DEVELOPMENT OF SEMIQUANTITATIVE FOOD FREQUENCY QUESTIONNAIRE FOR IDENTIFICATION OF INDIGENOUS DIETARY PATTERNS IN PREDIABETIC ADULT WOMEN

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ABSTRACT

Dietary patterns influence the progression of prediabetes, so it is necessary to develop representative instruments for measuring eating habits, primarily indigenous dietary consumption. The research aimed to develop a semiquantitative food frequency questionnaire to identify indigenous dietary patterns in prediabetes sufferers in Gorontalo Regency. The research was a descriptive study that tested the validity and reliability of the food frequency questionnaire semiquantitative (FFQ-SQ). The research was conducted in Limboto Barat Health Center, based on the prevalence of diabetes mellitus. Selection samples using purposive sampling with 30 adult women. The validity test used internal validity Pearson correlation, while the reliability test used internal consistency Cronbach α. Comparison of average FFQ-SQ and recall 2 x 24-hours using Wilcoxon test. The results showed that 12 food groups consisted of 207 food items and indigenous food products with validity tests 123 items valid, 67 items invalid, and 17 items never consumed by the subject study in the previous month; the reliability test showed food group category low 10, moderate 5 and high 3. Comparative analysis of the energy and nutrient intake between FFQ-SQ with recall 2 x 24 hours showed significant differences in intake of carbohydrates, fiber, vitamin E, vitamin B1, folic acid, vitamin C, potassium and zinc (p-value < 0.005), and comparison of energy and nutrient intake between FFQ-SQ1 and FFQ-SQ2 showed no significant difference (p-value> 0.005). The conclusion was FFQ-SQ with 123 items of foods and derived products is valid and reliable for measuring the eating habits of prediabetic adult women.

Keywords: dietary patterns, FFQ-QS, prediabetic adult, reliability, validity

INTRODUCTION

Diabetes mellitus type-2 (T2DM) is a metabolic disease with symptoms that arise in a person due to an increase in blood glucose concentration. T2DM is a non-communicable disease (NCD) that prevalence continues to increase, which increases the risk of morbidity and mortality due to various complications (Soelistijo, Suastika, et al. 2021). In 2018, the prevalence of diabetes mellitus (DM) based on a doctor's diagnosis was 1.5% and in Gorontalo province was 1.7% at all ages. At the age of ≥ 15 years the prevalence of diabetes was 2.0% and in Gorontalo province was 2.4%. The incidence of DM prevalence increased compared to 2013, which was 1.5% (Kemenkes RI, 2013; Kemenkes RI, 2018). Half of DM sufferers are undiagnosed, only two-thirds are diagnosed with pharmacological or non-pharmacological treatment, and only one-third have improved metabolic control(Perkeni 2019). Since 2014 the American Diabetes Association (ADA) has recommended T2DM prevention spectrum by treating hyperglycemia conditions and establishing a diagnosis of prediabetes(ADA 2013; Soelistijo et al., 2021).

Eating habits are related to the progression of diabetes mellitus. Vegetable and fruit consumption negatively correlates with blood glucose (Nailufar, 2022). The recommended consumption of vegetables per day ≥ 400 g based on WHO/FAO recommendations on diet, nutritional care and prevention of chronic diseases (Nishida et al., 2004). Perkeni recommended fiber intake of 20–35 g per day, and for DM patients at least 14 g per 1000 kcal and whole grain consumption (Soelistijo et al., 2021).

Food sources of carbohydrates with various proportions of sugar, starch and fiber content affect the glycemic response. Frequent diet of sugary foods and drinks is positively correlated with

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blood glucose (Nailufar, 2022). Dietary intake of sweet foods such as traditional cakes, biscuits, cakes, donuts and sweet snacks is significantly related to blood glucose level (Yunianto et al., 2019). Based on WHO recommendations, sugar intake is recommended at 5-10% of total energy intake (TEI), in adults and children under 5 years sugar consumption is not more than 50 g (total energy needs 2,000 kcal) and 27-40 g (WHO, 2015). While, based on recommendations from the Indonesian Ministry of Health, sugar intake is no more than 50 g per day (MOH, 2013). The description of consumption of risky foods such as SSB tends to be high in Gorontalo, namely consumption of ≥ 1 time per day sweet foods 40.9%, sweet drinks 56.1%, consumption of soft drinks, carbonated drinks 3.2%, consumption of energy drinks 3.5% (Kemenkes RI, 2018). he frequency of dietary sweetened condensed milk category is often 25.0% (Lasimpala et al., 2021).

The depiction of vegetable and fruit consumption in Gorontalo people is still low accompanied by high consumption of risky foods such as sugar sweet beverages (SSB). The proportion of fruit and vegetable consumption per day in a week < 5 servings per day 93.8% (MOH, 2018). The average fiber intake of adults is 15.3 ± 8.9 g per day far from the recommended fiber intake recommendation of 30 g per day (Permenkes RI, 2019; Nuryani et al., 2021).

