statistically significant ( $p < 0.05$ ). The mean scores for the Hand-cut meat samples were higher than the mean points for the Thinly sliced meat samples only for aroma; however the differences are not statistically significant ( $p > 0.05$ ).



**Figure 2. Average of points for characteristics of sensory evaluation (n=38)**  
(\*:  $p < 0.05$ , by Wilcoxon signed – rank test)

To chew 3g of thinly sliced meat, subjects needed  $53 \pm 22$  times and  $47 \pm 23$  seconds while to chew hand-cut meat of the same weight took  $73 \pm 35$  times

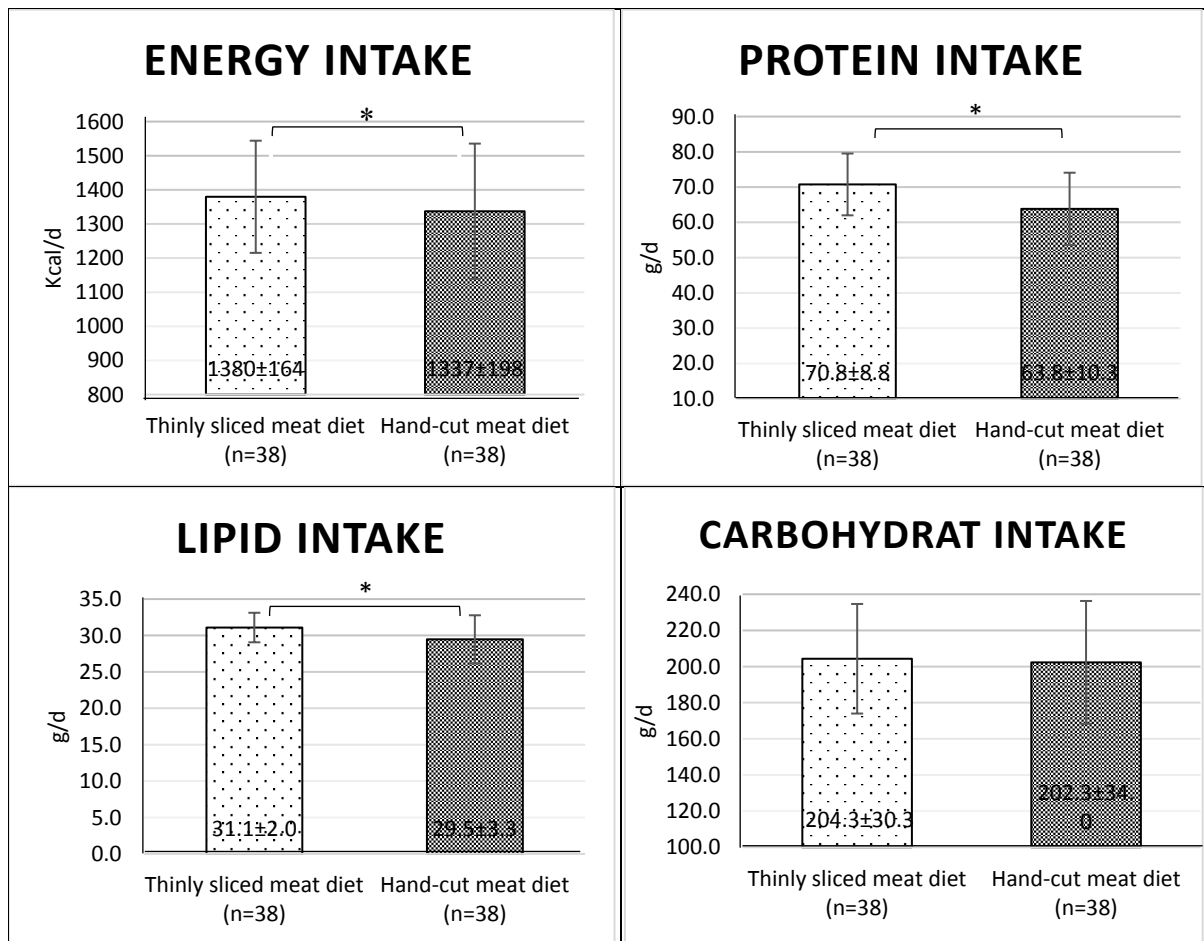
and  $65 \pm 33$  seconds (Fig.3). Both indicators were statistically significantly different ( $p < 0.05$ ).



**Figure 3. The time and number of times to chew the same weight (3g)**  
(\*:  $p < 0.05$ , by Wilcoxon signed – rank test)

Fig. 4 shows energy and nutrient intakes for diets using thinly sliced meat and diet using hand-cut meat. The results from the 38 subjects indicate that the mean energy, protein, lipid intakes for the sliced meat diet were higher than for the hand-cut meat diet. Values from the Sliced meat diet were  $1380 \pm 164$  kcal/day,  $70.8 \pm 8.8$ g protein per day,  $31.1 \pm 2.0$ g lipid per day, compared with  $1337 \pm 198$  kcal/day,  $63.8 \pm 10.3$ g protein per day,  $29.5 \pm 3.3$ g lipid per day. And the differences are statistically significant for mean

energy, protein, and lipid between the 2 diets ( $p < 0.05$ ). The mean carbohydrate is the same for both diets with no statistical significance ( $p > 0.05$ )  $204.3 \pm 30.3$  g in the Thinly sliced meat diet and  $202.3 \pm 34.0$ g in the Hand-cut meat diet. For all energy, protein, lipid and carbohydrate intakes, the distribution of data from the Hand-cut meat diet is scattered, from low to high values. While in for data in the thinly sliced meat diet, the distribution of data is concentrated at high values.



**Figure 4. The energy and nutrient intakes for diets using thinly sliced meat and diet using hand-cut meat (\*:  $p < 0.05$ , by Wilcoxon signed – rank test)**

**Table 2. The energy, nutrient and amount of meat intake by dentition**

	Moderate dentition (21-27 teeth) n=29		Poor dentition (20 teeth or less) n=9	
	Sliced meat diet	Hand-cut meat diet	Sliced meat diet	Hand-cut meat diet
Energy (kcal/d)	1400 $\pm$ 154	1368 $\pm$ 185	1352 $\pm$ 185	1218 $\pm$ 219
Protein (g/d)	72.7 $\pm$ 7.5	66.0 $\pm$ 9.1*	66.6 $\pm$ 10.2	55.7 $\pm$ 11.0*
Protein from meat (g/d)	29.4 $\pm$ 4.0	26.5 $\pm$ 5.9*	26.2 $\pm$ 3.7	20.4 $\pm$ 7.2*
Protein/ kg BW (g/kg/d)	1.36 $\pm$ 0.26	1.24 $\pm$ 0.28*	1.26 $\pm$ 0.28	1.13 $\pm$ 0.36
Lipid (g/d)	31.5 $\pm$ 1.9	30.0 $\pm$ 2.0*	29.8 $\pm$ 2.0	27.6 $\pm$ 3.8*
Carbohydrate (g/d)	207.2 $\pm$ 29.3	206.3 $\pm$ 31.9	194.9 $\pm$ 33.3	189.5 $\pm$ 39.1
Fiber (g/d)	9.5 $\pm$ 1.1	9.0 $\pm$ 1.6	7.8 $\pm$ 1.5	8.1 $\pm$ 1.9
Meat intake (g/d)	149.3 $\pm$ 20.1	133.7 $\pm$ 30.0*	132.8 $\pm$ 18.1	103.5 $\pm$ 36.5*

\*:  $p < 0.05$ , by Wilcoxon signed – rank test

Table 2 shows energy, nutrient and amount of meat intakes by dentition. The mean energy, protein, lipid intakes in the Thinly sliced meat diet were higher than in the Hand-cut meat diet in both the moderate dentition group and the poor dentition group. The results indicate that the mean amount of meat intake for the thinly sliced meat diet was higher than from for the hand-cut meat diet both in the Moderate dentition group and in the Poor dentition group. Subjects in the Moderate dentition group consumed  $72.7 \pm 7.5$  g protein per day and  $1.36 \pm 0.26$  g protein/kg per day in the Sliced meat diet while the Hand-cut meat was lower  $66.0 \pm 9.1$  g protein per day and  $1.24 \pm 0.28$  g protein/kg per day.

Subjects in the Poor dentition group had a protein intake per kg lower  $66.6 \pm 10.2$  g protein per day and  $1.26 \pm 0.28$  g protein/kg per day with the sliced meat diet compared with  $55.7 \pm 11.0$  g protein per day and  $1.13 \pm 0.36$  g protein/kg per day in the Hand-cut meat diet. Protein/kg BW, protein from meat and amount of meat intakes are statistically significant between the 2 diets ( $p < 0.05$ ).

## DISCUSSION

We found in this study that thinly sliced meat is easier to chew and is favored over meat sliced by hand in the elderly who have lost teeth. These findings suggest positive effects of thinly sliced meat on the time, number of chew and food intake in older adults who have difficulty in chewing from having lost teeth.

It was surprising that from the sensory test the subjects liked the sliced meat better than hand-cut meat with the overall taste score for the sliced meat 7.97 and that for hand-cut meat 6.89 ( $p < 0.05$ ). The better acceptability was mainly not only because of softness but also better taste (score of sliced meat 8.16 and 7.74, that of hand cut meat 6.42 and 6.89 ( $p < 0.05$ )). The results from this sensory evaluation showed that thinly sliced meat samples were rated higher than hand-cut meat samples in color, taste, softness, and over-all acceptability in the elderly people who have lost teeth. Sliced meat is thin, the uniform size and shape make them more eye-catching. When cooking, the meat pieces are evenly cooked so they are better. The use of manual slicing knives does not guarantee the uniformity of the pieces resulting in a dish that is less eye-catching and unevenly cooked. Easier chewing has affected to the elderly subjects who have difficulty in chewing due to tooth loss; this can improve their taste and appetite.

By using a meat slicer we can obtain pieces of meat with a thickness only 1.5mm so it is easy to chew and they are especially suitable for the elderly with lost teeth. This is shown by the time and number of chews. To eat one piece of thinly sliced meat (3g), subjects took less time and fewer chews than the hand-cut meat piece of the same weight ( $53 \pm 22$  times and  $47 \pm 23$  seconds compare with  $73 \pm 35$  times and  $65 \pm 33$  seconds). Both the chewing time and number of

chews were statistically significant for the two samples ( $p < 0.05$ ).

The use of thinner meat (although the same size) makes it easier for older people to chew and eat better; the subjects can eat more meat without too much difficulty, thereby significantly improving energy, protein, and lipids intake. According to the recommendation from NIN (7) protein needs for healthy elderly people are 60-70 g/d. However this was the recommendation for normal elderly who are living in their community. For the elderly research subjects who were being treated in hospitals, we used ESPEN guidelines on clinical nutrition and hydration in geriatrics (8) as a standard of control. According to ESPEN, protein intake in older persons should be at least 1 g protein per kg body weight per day. Daily amounts of 1.2-1.5 g/kg have been suggested for older persons with acute or chronic illness and up to 2.0 g/kg body weight per day in case of severe illness, injury or malnutrition (9). In our study, whether eating a Thinly sliced meat diet or a Hand-cut meat diet, subjects with moderate dentition achieved the recommended protein level. However, for those who with poor dentition, when eating the Hand-cut meat diet, it was not possible to reach this level of recommendation (they only consumed  $55.7 \pm 11.0$  g/d equivalent to  $1.13 \pm 0.36$  g/kg/d). These results were consistent with the National Health and Nutrition Examination Survey during 2005–2008, which were conducted on 9140 American adults and showed that participants in the poor dentition group had significantly lower energy intake than those with moderate dentition ( $P < 0.05$ ) (10). In both groups, when eating thinly sliced meat, protein intake was higher than with the hand-cut meat diet (the difference was statistically significant). This is an outstanding benefit when using thinly sliced meat (thickness 1.5mm) instead of hand-cut meat (thickness 3-5mm) in the diet for elderly subjects with lost teeth. Based on Figure 4, we can see not only the average but also the data distribution of the energy, protein, lipid and carbohydrate intakes when subjects ate Thinly sliced meat diet and the Hand-cut meat diet. While for the diet using sliced meat, the distribution data was concentrated in the higher part of the graph, in the diet using Hand-cut meat, the data were scattered, and there were even many values at the very low end of the figure.

