Promotion of optimized food-based recommendations to improve dietary practices and nutrient intakes among Minangkabau women of reproductive age with dyslipidemia

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ABSTRACT

Background and Objectives: Using a linear programming approach, an optimized food-based recommendations (FBRs) had been formulated for Minangkabau women of reproductive age with dyslipidemia in Indonesia. This study aimed to assess the effectiveness of the promotion of the FBRs for improving dietary practices and nutrient intakes. **Methods and Study Design:** A community-based, clustered-randomized trial was conducted among Minangkabau women of reproductive age (20–44 years) with dyslipidemia. The subjects were assigned either into the FBR group (n=48), or the non-FBR group (n=54). Baseline and end-line dietary data were assessed through interviews using a one-week semiquantitative food frequency questionnaire (SQ-FFQ) and two replicate 24-hour dietary recalls. The changes in dietary practice and nutrient intakes were analysed using ANCOVA test. **Results:** Significant changes were observed ($p<0.005$) in the consumption of the promoted food items and subgroups (sea fish, soy protein, dark green leafy vegetables, and potatoes). Significant changes were also observed in nutrient intake, especially energy intake from carbohydrates and unsaturated fatty acids (total PUFA, MUFA, n-3 and n-6 fatty acids), as well as the dietary P/S ratio and fiber intake. **Conclusions:** With current dietary practices, intakes of some typical problem nutrients such as n-6, zinc, iron, and fiber still could not achieve 100% of the RNIs, while the intake of SFA still exceeded the recommended intake. Further approaches are needed to expand the population food basket and promote behavioral change to address established cultural food habits, including reducing the use of cooking oil in food preparation and increasing vegetable consumption.

Key Words: nutrition intervention, food-based recommendations, linear programming, women of reproductive age, dyslipidemia

INTRODUCTION

Minangkabau society is well known as matriarchal ethnic group, where mothers play an important role in various aspects, especially related to household expenditure, food availability, diet and health.[1] Previous studies have found that the prevalence of dyslipidemia in Minangkabau women was relatively higher than other Indonesia ethnic groups.[2] Among the women of reproductive age, the prevalence of dyslipidemia (based on the indictors of total cholesterol ≥200 mg/dL or LDL-cholesterol ≥ 130 mg/dL) in the society was considerably high (44.1%).[3]

Dyslipidemia, characterized by abnormal serum lipid concentration (total cholesterol, low-density lipoprotein (LDL) cholesterol, high-density lipoprotein (HDL) cholesterol or triglycerides (TG), is an important modifiable risk factor for the development of atherosclerosis and heart diseases.[4,5] An increase in total blood cholesterol (≥200 mg/dl) contributed 34% and 27% to the occurrence of heart diseases in women and men, respectively.[6] In addition, referring to the Developmental of Health and Diseases (DoHAD) theory, dyslipidemia is one of the metabolic disorders that impact the next generation's health through the epigenetic contribution of women of reproductive age. Dyslipidemia in women of reproductive age adversely affects fertility, pregnancy, fetus, newborns and adult offspring.[7–10]

The factors responsible for the high mean serum cholesterol level in the Minangkabau women compared to other populations was still uncertain, but diet was most suspect.[3,11,12]

About 20.7% of energy intake comes from saturated fat (more than 10%) and PUFA to SAFA (P/S) ratio of 0.15 (below 2).[11] Due to traditional heritage of food processing, the use of other saturated fat sources, palm oil and animal resource protein among the Minangkabau population were considerably high.[13] On average, a household with three or four children uses 250 g of cooking oil a day.[14] According to the Indonesian Total Diet Survey data, the Minangkabau population consumed in average of 50.4 g of fat daily in the form of cooking oil, coconut oil and coconut and less than 100 g of vegetables and fruits per day.[15]

Thus far, improved dietary quality has been consistently associated with decreases in the levels of risk factors associated with chronic diseases.[16] However, improving the quality of diets is not easily achieved. Individuals are faced with the difficult task of choosing from a wide range of foods and beverages to meet their nutritional requirements without excessive energy intake.[17] To promote healthy eating in general population, the Indonesian dietary guidelines have been used by nutrition policymakers and program stakeholders.[18] In addition, for those with dyslipidemia, therapeutic nutrition guidelines have also been globally and nationally issued for dyslipidemia management.[19,20] However, dietary data from previous studies have shown that most individuals do not adhere to these guidelines.[3,15,21]

