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Association between Sago Consumption and NCDs' Clinical Signs among Those Consuming Sago in Kepulauan Meranti Regency, Riau Province, Indonesia

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Abstract Non-communicable diseases (NCDs) remain a public health disease worldwide, including Indonesia. Clinical signs of NCDs can be caused by many factors. These diseases may arise from a combination of underlying, modifiable, non-modifiable, and intermediate risk factors. Food consumption can be one of the factors that can prevent NCDs. This study aimed to identify the association between sago consumption and NCDs' clinical signs among those consuming sago in Kepulauan Meranti Regency, Riau Province. A total of 181 subjects were recruited in this cross-sectional study using purposive sampling. Questionnaire and direct measurement were used to collect the data. Sociodemographic, anthropometric, lifestyle, family history of DM, random capillary blood glucose (RCBG), cholesterol levels, systolic and diastolic blood pressure (SBP & DBP), and waist circumference (WC) data were collected. STATA 22.0 was used for descriptive statistics and comparing the two groups. The majority of subjects who rarely and often consumed sago had RCBG of <140 mg/dL (91.2%) and normal body mass index (65.2%). Sociodemographic characteristics, lifestyle (smoking and physical activity), family history of DM, and clinical signs (cholesterol levels, SBP, DBP, and WC) were not significantly different between subjects who rarely and often consumed sago in the group whose RCBG was 140-200 mg/dL. However, the education level, family income, family history of DM, SBP and DBP were significantly different in the group whose RCBG was <140 mg/dL. Sago consumption had a significant association with cholesterol levels and WC. Sago might have the potential as an alternative food to prevent NCDs.

Keywords: *food consumption, non-communicable diseases, nutrition, prevention, sago*

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1. Introduction

Non-communicable diseases (NCDs) are the leading cause of mortality worldwide with 41 million deaths annually, equivalent to 71% of all deaths globally. Fifteen million people aged between 30 and 69 years die from NCDs each year. More than 85% of these "premature" deaths occur in low- and middle-income countries. Cardiovascular diseases account for most NCDs deaths (17.9 million people/year), followed by cancer (9.0 million), respiratory diseases (3.9 million), and diabetes mellitus/DM (1.6 million). A combination of genetic, physiological, lifestyle and environmental factors can cause these diseases. Some risk factors for NCDs are unhealthy diets, lack of physical activity, active and passive smoking, and excessive alcohol consumption [1].

DM is one of NCDs. The individuals with an prediabetic condition (5-10%) can be at risk of developing DM, which is a heterogeneous metabolic disorder characterized by long-term impairment of insulin secretion and damage [2,3]. Prediabetes is a condition in which the blood glucose level is higher than an normal but lower than the cut-off points for DM [3,4]. The prevalence of DM in the world continues to increase, and Indonesia ranks sixth globally as the country with the highest prevalence of DM [5]. According to the data of the Indonesian Basic Health Research [6], the prevalence of DM among people under the age of 15 has doubled (2.1%).

The prevalence of DM in Riau Province was 1.0% while the prevalence in Kepulauan Meranti Regency was 0.6% [6]. Type 2 diabetes mellitus (T2DM) is the most common form of DM found in adults. Two major groups of factors influence the T2DM, namely unchangeable factors (e.g., sex, age, and family history of DM) and

changeable factors (e.g., smoking, alcohol consumption, physical activity, obesity, hypertension, cholesterol levels, and sedentary lifestyle) [5,7,8,9].

Decreased sensitivity of target tissues to the metabolic effects of insulin, known as insulin resistance, is one of the causes of T2DM. Obesity is one of the risk factors for T2DM which can be measured through waist circumference (WC) and body mass index (BMI). The prevention of T2DM can be carried out by controlling the risk factors [6,7]. Some studies showed that traditional food could be an alternative to prevent an RCBG level of 140-200 mg/dL from becoming T2DM by reducing hyperglycemia, insulin resistance, and obesity [10].