Dietary diversity is crucial to maintaining health and preventing T2DM in the prediabetes group. The development of instruments that facilitate the measurement of dietary patterns of prediabetic adults is important, especially with the abundance of indigenous foods with diverse nutritional compositions.

In measuring dietary patterns, standardized measuring instruments are needed, this is to ensure the consistency of measurements and the accuracy of the data collected. A standard measuring instrument must meet psychometric criteria, namely validity and reliability. Questionnaire (measuring instrument) in general is a tool used to measure natural phenomena and observed social phenomena. Questionnaires play an important role in determining the quality of a study, because the validity of the data obtained will be largely determined by the quality of the questionnaire used. So this study aims to develop a semi-quantitative food frequency questionnaire as an effort to identify indigenous dietary patterns in prediabetes patients in Gorontalo Regency.

METHOD

The study was a descriptive research by testing the validity and reliability of the food frequency quetionnare (FFQ-SQ) questionnaire. Research measured was quantitative, where the interpretation of study results based on statistical processed results was using computer applications.

The location of the study was determined purposively based on the criteria for the prevalence of people with diabetes mellitus in the working area of the Limboto Barat Health Center, Gorontalo Regency. The study was conducted in June – August 2023.

The subjects of the study were adult women with a total of 30 people (Siegel, 1992). The determination of the research samples were based on the minimum requirements for parametric statistic tests. Purposive sampling of subjects who meet the inclusion criteria. The inclusion criterias of the study was adult women, living in Gorontalo district, willing to participate in research and signing informed consent. The adult age group criteria are the adult age group of women ≥ 30–60 years based on the criteria of the highest incidence of diabetes (Kemenkes, 2018). While the exclusion criteria of subjects was adult women with comorbidities/chronic diseases based on doctors diagnosis, pregnant and lactating women.

The measurement of research data included data on basic characteristics, eating habits. Dietary patterns were measured using 2 x 24 hours recall and FFQ-SQ. The dietary patterns questionnaire was using FFQ-SQ that was developed by making a list of food ingredients, based on a list of food ingredients composition and based on food availability that can be found in Gorontalo (Kemenkes, 2013). Food grouping ingredients were based on FFQ-SQ food grouping in prediabetes, diabetes mellitus and food grouping patients for adult community groups in Indonesia (Sarmento, Riboldi, et al., 2013 ; Schwingshackl et al., 2017 ; Siddiqui, Zainal, Harun, & Ghadzi, 2019 ; Syauqy et al., 2021 ; Bazzano, Li, Joshipura, & Hu, 2008;

Basiak-Rasala, Rozanska, & Zatonska, 2019). In the preparation of food grouping, it would be compiled and developed in accordance with indigenous food and typical food products found in Gorontalo. Development of FFQ-SQ questionnaire in the form of 207 lists food items and processed indigenous food products found in Gorontalo. The food grouping list includes 18 food groupings consisting of 1) staple foods of cerealias and root vegetables - 10 items, 2) staple foods of flour products - 7 items, 3) animal protein of meat and poultry - 12 items, 4) animal protein of fish and seafood - 20 items, 5) vegetable protein of nuts and processed - 11 items, 6) milk vegetable protein and its processed products - 7 items, 7) factory processed food protein - 6 items, 8) light-colored vegetables - 14 items, 9) dark-colored vegetables 14 items, 10) fruits - 26 items, 11) sources of fats and oils as many as five items, 12) sugar, syrup and confectionery - 11 items, 13) seasonings of 12 items, 14) processed foods with oil 12 items of processed food products, 15) processed foods sources of protein nine items of processed foods, 16) processed foods sources of carbohydrates and nuts - 11 items, 17) snacks, as many as 12 items, 18) food and beverages packaged bottles or boxes as many as 8 items. Identification of indigenous food in this study base on 207 lists food consumption of the subject that can decrease or increase risk of diabetes such as staple food corn rice, cassava, and corn contain high fibers that can prevent diabetes and risky food such as food processing with high fat using coconut milk, sweet sugar food and beverages consumption that can increase risk of diabetes. Filling the FFQ-SQ instrument was carried out twice with a span of 1 week to compare the average intake of energy and nutrients. FFQ-SQ was also compared with the measurement results of the 2 x 24 hours recall questionnaire. FFQ-SQ was developed with the frequent dietary from grocery items every meal time (score 2.5), every day (score 1), 3 – 6 x per week (score 0.42), 1 – 2 x per week (score 0.14), rarely (score 0.04) and never (score 0). Filling out the FFQ-SQ questionnaire by asking for a list of food items and food consumed by research subjects within the last 1 month. The eating frequency score was grouped into frequent consumption if the score ≥ 0.43 and infrequent consumption if the < score is 0.43 (Marks, Hughes, & van der Pols, 2006). Some indigenous foods and typical food products found in Gorontalo that are not found in the data processing application or in the list of food ingredients composition will be made standard recipes in accordance with recipes and processing standards in the local area to subsequently include the composition of energy and nutrients in the database of food intake data processors.