The most recent study of Minangkabau women of reproductive age showed that current dietary practices predispose them to dyslipidemia. Intake of saturated fatty acids (SFA) exceeded recommendations, whereas polyunsaturated fatty acids (PUFA) (both n-3 and n-6 fatty acids), dietary fiber, iron, and zinc were typical problem nutrients. By using a linear programming approach, optimized food-based recommendations (FBRs) have been formulated with the use of locally available foods to improve intakes of the typical problem nutrients.[3] Although they seemed to have potential during the planning phase of food-based interventions, the effectiveness of FBRs in the community setting had not been tested.

In our community trial, we promoted optimized FBRs based on locally available foods to improve dietary practices, nutrient intakes, nutritional status, and lipid profiles in Minangkabau women of reproductive age with dyslipidemia. This article describes our results on the effects of the intervention in improving dietary practices and intakes of typical problem nutrients. The results for nutritional status and lipid profiles will be published elsewhere. We hypothesized that among Minangkabau women of reproductive age with dyslipidemia, promotion of the optimized FBRs with the use of locally available foods would be more effective than current standard programs from health centers for improving dietary practices and intakes of typical problem nutrients.

MATERIALS AND METHODS

Study area and design

The study was conducted in an urban setting in Padang, West Sumatra, Indonesia. It was designed as a cluster-randomized, community-based trial. Two subdistricts (Koto Tangah and Nanggalo) were purposively selected as study sites based on the following two criteria: findings of the highest new cases of dyslipidemia, especially among women of reproductive age as reported by the district health office; and feasibility for conducting a successful intervention, such as high community response rate, availability of a supported health taskforce (field nutritionist and cadres), and easy accessibility for routine monitoring in the field.

Randomization

To avoid contamination and to eliminate access barriers to participation in FBR promotion, randomization was conducted before subject recruitment at the health center level. The four health centers in subdistricts Koto Tangah and Nanggalo were randomly assigned to the intervention or comparison group using opaque envelopes by a public officer who was not involved in this study. All four health centers are similar in environmental factors, such as food availability, access to transportation, public services, and facilities. Blinding was not possible because both the subjects and the researchers clearly understood the differences between the two groups.

Study subjects

There were 123 subjects living in 16 sub villages of the four selected health centers included in the study. The sample size per group (n=60 per group; two groups) was expected to detect mean ± SD differences in LDL cholesterol concentration (as a secondary outcome) of 14±20 mg/dL, as observed in a previous study in another area,[22] assuming 80% power and 25% loss to follow-up. Potential subjects were identified before dyslipidemia screening. Field nutritionists and voluntary health workers (cadres) were requested to identify and list women of reproductive age fulfilling the inclusion criteria living in selected sites. An invitation letter was sent to all identified eligible subjects to visit the appointed field laboratories to undergo blood measurement. Informed consent was signed by all potential participants before blood measurement.

The inclusion criteria for subject recruitment were as follows: women of reproductive age (20–44 years); native Minangkabau ethnicity (both father and mother of Minangkabau ethnicity); abnormal blood lipid profile (total cholesterol >200 mg/dL, LDL cholesterol >100 mg/dL, HDL cholesterol <60 mg/dL, or TG >150 mg/dL); and signing written informed consent. The exclusion criteria were pregnancy; current or former smoking or alcoholism; history of heart disease, diabetes, asthma, cancer, chronic digestive tract disorders, hemophilia, or other chronic diseases; routinely taking cholesterol-lowering or blood pressure medications; vegetarian; using estrogen therapy; and participating in other studies.

Those who were eligible based on the inclusion and exclusion criteria were confirmed to participate in the intervention phase. After entering the intervention phase, subjects were dropped from the study if they could not be visited on three consecutive weeks; if an indication of one of the exclusion criteria was found during the intervention phase, e.g., becoming pregnant or newly diagnosed with a chronic disease; if they decided personally to withdraw; or if they did not undergo complete measurements at the end line.