Besides rice, sago is a traditional source of carbohydrates which is widely available in Indonesia (5.2 million hectares or ± 50% of the sago area worldwide). It is spread in several provinces, including Riau Province with Kepulauan Meranti Regency as a sago producer [11]. Sago is still consumed by most people even though it is not considered as a staple food. It has several advantages over other sources of carbohydrates. Sago has a low glycemic index (GI); i.e., around 27. It also contains resistant starch, and it is high in starch, amylose, and antioxidant [12,13,14]. These nutrients play a role in maintaining normal blood glucose by increasing the number of beta cells producing insulin, reducing hypoglycemia, and improving lipid metabolism [6,15]. However, rice -- as the main source of carbohydrate in Asia -- has a relatively higher GI (64-93), and several studies have shown that it can increase the risk of T2DM [15,16,18]. On the other hand, low-GI food may be useful in ameliorating hyperglycemia and glucose overload associated with diabetic conditions [19].

Studies have shown that consuming sago is good for health because it can reduce blood glucose, LDL cholesterol levels, and triglycerides levels [20]. Thus, it may reduce the risk of T2DM and heart disease [13,20,21]. Although Kepulauan Meranti Regency is a sago-producing region, NCDs' signs are still found in the area. Therefore, we were interested in identifying the association between sago consumption and NCDs' clinical sign among the sago-based agricultural community in Kepulauan Meranti Regency, Riau Province, Indonesia.

2. Methods

2.1. Study Design and Recruitment of Subjects

This study used a cross-sectional design, and it was conducted in Kepulauan Meranti Regency, Riau Province. The research protocol was approved by the Human Research Ethics Committee of Bogor Agricultural University Number 031/IT3.KEPMSM-IPB/SK/2017. The study involved 181 subjects living in several villages, namely Sungai Tohor, Tanjung Sari, Nipah Sendanu, Batin Suir and Lalang Tanjung. The subjects were selected purposively. The subjects were provided with an information sheet regarding the study and informed consent stating that they could withdraw without prejudice from the study at any time. They were then asked to complete a form regarding the demographic data (age, sex, education level, occupation, and family income).

The inclusion criteria were as follows: 1) age between 35 and 80 years, 2) not hospitalized, and 3) not suffering from serious illness or chronic drug consumption. The subjects recruited in this study were those without complications of co-infected patients. The subjects were divided into two groups; 1) a group that rarely consumed sago (<140 g/day), and 2) a group that often consumed sago (≥140 g/day). The grouping of subjects was based on the research by Hariyanto *et al*. [16] stating that sago consumption of 140 g/day could reduce blood glucose, cholesterol and triglyceride levels in diabetic patients. Therefore, blood glucose levels are used to describe one of the clinical signs of NCDs, besides WC and blood pressure.

2.2. Data Collection Procedure

The interviewer used questionnaires to collect data on subjects' characteristics (age, sex, education level, occupation, and family income). Anthropometric measurements were used to describe the BMI which consisted of weight and height using a Seca scale (capacity of 100 kg and an accuracy of 0.1 kg) and microtoise or stature meter (an accuracy of 0.1 cm). The BMI was calculated by dividing the weight (kg) with the square of height (m^2). WC was measured using a measuring tape with an accuracy of 0.1 cm. RCBG and cholesterol levels were measured using the Easy Touch GCU monitoring tool made in Taiwan with glucose and cholesterol test strips. Sphygmomanometer was used to determine SBP and DBP.

The family history of DM was obtained from questionnaires. The physical activity was recorded based on the type of physical activity or daily activities in minutes monitored for 24 hours. All values were expressed as a multiple of BMR which was called metabolic rate (MR). The results of the MR calculation were categorized according to the assessment of physical activity levels. The results were classified into vigorous (MR >2.09), moderate (MR <1.76-2.09), and light (MR <1.76). Smoking exposure was obtained from the questionnaire.