After the preparation of the list of food and beverage ingredients in the FFQ-SQ questionnaire, the validity and reliability of the FFQ-SQ questionnaire was tested. The internal validity test was a correlation between the score of food items and the total score using the Pearson correlation test, the correlation coefficient was using r count compared to r table (r table, dp = n – 2 = 28, r table = 0.333), while reliability test using internal measurement of cronbach consistency α with > category 0.9 high reliability, 0.7 – 0.9 high reliability, 0.5 – 0.7 moderate reliability, < 0.5 low reliability (Lee et al. 2002; Juliandi, 2008; Siddiqui et al. 2019). In the FFQ-SQ instrument, take measurements 2 times with range time of 1 week (Lee et al. 2002; Siddiqui et al. 2019). A Wilcoxon test was used to analyze the comparison between the average intake of energy and nutrients using a 2 x 24-hours recall questionnaire and FFQ-SQ and compare the average intake of FFQ-SQ1 with FFQ-SQ2 with p value = 0.005. Research subjects on the validity and reliability test were asked for qualitative advice and opinions regarding the list of food ingredients contained in the questionnaire, as well as recommendations for certain types of food commonly consumed but not included in the FFQ-SQ questionnaire list.

Data collection was carried out by filling out questionnaires, interviews and direct measurements. The time needed by research subjects in filling FFQ-SQ ± 30 – 45 minutes. Processing and analysis of food intake data using Nutrisurvey, Microsoft Excel while validity and reliability analysis using static product and service solution (SPSS 16). This research has passed the review of the health ethical research commission of the Faculty of Nursing and Health, University of Muhammadiyah Semarang number 094/KE/07/2023.

RESULTS AND DISCUSSION

Table 1. Research subject characteristic

Characteristic	n	%
Age		
30 – 34	4	13.3
35 – 39	7	23.3
40 – 44	14	46.7
45 – 49	5	16.7
Marital status		
Married	29	96.7
Divorced	1	3.3
Education		
< 9 years	20	66.6
≥ 9 years	10	33.4
Partner's education		
< 9 years	20	66.6
≥ 9 years	10	3.,4
Occupation		
Civil servant	1	3.3
Private servant	2	6.7
Entrepreneur	3	10.0
Laborer	2	6.7
Housewife	22	73.3
Partner's occupation		
Civil servant	1	3.3
Private servant	3	10.0
Entrepreneur	10	33.3
Laborer	16	53.4
Income		
< Minimum wage	25	83.3
≥ Minimum wage	5	16.7
Gestational Diabetes		
Yes	2	6.7
No	28	93.3
Historical hypertension		
Yes	9	30.0
No	21	70.0
Historical NCD		
Yes	4	13.3
No	26	86.7
Family historical diabetes		
Yes	1	3.3
No	29	96.7
Family historical NCD		
Yes	5	16,7
No	25	83,3

Note: NCD: non-communicable disease.

An overview of the characteristics of research respondents in the validity and reliability test of the FFQ-SQ questionnaire is shown in Table 1. Based on age characteristics, it shows that the largest age group is in the 40 - 44 year age category, particularly 14 women (46.7%). Marital status with married status as many as 29 women (96.7%), ethnic group 30 women (100%) Gorontalo tribe, highest level of education at middle school and high school level, with 8 people each (26.7%), most of the respondents' occupation are housewives (housewives), with amount of 22 women (73.3%) while the education of the partner, or the respondent's husband, is mostly at elementary school level, particularly 13 people (43.3%) while the most of the respondent's partner's occupation is as a laborer, particularly 16 respondents (53.4%), with an income level below the regional minimum wage for Gorontalo province, 25 respondents (83.3%).

Ethnic characteristics and disease histories are shown in Table 1. The ethnic characteristics of the research subjects are Gorontalo ethnic, which has a very low smoking habit of only 3.3% and the subjects have no history of consuming alcoholic beverages. Results in the questionnaire reliability test study show that 2 people (6.7%) had a history of gestational diabetes, 9 people (30.0%) had a history of hypertension. Based on the history of non-communicable diseases, it shows that 4 people (13.3%) had a history of non-communicable diseases, meanwhile, 1 person (3.3%) had a history of non-communicable diseases experienced by family members with a history of diabetes mellitus. As for the type of history of non-communicable diseases experienced by research subjects, there were 5 respondents (16.7%) who had family members with a history of hypertension and gout. A history of non-communicable diseases in family members is also a risk factor for prediabetes in accordance with the Indonesian Prediabetes Risk Score (INA-PRISC) prediabetes risk factor enforcement criteria (Fujiati, Damanik, Bachtiar, Nurdin, & Ward, 2017).