Intervention

The optimized FBRs used in the intervention were developed by a linear programming approach using three of the four modules available in WHO Optifood software.[23] Details of the method and the final FBRs are described elsewhere.[3] The FBR was initially developed based on the energy requirements in Indonesian RNI for women of reproductive age, using median body weight (55 kg) and override energy of 2150 Kcal. It was considered has met the energy reduction for those with overweight or obese, but it was still enough to maintain ideal body weight for those with normal body weight or gaining additional body weight for those with underweight. The energy recommendation of 2,150 kcal is also about 1000 kcal lower when compared to the energy requirement when based on the actual median body weight of these women (67.6 kg body weight ~ 3164 kcal).

Before the intervention, small-scale pilot trials (trials of improved practices, TIPs) involving 20 women of reproductive age were conducted to investigate the acceptability and feasibility of the draft FBRs. TIPs were conducted in two visits with the 20 subjects, with a 1 week interval between visits. At the first visit, the participants were given health messages related to dietary risk factors for dyslipidemia. Messages in the FBRs were explained with the use of printed educational materials. The subjects were then encouraged to try to practice the FBRs for the next 7 days and record the food items and food groups they consumed during the week in a written monitoring form. In the follow-up visit, an in-depth interview was carried out to explore the challenges they faced when practicing the FBRs, the benefits of putting the FBRs into practice, their understanding of the educational materials, and suggestions for methods of delivery of the FBRs for the intervention.

Input from the TIPs was used to revise the final draft of the FBRs, modify the educational material, and design delivery methods for the intervention. The final optimized FBRs (Table 1) emphasized messages for dietary improvement, especially with regard to consumption and portion sizes of staple foods, snacks, animal and plant protein (PUFA and monounsaturated fatty acid [MUFA] sources), potatoes, vegetables (dark green vegetables), and fruits and the use of fat and vegetable oil in the daily diet. Small potato with skin is explicitly mentioned in the FBR due to its potential as zinc and fiber sources in the population diet. It is consumed as a condiment in protein source side dishes in the form of small whole potato (with skin) in curry or rendang (sauteed beef cooked with coconut milk and seasoning), rather than as a starchy staple. The recommendations were made to optimize intakes of typical problem nutrients previously identified in the diet of Minangkabau women of reproductive age with dyslipidemia, namely, PUFA (n-3 and n-6 fatty acids), fiber, iron, and zinc.[3]

Before the interventions started, a study team consisting of educators with a background in nutrition education, field nutritionists from the health centers, and research assistants were informed about the goals of the intervention and trained on how to prepare, conduct, and evaluate the intervention. They received a 2 day training package consisting of an introduction to dyslipidemia and its risk factors, FBRs for Minangkabau women of reproductive age, goals of the intervention, how to deliver FBRs to audiences using educational tools and printed materials, information on communication skills, how to deal with possible problems emerging during the intervention, outcome assessment, and monitoring and evaluation of the intervention program.

The intervention was conducted between January and May 2019. The study did not compare the intervention group (FBR group) with a true control group but rather compared it with a group that received once nutrition counseling from the standard care of nutrition health program (non-FBR group). Subjects in the FBR group were introduced to the FBRs (Table 1) and encouraged to shift their dietary practices according to the FBRs in the following weeks. They were given an example of a 1-week menu plan and a weekly checklist for foods they consumed daily as recommended by the FBRs. The intervention package (Table 2) highlighted the method of delivery for promotion of the FBRs, which consisted of an initial meeting with the study subject; routine contact through weekly home visits and monthly group sessions during the 12-week intervention; and monthly educators' meetings to discuss barriers, solutions, and follow-up actions. Initial meetings with the study subjects in the FBR group were conducted by the principal investigator assisted by the study team. Weekly home visits and monthly group sessions in the FBR group were conducted by trained educator, assisted by voluntary health workers (cadres). Each educator was responsible for visiting and promoting the FBRs to 10 to 14 subjects each week.

As a comparison group, the non-FBR group received an appropriate explanation of their dyslipidemia status at the beginning of the intervention. They also received once standard nutrition promotion by field nutritionists from primary health care either in group or individually related to balance nutrition and dietary advice for dyslipidemia management, but without FBR provision. They were also informed and challenged to have second lipid profile measurements after 12 weeks of intervention.