The calculation of the minimum sample size was based on the standard deviation of WC from the previous study (7.9) [22], and the values of the degree of precision and degree of freedom used were 1 and 64, respectively.

2.3. Measurement of Dietary Intake

The data regarding the subjects' consumption of sago processed products were collected through questionnaires and direct interview by enumerators. Sago consumption data were assessed using the semi-quantitative food frequency questionnaire. The amount of sago was summed in a week based on meal frequency and divided by seven to get the daily consumption. This study examined the intake levels of several kinds of sago product to assess the subjects' sago consumption. The sago products were sago noodle, sago vermicelli, *lempeng sagu* (sago pancake with additional grated coconut that was eaten with fried anchovy), *sempolet* (sago pulp with added shrimp, snails,

squid or shellfish and fiddlehead fern), sago *rendang* (small-granule sago eaten with bananas), *gobak* (sago crust made by pan-frying sago and grated coconut without oil), sago *mutiara* (sago in the form of granules cooked with added sugar and coconut milk), *kapurung* (sago porridge eaten with fish curry), *sesagon* (a snack made from sago flour and grated coconut as the main ingredients), and sago *lemak* (sago in the form of granules made with the addition of coconut milk).

2.4. Statistical Analysis

The analysis was conducted using SPSS version 20 (SPSS Inc., New York, NY, USA). The dietary intake data were processed using Nutrisurvey software. The results of the descriptive statistics of the variables were expressed as mean ± standard deviation (SD). The bivariate analyses were performed using the independent sample t-test to compare the two groups and Pearson correlation analysis to determine the relationship between the factors examined in this study and the RCBG level of 140-200 mg/dL. The results were considered significant if the p-values were less than 0.05 or ≤0.01.

3. Results

3.1. Subjects' Characteristics

The background information for the subjects is presented in Table 1. The results showed that the number of subjects who often consumed sago (55.25%) was more than those who rarely consumed sago (44.75%). The subjects who often consumed sago were mostly women aged ≥50 years (56%). Most of the subjects in both groups had low education levels, either in the group that rarely consumed sago (81.5%) or the one that often consumed sago (91%). Most of the subjects in both groups had low income, either in the group who rarely consumed sago (86.4%) or the one who often consumed sago (94%).

As shown in Table 2, the mean BMI (23.67±5.09 kg/m^2) in most subjects in both groups (65.2%) was normal. These results were supported by data in Table 1 indicating that the mean of physical activity levels was vigorous (66.9%). Generally, the subjects in both groups were active or passive smokers (83.4%) without a family history of DM (92.3%).

The present study showed that 39.22% of subjects often consumed sago (once or more than once a day), and the mean of sago consumption was 173.73±88.27 g/day. Most of the subjects (71.16%) had consumed sago for more than ten years. As presented in Figure 1, the results of RCBG measurement showed that there were more subjects with RCBG levels less than 140 mg/dL in the group that rarely consumed sago (40.88%) and the group that often consumed sago (52.28%) compared to those with RCBG levels of 140-200 mg/dL.

3.2. NCDs' Clinical Signs

The results showed that the mean RCBG of the subjects was 102.28±27.76 mg/dL. Most of the subjects (91.2%) had RCBG levels that were still within the normal range, while the rest of them (8.8%) had RCBG levels of 140-200 mg/dL. The factors that affected the incidence of RCBG levels of 140-200 mg/dL were the variables in this study (BMI, SBP, DBP, cholesterol levels, and WC) that were commonly categorized as normal (Table 2).