The mean carbohydrate was the same for both diets and was not statistically significant ( $p > 0.05$ ). This can be explained by the traditional diet of Vietnamese people. The main source of carbohydrates comes from rice, which is often cooked separately, seldom in combination with other ingredients when cooking. So, consumption of rice or carbohydrates is almost constant at every meal. Some of the subjects in our study had a history of diabetes for many years (they had received instruction on nutrition for diabetics before), so they controlled their own diet (limiting their foods rich in carbohydrate intake) by themselves. Therefore, the amount of energy intake



from carbohydrates in the subjects in our study accounts for only about 50% of the total energy intake.

In this study, the meals were prepared and weighed before being given to the subjects. After they had eaten, we weighed the food remaining and calculated the amount of food intake. During the study, subjects were not allowed to eat anything apart from diets that were prepared. This helps us to accurately control the amount of food and nutrients intake by the subject and reduce recall errors or errors from images.

There are studies that have provided evidence of an association between poor nutritional status and prolonged hospital stay, decreased quality of life, and increased morbidity and mortality (11). Better chewing ability of the elderly leads to better nutritional status and quality of life, as has been demonstrated through previous studies (12, 13). Chewing ability is closely correlated with the number of natural teeth present: there is a threshold of 20–21 teeth, below which chewing ability declines (14, 15). Our results were consistent with this view. There were only 10% malnourished patients in the moderate dentition group while 1/3 of subjects in the poor dentition group were malnourished. From results of this study, using thinly sliced meat improved the energy and nutrients intake and it also was expected to improve the nutritional status in the elderly. Our study was conducted with only 38 subjects and has not yet assessed the long-term effects of sliced meat on improving the nutritional status of subjects. However, while there are these limitations, still results of the present study are an important first step for further studies with longer duration and on a larger number of subjects, not only the elderly in a hospital but also the elderly living in the community.

In conclusion, thinly sliced meat is easier to chew and preferred to meat sliced by hand for the elderly who have lost teeth. Using thinly sliced meat improved the energy and nutrients intake in older adult who have difficulty in chewing (the difference is statistically significant). From these findings, besides minced meat, thinly sliced meat can become an optimal choice for elderly people who have lost teeth and are having difficulty chewing thick pieces of meat to diversify their meals. We expect the diets for elderly people who have lost teeth in Vietnam could have more variety and improve their daily meals, thus increasing their food intake and finally improving their quality of life through their diet.

#### CONFLICT OF INTERESTS

The authors declare no conflict of interests regarding the publication of this article.

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## Original

### Analysis of Fiber Intake and Its Sources in a Year School Lunches at a School in Japan

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**ABSTRACT** *Background:* Deficiency of dietary fiber is the most important health-related nutrition problem at present in Japan. It is also true for school lunch. In Japan almost all the elementary school students have school lunch throughout the year and the recommendation of fiber for the upper grade students is 6g/lunch. However, they have not been successful. *Objective:* To analyze the contribution of fiber sources in school lunch and to find the new method(s) to increase fiber intake to more than 6g. *Method:* Fiber intake by all the school lunches in a year (197 days) at a public school was calculated by using the Japanese Standard Food Composition Table. All the 197 menus were grouped into 3 categories of fiber as more than 6g, 5 - 5.9g and lower than 4.9g. Furthermore, the contribution of various food groups (cereals, vegetables, potatoes, fruits, beans, soy products, nuts and seeds, seaweed, mushrooms, etc.) were calculated. More detail analysis was conducted for the vegetable (root vegetables, stalk vegetable, leafy vegetables, fruit- vegetables, flower vegetable). *Result:* Staples foods of 197 menus were 141 for rice and 56 for wheat, being about 75 % was rice. However, among the 18 menus with more than 6g fiber intake, as the staple foods, 9 and 9 used rice and bread, respectively. When the rice was the staple food, a lot of burdocks, konnyaku and soybean were used. There were 27 menus with a fiber of 5 -5.9g and only 6 of them used rice as a staple food. Fiber supplied by commonly used rice (85g) was only 0.4g. The average intake of fiber from vegetables was 1.9g. The use of rice as a staple food for more than 3.5 times a week (5 days) is recommended by the Japanese government to sustain and to activate the local products. Under such a situation, we have to consider the use of brown rice. *Conclusion:* To meet the fiber requirement by vegetables is difficult and fiber-rich foods such as brown rice may be recommended for Japanese school lunch.

**Key words:** school lunch, vegetable, fiber, rice

## INTRODUCTION

The School Lunch Law was established in 1954 in Japan, and the current school lunch is implemented based on the School Lunch Practice Standards (1). Among dietary intake criteria, dietary fiber is determined as a nutrient to set a target amount for primary prevention of lifestyle-related diseases. A target amount per day of 18 years or older for the male is 19 g or more and for female is 17 g (2). However, the data related to the dietary fiber requirements of children were limited. It is difficult to determine the relationship between dietary fiber intake and the incidence rate of lifestyle-related diseases. According to annual nutrition survey of school children, the fiber intake of fifth-grade children in elementary school was 10-15g (3). It has been shown that fiber intake of children may be lower than the requirement. Generally, vegetables are considered as an important source of dietary fiber.

In addition, the Ministry of Agriculture, Forestry and Fisheries' proposal to consume 350 g of vegetables per adult per day seems to strongly support the opinion that it is necessary to eat vegetables(4). Definition of vegetable is different not only from country to country but also from ministry to ministry within Japan. However, some students say that they are not good at vegetables because of taste. So far, nutrition teachers and school nutrition staffs have made many reports on leftovers of vegetables in school lunches (5) but have yet to find clear improvement. In this study, we analyze the menu of past school lunch to clarify what kind of menu can meet the standard

amount of fiber, and the fiber intake standard of elementary school-aged 10 to 11 years. Thereby we suggested a viable solution to improve the amount of fiber intake by children in school meals.

## METHODS

In this study, we used 197 menus for school meals in a year at an elementary school. The local government offers a complete school lunch, with 3.5 times a week for rice. The usage of milled rice for the upper grades of elementary school is 85g. In addition, the bread implemented by the city is a bread containing rice flour in which the percentage of flour used is 90% wheat flour and 10% rice flour produced in the prefecture. In the upper grades, rice flour bread is mainly provided with 63 g wheat flour and 7 g of rice flour.

Fiber intake in 197 menus in a year was calculated using the Japanese Food Composition Table (6). Specifically, dietary fiber was classified into three groups: 6g or more, from 5 to 6g and less than 5g. The staple food was classified into cooked rice and bread, and the tendency of fiber intake per serving by staple food was analyzed. We also estimated the amount of dietary fiber contained in the staple food. Furthermore, the ratio of fiber intake was calculated by the food group as follows cereals, vegetables, potatoes, fruits, beans, soybean products, seeds and fruits, seaweed, mushrooms, etc. In particular, vegetables were divided into five types; root vegetables, stem vegetables, leaf vegetables, fruits and vegetables (Photo 1) and their characteristics were analyzed. Fruits, mushrooms, seaweeds, beans, seeds and potatoes are not vegetable by the Japanese definition (6)

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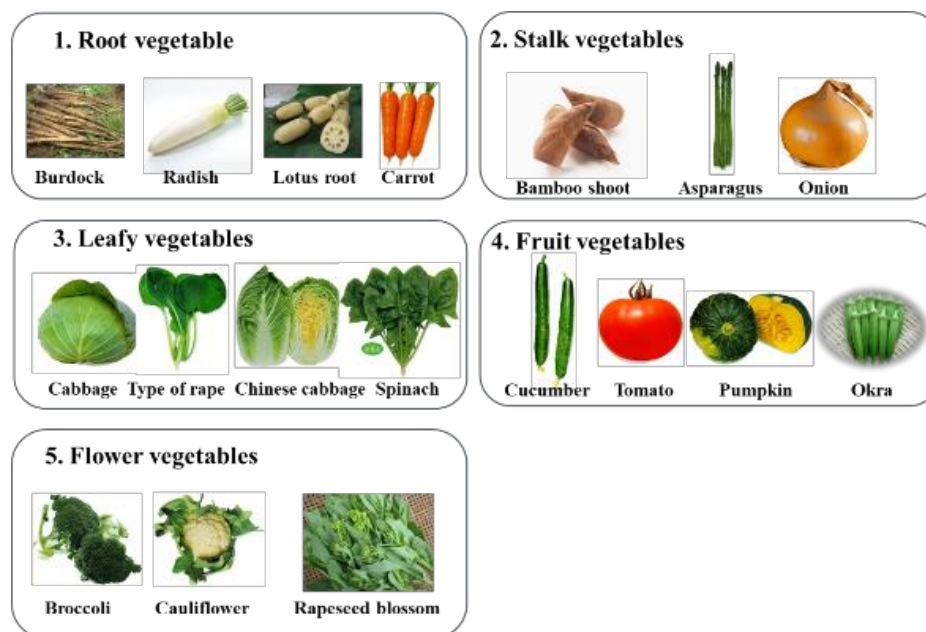


Photo 1. Classification of Japanese vegetables

### RESULT

The distribution of staple food in 197 days is 141 days as rice and 56 days as bread, so 3/4 of the school meals using rice were staple food. After sorting the menus according to the amount of fiber, the result was 18 menus providing 6 g or more of fiber, 27 menus providing 5 g to 5.9 g and 152 menus providing 4.9 g or less. The average vegetable intake was 103 g, 105 g and 82 g when the fiber intake was 6 g or more, 5 to 5.9 g and 1.9 g or less, respectively. The average amount of plant-based fiber is 2.9 g, 2.1 g and 1.7 g for menus provided from 6 g or more, 5 to 5.9 g and 4.9 g. or less, respectively. The average amount of plant-based fiber in 193 meals is 1.9 g.

Table 1 shows menus that provide 6g or more of fiber (18 menus). The average amount of fiber provided from this menu group was  $6.9 \pm 0.9$  g. Staple food of 18 menus with fiber content of 6 g or more was the fact that the number of regular meals is 9 for rice and 9 for bread.

Table 1. Menu provided more than 6g of fiber per serving

No	Amount of fiber (g)	Staple food	Menu
1	8.5	Bread	apple jam, milk, pork beans, seaweed salad, yuzu dressing
2	8.4	Bread	apple jam, milk, pork beans, corn
3	8.4	Bread	sugar-reduced jam, milk, pork beans, boiled vegetables, mayonnaise
4	7.9	Rice	milk, soybean kinpira burdock, croquette, boiled cabbage, worcester sauce
5	7.3	Bread	milk, stewed hamburger, broccoli, pumpkin potage
6	7.3	Rice	milk, chicken and konjac miso stew, croquette, broccoli, worcester sauce
7	6.8	Rice	milk, pork and burdock stew, seaweed salad, green soybean dressing, mixed nuts
8	6.8	Rice	milk, Japanese style hamburger, soybean chopped burdock
9	6.3	Bread	small bread with rice flour, milk, spaghetti napolitan, boiled vegetables sesame dressing, frozen mandarin orange
10	6.2	Bread	small bread with rice flour, margarine, milk, fried soba noodle, fried beans
11	6.2	Bread	plain bread with rice flour, apple jam, milk, fried vegetable, university potato
12	6.2	Bread	apple bread with rice flour, milk, seaweed udon noodle, fried beans, mandarin orange
13	6.2	Bread	soybean flour fried bread with rice flour, milk, pumpkin potage, omelette ketchup
14	6.2	Rice	milk, soybean chopped burdock, thick roasted egg, yukari pickled
15	6.2	Rice	milk, soybean chopped burdock, crab egg roll, instant pickles
16	6.2	Rice	milk, sudachi vinegar, small fish nut
17	6.1	Rice	milk, soybean chopped burdock, grilled saury, sudachi
18	6.1	Rice	milk, simmer sour pork with burdock, thick omelet containing vegetables, yukari pickled, mixed nuts

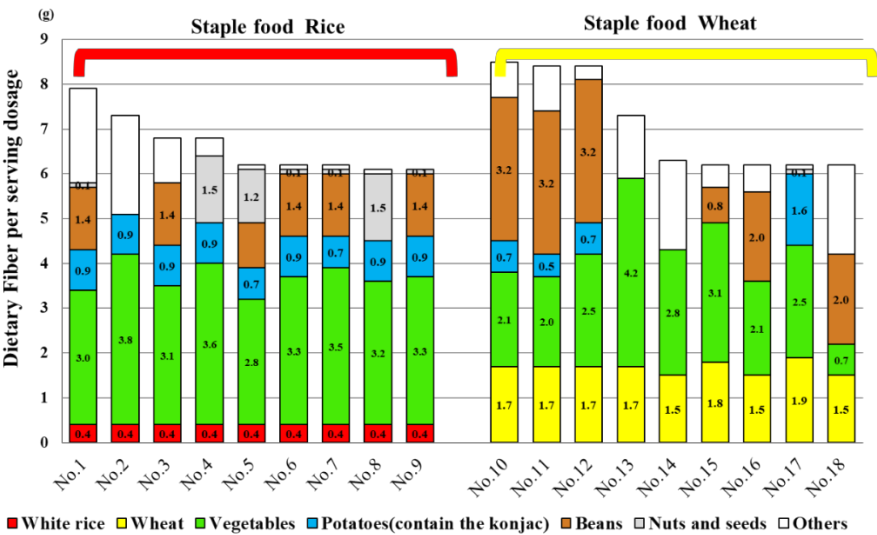


Figure 1. Origin of dietary fiber when the staple food was rice (left) or bread (right)

Figure 1 shows the origin of dietary fiber by staple food. When rice was staple food, only 0.4 g of fiber from rice, 2.9 g of fiber from vegetables, about 0.9 g of fiber from tubers (mostly konnyaku) and beans is about 0.9 g (mostly soy) and 0.5 g of fiber from nuts (mostly sesame and mixed nuts) were consumed. In the case of staple food was bread, the amount of fiber from bread was 1.7 g, 2.4 g from vegetables, about 0.4 g from tubers (mainly potatoes), about 1.6 g from

beans (mainly soy and beans), seeds and fruits (mostly mixed nuts that consume 0.1 g of fiber).