Data collection

Baseline data collection included variables of sociodemographic characteristics, nutritional status, dietary practices, and nutrient intakes. All variables except sociodemographic characteristics were remeasured at the end of the 12 week intervention. Screening for dyslipidemia was done through measurements of lipid profiles, covered data on total cholesterol, LDL, HDL, and triglycerides. As much as 5 ml venous blood sampling was drawn after overnight fasting. For the patient safety during dyslipidemia screening, blood sampling was carried out by professional phlebotomists and under the supervision of the health center medical team. Blood was taken after the subjects signed informed consent. Total plasma cholesterol, HDL-cholesterol and triglycerides were measured through enzymatic colorimetric method with standardized procedures at local certified laboratory using Selectra-E Analyzer, while LDL- cholesterol was calculated using Friedewald equation.[24] The classification guidelines are based on NCEP ATP II19, in which dyslipidemia subjects were identified based on total cholesterol level ≥200 mg/dL, LDL-cholesterol level ≥100 mg/dL, HDL-cholesterol <60 mg/dL or TG ≥150 mg/dL.

Sociodemographic characteristics included age, household size, income, education, and occupation. These data were collected through a structured interview using a questionnaire. Nutritional status was assessed on the basis of body mass index (BMI) and waist circumference. Measurements of body weight, height, waist circumference, and blood pressure were conducted at the same time as the screening process. Body weight was measured to the nearest 0.1 kg while subjects were standing on a SECA digital scale. Height was measured to the nearest 0.1 cm, using a non-stretch tape meter fixed to a wall, with the subject standing without shoes and with shoulders in a normal position. BMI was calculated as the weight in kilograms divided by the square of the height in meters (kg/m^2). Waist circumference was measured with a SECA measuring tape with an accuracy of 0.1 cm. The subjects' dietary practices and compliance with FBRs were recorded during interviews using a 1-week semiquantitative food frequency questionnaire. The food frequency questionnaire includes lists of foods suggested in the FBRs and usual food items consumed by the subjects. Nutrient intakes were measured by two replicates 24 h dietary recalls on nonconsecutive days. Dietary intake data were entered into Nutrisurvey software (http://www.nutrisurvey.de) to convert grams of food consumed into nutrient intakes. As a nutrient reference, a food composition table was developed for all food items consumed by at least 5% of the respondents. Most of the food items' nutrient content were adopted from the Indonesian Food Composition Table,[25] except for fatty acid content of certain foods (total SAFA, MUFA, PUFA, n-3 and n-6 fatty acids) was adopted from United States Department of Agriculture Food Composition Table.

Data analysis

The data were entered into IBM SPSS version 20 software for Windows. Univariate analysis was performed to determine the distribution of values of each variable studied. Continuous variables were tested for data normality based on the Kolmogorov–Smirnov test. Recoding of multiple variables was done during the analysis process. Categorical data were analyzed descriptively and presented in the form of frequency distributions, n (%). Normally distributed continuous data were presented as means and standard deviations, and non-normally distributed data were presented as medians and ranges.

Continuous data were analyzed by the independent t-test or the Mann–Whitney test for between-group differences, and the dependent t-test or the Wilcoxon test was used to analyze within-group changes in dietary practices and nutrient intakes over time, depending on the normality of data distribution. Categorical data were analyzed by the chi-square test for between-group differences or the McNemar test for within-group differences. Furthermore, we conducted the ANCOVA test to see the difference in changes of the outcomes and control potential bias due to the between group differences of some characteristics at baseline. Values of $p < 0.05$ for all the tests were considered to indicate statistical significance.

Ethical approval

This study was ethically approved by the Human Ethics Committee, Faculty of Medicine, Universitas Indonesia (ethical clearance reg no: 1269/UN2.F1/ETIK/2018). Recommendation for the study was also obtained from the Provincial Government Board of West Sumatra (Recommendation no: B.070/48-PERIZ/DPM&PTSP/I/2019) and the Padang City Review Board (recommendation no: 200.01.130/Kesbangpol/2019). The trial was registered at ClinicalTrials.gov Protocol Registration and Result System (PRS) as NCT04085874

RESULTS

On the basis of their abnormal lipid profiles (total cholesterol, LDL cholesterol, HDL cholesterol, or TG), 123 of 269 women of reproductive age participating in dyslipidemia screening were recruited to participate in the study and assigned to the FBR group (n=61) or the non-FBR group (n=63) at baseline. Of these, 102 subjects completed the study, comprising 48 women in the FBR group and 54 women in the non-FBR group (Figure 1).