Table 1. Subjects' characteristics based on the frequency of sago consumption

Characteristics	Frequency of sago consumption	
	Rarely (n=81)	Often (n=100)
	n (%)	n (%)
Sex		
Men	26(32.1)	36(36)
Women	55(64.9)	64(64)
Age		
<50 years	41(50.6)	44(44)
≥50 years	40(49.4)	56(56)
Education level		
Low education	66(81.5)	91(91)
High education	15(18.5)	9(9)
Occupation		
No occupation	23 (28.4)	29 (29)
Occupation	58 (71.6)	71 (71)
Family income/month		
Low	70(86.4)	94(94)
High	11(13.6)	6(6)
Physical activity		
Vigorous	55(67.9)	66(66)
Moderate	26(32.1)	34(34)
Smoking		
Yes	67(82.7)	84(84)
No	14(17.3)	16(16)
Family history of DM		
Yes	9(11.1)	5(5)
No	72(88.9)	95(95)

Table 2. Distribution of subjects' clinical signs

Variable	Frequency of sago consumption		Mean±SD
	Rarely (n=81)	Often (n=100)	
	n (%)	n (%)	
RCBG			102.28 ± 27.76
<140 mg/dL	74(91.4)	91(91)	
140-200 mg/dL	7(8.6)	9(9)	
BMI			23.67±5.09
18.5-24.9 kg/m^2	49(60.5)	69(69)	
25.0-27.0 kg/m^2	32(39.5)	31(31)	
SBP			132.04±25.52
Normal (<130 mm/Hg)	42(51.9)	52(52)	
Hypertension (≥130 mm/Hg)	39(48.1)	48(48)	
DBP			82.39±14.26
Normal (<80 mm/Hg)	42(51.9)	64(64)	
Hypertension (≥80 mm/Hg).	39(48.1)	36(36)	
Cholesterol			171.03±66.28
Normal (≤200 mg/dL)	55(67.9)	77(77)	
High (≥200 mg/dL).	26(32.1)	23(23)	
WC			85.21±12.08
Normal: Men (<90 cm) & Women (<80 cm)	57(70.4)	70(70)	
High risk: Men (≥90 cm) & Women (≥80 cm).	24(29.6)	30(30)	

RCBG: random capillary blood glucose; BMI: Body mass index; SBP: systolic blood presure;
DBP: diastolic blood pressure; WC: waist circumference.

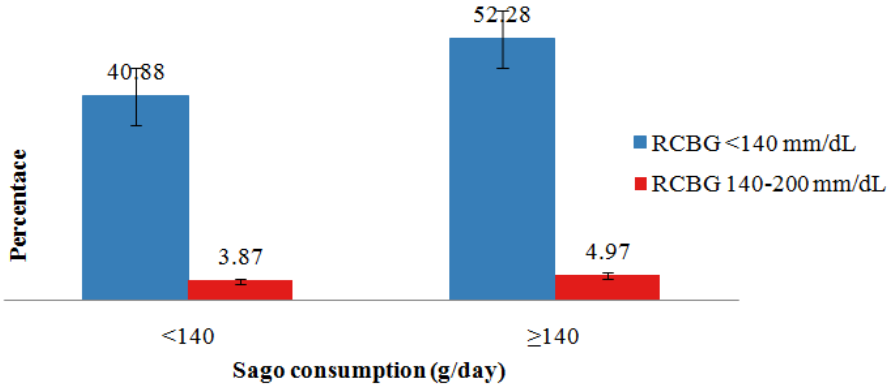

Figure 1. Random capillary blood glucose are based on the amount of sago consumption