Validity is the ability of a measuring instrument to measure what it should measure, and provide the true value of the variable being measured. The method used to measure the validity of the questionnaire is the Pearson correlation between the score of each item and the total score, better known as the internal validity test. Reliability is the ability of a measuring instrument

or questionnaire to provide consistent results, which can be done by analyzing Cronbach's alpha values (Sinaga, 2017).

An overview of the list of food ingredients in the FFQ-SQ food grouping, validity, and reliability analysis is shown in Table 2. Grouping of FFQ-SQ food ingredients for patients with prediabetes, diabetes mellitus and food grouping for adult groups in Indonesia (Sarmento et al., 2013 ; Schwingshackl et al., 2017 ; Siddiqui et al., 2019 ; Syauqy et al., 2021). In preparing the next food grouping, it was arranged and developed according to indigenous food and typical food products found in Gorontalo. The staple food of cerealias and root vegetables shows that there are 2 food items with a calculated *Pearson* r correlation value < r table, namely white rice (r = -0.087) and taro (r = -0.020). This is due to the research subjects' habit of consuming white rice every day with an FFQ score of 1.547 (frequent consumption), resulting in data homogeneity, while the taro food item has an FFQ score of 0.014 (rare consumption). Meanwhile, the result of the reliability test with a Cronbach's alpha value of 0.485 indicates low reliability. The staple food product flour shows 2 food items with calculated r values < r table, specifically noodles (r = -0.002) and pasta (r = 0.127) because these food items are very rarely consumed by respondents. The result of the reliability test analysis with a Cronbach's alpha shows value of -0.285 which is low reliability.

Table 2. Analysis of validity and reliability test of FFQ-SQ

Food grouping	Food items	r	Signifincae (two tailed)	Cronbach's alpha	Validity	Reliability
Cerealia staple foods and root vegetables	Corn rice, corn, cassava, potatoes, purple sweet potato, white sweet potato	0.5 – 0.7	< 0.05	0.485	Valid	Low
	Brown rice, yellow sweet potato	< 0.5	< 0.05	0.485	Valid	Low
	White rice, taro	< 0.5	> 0.05	0.485	Invalid	Low
Staple food flour products	Laksa/vermicelli, cereal, spaghetti	0.5 – 0.9	< 0.05	-0.285	Valid	Low
	Bread, sago	< 0.5	< 0.05	-0.285	Valid	Low
	Noodle, pasta	< 0.5	> 0.05	-0.285	Invalid	Low
Animal protein (meat and poultry)	Beef, goat meat, beef jerky, offal (liver, intestines, lungs, marrow), free-range chicken meat, duck, liver, chicken eggs,	0.5 – 0.9	< 0.05	0.424	Valid	Low
	Duck eggs, quail eggs	< 0.5	< 0.05	0.424	Valid	Low
	Broiler, gizzard	< 0.5	> 0.05	0.424	Invalid	Low
Animal protein (Fish and *seafood*)	Shellfishes	0.5 – 0.9	< 0.05	0.326	Valid	Low
	Mackerel / oci fish, skipjack tuna, trevally, crab, shrimp, nike (largesnout goby) fish	< 0.5	< 0.05	0.326	Valid	Low
	Flying fish, snapper, rabbitfish, tuna, mackerel, tilapia, milkfish, snakehead fish, catfish, wet anchovies, dried fish, dried anchovies, squid	< 0.5	> 0.05	0.326	Invalid	Low