Selected socio-demographic characteristics, baseline lipid profile and nutritional status

Selected sociodemographic characteristics of the subjects at baseline are summarized in Table 3. Sociodemographic characteristics were comparable between the FBR and non-FBR groups except for age, which was significantly greater in the FBR group (median, 39.5 years; range, 22–44) than in the non-FBR group (median, 35.5 years; range, 21–44). Most of the participants (56% and 70% in the FBR and non-FBR groups, respectively) had 12 years of schooling. Most women in both groups worked as housewives. The median per capita monthly income of the subjects in the FBR and non-FBR group was IDR 525,000 and

500,000 respectively, which is equivalent to USD 36/month. The majority of subjects had moderate physical activity and a median parity of 2 (range, 0–6).

The baseline total cholesterol and LDL concentrations (mean±SD) of the participants in the FBR group (221±28 and 149±27 mg/dL, respectively) were significantly higher than those in the non-FBR group (207±36 and 135±32 mg/dL, respectively) ($p<0.05$). The mean HDL cholesterol level in the FBR group (44.7±6.1 mg/dL) was lower than that in the non-FBR group (46.2±7 mg/dL), although the difference was not statistically significant. Serum TG was also higher in the FBR group, but not significantly ($p>0.05$). The Castelli index (total cholesterol/HDL cholesterol), which implies an increase in atherogenic risk, was higher in the FBR group ($p<0.05$).

The majority of the participants were overweight or obese (81.3% and 75.3% in the FBR and non-FBR groups, respectively), with mean±SD BMI of 28.7±4.3 and 28.1±4.6 kg/m^2 in the FBR and non-FBR groups, respectively. The waist circumference of the participants in the FBR and non-FBR groups was 90.9±9.2 and 89.8±10.1 cm, respectively; thus, they were mostly categorized as having abdominal obesity (85.4% and 75.9% in the FBR and non-FBR groups, respectively). There were no significant differences in nutritional status between the two groups ($p>0.05$).

Effect of FBR promotion on dietary practice

Effect of FBR promotion on dietary practices could be observed from changes of overall dietary compliance score (Table 4) and weekly consumption (serving/week) for each recommended food items or food groups (Table 5). Based on the compliance score, the two groups were comparable at baseline ($p>0.05$). After 12-week intervention, there was a significant between-group difference ($p=0.001$). Overall compliance score in the FBR group was significantly better than in non-FBR group. The total compliance score (mean±SD) in the FBR group increased 14.5±22.4 point, from 52.7±12.8 to 67.2±18.8. This improvement was higher than the non-FBR group that increase 7.1±19.6 point, from 49.2±14.4 to 56.2±14.9. The significant effect was remined after adjusted with income, baseline compliance score and age ($p=0.004$). By using pool end-line median score as cut off, those who had a good compliance score of the FBRs increased from 27.1% to 70.8% in the FBR group and from 20.4% to 44.4% in the non-FBR group.

Figure 2 shows percentage of participant who comply with the optimized FBRs at baseline and after 12-weeks intervention. The percentage of those who comply with the recommendations for sea fish, soy product (tofu/tempeh), dark green leafy vegetables

(DGLV), and potato improved significantly, with an increase of 33.4%, 27.6 %, 32.7% and 21.1% respectively in the FBR group compared to only 6.4%, 11.1%, 7.4% and -1.9% in the non-FBR group. Meanwhile, percentage of those who comply with staple food, snacks, egg and poultry relatively did not change. Percentage of compliance on fatty foods consumption reduced about 10% in the both groups, but statistically not significant.