Table 3. Subjects' demographic characteristics based on sago consumption

	RCBG levels of 140-200 mg/dL (n=16)			RCBG levels of <140 mg/dL (n=165)		
	Rarely	Often	p-value	Rarely	Often	p-value
Sex			0.257			0.659
Men	2(28.6)	5(55.6)		24(32.4)	31(34.1)	
Women	5(71.4)	4(44.4)		50(67.6)	60(65.9)	
Age			0.158			0.510
<50 years	4(57.1)	2(22.2)		37(50)	42(46.2)	
≥50 years	3(42.9)	7(77.8)		37(50)	49(53.8)	
Education level			0.727			0.000
Low	6(85.7)	8(88.9)		60(81.1)	83(91.2)	
High	1(14.3)	1(11.1)		14(18.	8(8.8)	
Occupation			0.705			0.957
No occupation	2(28.6)	3(33.3)		21(28.4)	26(28.6)	
Occupation	5(71.4)	6(66.7)		53(71.6)	65(71.4)	
Family Income/month			-			0.000
Low	7(100)	9(100)		63(85.1)	84(93.4)	
High	0(0)	0(0)		11(14.9)	6(6.6)	
Physical activity			0.158			0.268
High	4(57.1)	7(77.8)		51(68.9)	59(64.8)	
Moderate	3(42.9)	2(22.2)		23(31.1)	32(35.2)	
Smoking			0.727			0.715
Yes	6(85.7)	8(88.9)		61(82.4)	76(83.5)	
No	1(14.3)	1(11.1)		13(17.6)	15(16.5)	
Family history			-			0.002
Yes	7(100)	9(100)		65(87.8)	86(94.5)	
No	0(0)	0(0)		9(12.2)	5(5.5)	

RCBG: random capillary blood glucose; BMI: Body mass index; SBP: systolic blood presure; DBP: diastolic blood pressure; WC: waist circumference
All estimates were weighed and calculated by considering the complex study design.
p-value was obtained from the independent sample t-test, p-value <0.05.

Table 4. Subjects' clinical signs based on sago consumption

Characteristics	RCBG levels of 140-200 mg/dL (n=16)			RCBG levels of <140 mg/dL (n=165)		
	Rarely	Often	p-value	Rarely	Often	p-value
BMI (kg/m2)			0.705			0. 958
Normal	5(71.4)	6(66.7)		34(45.9)	42(46.2)	
Overweight	2(28.6)	3(33.3)		40(54.1)	49(53.8)	
SBP (mmHg)			0.705			0.033
Normal	5(71.4)	3(33.3)		34(45.9)	33(36.3)	
Hypertension	2(28.6)	6(66.7)		40(54.1)	58(63.7)	
DBP (mmHg)			0.258			0.025
Normal	3(42.9)	2(22.2)		23(31.1)	21(23.1)	
Hypertension	4(57.1)	7(77.8)		51(69.9)	76(76.9)	
Cholesterol (mm/Hg)			0.257			0.747
Normal	2(28.6)	4(44.4)		22(29.7)	26(28.6)	
High	5(71.4)	5(55.6)		52(70.3)	65(71.4)	
WC (cm)			0.257			0.747
Normal	2(28.6)	4(44.4)		22(29.7)	26(28.6)	
High risk	5(71.4)	5(55.6)		52(70.3)	65(71.4)	

RCBG: random capillary blood glucose; BMI: Body mass index; SBP: systolic blood presure; DBP: diastolic blood pressure; WC: waist circumference
All estimates were weighed and calculated by considering the complex study design.
p-value was obtained from the independent sample t-test, p-value <0.05.

Table 5. Association between the significant variables among the subjects consuming sago

	RCBG	SBP	DBP	Cholesterol	WC	BMI
Sago consumption						
x^2	12.6	-8.6	-13.4	-16.5	17.5	9.1
p	0.092	0.25	0.071	0.026	0.019	0.221
RCBG						
x^2		18.4	-5.4	0.9	9.8	-112
p		0.013	0.472	0. 906	0.188	0.875
SBP						
x^2			59.8	24.2	8.1	-2.7
p			0.000	0.001	0.279	0.715
DBP						
x^2				8.3	11.1	9.3
p				0.266	0.136	0.211
Cholesterol						
x^2					1.5	-11.8
p					0.845	0.113
WC						
x^2						75.6
p						0.000

RCBG: random capillary blood glucose; BMI: Body mass index; SBP: systolic blood presure; DBP: diastolic blood pressure; WC: waist circumference
** Highly significant correlation between factor.
* Significant correlation between factor.

There was no significant difference in all variables among the subjects with RCBG levels of 140-200 mg/dL between the group that rarely consumed sago and the one that often consumed sago. Education levels, family income/month, and family history of DM among the subjects with RCBG levels of less than 140 mg/dL were significantly different between the two groups (Table 3).