Food grouping	Food items	r	Signifincae (two tailed)	Cronbach's alpha	Validity	Reliability
Vegetable protein (legumes and their derived products)	Tempeh, tofu, green beans	0.5 – 0.9	< 0.05	0.312	Valid	Low
	Peanuts	< 0.5	< 0.05	0.312	Valid	Low
	Cashew nuts, jack beans, almonds, red beans, green bean sprouts	< 0.5	> 0.05	0.312	Invalid	Low
	Melinjo, sunflower seed	-	-	-	-	-
Vegetable protein (milk and its derived products)	Fresh skimmed milk, fresh milk, cheese, ice cream	0.5 – 1.0	< 0.05	0.823	Valid	High
	Powdered milk, yoghurt	< 0.5	< 0.05	0.823	Valid	High
	Skimmed, powdered milk	-	-	-	-	-
Processed protein foods (manufactured products)	Canned fish, sausages, salted eggs	0.5 – 0.9	< 0.05	0.223	Valid	
	Canned corned beef, smoked beef, frozen seafood	-	-	-	-	
Light colored vegetables	Cabbage, mustard greens, chayote, zucchini, yellow pumpkin, papaya flowers	0.5 – 0.9	< 0.05	0.606	Valid	
	Vegetables cucumber, carrot, bamboo sprouts, young jackfruit	< 0.5	< 0.05	0.606	Valid	
	Purple eggplant, young papaya, tomatoes	< 0.5	> 0.05	0.606	Invalid	
	Mushrooms	-	-	-	-	
Dark colored vegetables	Green spinach, red spinach, aibika leaves, long bean leaves, cassava leaves, broccoli	0.5 – 0.9	< 0.05	0.414	Valid	
	Kale, long beans	< 0.5	< 0.05	0.414	Valid	
	Melinjo leaves, lettuce, bok choy, fern vegetables	< 0.5	> 0.05	0.414	Invalid	
	Chinese okra, bitter melon	-	-	-	-	
Fruits	Apples, oranges, young coconuts, mangoes, papaya	0.5 – 0.9	< 0.05	0.593	Valid	
	Avocado, duku, durian, melon, pineapple, watermelon	< 0.5	< 0.05	0.593	Valid	
	Guava, water apple, ambarella, langsat, cavendish/ambon banana, saba/kepok banana, uli banana, plantain, horn banana, rambutan, snake fruit, sapodilla	< 0.5	> 0.05	0.593	Invalid	
	Srikaya, soursop, breadfruit	-	-	-	-	
Fat and Oil Sources	Palm oil, coconut milk	0.5 – 0.9	< 0.05	-0.609	Valid	
	Olive oil	< 0.5	< 0.05	-0.609	Valid	
	Coconut oil, Margarine/ butter	< 0.5	> 0.05	-0.609	Invalid	

Food grouping	Food items	r	Signifincae (two tailed)	Cronbach's alpha	Validity	Reliability
Sugar, Syrup, and Confectionery	Rock sugar	0.5 – 0.9	< 0.05	-0.068	Valid	
	Sweetened condensed milk, chocolate, palm sugar, granulated sugar, palm sugar, syrup, liquid drinks, powdered drinks, jam, candy, tea, coffee	< 0.5	> 0.05	-0.068	Invalid	
Spices	Leeks, shallots, sauce	0.5 – 0.9	< 0.05	0.446	Valid	Low
	Cayenne pepper, shrimp paste, sweet soy sauce	< 0.5	< 0.05	0.446	Valid	Low
	Red chili peppers, green chili peppers, garlic, basil leaves, soy sauce	< 0.5	> 0.05	0.446	Invalid	Low
	Onion	-	-	-	-	-
Snack	Banana chips, peanut brittle, crackers, wafers, wafer rolls	0.5 – 0.9	< 0.05	0.570	Valid	Moderate
	Cassava chips, cookies, pia, sponge cake	< 0.5	< 0.05	0.570	Valid	Moderate
	Biscuit	< 0.5	> 0.05	0.570	Invalid	Moderate
	Emping, tempe chips	-	-	-	-	-
Packaged food and drink, bottles/carton	Coffee products, Dairy products, Tea, Pudding	0.5 – 0.9	< 0.05	0.585	Valid	Moderate
	Juice/fruit juice, ionic drinks	< 0.5	> 0.05	0.585	Invalid	Moderate
	Soy milk products, Soft drinks (soda)	-	-	-	-	-
Processed foods in oil	Crispy fried chicken, yellow rice, fried stuffed tofu, fried tempeh, vegetable bakwan, fried banana	0.5 – 0.9	< 0.05	0.736	Valid	High
	Fried rice, fried noodles, corn fritter, Sabongi, Martabak egg, sweet Martabak	< 0.5	< 0.05	0.736	Valid	High
Processed food sources of protein	Meatballs, Coto, Chicken Soto, Woku fish, Iloni chicken	0.5 – 0.9	< 0.05	0.571	Valid	Moderate
	Chicken feet	< 0.5	< 0.05	0.571	Valid	Moderate
	Rib soup, sour sauce, tuna satay	< 0.5	> 0.05	0.571	Invalid	High
Processed foods sources of carbohydrates and vegetables	Tinutuan, Gado – gado, Chicken noodles, Binte Biluhuta, Ilabulo, Lalampa,	0.5 – 0.9	< 0.05	0.767	Valid	High
	Bamboo rice, potungo vegetables, dodol pocong, iced green banana	< 0.5	< 0.05	0.767	Valid	High
	Iced Brenebone	< 0.5	> 0.05	0.767	Invalid	High

There is a tendency for low reliability in the carbohydrate source food group due to the large list of food items, namely 17 food items with a varied distribution and generally infrequent consumption, except for consumption of white rice which is in the frequent category.