Effect of the intervention on weekly consumption (serving/week) is presented in Table 5. Firstly, significant within-group differences were observed in consumption of snacks, eggs, sea fish, poultry, soy protein (tempeh/tofu), total vegetables, dark green leafy vegetables (DGLV), fruits and potato in the FBR group. A decrease (mean±SD) of -1.4±5.2 serving/week was observed in snacks consumption, while the others with improvements that vary from 0.8±1.6 serving/week for poultry to 2.5±3.5 servings/week for sea fish consumption. Among the participants in the non-FBR group, within-group differences were only observed in total vegetables, DGLV, and fruits with an improvement 1.4±3.6, 1.4±3.2 and 0.8±2.4 servings/week respectively. Consumption of fatty foods, especially fried foods, although not statistically significant, decreased in the FBR group, conversely increased in the non-FBR group.

Secondly, with the comparison of the FBR and non-FBR group at baseline, the two groups had similar dietary practices. Significant differences were found in vegetable consumption, in which the FBR group had a higher total vegetable consumption (p=0.007) and in the consumption of foods processed with coconut milk (p = 0.042). After 12-weeks intervention, Man Whitney test revealed significant between-group differences in consumption of sea fish, poultry, soy protein (tempeh/tofu), total vegetable, DGLV, fruits and potato (p<0.05), with an increase (mean ± SD) of 2.5±3.5, 0.8±1.6, 1.9±5.0, 2.4±6.5, 2.0±4.5, 2.0±4.8, and 2.0±5.1 servings/week in the FBR group, compared to 0.0±2.9, 0.0±2.3, 0.5±4.6, 1.4±3.6, 1.4±3.2, 0.8±2.4, and 0.2±3.1 servings /week respectively in the non-FBR group. The ANCOVA test showed the effect of FBR promotion on changes of weekly consumption of the promoted foods, after adjusted with baseline parameters, income and age. The significant effects still occurred for sea fish (p<0.001), poultry (p=0.002), soy products (p=0.005), total vegetables (p<0.001), DGLV (p=0.011), fruits (p=0.004) and potato (p=0.001), but not significant for staple, snacks, eggs and fatty foods (p>0.05).

Table 5 also clearly shows that subjects in the FBR group could follow the recommendations related to the consumption of staple foods and protein sources such as fish, eggs, and poultry easily. The consumption of fruit also somewhat improved. Even though the subject could easily improve the consumption of DGLV, most of them were difficult to achieve the total vegetable consumption of at least 2 servings a day. The same finding was observed in the consumption of fatty foods which remained relatively high.

Effect of FBR promotion on nutrient intakes

Table 6 presents the effect of the FBR promotion on intakes of energy and selected nutrients. The two groups had similar intake profiles at baseline, except for significant differences in the intakes of total carbohydrates (p=0.004), linoleic acid (p=0.003), and MUFA (p=0.025) and in the percentage of energy from PUFA (p=0.041) and MUFA (p=0.004). Subjects in the FBR group had higher intake of total carbohydrates and lower intakes of linoleic acid and MUFA, as well as lower percentages of energy from PUFA and MUFA. After the 12 week intervention, significant between-group differences were observed in the intake of energy (p=0.044), the percentage of energy from protein (p=0.031), the intake of fat (p=0.010), the intake of MUFA (p=0.032), the intake of SFA (p=0.002), the percentage of energy from SFA (p=0.001), the PUFA to SFA (P/S) ratio (p=0.002), and the intake of fiber (p=0.022).

We also performed ANCOVA test to observed the effect of FBR promotion of changes of nutrient intakes. After adjusted to baseline parameter, income and age, significant effect of FBR promotion remained on energy intake (p=0.006), fat intake (p=0.028), carbohydrate intake (p<0.001), percentage of energy from carbohydrate (p<0.001), MUFA intake (p=0.033), n-6 intake (p=0.020), percentage of energy from PUFA (p=0.044), percentage energy from MUFA (p=0.008) and P/S ratio (p=0.003).

Comparing baseline and end-line nutrient intake within the FBR group, we observed decreases in the intakes of energy (p=0.035), fat (p=0.552), total carbohydrate (p<0.001), and SFA (p=0.874). Significant improvement occurred in the percentage of energy from protein (p=0.003), the intakes of PUFA (both n-3 and n-6 fatty acids) and MUFA, and the percentages of energy from PUFA and MUFA (p<0.001), P/S ratio, and fiber intake (p=0.001). Significant within-group increases occurred in the non-FBR group in the intakes of protein (p=0.044), n-3 and n-6 PUFA (p<0.001), SFA (p=0.030), and fiber (p=0.005), as well as the percentage of energy from SFA (p=0.028). The intakes of iron and zinc increased in the FBR group and decreased in the non-FBR group, although the changes were not statistically significant.