Figure 2 shows ccontribution of dietary fiber from 5 types of vegetable by stable foods. When staple food was rice, 2.4g of total 3.3g was from root vegetables and when staple food was bread, total intake was 2.4 g and similar intakes from 5 types of vegetables.

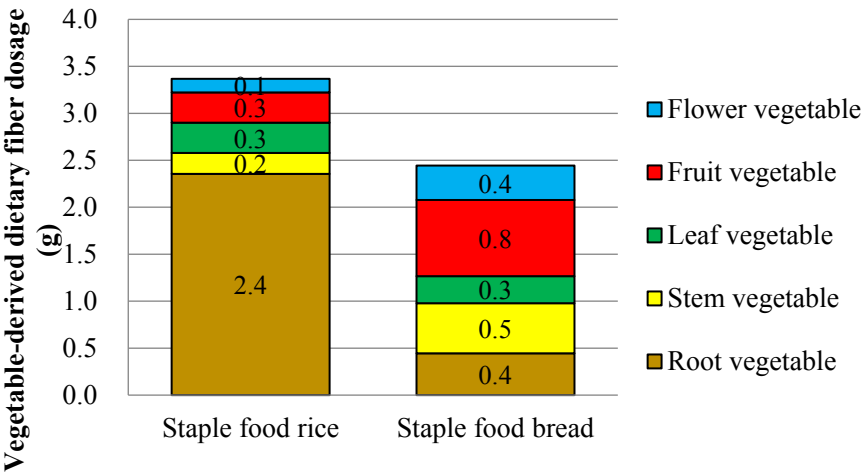
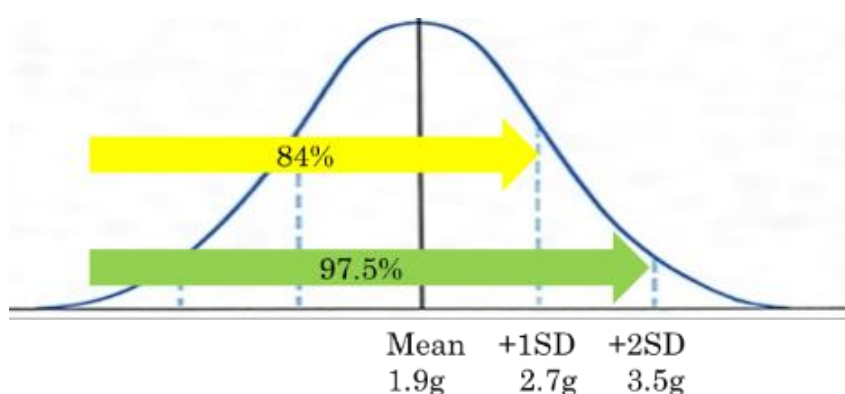


Figure 2. Contribution of dietary fiber from 5 types of vegetable by rice or bread as staple foods (n=9 in each staple food)

Table 2 shows 27 menus that provide between 5 and 5.9g per meal. This menu group provides an average of  $5.4 \pm 0.3$  g of fiber. There were only 5 menus using rice as a staple food. In addition, this group often served stewed dishes using root vegetables as side dishes.

**Table 2. Menu provided 5 - 5.9 g of fiber per serving**

No	Amount of fiber (g)	Staple food	Menu
1	5.9	Bread	reduced sugar jam, milk, chicken and cabbage curry sauteed, abe river mochi
2	5.9	Bread	milk, boiled vegetable in cream, omelette ketchup, kiwi fruit
3	5.8	Bread	,milk, wiener chili sauce, boiled vegetable mayonnaise
4	5.8	Rice	red rice, milk, shrimp fry, boiled cabbage, tartar sauce, kinju juice, honey peanut
5	5.7	Bread	chocolate paste, milk, grilled rice noodle, boiled vegetable, mayonnaise
6	5.7	Bread	milk, Western-style boiled fruit cocktail
7	5.6	Bread	chocolate pate, milk, stewed hamburger, corn soup
8	5.6	Bread	soybean paste, milk, seaweed udon noodle, yukari pickle, corn
9	5.5	Bread	brown sugar bread with rice flour, milk, scotch egg, boiled vegetable, corn bottage soup
10	5.5	Bread	cocoa bread with rice flour, milk, borsch, Japanese style salad, Japanese dressing.
11	5.5	Rice	milk, chikuzenni, narutokintoki croquette
12	5.3	Bread	plain bread with rice flour, soybean paste, milk, spaghetti napolitan, French salad, French dressing
13	5.3	Bread	half-calorie margarine, milk, stir-fried vegetable, abe river mochi
14	5.3	Bread	milk, stewed hamburger, corn potage soup, moonlit jelly
15	5.3	Bread	spaghetti with soybean flour, seaweed salad, sesame dressing
16	5.2	Bread	self-edd sandwich, milk, corn potage soup
17	5.2	Bread	sugar jam, spaghetti with meat sauce, French salad, French dressing
18	5.2	Bread	small butter bread with rice flour, milk, spaghetti with meat sauce, French salad, French dressing
19	5.2	Bread	milk, clam of chowder meat dumpling, boiled cabbage
20	5.2	Rice	Milk, Braised foods, Boiled cabbage, komatsuna, mixed nuts
21	5.2	Rice	milk, yuzumossi oden, yuzumiso oden miso, mandarin orange, Nozawa-ha pickled with rice flour
22	5.1	Bread	milk, spaghetti soup, seaweed salad, blue jiso dressing
23	5.1	Bread	milk, mushroom spaghetti, Japanese salad, citrus fruit dressing
24	5.1	Bread	milk, spaghetti Napolitan, French salad, French dressing
25	5	Bread	sandwich, milk, corn potage soup
26	5	Bread	pumpkin bread, milk, gome udon, small sardine tempura, ponkan orange, setubun festival menus
27	5	Rice	Hayashi rice, milk, seaweed salad, green joso dressing



**Figure 3. Mean intake of fiber from vegetable and the values of mean+1SD and +2SD**

Figure 3 shows that the mean value of vegetable-derived fiber is 1.9g and the mean + 1SD is 2.7g that cover 84% of the participants (yellow arrow). The mean + 2SD is 3.5g that includes 97.5% of participants (green arrow). These results indicate that it is very difficult to take more than 3g from vegetable.

Figure 4 shows the distribution of various vegetable intakes of 197 lunches in a year. Intakes from root vegetable was 36%, stem vegetable 21%, leafy vegetable 22%, fruit vegetable 15% and flower vegetable 6%.

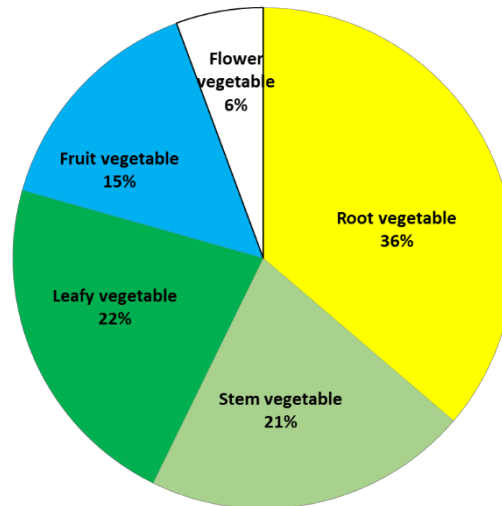


Figure 4. Distribution of various vegetable intakes

### DISCUSSION

In this study, the distribution of staple food in 197 days was 141 days as rice and 56 days as bread, in other words 3/4 of the school meals using rice as staple food. It was found that when the staple food was white rice, the menu from which vegetables can be satisfied with fiber requirement was extremely limited. Staple food of 18 menus with fiber content of 6g or more in 197 days were 9 menus using rice and 9 menus using bread. The menu used rice characterized by burdock, konjac, soybeans used in large amounts.

In the school lunch standard for every child or student, effective April 1, 2013, the standard value of fiber was set at 6g for elementary children 10 to 11 years old. Among the menus that provide 6g of fiber, 9 menus use rice as staple food, the dietary fiber is 0.4g from rice, 0.9g from konjac, 0.9g from soybeans and 0.9g from nuts and 2.9g from vegetables. Similarly, if staple food was bread, then the fiber is 1.4 g from bread, 0.4g is from tubers, 1.6g was from beans, 0.1g was from the grain and 0.1g and 2.5g were derived from vegetables. As a result, the amount of vegetable-derived fiber provided at a school meal was approximately 3g, which makes it very difficult to increase vegetable-derived fiber to 3.5g or more. A menu with fiber of vegetable origin of 3.5g or more is used mainly with burdock, legume and konjac. When leafy vegetables like cabbage and cardamom were used, the amount of dietary fiber was usually 2g or less.

Eating insufficient fiber is often thought to be due to insufficient intake of vegetables. According to FAOSTAT (Food Balance Sheet) based on FAO (7) guideline, the results of annual vegetable consumption per capita in 2009 in major countries around the world show that Japanese vegetable consumption is 278g, in the United States is 337g, Canada is 308g. Thus, the consumption of Japanese vegetables compared to other countries is not large. However, there is no unified definition of vegetables and fruits in the world due to the culinary culture of each country and the way of thinking of each country.

In comparison on FAO (7), Japanese and American definitions of vegetables, in Japan, "vegetables" are edible herbaceous plants that refer to edible plants with a high water content (6). They mainly eat leaves, roots, stems (including rhizomes), flowers, buds, and fruits as side dishes. In contrast, the United States classifies vegetables into five subgroups: dark green vegetables, red and yellow vegetables, legumes, starchy vegetables, and others (8). Among them are potatoes, sweet potatoes and other potatoes, as well as seasonings such as tomato ketchup. If we compare the definition of Japanese vegetables with the definitions of each country, it seems that vegetable consumption in Japan is not small. In a school lunch this study, the average dietary fiber intake from vegetables was 1.9g. The current target intake of vegetables is set for green-yellow vegetables and light-colored vegetables. For example, referring to the Japanese definition, if vegetables are classified into five types: root vegetables, stem vegetables, leaf vegetables, fruit vegetables, and flower vegetables (6), the dietary fiber content differs, and root vegetables contain many dietary fibers. Isn't a standard for target intake necessary? If we are trying to fill our dietary fiber with vegetables, we will need to think more about the scientific rationale that "let's meet the 350g per day regardless of whether it's leafy or root vegetables." It is also important to taste various dishes from the viewpoint of expanding the food experience. Couldn't it be better to eat vegetables more freely? We guess 100-200g for leafy vegetables and 100-200g for root vegetables.