In the group of animal protein sources, meat, and poultry, there are 2 food items with calculated r values < r table, namely broiler chicken (r = 0.136) and gizzards (r = 0.219), which could be because consumption of these foods is relatively rare. Reliability test shows Cronbach's alpha value of 0.424 which is a low reliability. In the group of animal protein sources, fish and seafood, there are 11 food items with a calculated r value < r table, namely flying fish (r = 0.215), snapper (r = 0.230), rabbitfish (r = 0.230), tuna (r = 0.264), mackerel (r = 0.174), tilapia fish (r = 0.283), milkfish (r = 0.221, catfish (r = -0.004), wet anchovies (r = 0.160), dried anchovies (r = 0.303) and squid (r = 0.236), this could be due to the relatively rare consumption of these foodstuffs. Reliability test shows a Cronbach's alpha value of 0.326 which is also a low reliability. In the group of vegetable protein sources, there are nuts and their derived products shows 4 food items with a value of r count < r table, namely *karo* beans (r = 0.022), almonds (r = 0.194), red beans (r = 0.124) and green bean sprouts (r = 0.300) because these food items are very rarely consumed by respondents. There were 2 food items that research subjects had never consumed in the last month, melinjo and sunflower seed. Reliability test shows Cronbach's alpha value of 0.312 which is a low reliability. Vegetable protein sources in the milk group and its derived products show that most of the food items have a calculated r > r table, however, 1 food item has never been consumed by research subjects in the last 1 month, specifically powdered skim milk. Reliability test shows Cronbach's alpha value of 0.823 which is a high reliability. Manufactured processed protein foods showed 3 food product items that research subjects had never consumed in the last month, they are canned corned beef, smoked beef and frozen seafood. Reliability test shows Cronbach's alpha value of 0.223 which is a low reliability. Reliability test analysis shows a low reliability category, this could be due to the large list of food items, which are 56 food items and processed products with a diverse distribution and generally infrequent consumption.

The habit of consuming vegetables and fruit has a good impact on the mornings of prediabetics. The list of vegetable group food ingredients was based on the types of vegetables that can be found in Gorontalo. Consumption of light-coloured vegetables shows 2 food items with calculated r values < r table, particularly young papaya (r = 0.215) due to low consumption, tomatoes (r = 0.251), which could be caused by frequent consumption of the category resulting in data homogeneity for food items (FFQ-SQ score = 0.934), and indigenous food that is generally found in Gorontalo is with a spicy taste of cayenne pepper and tomato sauce (Nuryani, Muhdar IN, Ramadhani F, Paramata Y, Adi DI, 2021). There is 1 food item that has never been consumed by research subjects in the last one month, namely consumption of mushrooms. The reliability test shows Cronbach's alpha = 0.606, which is a moderate reliability. Validity is classified as moderate because almost all of the food items in the questionnaire have been consumed by research subjects in the last month. Hence, the heterogeneity of the data varies. Consumption of dark-coloured vegetables shows 4 food items with calculated r values < r table, namely melinjo leaves (r = 0.292), lettuce (r = 0.292), pokchoy (r = 0.082) and fern vegetables (r = 0.082), this can be caused by the rarity of consumption category, resulting in homogeneity of data for food items (FFQ-SQ score = 0.002). Two food items are never consumed, namely gambas and pare or bitter melon. The reliability test shows a Cronbach's alpha value = 0.414, which is a low reliability. This could be due to the extensive list of food ingredients (14 items) and many items that are rarely consumed or never consumed. Analysis of fruit consumption shows 11 food items with calculated r values < r table, namely guava (r = 0.293), ambarella/Spondias *dulcis* (r = 0.234), langsat (*r* = 0,265), cavendish banana (*r* = 0,254), saba banana (*r* = 0,031), uli banana (*r* = 0,036), plantain (*r* = -0,064), horn banana (*r* = 0,182), rambutan (*r* = 0,035), snake fruit (*r* = 0,281), and sapodilla (*r* = 0,215) could be due to the rarity of the consumption category. Meanwhile, there are three food items that the research subjects never consumed: sugar apple,

soursop and breadfruit. The reliability test shows Cronbach's alpha = 0.593, which is a moderate reliability. This could be due to the large number of food items, resulting in the consumption of various fruits, even in small quantities.

The food group components that are very important in identifying risk factors for prediabetes are the consumption of risky foods such as sugar, salt, fat and local processed food products with high sugar and fat content and consumption by research subjects. In comparison, the risky foods group, such as consumption of processed foods, soft drinks, fats and sugars, has a lower effect on health status (Bhisma, Triastuti, Pikir, & Trissatharra, 2023). Consumption of fat and oil sources shows one food item with a calculated r value < r table, namely coconut oil (r = 0.171). The reliability test shows Cronbach's alpha value = -0.609, indicating low reliability.