Based on the sago consumption, there were no significant differences in clinical signs (BMI, SBP, DBP, cholesterol levels, and WC) among the subjects with RCBG levels of 140-200 mg/dL between the groups that rarely and often consumed sago. SBP and DBP of the subjects with RCBG levels less than 140 mg/dL were significantly different between the groups (Table 4).

Table 5 showed the results of Pearson's x^2 and p-values among variables. The results indicated that the association between the variables was extremely significant with p-values less than 0.01 (<1%) and 0.05 (<5%). There were extremely significant associations between SBP and DBP (p=0.000 and x^2=59.8), SBP and cholesterol levels (p=0.001 and x^2=24.2), and between WC and BMI (p=0.000, x^2=75.6). There were also significant associations between sago consumption and cholesterol levels (p=0.026, x^2=-16.5), sago consumption and WC (p=0.019, x^2=17.5), and RCBG levels and SBP (p=0.013, x^2=18.4).

4. Discussion

The present study suggested that the effect of sago consumption could be seen from the results of RCBG measurement in the two groups. Some studies showed that sex, age, and education levels were the significant factors associated with the incidence of RCBG levels of 140-200 mg/dL [23,24] while occupation and family income were not significantly associated with the incidence of RCBG levels of 140-200 mg/dL [25,26].

Education determines a person's knowledge of the dietary patterns [9]. However, in general, high income and good occupation will lead to the consumption of high-fat and high-carbohydrate food and inadequate dietary fiber intake which can cause a risk of having RCBG levels of 140-200 mg/dL [27]. Some studies suggested that a family history of DM was significantly associated with the incidence of T2DM [28].

An association between WC and BMI was found in the present study. Other studies have also demonstrated that obesity is a risk factor for RCBG levels of 140-200 mg/dL [24,29]. Obesity can be determined by BMI. It is usually associated with blood glucose levels in patients with T2DM and can be reduced by consuming low-GI and high-fiber food [30]. Sago is a low-GI food. This mechanism occurs because the suspension of food (chyme) reaches the small intestine slowly, the absorption of glucose in the small intestine becomes slow, and the fluctuations in blood glucose levels are also relatively small [31].

Association between sago consumption, cholesterol levels, and WC was supported by a study by Amir *et al*. [30] which showed that sago consumption patterns could affect LDL levels. Trisnawati *et al*. [9] showed that cholesterol levels were significantly associated with the incidence of T2DM. Some studies suggested that WC was significantly associated with the incidence of T2DM [17,32], causing an increase in free fatty acids (FFA) and damaging pancreatic β cells that could produce insulin due to lipotoxicity [6]. This mechanism occurs because cholesterol plays a role in pancreatic beta cell dysfunction through an increase in serum cholesterol which increases pancreatic cholesterol and FFA, especially in the case of obesity [33].

In the present study, it was observed that there were associations between RCBG and SBP. Several studies have shown that blood pressure is significantly associated with the incidence of T2DM. The mechanism was related to high sodium intake causing the changes in insulin sensitivity and insulin plasma concentration associated with nitric oxide pathways [9,25,34].

Besides rice, the carbohydrate adequacy of the subjects in this study was also fulfilled by sago which had high fiber and amylose content, resulting in more resistant starch which became prebiotics for the intestines and facilitated digestion [35]. The high amylose content in sago was due to the presence of α-(1,4)-glycosidic bonds that were not branched with a more crystalline structure and stronger hydrogen bonds, making it difficult to be hydrolyzed by digestive enzymes and resulting in slow digestion. High levels of amylose also slow down the digestion of starch which causes low GI [36]. The high content of sago fiber also affected blood sugar [37]. The subjects in this study had normal energy and carbohydrate intakes (1,848 kcal and 284.5 g, respectively) and normal energy and carbohydrate adequacy levels (91.9% and 93.6%, respectively). However, there was a mild deficiency in protein intake (48.3 g) and adequacy levels (84.9%) with excessive fat intake.