According to a report from the Survey and Research Cooperation Council on the Development of Standards for Eating Children's Meals for School Lunch (March 1991), "It is not enough to simply fill 8 g of dietary fiber per 1,000 kcal of energy. Efforts to promote the use of brown rice (including germinated brown rice), potatoes, beans, seeds, nuts, vegetables, mushrooms, algae, etc. to increase intake while maintaining the desired Japanese food culture should be encouraged through school lunches to help children



stay in their daily diet

Increasing fiber intake from vegetables is not easy. We want to suggest the use of sprouted brown rice to increase dietary fiber intake. The reason for this is that new cookware is required to use brown rice, but germinated brown rice can be cooked with the same equipment as white rice. Already, some municipalities use germinated brown rice for school meals. The amount of germinated brown rice used is 5 to 10% of that of polished rice, and it is used about once or twice a month. However, in order to take advantage of the fact that brown rice is easy to ingest dietary fiber, it is preferable to use 50-100% germinated brown rice. The use of germinated brown rice will also be significant in maintaining the food culture that has been cultivated on rice by Japanese people. In addition, cultivating the eating habits of eating germinated brown rice during school age may contribute to future health.

The use of rice as a staple food for more than 3.5 times a week (5 days) is recommended by the Japanese government to sustain and to activate the local products. Under such a situation, perhaps the only way to increase the fiber intake to more than 6 g is the use of brown rice. Brown rice needs special cooking pan, therefore, pre-germinated brown rice may be recommended.

In conclusion to meet the fiber requirement by vegetables is difficult and fiber-rich staple foods such as brown rice or pre-germinated brown rice must be recommended.

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**Original****Undernutrition in Older Adults Northern Thailand May Be Improved by Increasing Lipid Consumption**

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**ABSTRACT** Undernutrition is highly prevalent in older people. Understanding nutritional intake and dietary pattern of older people may help to design strategies to prevent malnutrition and improve dietary intake and nutrition status. However, there is lack of data on nutritional intake and dietary pattern of older people. Therefore, the purposes of present study was to determine the dietary intake and food pattern in older adults northern Thailand. The participants were interviewed using twenty four - hour dietary recall and assessed anthropometrically. Results showed that the mean age of the participants (n=50) was 59 ± 10 years, the prevalence of underweight was 18% in males and 9% in females. Estimated daily energy intake were accounting to 92% of the Thai recommended dietary allowances (RDA), mean lipid intake was 40% of the Thai RDA in males and 47.2 in females. Mean carbohydrates and protein intake were adequate, mean sodium intake was 151% of the Thai RDA in males and 152 in females. The food components largely consisted of vegetables, herbs, seasonings, with less meat and oils. In conclusion, the northern Thai older adults had inadequate energy and lipid consumption. Further studies may be suggested to promote the consumption of lipids by using vegetable oils for cooking dishes, if the older people do not have dyslipidemia.

**Keywords:** Undernutrition, older adults, northern Thailand, lipid consumption

**INTRODUCTION**

The aging population is increasing rapidly worldwide. In Thailand, there were approximately 11 million older adults (16.7%) aged 60 years and older in 2019, and this number is expected to increase 5 percent every year (1).

Malnutrition referred to as undernutrition is common in older people. The estimated proportion of older adults who are at risk of malnutrition is about 27% in community/outpatients and 50% in other healthcare settings (2). Causes of malnutrition in the elderly are related to several factors, including inadequate intake, due to deterioration of the senses of smell and taste, and decline in gastric emptying associated with satiation (3). Malnutrition is associated with frailty, sarcopenia, and decreased immunocompetence and leads to an increased rate of mobility and mortality (4).

In Phayao Province in the northern part of Thailand, the older adult proportion has increased from 15.3 percent in 2012 to 20 percent in 2017 (5). Most older adults in Phayao work in the agricultural field. Currently, there are limited data on nutrition intake in this population in northern Thailand. Understanding the nutritional intake and dietary pattern of older people may help to design strategies to prevent or improve dietary intake and nutrition status.

The purposes of present study was to determine the nutritional intake and dietary pattern in older adults who live in Chiang Kham district, Phayao Province, Thailand.

**METHODS**

This study was conducted with a cross-sectional study. The older adults (≥ 55 years old) who live in Chiang Kham district, Phayao Province, Thailand and having no dementia were enrolled in the study.

The participants were interviewed using twenty - four hour dietary recall and assessed anthropometrically. Trained interviewers determined participants' dietary intake; they were requested to describe precisely the foods and beverages consumed during the 24 hours prior to the interview. All data were calculated for energy and nutrient intake (carbohydrate, protein, lipids, dietary fibre and sodium) by the INMUCAL-N software version 3, Institute of Nutrition, Mahidol University, Thailand.

Height was measured using a portable, free-standing stadiometer, body weight and percent body fat were measured about 2 hours or more after breakfast, using Omron Karada scan (model HBF-375, Japan). The body mass index (BMI) calculation is the weight in kilograms, divided by the height in meters squared (kg/m<sup>2</sup>) and categorized into 4 groups according WHO cut off points: underweight: BMI <18.5 kg/m<sup>2</sup>, normal: BMI 18.5-24.9 kg/m<sup>2</sup>, overweight: BMI 25.0-29.5 kg/m<sup>2</sup> and obesity: BMI > 30 kg/m<sup>2</sup>.

**Ethical Considerations**

This study was reviewed and approved by the Committee on Human Rights Related to Human Experimentation, University of Phayao, Phayao, Thailand. Project number 2/039/59.

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### Statistical Analysis

All procedures of data analysis were performed using Microsoft Excel Software 2013. Descriptive statistics such as mean, standard deviation and percentage was used to quantify the characteristics of the participants, dietary intakes and compared with the Thai Recommended Dietary Allowance (RDA).

### RESULTS

From our study, we found the mean age of the participants (n=50) was  $59 \pm 10$  years. Their characteristics are shown in Table 1. Prevalence of underweight, normal, overweight and obesity of the males and females in this study are shown in Figure 1. Data on dietary intake could be obtained from 43 participants who were fully interviewed for dietary

recall. Energy and nutrient intake of the participants and Thai RDA are shown in Table 2. Comparison of energy and nutrient intakes with Thai RDA is shown in Figure 2.

The food components largely consisted of vegetables, herbs, seasonings, with less meat and oils. Common animal protein sources included chicken, fish such as Nile Tilapia (*Oreochromis niloticus*), snakehead fish (*Channa striatus*) and salt mackerel, pork belly, pork ribs, eggs and frog. Cooking oils included palm oil, soy bean oil, and lard. General seasonings used included salt, shrimp paste (Kapi), monosodium glutamate (MSG), fish sauce (Nampla), pickled fish (Plara), crab paste (Nampu) and soy sauce. A sample of daily foods (1 day) is shown in Figure 3.

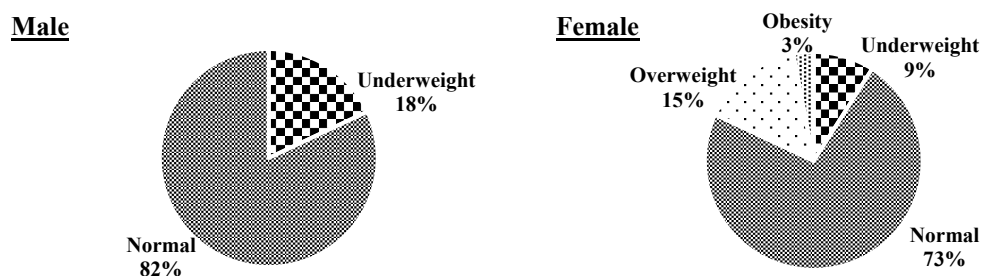


Figure 1. Prevalence of underweight, normal, and overweight in the males (n=17) and females (n=33)

Table 1. Characteristics of the participants (n=50)

Characteristics	Male	Female
Number (%)	17 (34)	33 (66)
Height (cm)	$163.2 \pm 6.7$	$151.6 \pm 6.0$
Weight (kg)	$59.7 \pm 12.8$	$52.9 \pm 7.6$
Body Mass Index (kg/m <sup>2</sup> )	$21.6 \pm 2.58$	$23.06 \pm 3.0$
% Body fat	$23.5 \pm 3.9$	$32.4 \pm 5.8$

Data are mean  $\pm$  SD

Table 2. Energy and nutrient intake of the participants and Thai RDAs (6) (n=43)

	Daily intake		RDA <sup>a</sup>	
	Male (n=15)	Female (n=28)	Male	Female
Dietary energy (kcal)	$1,643 \pm 387 (91.8)$	$1,437 \pm 440 (92.1)$	1,790	1,560
Carbohydrate (g)	$304 \pm 98 (112.6)$	$246 \pm 86 (102.5)$	270	240
Protein (g)	$53 \pm 18 (89.8)$	$54 \pm 27 (108)$	59	50
Fat (g)	$24 \pm 16 (40.0)$	$25 \pm 15 (47.2)$	60	53
Dietary fibre (g)	$6 \pm 2 (24)$	$7 \pm 4 (28)$		25
Sodium (mg)	$3,020 \pm 1,481 (151)$	$3,035 \pm 1,503 (152)$		2,000
%Distribution of P:F:C <sup>b</sup>	74:13:13	69:15:16	45-65:10-15:20-35	

Data are mean  $\pm$  SD; the number in bracket is %RDA; <sup>a</sup> Thai RDAs: Thai recommended dietary allowances, estimated energy requirement for Thai adult age 61 – 70 years (light activity). Distribution of energy: carbohydrate 45 – 65%, lipids 20-35% and protein is 1 kg/day (or 10-15%); <sup>b</sup> P: F: C is protein, fat and carbohydrates.

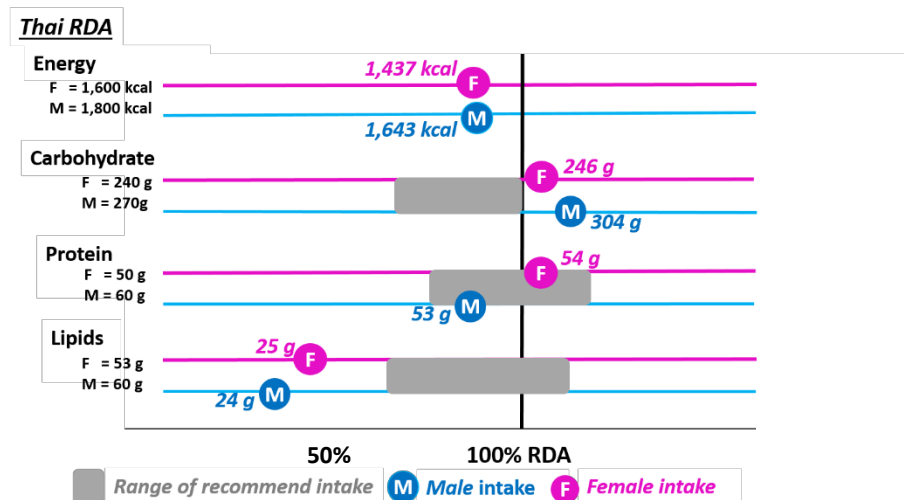


Figure 2. Comparison of energy and nutrient intakes with Thai RDAs



Figure 3. Examples of daily foods (1 day)

## DISCUSSION AND CONCLUSION

This study showed that older adults had lower energy, lipids and fibre intake than the Thai RDA. The percentage of carbohydrate, protein and fat to total calorie intake per day was 74:13:13 in males and 69:15:16 in females, respectively. This pattern seems to be similar to a previous study that determined dietary intake by 3-day dietary records in for Thai elderly in Bangkok (n=32) (7).

There are many studies demonstrating a decline in food intake with aging (8). A poor appetite is shown to be an important determinant of poor dietary intake in older adults and of incidence of undernutrition. Older persons often have a poor appetite due to various reasons including chewing problems, olfactory losses and poorer health. About one-fifth of the males and one-tenth of the females were found to be underweight, as determined by BMI less than 18.5 kg/m<sup>2</sup>. This was two times as high as underweight in the survey of the Thai National Health Examination, NHES V 2014 that is shown in Figure 4. Undernutrition may start in the young old (age 60 – 69 years old) and increase at advanced ages. However,

the dietary patterns of older people may not change much compared to those of adulthood. Therefore, in order to have appropriate nutritional status in the later stages of life, healthy eating behaviors should be promoted at a young age.

The northern indigenous foods generally used little oil in cooking. Cooking with less oil may be appropriate for individuals who are overweight/ obese, but some older people take in too few calories and are also underweight; low fat/oil choices may make it difficult for them to consume enough food to maintain a positive energy balance (9). Adequate energy intake is necessary for optimizing protein utilization and allows the body to utilize protein for non – energy yielding functions such as the maintenance of lean body mass (10).