Food in syrup and confectionery shows only one food item with a calculated r value < r table, namely rock sugar (r = 0.939). Meanwhile, the reliability test has a Cronbach's alpha value = -0.609, which shows low reliability. This could be due to the extensive list of food ingredients (11 items) and many food items that are consumed infrequently. Food types of buffer spices show five items with a calculated r value < r table, namely red chili peppers (r = -0.012), green chili peppers (r = 0.016), garlic (r = 0.276), basil leaves (r = 0.173) and soy sauce. (r = 0.128). Onions are the one of spice item that has never been consumed in the last month. The reliability test has a Cronbach's alpha value = 0.446, which indicates low reliability. Kitchen spices show five items with a calculated r value < r table, namely red chili peppers (r = -0.012), green chili peppers (r = 0.016), garlic (r = 0.276), basil leaves (r = 0.173) and soy sauce. (r = 0.128). There is 1 spice item that has never been consumed in the last month, namely onions. Meanwhile, the reliability test has a Cronbach's alpha value = 0.446, which indicates low reliability. This could be due to the large number of food items with infrequent consumption by research subjects. In the snack type food group, almost all food items show a calculated r value > r table, but only chips and tempeh chips that have never been consumed in the last month. Meanwhile, the reliability test has a Cronbach's alpha value = 0.570, which shows high reliability. This could be due to food product items for snacks, although there are many food items, the frequency of consumption is quite high and consumed by many research subjects. Analysis

Table 3. Comparative Analysis between intakes of FFQ-SQ and 2 x 24-hours Recall

Nutrients	2 x 24 h Recall	FFQ-SQ1	FFQ2	p-value*	p-value**
	Mean ± SD	Mean ± SD	Mean ± SD		
Energy (kcal)	1207.5 ± 493.6	1296.6 ± 514.0	1485.9 ± 620.3	0.054	0.127
Protein (g)	42.9 ± 13.7	45.0 ± 16.3	50.7 ± 23.3	0.586	0.249
Fat (g)	38.3 ± 20.2	38.6 ± 17.7	61.9 ± 94.4	0.967	0.399
Carbohydrate (g)	174.0 ± 108.8	196.1 ± 91.2	222.3 ± 80.7	0.012	0.069
Serat (g)	4.8 ± 4.3	11.0 ± 4.2	12.1 ± 6.6	<0.001	0.593
Cholesterol (mg)	134.5 ± 141.0	124.7 ± 78.3	125.8 ± 80.8	0.271	0.943
Vitamin A (µg)	965.3 ± 1585.0	111.9 ± 813.6	1331.9 ± 586.9	0.141	0.106
Carotene (µg)	0.213 ± 0.466	0.326 ± 0.488	0.323 ± 1.891	0.073	0.388
Vitamin E (mg)	2.496 ± 1.684	3.946 ± 1.858	3.953 ± 1.891	0.003	0.773
Vitamin B1 (mg)	0.406 ± 0.214	0.586 ± 0.311	0.603 ± 0.310	0.006	0.630
Folic acid (mg)	70.36 ± 71.81	163.7 ± 100.8	159.9 ± 94.2	<0.001	0.992
Vitamin C (mg)	30.63 ± 86.19	59.70 ± 47.62	50.04 ± 37.36	<0.001	0.339
Sodium (mg)	507.14 ± 697.02	649.55 ± 775.78	607.22 ± 498.26	0.360	0.845
Potassium (mg)	1363.0 ± 1275.6	2042.7 ± 937.4	2555.1 ± 1715.4	<0.001	0.245
Zn (mg)	3.65 ± 1.57	4.73 ± 1.93	5.20 ± 2.60	0.002	0.537

*) Wilcoxon test variable of 2 x 24 hours Recall
**) Wilcoxon test variable of FFQ-SQ1 and FFQ-SQ2

of food and beverage products packaged in bottles or cartons shows 2 products with calculated r values < r table, particularly juice/fruit juice (r = 0.063) and electrolyte drinks (r = 0.63). Soy milk and soft drinks were two of many products listed in packaged processed food that were never consumed by the research subjects. The reliability test has a Cronbach's alpha value = 0.585, which shows moderate reliability. This could be due to the large number of food items consumed by many research subjects.