4.1. Limitations and Strengths of the Study

This study had several benefits. Specifically, it was one of the community nutrition studies aimed to determine the effect of sago consumption among people consuming sago for a long time. Despite these benefits, our study had some limitations. It did not measure the fasting blood glucose or postprandial blood glucose and lipid profile of the subjects.

5. Conclusion and Recommendation

In conclusion, most of the subjects in both groups had blood glucose levels less than 140 mg/dL rather than 140-200 mg/dL with normal BMI. Sago consumption had a significant association with cholesterol levels and waist circumference. The results suggest that sago might be an alternative food to control NCDs.

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List of Abbreviations

NCDs: Non-communicable diseases, T2DM: Type 2 Diabetes Mellitus, RCBG: random capillary blood glucose, BMI: Body mass index, SBP: systolic blood pressure, DBP: diastolic blood pressure, WC: waist circumference.

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QUESTIONNAIRE

RESPONDENT CODE:

IDENTITY OF RESPONDENT

Name :
Place and date of birth :
Age :
Home Address :
Mobile Phone Number :
Date of Questionnaire Completion :
Enumerator's Name : Initials/Signature :

RESPONDENT'S SOCIOECONOMIC STATUS

Education Level:
- a. Not attending school
- b. Elementary School/Islamic Elementary School
- c. Junior High School/Islamic Junior High School
- d. Senior High School/Islamic Senior High School
- e. Associate Degree
- f. Bachelor's Degree
- g. Others .....

Types of Occupation:
- a. Personnel of Indonesian National Armed Forces
- b. Civil servant
- c. Private employee
- d. Farmer
- e. Merchant/Service Provider
- f. Farmworker
- g. Student
- h. Housewife

Monthly income:
- a. < IDR 500,000
- b. > IDR 500,000
- c. IDR 1,000,000 - IDR 2,500,000
- d. IDR 2,500,001- IDR 5,000,000
- e. > IDR 5,000,000

Total household expenditure:
- a. Food expenditure : .....
- b. Non-food expenditure : .....

QUESTIONNAIRE

PART 1. SAGO CONSUMPTION HABITS		
1.	Do you often consume sago or sago processed products? Yes 2. No	☐
2.	How many times do you eat sago in a day? Less than twice a day 3. Three times a day Twice a day 4. More than three times a day	☐
3.	How long have you been consuming sago? < 1 year 3. 5-10 years 1 year to 5 years 4. > 10 years	☐
4.	How many times do you consume sago in a month for the past one year?	☐

	Less than once a day 4. Once to twice/week Once a day 5. Less than once a month 3-6 times/week	
5.	How many portions of sago do you eat every day? < half portion (plate) 3. 2 plates ½ plate 4. > 2 plates One plate	☐
6.	In what form does the sago you consume? Sago noodle 4. *Gobak* *Lempeng* (sago pancake) 5. Various kinds of cakes *Sempolet* You can choose more than one answer	☐☐☐
7.	Do you consume sago as a daily staple food or just snack? Staple food 2. Snack	☐
8.	Where do you usually get food (sago flour/sago processed products)? Small shop/market in the form of flour or sago processed products Your garden and it is processed by yourself Sago flour which is bought and processed by yourself Others	☐
9.	Why do you consume sago? It tastes delicious 3. Easy to get Cheap 4. Habit/tradition	☐
10.	What carbohydrate sources do you consume besides sago? Rice 3. Cassava Corn You can choose more than one answer	☐☐☐