In addition, we found carbohydrates were the main energy source (72% of total calories). Related to the data of the Thai National Health Examination Survey IV, of adults aged 30 - 59, reported that a carbohydrate-rich dietary pattern was popular in northern region of Thailand and rural areas (11).

	60 - 69 years		70 - 79 years		80+ years	
BMI (kg/m <sup>2</sup> )	Male n=1,894	Female n=2,447	Male n=985	Female n=1,250	Male n=337	Female n=370
< 18.5	9.4	4.3	14.0	10.0	23.9	23.6
18.5 - 24.9	59.7	45.1	61.9	51.6	64.8	54.8
25 - 29.9	25.7	38.9	21.2	31.2	10.1	17.7
≥ 30	8.0	11.8	2.9	7.2	1.2	3.9

Adapted data from Thai National Health Examination Survey, NHES V

**Figure 4. Percentage of Thai older adults according to BMI in 2014**

In conclusion, the northern Thai older adults had inadequate energy and oils consumption. Although the amount of protein intake was sufficient, it may be necessary to consider whether the quality of the protein is good enough. Further studies may be suggested to promote the consumption of lipids by using vegetable oils for cooking dishes such as stir fried vegetables or rice and coconut milk in curry dishes, if the older people do not have dyslipidemia. And to increase high biological value proteins, soy bean milk may be recommended.

#### ACKNOWLEDGEMENTS

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**Letter to the Editor****The Bhutanese Way of Eating: Food for Thought for a Country in Nutrition Transition**

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*Faculty of Nursing and Public Health, Khesar Gyalpo University of Medical Sciences,  
Kingdom of Bhutan***Dear Editor:**

The Kingdom of Bhutan is a beautiful landlocked country among the Himalayas in South Asia, sandwiched between India and China. With a population of slightly more than 700,000, Bhutan is an agrarian society where majority of the population depends on subsistence farming and animal husbandry. Because of being landlocked and difficult geographical terrain, Bhutan has been able to maintain her unique culture including the food habits for centuries. Back in the days the Bhutanese people worked hard and lived off their fields eating whatever was grown, depending mostly on grains as staples, dairy products mostly butter and cheese and meat. Bhutan may be small agrarian based economy but it is also one of the fastest growing economy and hence with globalization, the old ways are quickly diminishing or being replaced by modern amenities making people more sedentary, less active but continued with the old method of eating habit that has given ways to modern lifestyle associated diseases such as type II diabetes, hypertension and hyperlipidemia along with malnutrition and micronutrient deficiency. The national nutrition survey 2015 (1), reported that the Bhutanese diet consisted of starchy staples mostly rice, maize and potatoes, eaten with dairy products such as butter/oil and cheese. Meat products, vegetables and fruit consumption was reportedly very low at around 1 to 1.5 times per week. This finding was consistent with the result from the nutritive analysis of the one-day school meal, where the meals provided in schools was mainly rice with potatoes, use of fats and salts were twice the recommended daily allowance (2).

The national dish equivalent for the Bhutanese is red rice with spicy chili cooked with cheese and butter gravy. Chili is considered more as a vegetable rather as condiments whereas cottage cheese is used as a condiment cooked with chili and various other vegetables. Whatever little vegetables Bhutanese eat is mostly laced with cheese which is rich in calcium and phosphorous and when cooked with vegetables the oxalate and phytate from the vegetables could form a complex with the calcium from the cheese, decreasing the absorption of nutrients both from the vegetables and cheese. Perhaps this could be one of the factors that might have led to the high rates of anemia in the country especially among children. Iron deficiency anemia is one of the major micro-nutrition deficiencies amongst women and children with 43.8% of children below five year being mostly affected, followed by women of reproductive age (34.9%), adolescence girls (31.3%) and pregnant women (27.3%). In the same survey, complimentary food for breastfed children was found low in diversity with

only 11.7% receiving the minimum acceptable diet, and only 15.3% receiving four food groups (carbohydrate, fruits, vegetables and animal source foods). Coupled with the faculty diet, low consumption of nutrient rich vegetables and fruits, and minimum use of meat and meat products in the diet were recognized as some of the factors that could have contributed to the micro nutrient deficiency. Bhutan being largely a Buddhist country slaughtering and raising of animal for meat is uncommon, and majorly depend on imports. This could be one reason where meat is not very common in a Bhutanese diet.

The need for revision of the typical Bhutanese diet has been under discussion over a long period of time. The Royal Government has recognized lack of dietary diversity and iron deficiency anemia as a public health problem especially among children under five years of age. Thus the government has started various programs to imminently improve the nutritional status of children and in the long term to inculcate dietary diversification among general population. One such vital program is home fortification of complementary food with micronutrient powder along with promotion of complementary food diversification for children (3). This program is targeted to children between 6 – 23 months where mother / caregivers will be taught how to fortify the infant's food with the micro nutrient powder containing 15 micronutrients (vitamin A, B groups, C, E and three minerals namely copper, iodine, iron, selenium and zinc). In addition they are also taught how to prepare complementary food using locally available grains / cereals, vegetables and meat and meat products. Thus while the micronutrient deficiency will be corrected by point fortification, mother will learn about the value of diet diversification for children and the whole family. The other program is rice fortification with micronutrients (vitamin A, B groups and minerals iron and zinc) for children who are studying at schools with feeding program (4). In addition the school has revised their curriculum making agriculture and animal husbandry as integral part of learning, teaching children the value of food while learning about the biology of plants and animals. The Prime minister of Bhutan Dr Lotay Tshering has personally taken his own initiative to promote healthy lifestyle and diet by recently launching a social media campaign through his Facebook page called "Healthy འབྲུག་ལུ་ - A PMO, Bhutan initiative" encouraging people to eat healthy, diversify diet including fruits and vegetables, and promoting physical activity to reduce lifestyle associated non communicable disease.

Since the nutrition survey in 2015, many advocacies have happened related to the need in

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diversification of diet, replacement of rice staple with other available cereals such as buckwheat, wheat, maize and millets. With the increasing literacy rate (71.4%) among the general population and constant media awareness, people have become more health conscious and are mindful on what they eat. During the time of COVID-19 people have realized that self-sufficiency is an integral part of food and nutrient security and micronutrient rich foods such as fruits and vegetables, and animal source proteins are essential for immunity to fight against infection. Bhutan and her people have to be mindful about exploitation brought about by industrialization, and its greatest impact will be on the health of the people brought about by change in lifestyle and food and the impact will not always be positive. We might be conquering hunger but the double /triple burden of nutrition cannot be avoided. Highly industrialized nations have equally larger and more expensive health problems

related to faulty and imbalance diet and it should be the lesson for the Bhutanese people to eat healthy balanced with adequate physical activity.

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## **Review**

### **Exclusive Breastfeeding: A Review of Barriers and Enhancers to Practice in Africa and Asia**

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**ABSTRACT Background:** Although the benefits of exclusive breastfeeding (EBF) are well established, practice rates have declined in many countries, particularly in Africa and Asia, and have been linked to the huge burden of child mortality in the two regions. The decline has been largely attributed to a variety of factors that prevent mothers from effectively practicing EBF. The objective of this review was to identify the factors that influence EBF in African and Asian countries to identify synergies and document experiences and lessons that can be shared to facilitate widespread practice in developing countries. **Methods:** A literature search was conducted using PubMed, Cochrane Library, Google Scholar and CINAHL Complete. Studies conducted in Africa and Asia and published between 2005 and 2020 that addressed enhancers and barriers of EBF were included. Data on factors influencing EBF were extracted and discussed under four major headings: maternal factors, cultural beliefs and practices, health system factors and government policies. A total of 34 studies comprising 19 from Africa and 15 from Asia were included in the review. **Results:** The key barriers to EBF identified were maternal factors such as mothers' perception of insufficient breastmilk production, cultural practices such as giving prelacteal feeds, health system factors such as poor or inadequate education on breastfeeding and inadequate governmental policy support such as paid maternity leave for the recommended 6-month period for EBF. The key enhancers identified were family support, pro-breastfeeding governmental policies and provision of adequate information on breastfeeding to families and communities. **Conclusions and Recommendations:** Successful EBF practice is hampered by various individual, family and societal barriers. At the core of these barriers is inadequate education on the benefits of EBF and poor policy and legislative environment to support the practice of EBF. Strategies to enhance EBF should include universal education on the benefits of EBF, which should instigate family support for EBF, and promotion of legislation such as paid maternity leave for both parents, which would enable EBF by mothers and support by fathers. Emphatic health education and communication messages to discourage and curtail negative cultural practices that mitigate successful EBF, such as the practice of prelacteal feeds, are needed. Broader consultation and stakeholder engagement to ensure community buy-in to remove barriers to EBF practice in both Africa and Asia is critical to achieving global goals from improving young child nutrition.

**Key words:** exclusive breast feeding, barriers, enhancers, Africa, Asia

#### **INTRODUCTION**

The World Health Organization (WHO) defines exclusive breastfeeding (EBF) as the feeding of an infant with breastmilk only, without any other liquids or solids, not even water. However, drugs and oral rehydration solutions could be given [1]. In addition, the WHO

recommends exclusive breastfeeding for the first six months of life and subsequent introduction of complementary foods while breastfeeding continues until the child is at least two years old [2]. The benefits of exclusive breastfeeding for both mothers and infants have been well documented [3-9]. These include a reduction in child morbidity and mortality by protecting children against infections and enhancing immunity.

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Studies suggest that optimal breastfeeding in the first year and complementary feeding practices reduce approximately 20% of deaths in children under 5 years of age [10]. In 2018, 52% of under-five mortalities in the world occurred in just five countries: India, Nigeria, Pakistan, Ethiopia and the Democratic Republic of the Congo, all located in Africa and Asia [21]. Nigeria and India alone accounted for almost one-third of these deaths, and approximately 45% of child deaths were linked to malnutrition [21]. In both African and Asian regions, malnutrition is strongly associated with poor feedings and hygienic practices that lead to infections. Most women in Africa and Asia traditionally undertake some form of breastfeeding. However, the practice of exclusive breastfeeding is relatively low. For example, in Ghana and Nigeria, 98% of children are breastfed during childhood [11, 12]. However, in 2016, only 36% of infants were exclusively breastfed in Sub-Saharan Africa [13]. Although breastfeeding is almost universally acceptable to mothers in Africa, the challenge arises when breastfeeding has to be practiced exclusively for the first six (6) months of infancy. Despite the enormous challenges associated with increasing EBF, some African countries have successfully made progress, while others are still lagging behind.

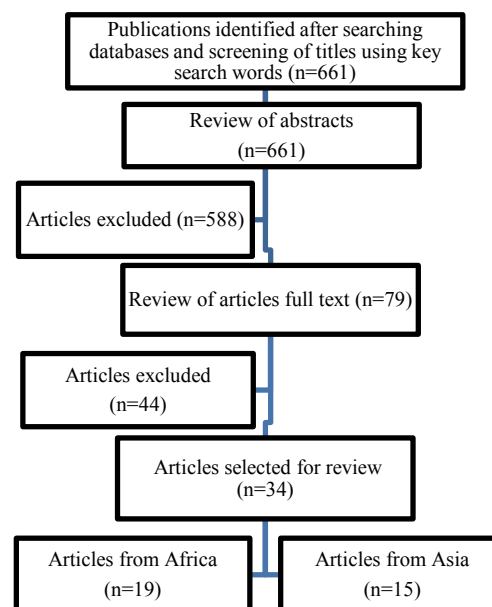
In general, the developing world recorded marked improvements in EBF rates, particularly in the early 1990s when the baby-friendly initiative was launched [15]. The greatest improvements were seen across West and Central Africa, with remarkable progress in Malawi and Rwanda in East Africa. In Malawi, EBF rates increased from 3% in 1992 to 71% in 2010 [16], and in Rwanda, the increase was from approximately 38% in 2009 to 86.9% by 2015 [17]. On the other hand, some countries reported very low rates of EBF practice in the region, such as 12% in Cote d'Ivoire, 3% in Chad and 6% in Gabon in 2015 [18]. Unfortunately, countries such as Ghana, which had achieved great gains in EBF practice by 2008, recorded declines from 64% in 2008 to 52% in 2014 [19, 20]. Asia also faces a similar challenge of low exclusive breastfeeding rates even though breastfeeding is generally acceptable and universally practiced. Countries such as Cambodia and Sri Lanka in South East Asia made remarkable progress in increasing their exclusive breastfeeding rates [15]. Between 1995 and 2007, Sri Lanka increased its EBF rate from 17% to 76%. Similarly, within a period of 10 years, Cambodia increased its EBF rates from 11% in 2000 to 74% in 2010 [15]. Hong Kong, Thailand, Vietnam and Myanmar also reported EBF rates ranging from 7% to 24% between 1995 and 2010 [14]. These indicators make it imperative to understand the underlying drivers of these trends to inform step-up actions across relevant sectors to improve EBF rates in Africa and Asia.