Processed food products, both traditional and typical of Gorontalo and other food products, can influence people's consumption habits, which impact controlling blood glucose. Processed food is divided into three food groups: processed food with oil, processed food as a source of protein, and processed food as a source of carbohydrates, vitamins and minerals. Egg martabak (r = 0.078) and sweet martabak (r = 0.124) were the two processed food items that have r values < r table. The reliability test with Cronbach's alpha value = 0.736 shows high reliability, possibly due to the research subjects' frequent consumption of processed food snacks with oil, resulting in high FFQ-SQ scores. Processed food sources of protein show all processed food items with calculated r values < r table and Cronbach's alpha = 0.571, which shows moderate reliability, which may be due to the variety of processed foods consumed by research subjects. Processed food sources of carbohydrates and vegetables show one processed food item with a calculated r value < r table, namely Brenebone ice (r = 0.248). Cronbach's alpha analysis = 0.767 shows high reliability, possibly due to the research subjects' high consumption of processed foods. The processed food product items are a list of typical Gorontalo processed foods popular and widely consumed by research subjects.

The validity test uses a correlation test. The results of this study are almost the same as the results of previous research, which found variability in validity tests, namely the correlation coefficient FFQ1 and FFQ2 (r = 0.58 – 0.92), a moderate – high relationship based on the validity test on nutritional components (r = 0.40 – 0.68) (Liu et al., 2022). Research testing the validity of the FFQ questionnaire in Japanese society shows varying validity values (r = -0.12 – 0.86) (Nanri, Fujiwara, Miyake, Kashino, & Mizoue, 2022). Likewise, the results of research testing the validity of the FFQ questionnaire in the adult group, with Pearson's correlation (r = 0.58 - 0.90) (Marques-Vidal et al., 2011). Another study that tested the validity of the FFQ-SQ showed that an increase in food consumption scores using the FFQ-SQ measurement positively correlated with an increase in biochemical biomarkers in metabolic syndrome sufferers, such as fasting blood glucose with fruit consumption (r = 0.221) and dessert consumption (r = 0.229), blood pressure with snack consumption (r = 0.272) (Nirdnoy et al., 2023).

A comparison of the average intake of energy and nutrients between the 2 x 24-hours recall and the FFQ-SQ is shown in Table 3. Wlicoxom analysis compared the average intake between the 2 x 24-hours recall with the FFQ-SQ and the average intake. between FFQ-SQ1 and FFQ-SQ2. Comparison of energy and nutrient intake between FFQ-SQ and 2 x 24-hours recall shows that the average intake of energy, protein, fat, cholesterol, vitamin A, carotene and sodium shows the same results (p-value> 0.05). It shows that the FFQ-SQ is representative in describing energy and nutrient intake using a 2 x 24-hours recall questionnaire. However, there are significant differences in the average intake of carbohydrates, fiber, vitamin E, vitamin B1, folic acid, vitamin C, potassium and zinc when using the FFQ-SQ instrument and 2 x 24-hours recall. It could be because the FFQ-SQ questionnaire had already been adjusted with the indigenous Gorontalo foods source of fiber, vitamins and minerals, which consisted of 54 items of vegetables and fruits so that the subjects could name the foods they ate within the last month. The results of this study are almost the same as previous research findings, which showed that the comparison of macronutrient intake tended to be higher when measured using FFQ compared to recall for protein nutrients; however, there was no difference in energy, carbohydrate and fat intake (Marques-Vidal et al., 2011).

A comparison of energy and nutrient intake between the FFQ-SQ1 and FFQ-SQ2 questionnaires was taken with two measurements with a timespan of one week. The study

results showed no differences in energy intake, macronutrients or micronutrients between FFQ-SQ1 and FFQ-SQ2 measurements (p-value > 0.05). FFQ-SQ is a valid measuring tool for assessing energy intake, nutrients, food ingredients and processed food products based on local food menus, which can potentially increase the risk of prediabetes. Using the FFQ-SQ instrument is essential to examine unhealthy and risky eating habits so that recommendations can be given to at-risk community groups to prevent prediabetes. The unique characteristics of processed foods with various ingredient compositions and the use of spices on local menus can be analyzed using the FFQ-SQ questionnaire.

CONCLUSION

There are 12 food groups consisting of 207 items of food ingredients and local food products, which are generally found in Gorontalo with validity test results of 123 valid items, 67 items are invalid, and 17 items of food ingredients and processed food products have never been consumed by the subject within one month. Lastly, reliability test analysis shows low reliability on ten food group items, moderate reliability on five food group items, and high reliability on three food group items and processed food products. Comparative analysis of energy and nutrient intake between FFQ-SQ with 2 x 24-hours recall, there were significant differences in the average intake of carbohydrates, fiber, vitamin E, vitamin B1, folic acid, vitamin C, potassium and zinc (p-value < 0.005); meanwhile, a comparison of energy and nutrient intake between FFQ-SQ1 and FFQ-SQ2 showed that there was no significant difference in energy and nutrient intake (p-value> 0.005). It is recommended to develop the research instruments by comparing the average intake of energy and nutrients with food weighing and the need to develop instruments for measuring eating habits to identify risky food consumption habits, especially local food groups in several regions in Indonesia.

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