PART 2. CLINICAL SYMPTOMS OF NCDs

A. PHYSICAL EXAMINATION

BODY WEIGHT AND HEIGHT

	Body weight (kg)	..... kg	☐☐,☐☐
	Body height/length (cm)	..... cm	☐☐☐,☐

WAIST CIRCUMFERENCE

	Waist circumference (cm)	..... cm	☐☐☐,

HIP CIRCUMFERENCE

	Hip circumference (cm)	..... cm	☐☐☐,

IDENTIFICATION OF NCDs' CLINICAL SYMPTOMS

BLOOD SUGAR

1.	Have you been diagnosed with diabetes by a physician? 1. Yes 2. No **If yes, continue to Q02 and Q03. If not, continue to Q04**	☐
2.	How long have you had diabetes? ≤ one year 2. 1-5 years 3. ≥ 5 years	☐
3.	Are you currently doing the following things to control diabetes? Diet 3. Taking antidiabetic drugs Exercise 4. Insulin injection	☐
4.	Have you ever experienced the following symptoms? (give a check mark [√] in the box if the answer is yes)	

	Excessive thirst (polydipsia)	☐	Blurry vision	☐
	Excessive urination volume and frequent urination (polyuria)	☐	Impotence (for men)	☐
	Excessive hunger (polyphagia)	☐	Slow healing of wounds	☐
	Rapid weight loss	☐	Vaginal discharge (for women)	☐
	Fatigue	☐	Fungal infections in the folds of the skin	☐
	Tingling in the hands and feet	☐	Giving birth to a large baby weighing >4 kg (for women)	☐
	Itching	☐		

5.	Have you ever checked your blood sugar level? Yes, When was the last time you checked it? ..... Blood sugar examination: fasting/random(*) Your blood sugar level: ..... No	☐
6.	Is there any of your parents/family that has diabetes? Yes 2. No	☐

RANDOM BLOOD SUGAR EXAMINATION IS PERFORMED USING FINGER-PRICK TEST

7.	Do you agree to have your blood taken? Yes 2. No	☐
8.	Date of examination: Day/Date: ..... / ..... Time:	
9.	Blood glucose level:	

HYPERTENSION/HIGH BLOOD PRESSURE

1.	Have you ever diagnosed with hypertension by a physician? 1. Yes 2. No **If yes, continue to Q02 and Q03. If not, continue to Q03**	☐

2.	When was the first time you were diagnosed with hypertension?			**Year:** ☐
3.	Are you currently taking medication to control hypertension? Yes 2. No **If yes, what kind of medication?**			☐ **Medication: .....**
BLOOD PRESSURE IS MEASURED ON THE LEFT ARM				
4.	Do you agree to have your blood pressure measured? Yes 2. No			☐
5.	Date of Examination: Day/Date: ..... / ..... Time:			
	b. Sistolic blood pressure (mmHg)	☐☐☐	c. Diastolic blood pressure (mmHg)	☐☐☐
TOTAL CHOLESTEROL				
1.	Have you checked your cholesterol level? Yes 2. No If yes, continue to Q02 and Q03. If not, continue to Q03.			☐
2.	When was the last time your cholesterol level was checked? **What is your cholesterol level?**			**Year :** ☐
3.	Are you currently taking medication for your cholesterol level? Yes 2. No **If yes, what kind of medication?**			**Medication: .....** ☐
TOTAL CHOLESTEROL LEVEL EXAMINATION IS PERFORMED USING FINGER-PRICK TEST				
4.	Do you agree to have your blood taken? Yes 2. No			☐
5.	Date of Examination: Day/Date: ..... / ..... Time:			
6.	Total cholesterol level:			

SEMI-QUANTITATIVE FFQ

Explain in detail the types of sago processed products you consume in the following table. Fill in the Household Size (URT) and the amount (g) for each type of sago processed products and give a check mark (√) for your choice.

Number	Types of sago processed products	Amount/meal		Eating frequency					
		URT	Amount (g)	>Once/day	Once/day	3-6 times/week	Once to twice/week	2-3 times month	Once/month
1.	Sago noodle								
2.	Sago vermicelli								
3.	*Lempeng*								
4.	*Sempolet*								
5.	*Sagu rendang*								
6.	*Gobak*								
7.	*Sagu mutiara*								
8.	Sago porridge (*kapurun*)								
9	*Sesagon*								
10	*Sagu lemak*								