Currently, most countries in Africa and Asia have exclusive breastfeeding rates lower than 50% [15]. There is therefore an urgent need to understand the drivers of exclusive breastfeeding by mothers to inform workable solutions to scale up the practice of EBF in Africa and Asia. This review examines the factors that mitigate EBF and those that enhance EBF in some African and Asian countries to inform strategies to increase EBF in countries towards the achievement of

the Global Nutrition Target of 50% exclusive breastfeeding rates by 2025 and the Sustainable Development Goals.

## METHODS

A literature search was conducted using the search engines PubMed, Cochrane Library, Google Scholar and CINAHL Complete. The initial search was conducted in October 2015 and updated in June 2020. The search words used were exclusive breastfeeding, breastfeeding, barriers, facilitators, enhancers, constraints, Africa and Asia. The search was restricted to articles and abstracts that were published in English, peer reviewed, conducted either in Africa or Asia and published between 2005 and 2020. Research articles that specifically looked at conditions that were contraindications to breastfeeding, such as mothers on chemotherapy, alcohol and drug addiction and alcohol, were excluded, with the exception of HIV. A total of 667 articles were obtained from the various databases. Seventy-nine of the abstracts were relevant to the research topic on enhancers and barriers to breastfeeding and conducted in either Africa or Asia. After full review of the articles, 34 were found to have explored the barriers and enhancers of breastfeeding. Nineteen (19) of these studies were conducted in Africa, and 15 were from Asia (Figure 1).



**Figure 1. Flowchart of article selection.**

## RESULTS

A summary of the findings of the 34 studies selected for this review is presented in Tables 1 and 2. Table 1 presents reports on studies conducted in Africa, and Table 2 presents studies conducted in Asia. Based on the data presented in Tables 1 and 2, Table 3 provides a summary of the barriers and enhancers of EBF across Africa and Asia. Papers reviewed from Asia were conducted in Myanmar, Laos Peoples Democratic

Republic (LPDR), Taiwan, Pakistan, Korea, Vietnam, China, Sri Lanka, Indonesia, Malaysia, Hong Kong, Timor Leste, Bangladesh and India. These represent fourteen (14) out of the forty-eighty (48) countries in Asia. The studies included in this review for Africa were from Ghana, Nigeria, Kenya, Ethiopia, Zambia, Cameroon, Zimbabwe, South Africa, DR Congo, Malawi, Uganda and Mozambique, which constitute twelve (12) out of fifty (54) countries in the region. Three of the studies included in this review were conducted among HIV-positive mothers.

A total of 15,871 adults were involved in the studies, comprising 14,807 mothers, 284 fathers, 275 grandmothers, 136 health professionals and 84 community members and leaders. One of the studies did not categorically state the total number of persons who participated. Data were gathered using qualitative, quantitative and mixed method approaches. The sampling methods employed were convenient, purposive, random and systematic sampling techniques. One study was a randomized controlled trial. Fifteen of the studies were conducted in urban communities, six in rural communities, ten in both rural and urban communities and two in peri-urban or sub-urban communities.

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## DISCUSSION

The barriers and enhancers of EBF identified in the reviewed studies were discussed under four broad domains as follows: maternal factors, cultural beliefs and practices, health system factors and policy environment.

### Barriers to Exclusive Breastfeeding

#### Maternal factors

Most maternal factors identified as barriers to exclusive breastfeeding were similar across the African and Asian regions and countries. These maternal factors include mother's employment status and working

outside the home, lack of time for EBF, perception of breastmilk being inadequate for the baby, health status of mother, late decision to breastfeed and anxiety of mother. The employment status of the mother seems to be the utmost barrier to EBF, with similar sentiments expressed among mothers in the studies across both Africa and Asia [24, 30, 36, 37, 43, 44, 54, 55]. Employment outside the home consistently prevents mothers from effectively practicing exclusive breastfeeding even if they had the desire to do so [10, 24, 25, 30, 36, 43, 44, 46, 47, 49, 50, 54]. Considering the level of poverty in both Africa and Asia, it seems plausible that mothers must work to support their families and therefore cannot afford to be at home all the time to breastfeed their babies on demand. In most African and Asian countries, mothers are significant contributors to family income. Therefore, they are unable to practice exclusive breastfeeding for the recommended 6-month period because they have to resume duty after the standard maternity leave period after delivery, which is often less than 6 months. Interestingly, we found that high income was also identified as a barrier to exclusive breastfeeding in Ethiopia [37]. The authors explained that mothers with high income were more likely to be working full-time and tend to be outside the home often. Additionally, these mothers may readily afford infant formula and might not be willing to go through the demands of exclusive breastfeeding when they have to go back to work.

Poor maternal health was identified as a barrier to exclusive breastfeeding in some studies [54]. Mothers who went through caesarean delivery or vaginal delivery with episiotomy were likely to forgo exclusive breastfeeding [37, 48]. The pain mothers go through generally can lead to delay in initiation of breastfeeding and sometimes early introduction of other feeds apart from breast milk. Some mothers expressed fears of possibly dying as a result of breastfeeding when they themselves were not well [29]. Mothers also indicated that health problems affecting the breast, such as cracked nipples, sores and pain in the breast, often posed a challenge to exclusive breastfeeding [54]. It is clear from these studies that mothers' perception of their general wellbeing is fundamental to continuous, successful exclusive breastfeeding.

The perception that milk production was insufficient and that babies were unlikely to be satisfied with breastmilk alone were also identified as major barriers to exclusive breastfeeding [10, 24-25, 27-29, 34-36, 38, 48-50, 56]. These concerns were echoed by most of the participants across the various studies conducted in both Africa and Asia. Mothers perceived their babies to be hungry even after breastfeeding [24]. In Nigeria and Kenya, there were perceptions that babies could be addicted to breastmilk; therefore, they should be introduced to other foods in addition to breastmilk to increase their exposure to different kinds of food and taste [10, 24]. In Cameroon, breastmilk was perceived to be an incomplete meal, thus justifying the need to supplement it with other foods [30]. Similarly, Vietnamese mothers would give water because they felt the child was thirsty [48]. They also believed that the mouth of the child should be cleaned with water after breastfeeding to prevent oral thrush.

**Table 1: Summary of findings from studies in Africa**

Author (Year) [Ref] COUNTRY	Study Design	Population/ Sample Size	Setting	Key Findings on Barriers and Enhancers of Exclusive Breastfeeding	
Agumbadie et al., (2012) [24]	Mixed method	N=210 Mothers (n=200) Nurses (n=10)	Urban	<b>Barriers</b> <ul style="list-style-type: none"> <li>Perception of breastmilk insufficient for baby</li> <li>Fear of baby becoming addicted to breast milk</li> <li>Pressure from in-laws to stop EBF</li> <li>Mother's employment</li> <li>Inadequate support from spouse</li> <li>Conflicting information from opinion leaders such as grandmothers, mothers-in-law</li> <li>Lack of support to initiate EBF after birth due to busy schedules of nurses, which prevents them from adequately assisting mothers who have challenges initiating EBF</li> </ul>	
Alutu et al., (2006) [25]	Mixed method	N= 536 Mothers (n=536)	Urban/Rural	<b>Barriers</b> <ul style="list-style-type: none"> <li>Perception of breastmilk insufficiency</li> <li>Mother's employment</li> <li>Myths and beliefs that breastfeeding cannot be practiced for a long time since milk turns into blood</li> </ul>	
NIGERIA					
Arts et al., (2011) [26]	Qualitative/ focus group discussions	N=342 Mothers (n=95), Fathers (n=85), Grandmothers (n=82), Nurses (n=80)	Urban	<b>Barriers</b> <ul style="list-style-type: none"> <li>Negative family influence (fathers, grandmothers)</li> <li>Belief that water should be given to baby</li> <li>Lack of support from family and healthcare providers to initiate and continue EBF when there are challenges</li> </ul>	
MOZAMBIQUE					
Cherop et al., (2009) [10]	Cross sectional	N=384 Mother- infant pair (n=384)	Urban	<b>Barriers</b> <ul style="list-style-type: none"> <li>Perception of inadequate breastmilk production and breastmilk insufficiency</li> <li>Perception that babies need to be introduced to the taste of other foods</li> <li>Mother's employment</li> <li>Lack of time for mothers working outside the home</li> </ul>	
KENYA					
Madufo et al., (2013) [31]	Mixed method	N= 128 Mothers	Urban	<b>Barriers</b> <ul style="list-style-type: none"> <li>Perception of breastmilk insufficiency</li> <li>Lack of time due to mother's employment</li> <li>Lack of knowledge about EBF</li> <li>Lack of support from husband and family members</li> </ul>	
NIGERIA					
* Maman et al., (2012) [32]	Qualitative /In depth interview	N=40 Pregnant and post-partum women	Urban	<b>Barriers</b> <ul style="list-style-type: none"> <li>Financial constraints</li> <li>Breast health issues and concerns</li> <li>Misinformation about HIV transmission</li> <li>Prior feeding experiences</li> </ul>	<b>Enhancers</b> <ul style="list-style-type: none"> <li>Knowledge about HIV transmission through breastfeeding</li> <li>Information from clinical staff</li> <li>Support from clinical staff</li> <li>Other support networks</li> </ul>
DR CONGO					
Muchachia et al., (2015) [33]	Mixed method	N= 24 Mothers (n=20) Health workers (n=4)	Rural	<b>Barriers</b> <ul style="list-style-type: none"> <li>Belief that boys eat more than girls and so will require more milk</li> <li>Cultural practices such as nhova where traditional medicine is given to the baby</li> <li>Grandmothers and mothers-in-law opposing EBF</li> <li>Gender inequalities - influence of fathers.</li> </ul>	<b>Enhancers</b> <ul style="list-style-type: none"> <li>Low income of mothers which impacts on mother's nutrition</li> <li>High level of formal education of mother</li> <li>High income</li> </ul>
ZIMBABWE					
*Nor et al., (2012) [34]	Qualitative	N=17 Mothers (n= 17)	Rural /Urban	<b>Barriers</b> <ul style="list-style-type: none"> <li>Erroneous understanding of EBF</li> <li>Perception of milk insufficiency</li> <li>Perception that babies need water and other Zulu traditional medicines</li> </ul>	<b>Enhancers</b> <ul style="list-style-type: none"> <li>Perception of a breastfed baby as "healthy baby"</li> <li>High cost of formula milk</li> <li>Perception of formula milk fed to HIV babies</li> </ul>
SOUTH AFRICA					

**Table 1: continued**

Author (Year) [ref] COUNTRY	Study Design	Population/ Sample Size	Setting	Key Findings on Barriers and Enhancers of Exclusive Breastfeeding	
* Østergaard et al., (2014) [35]  MALAWI	Qualitative In-depth interviews and observations	N=21 Mothers	Urban	<b>Barriers</b> <ul style="list-style-type: none"> <li>Perceived insufficiency of milk</li> <li>Poor counselling by HIV counsellors right after testing mothers of their HIV status</li> <li>Stigma of breastfeeding</li> <li>Lack of control over breastfeeding because mothers/ grandmothers dictate what should happen</li> </ul>	<b>Enhancers</b> <ul style="list-style-type: none"> <li>Stable relationship with a man/husband rather than living alone</li> <li>Older age of mothers and therefore more experienced</li> <li>Mothers not living in the same house with grandmothers/mothers-in-law</li> </ul>
Oloo et al., (2009) [36]  GHANA	Qualitative/ focus group discussions	N=35 Mothers	Peri-urban	<b>Barriers</b> <ul style="list-style-type: none"> <li>Perception of milk insufficiency</li> <li>Child refusing to be breastfed</li> <li>Breast and nipple problems in mothers</li> <li>Mother's employment</li> <li>Lack of support from spouse. Fathers prefer to provide money for formula than to feed mother. Cultural practices such as not wanting to expose breast in public</li> </ul>	<b>Enhancers</b> <ul style="list-style-type: none"> <li>Influence from other family members such as mothers and grandmothers who preferred feeding</li> <li>Positive EBF experiences such as reduced morbidity with older children</li> <li>EBF is inexpensive and convenient</li> </ul>
Shifraw et al., (2015) [37]  ETHIOPIA	Cross sectional	N=648 Mothers	Urban	<b>Barriers</b> <ul style="list-style-type: none"> <li>Mothers with high income can afford formula</li> <li>Mother's employment</li> <li>Cesarean section (poor health status of mother)</li> </ul>	<b>Enhancers</b> <ul style="list-style-type: none"> <li>Low income (complementary /alternate feeding not affordable. Vaginal delivery (good health status of mother)</li> </ul>
Webb-Girard et al., (2012) [38]  KENYA	Qualitative/ focus group discussions/ interviews	N=148 Mothers	Urban	<b>Barriers</b> <ul style="list-style-type: none"> <li>Perceived milk insufficiency</li> <li>Food insecurity informs maternal confidence in ability to EBF</li> </ul>	
Goosen et al., (2016) [39]  SOUTH AFRICA	Qualitative, focus group discussions/ purposive	N=91	Urban	<b>Barriers</b> <ul style="list-style-type: none"> <li>Perception of milk insufficiency</li> <li>Perception of infants needing water</li> <li>Poor education on breastfeeding at antenatal and postnatal clinics</li> <li>Lack of support from the community</li> <li>Local beliefs: a stressed mother could pass on the stress to the baby being breastfed.</li> </ul>	
Rujumba et al., (2020) [40]  UGANDA	Qualitative, informant interview	N=15	Urban/rural	<b>Barriers</b> <ul style="list-style-type: none"> <li>Perceived breastmilk insufficiency</li> <li>Heavy work load</li> <li>Inadequate education on EBF at health facilities</li> </ul> <b>Enhancers</b> <ul style="list-style-type: none"> <li>Supportive health team with requisite knowledge in breastfeeding</li> <li>Community breastfeeding support groups</li> <li>Media</li> <li>Professional Associations</li> </ul>	
Mohamed et al., (2020) [41]  KENYA	Qualitative, Focus group discussions/ key informant interviews	N=72	Urban/rural	<b>Barriers</b> <ul style="list-style-type: none"> <li>Perceived breastmilk insufficiency</li> <li>Belief that baby needs water</li> <li>Negative grandparents/mother-in-law's influence</li> <li>Negative maternal attitude towards EBF</li> <li>Home delivery</li> <li>Caesarean section delivery</li> </ul>	<b>Enhancers</b> <ul style="list-style-type: none"> <li>High knowledge on EBF</li> <li>Positive maternal attitude towards EBF.</li> <li>Attendance to maternal and child health clinics</li> <li>Supportive husband</li> <li>Islamic teaching that breastfeeding is a child's right</li> <li>Self-confidence of mothers to breastfeed</li> </ul>

**Table 2. Summary of findings from studies in Asia**

Author (Year) [Ref] COUNTRY	Study Design	Population/ Sample Size	Key Findings on Barriers and Enhancers of Exclusive Breastfeeding
Khanal et al., (2014) [46]	Cross sectional	N=975 Mother infant pair	<div>Barriers</div> <ul style="list-style-type: none"> <li>• Mother earning income</li> <li>• Perception that new born baby is below average size. Residency in the capital city</li> </ul> <div>Enhancers</div> <ul style="list-style-type: none"> <li>• Mothers with ability to decide on health-related matters</li> </ul>
TIMOR LESTE Lee, et al., (2013) [47] Setting Rural/urban	Qualitative/ focus group discussions/interviews Purposive sampling	N=47 Mothers. Health workers Community elders	<div>Barriers</div> <ul style="list-style-type: none"> <li>• Mother's employment</li> <li>• Conflicting information from different sources</li> </ul> <div>Enhancers</div> <ul style="list-style-type: none"> <li>• Health status of mother i.e. HIV infection</li> <li>• Lack of information on exclusive breastfeeding</li> </ul>
LAO PDR Nguyen et al., (2013) [48] Setting Urban	Qualitative/interviews	N=6068 Mother/child dyad	<div>Barriers</div> <ul style="list-style-type: none"> <li>• Perception that baby will be thin/sly</li> <li>• Perception that breastmilk is not nutritious enough for baby</li> </ul> <div>Enhancers</div> <ul style="list-style-type: none"> <li>• Infants' mouth needing to be cleaned with water to prevent oral thrush</li> <li>• Caesarean delivery</li> <li>• Vaginal delivery with episiotomy</li> </ul>
VIETNAM Perera et al., (2012) [49] Setting Rural/urban	Prospective observational	N=500 Infant mother pair	<div>Barriers</div> <ul style="list-style-type: none"> <li>• Mother's employment</li> <li>• Growth faltering of baby between 2-4 months</li> </ul> <div>Enhancers</div> <ul style="list-style-type: none"> <li>• Maternal anxiety</li> <li>• Advanced maternal age &gt;30 years</li> </ul>
SRI LANKA Premani et al., (2011) [50] Setting - PAKISTAN Setting Urban	Qualitative/ In-depth interview	N=6 Mothers	<div>Barriers</div> <ul style="list-style-type: none"> <li>• Cultural norms</li> <li>• Lack of privacy to breastfeed at home due to joint family system</li> <li>• Concerns about breastfeeding in public</li> <li>• Lack of time</li> </ul> <div>Enhancers</div> <ul style="list-style-type: none"> <li>• Maternal knowledge</li> <li>• Self-motivation</li> <li>• Early decision to breast feed</li> <li>• Support from family/husband</li> <li>• Support from health care professionals</li> </ul>
Susiloretni et al., (2015) [51] INDONESIA Setting Rural	Quasi experimental	N=599 Mothers (n=163) Fathers (n=163) Grandmothers (n=163) Community leaders (n=82) Midwives (n=28)	<div>Barriers</div> <ul style="list-style-type: none"> <li>• Breast engorgement</li> <li>• Lack of support from grandmothers</li> <li>• Provision of sample of formula sample at discharge from hospital</li> </ul> <div>Enhancers</div> <ul style="list-style-type: none"> <li>• Maternal knowledge</li> </ul>
Tan (2011) [52] MALAYSIA PENINSULAR Setting Rural/urban	Cross sectional	N=682 Mothers	<div>Barriers</div> <ul style="list-style-type: none"> <li>• Mothers' employment</li> <li>• Unsupportive husbands</li> </ul> <div>Enhancers</div> <ul style="list-style-type: none"> <li>• Non-working mothers</li> <li>• Non-smoking mothers</li> <li>• Mothers with more than one child</li> <li>• Supportive husbands</li> </ul>
Tengku et al., (2012) [53] MALAYSIA Setting Rural/urban	Qualitative/ In depth interview	N=30 Mothers	<div>Barriers</div> <ul style="list-style-type: none"> <li>• Perceived milk insufficiency</li> </ul> <div>Enhancers</div> <ul style="list-style-type: none"> <li>• Perceived low nutritional quality of breast milk</li> <li>• Mother's employment</li> </ul>
Thiet et al., (2016) [54] MYANMAR Setting Rural/urban	Qualitative/ In depth interview	N=44 Mothers (n=24) Fathers (n=10) Grandmothers (n=10)	<div>Barriers</div> <ul style="list-style-type: none"> <li>• Perceived insufficient production of breast milk</li> <li>• Mothers working outside the home</li> <li>• Cracked nipples</li> <li>• Poor maternal health</li> </ul> <div>Enhancers</div> <ul style="list-style-type: none"> <li>• Belief that breastfeeding makes mother look unattractive</li> <li>• Concerns about breastfeeding in public</li> <li>• Support from fathers and grandmothers</li> </ul>
Tsai et al., (2015) [55] TAIWAN Setting Urban/sub-urban	Qualitative	N=300 Mothers	<div>Barriers</div> <ul style="list-style-type: none"> <li>• Older age of mother</li> <li>• Living in a metropolis</li> <li>• Mother's employment</li> </ul> <div>Enhancers</div> <ul style="list-style-type: none"> <li>• High level of health literacy</li> <li>• Intention to breastfeed for a long time</li> <li>• Greater self-efficacy</li> <li>• Rooming-in</li> <li>• Early initiation of breastfeeding</li> </ul>
Khatun et al., (2018) [56] BANGLADESH Setting Urban	Mixed method	N= 342 Mothers 18 in-depth interviews	<div>Barriers</div> <ul style="list-style-type: none"> <li>• Milk insufficiency</li> <li>• Maternal employment</li> <li>• Caesarean delivery</li> <li>• Lack of support from grandmother</li> <li>• No creche at work place</li> <li>• Doctor prescribed formula</li> </ul> <div>Enhancers</div> <ul style="list-style-type: none"> <li>• Education on breastfeeding</li> <li>• Family support</li> <li>• Advice from doctors</li> <li>• Free cost of breastmilk</li> </ul>

\* studies with HIV-positive respondents

**Table 3: Summary of barriers and enhancers of exclusive breastfeeding in Asia and Africa**

	AFRICA	ASIA
	<b>Maternal Factors</b>	
<b>Enhancers</b>	<ul style="list-style-type: none"> <li>• Formal education</li> <li>• Older age</li> <li>• Low income</li> <li>• Vaginal delivery</li> <li>• Home delivery</li> <li>• Attendance to maternal and child health clinics</li> <li>• Self-confidence /motivation</li> </ul>	<ul style="list-style-type: none"> <li>• Higher formal education</li> <li>• Unemployed mother</li> <li>• Mother with more than one child / previous experience</li> <li>• Planning and commitment to breastfeed</li> <li>• Rooming in</li> <li>• Married woman/ living with spouse</li> <li>• Self-motivation</li> <li>• Living in rural area</li> <li>• Non-smoking mother</li> </ul>
<b>Barriers</b>	<ul style="list-style-type: none"> <li>• Mother's employment</li> <li>• Poor health status of mother</li> <li>• Perception of insufficient breastmilk production</li> <li>• Inadequate time</li> <li>• High income to purchase formula</li> <li>• Caesarean delivery</li> <li>• Reduced physical attraction</li> </ul>	<ul style="list-style-type: none"> <li>• Mother's employment</li> <li>• Health status of mother</li> <li>• Perception of insufficient breastmilk</li> <li>• Perceived poor quality of breastmilk</li> <li>• Lack of time</li> <li>• Caesarean delivery</li> <li>• Physical attraction</li> <li>• Older age of mother</li> <li>• Late decision to breastfeed</li> <li>• Living in an urban area</li> <li>• Maternal anxiety</li> </ul>
	<b>Cultural Beliefs and Practices</b>	
<b>Enhancers</b>	<ul style="list-style-type: none"> <li>• Family support</li> <li>• Leaving away from grandmothers/mother's-in-law</li> </ul>	<ul style="list-style-type: none"> <li>• Family support from husbands, grandmothers, mother's-in-law</li> <li>• Presence of domestic helper</li> </ul>
<b>Barriers</b>	<ul style="list-style-type: none"> <li>• Lack of family support (Influence of grandmothers/mother's-in-law)</li> <li>• Myths and beliefs about breastmilk and practice of breastfeeding</li> <li>• Effect of gender inequality</li> </ul>	<ul style="list-style-type: none"> <li>• Lack of family support (husbands, grandmothers/mother's-in-laws)</li> <li>• Lack of privacy to breastfeed due to extended family system</li> <li>• Cultural norms</li> </ul>
	<b>Health System Factors</b>	
<b>Enhancers</b>	<ul style="list-style-type: none"> <li>• EBF Education from health workers</li> </ul>	<ul style="list-style-type: none"> <li>• Education on breastfeeding</li> <li>• Support from healthcare professionals</li> </ul>
<b>Barriers</b>	<ul style="list-style-type: none"> <li>• Lack of education on EBF</li> <li>• Lack of education on breastmilk composition</li> </ul>	<ul style="list-style-type: none"> <li>• Lack and inadequate education</li> <li>• Conflicting EBF educational information</li> </ul>
	<b>Policy Environment</b>	
<b>Enhancers</b>	<ul style="list-style-type: none"> <li>• Cost of infant formula</li> </ul>	<ul style="list-style-type: none"> <li>• Workplace provision to breastfeed</li> <li>• Storage facilities at the work place</li> </ul>
<b>Barriers</b>		<ul style="list-style-type: none"> <li>• Maternal leave less than 6 months</li> <li>• Increased workload after maternity</li> </ul>

In Africa (Ghana) and Asia (Myanmar), a mother's view of her physical looks and attractiveness and her perception of how others view her was also identified as a significant issue that posed a challenge to exclusive breastfeeding [36, 54]. Some of the mothers felt that continuous breastfeeding would make them look less attractive. Others felt uncomfortable breastfeeding in public places [36, 54]. These perceptions are influenced by women's assessment of how society perceives mothers breastfeeding in public and likely to be a reflection of changes in societal values over time. New adjustments are needed to support women when they have to breastfeed in public places.

#### ***Cultural beliefs and practices***

Culture or tradition tends to govern the way people live. Breastfeeding itself is an art that thrives on a complex interaction between biology and culture [57]. Several of the difficulties that arise with exclusive breastfeeding tend to be entrenched in cultural beliefs, which usually conflict with the science of breastfeeding [57]. This assertion was observed in some of the studies

reviewed, ranging from beliefs regarding the breastmilk itself to specific roles that needed to be played by individuals in the family or community. These beliefs and behaviours were so culturally entrenched that mothers had difficulty overlooking them. For example, in some societies, colostrum was considered "bad milk" or "does not contain any nutrients" and therefore should not be fed to babies [27, 50]. In some cultures, babies were expected to be fed certain "foods" that are believed to be beneficial. In Zimbabwe, for example, it is believed that feeding babies cooking oils and water prevents or treats colic and sunken fontanel [24]. There is also a belief that newborn babies need to be fed with solids within a week after birth to signify genetic connection to their ancestors [30].

In some cultures, as obtains in Kenya, South Africa and Ghana, babies are fed with certain 'concoctions' to protect the baby because of religious beliefs, particularly the belief that others might cast evil spells on the baby [33, 53, 55]. In one study in Cameroon, a substance called Viindi, which is a solution prepared from washing

off passages of the Koran that have been written with charcoal on a wooden slate, is given to the infant for protection [27]. Similar practices were reported in Zimbabwe, where the baby is given concoctions usually composed of tree barks, roots, juices, herbs, cooking oil and wild fruits to treat a condition known as nhova (which is the administration of traditional medicines to babies to prevent sunken fontanel and death) [29]. In Cameroon, a breastfeeding mother does not engage in sexual intercourse. This is because it is believed that sexual intercourse “spoils the milk” and has the tendency to “spoil the child” [27]. This belief implies that a breastfeeding mother cannot engage in sexual intercourse. She would have to avoid sexual intercourse to successfully breastfeed her baby. This belief therefore discourages breastfeeding of the baby for a significant period.

Culturally, the contribution of fathers, grandmothers, in-laws and sometimes elderly persons society in decision-making at the household level cannot be understated. The influence of extended family and opinion leaders in African and Asian societies is still upheld to a very large extent. In Cameroon, mothers indicated that to “avoid confrontation” with husbands or other relatives whose opinion cannot be ignored, they succumbed to the pressures of introducing other feeds [27]. Similar concerns were expressed by mothers in Ghana, Nigeria, Lao PDR, Vietnam and Mozambique, where grandmothers were found to be very influential in offering advice on breastfeeding [20, 33, 42, 49, 52]. This implies that a decision to exclusively breastfeed would have to be endorsed by all revered family and community members in order not to incur their wrath. This happens especially in societies where opinions of the elderly are very highly regarded. In conclusion, therefore, the whole community needs to be well informed and educated to ensure that women receive the needed support to breastfeed successfully.

#### **Health system factors**

Breastfeeding is an art that is surrounded by many myths and misconceptions. Several of the challenges that arise during breastfeeding occur when information given about breastfeeding conflicts with the individual's own cultural beliefs [57]. Inadequate knowledge on the subject of exclusive breastfeeding was identified as a key barrier to exclusive breastfeeding across the various studies. Studies in Ethiopia, Zambia, Nigeria, the Democratic Republic of Congo, South Africa and India clearly identified a lack of knowledge on exclusive breastfeeding as well as a general lack of education on appropriate infant feeding practices as barriers to EBF [25-26, 28-29, 31, 36]. When people are well educated on the composition of breast milk and how it helps to protect the child against infectious and other diseases, then it is likely to be well utilized.

The perception expressed by some mothers that breast milk is insufficient can be successfully addressed when well-structured educational messages and strategies tailored to meet the needs of specific populations are provided, preferably through the health system and during antenatal care, which is well patronized by mothers in Asia and Africa for at least one visit.

Health education programmes should aim at providing consistent messages and avoid ambiguity,

which tends to confuse mothers and significant others who support breastfeeding. These key messages were among the sentiments expressed by mothers in some studies [24, 49]. The mothers expressed concern about conflicting messages they receive from the hospitals and significant members of the community whose opinions matter in breastfeeding a baby. These include basic issues such as the definition of exclusive breastfeeding and the addition of water to breastmilk [34, 49]. Inadequate education on exclusive breastfeeding was not only limited to mothers but also to healthcare professionals. For example, healthcare workers were quick to advise mothers to switch to formula when mothers reported challenges with exclusive breastfeeding [52]. Other mothers lamented about the lack of support from healthcare professionals when they needed clarification due to their busy work schedules [24, 26].

#### **Policy-related factors**

The absence of strong policies and political will to support breastfeeding can be a major barrier to EBF. A major barrier to EBF is the duration of paid maternity leave. In all countries studied, maternity leave is often less than 6 months. This makes it difficult to continue to breastfeed exclusively when mothers have to return to work. Mothers bemoaned the absence of facilities in the workplace that could enable exclusive breastfeeding and make breastfeeding more comfortable for working mothers [43]. Mothers also expressed their reservations about breastfeeding in public due to lack of privacy [50, 54]. Some policies could be enacted to ensure that mothers are provided with private and convenient places that could support breastfeeding in public.

#### **Enhancers of Exclusive Breastfeeding.**

##### **Maternal factors**

Enhancers to EBF were varied and included the health status of the mother following vaginal delivery as well as other health and breast concerns, motivation to breastfeed, higher formal education, being married and older age of mother with previous breastfeeding experience. In Kenya and Ethiopia in Africa and Bangladesh and Lao PDR in Asia, mothers who delivered vaginally and in good health were more likely to exclusively breastfeed compared to those who went through caesarean sections [37, 47, 39, 56]. Additionally, those with intent, preparedness and commitment to breastfeed exclusively for a long time had an enhanced ability to breastfeed [55]. Younger mothers and those with low income who could not afford milk formula were also more likely to exclusively breastfeed [37, 55]. Similarly, mothers with high formal education were more likely to EBF compared to those with lower education. This could be attributed to the benefits of higher education and a better understanding of the benefits of exclusive breastfeeding [32]. In Zimbabwe, older women were more likely to exclusively breastfeed [32], probably due to their previous experiences with breastfeeding [33].

Maternal knowledge on breastfeeding as well as formal education also contributed to enhancing exclusive breastfeeding in Zimbabwe, Cameroon and Kenya [27, 30, 39]. Similarly, in Asian countries such as Bangladesh, Indonesia, Pakistan and Hong Kong, these observations were found to be true [43, 45, 38, 56]. In Hong Kong, being married enhanced exclusive



breastfeeding [45], while higher income in South Africa was found to be an enhancer to exclusive breastfeeding. However, the opposite was true in Ethiopia, where mothers with higher income were less likely to breastfeed [34, 37]. Older maternal age proved to be an enhancer of exclusive breastfeeding among women in Malawi. In contrast, young maternal age enhanced exclusive breastfeeding in Taiwanese women in Asia [35, 55]

#### ***Cultural beliefs and practices***

The principal cultural factor that enhanced EBF across both regions was support from family members. The traditional roles of every member of the family are well defined. It is not the norm for mothers across Africa and Asia to receive support from their spouses, though studies from this review show that support from fathers and sometimes from other members of the family, such as grandmothers, provided an impetus for EBF [29, 32, 47]. In some cultures, babies are separated from mothers to allow mothers to rest. However, when babies and mothers are not separated but rather allowed to be in the same room (i.e. rooming-in), mothers' chances of breastfeeding were enhanced [38, 48]. Rooming-in also contributes to enhancing the early initiation of breastfeeding and tends to increase the chances of exclusively breastfeeding [48].

#### ***Health System Factors***

Some mothers alluded to the benefits of receiving breastfeeding information from healthcare professionals and reported that it enhanced their ability to exclusively breastfeed [27, 44]. For example, among HIV-infected mothers, knowledge about HIV transmission through breastfeeding enhances their chances of breastfeeding [32]. This was possible because they could appreciate the circumstances under which transmission was most likely to occur and make an informed decision on the risks and benefits of breastfeeding under the circumstance. A high level of literacy appeared to enhance breastfeeding because literate mothers were found to be more compliant with exclusive breastfeeding guidelines when compared to illiterate mothers [30]. Lessons learned from success stories from Sri-Lanka, Malawi and Cambodia demonstrated the impact of public education on breastfeeding as an enhancer to exclusive breastfeeding [15]. The use of mass media and targeted home visits also greatly improved exclusive breastfeeding rates.

#### ***Enabling policy environment***

The baby-friendly initiative in countries promotes EBF. However, some health facilities do not adhere to this initiative because there is no strong political will to enforce the recommendations. In Indonesia, for instance, mothers were provided with formula samples at discharge, which prevented them from exclusively breastfeeding [20]. Policies that provide an enabling environment in healthcare facilities and workplaces to support breastfeeding also enhance the ability of mothers to breastfeed exclusively [43]. Places of work that provided spaces for mothers to conveniently breastfeed during working hours were useful in motivating mothers to continue to breastfeed [43]. Countries that have made gains in EBF have done so through collaborative efforts from all stakeholders, including government, healthcare professionals, commercial entities, mothers and the community [15].

According to the WHO, countries that have programmes and policies in line with the recommendations of the WHO/UNICEF Global strategy for infant and young child feeding have made the most gains in enhancing EBF [16]. Therefore, the ultimate facilitator to EBF lies with governments taking the lead in creating the enabling environment by enacting policies and legislations such as longer paid maternity leaves for mothers and making it compulsory that workplaces create facilities that are conducive to breastfeeding.

Based on the findings from this review, recommendations to improve breastfeeding include i) addressing maternal perceptions of exclusive breastfeeding through adequate education; ii) ensuring that key decision makers and opinion leaders in the family and community, such as fathers, grandmothers and in-laws, are educated and encouraged to support exclusive breastfeeding; iii) enacting policies to protect working mothers and ensure that they have adequate time to dedicate to breastfeeding should be considered; iv) those in the formal sector could be provided with adequate duration of paid leave and those in the informal and low income settings could be supported with a stipend to ensure they abstain from work to enable them breastfeed adequately. Additionally, health professionals should regularly be updated on their role to educate mothers and the community and the need to provide support for mothers during difficult and confusing times. Some of these can be achieved by using breastfeeding support groups.

#### ***LIMITATIONS***

This review has some limitations. There could be some level of bias since not all the studies included in this review primarily sought to investigate the barriers and enhancers of exclusive breastfeeding. Nonetheless, the relevant information was extracted from their findings, regardless of their study objectives. Second, most of the studies reviewed used qualitative data collection methods rather than quantitative approaches. Qualitative data collection approaches tend to be more subjective compared to quantitative approaches. However, the qualitative approach is very useful in providing depth and bringing to the fore the real reasons why people do what they do to inform the development of effective interventions.

#### ***CONCLUSIONS AND RECOMMENDATIONS***

The key barriers to exclusive breastfeeding identified in this review were perceptions about the adequacy of breastmilk produced by mothers to meet the nutritional needs of their babies, poor maternal health, especially following caesarian delivery, lack of adequate information on EBF for mothers and family members, negative cultural practices such as proving teas and concoction for babies for medicinal and spiritual or protective purposes, issues regarding maternal employment and government policies such as brief maternity leave and lack of enabling environment that were not in consonance with the practice of exclusive breastfeeding. We found that the enhancers of breastfeeding were related to adequate information, support from family and some government policies that sought to improve breastfeeding. The involvement of all stakeholders in promoting the practice of exclusive

breastfeeding is paramount to the success of achieving global goals regarding the health, nutrition and survival of children. All stakeholders, especially governments, have to be committed to achieving global goals through constant communication and education strategies aimed at removing the specific barriers. In addition, governments must provide leadership and the resources needed to educate and empower all stakeholders to play their respective roles towards the achievement of success. Further studies could investigate EBF promotive intervention strategies that work. These strategies should not only emphasize the benefits of exclusive breastfeeding but also address the barriers that mitigate successful breastfeeding.

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