DISCUSSION

The present study showed that promotion of customized FBRs that emphasized the use of locally available foods improved dietary practices related to dyslipidemia among

Minangkabau women of reproductive age. Compliance data on the 11 food items/food sub groups in the FBRs show that more than 50% of respondents in the FBR group comply well, except for the total consumption of vegetables and potatoes. Even, for some recommendations of commonly consumed foods such as animal source protein, soy protein, green vegetables and fruit can be followed by more than 60% of the respondents. Overall, about 67% of the recommendations given can be applied by respondents in daily dietary practices. When using a pooled end-line median compliance score as cutoff point, about 70% of the respondent in the FBR group was categorized to have a good compliance scores compared to only 44% in the non-FBR group. We observed an increase of 43% in the percentage of subjects with good compliance in FBR group, compared to 24% in the non-FBR group.

This study shows that the level of adherence in the FBR group was significantly higher than the non-FBR group. This might be related to both the clarity of the messages in the FBR and the delivery mode used during the intervention. As revealed from the qualitative data, respondents in the FBR group mentioned that the message conveyed in the FBR was more specific and easier to understand and practice. Also, the regular meetings between the promoter and the subject during the intervention could assist the subjects to ask questions and discuss the difficulties they faced in the process of changing dietary practices as suggested.

Apart from the improvements mentioned above in the consumption of nutrient-dense foods that were available locally, the percentage of those who adhered to recommendations for total vegetable consumption was not as expected. Less than 30% of the subjects adhered to the recommended minimum of two servings per day of vegetables Qualitative data from monitoring during the intervention showed that although the subjects perceived the health benefits of eating vegetables, they still found it difficult to fully adhere to the recommendations. The main reasons for this were family food preferences and eating habits. Most of the subjects admitted that daily consumption of vegetables was not their habit. When mothers cooked vegetables, the vegetables were left over because most household members were not used to consuming vegetables at every meal. This dietary practice is in line with the findings of previous studies that 97% of the Minangkabau community consume less than the recommended amount of vegetables.[26]

Another interesting finding is that the consumption of fatty foods, especially foods processed with cooking oil, did not reduce, but increased in both groups. Although the FBRs emphasize that consumption of fatty foods should be limited to two servings a day, most subjects do not comply with this recommendation. On the basis of the qualitative data from monitoring of the intervention, most participants in the FBR group perceived the benefits of reducing consumption of fatty foods. However, it was very difficult for them to change the food preferences, cooking practices, and eating patterns that they had practiced so far, even inherited them from previous generations. They said that their enjoyment of food would be reduced if each meal did not include fried side dishes mixed with oily chili sauce. Furthermore, fried food can be stored longer and served on the following day, which is convenient because cooking (especially of protein-based side dishes) is routinely done only once a day. The differences in the impact of interventions on certain dietary practices and nutrient intakes show that changes in eating behavior are unique and complex. Many familial and psychological, as well as cultural and social, factors influence eating patterns and dietary behaviors.[27] Although many food beliefs and preferences unknowingly lead to poor nutrition and health problems, the family's food beliefs, preferences, and habits that are passed on from generation to generation and become customs and traditions dictate the homemaker's decisions on food selection and preparation.[28]

Another reason for the less than optimal changes in certain dietary practices may be related to the planning phase of the FBR promotion. The results of the intervention show that the majority of respondents were able to fulfill the FBRs for food portions based on their existing diet, but compliance was worse for FBRs for particular foods or food groups such as vegetable and fried foods. Most of the messages in the FBRs, such as recommendations related to staple foods and protein sources, were based on local dietary patterns related to types of food and portion sizes, but some messages were based on established dietary guidelines for meeting nutrient requirements. For example, we found that the median (min–max) vegetable consumption among the FBR group was 7 (2–16) servings per week, with a portion size of 25 (5–60) g. The recommendation of a minimum of 14 servings of vegetables per week with portion sizes of 100 g in the final FBRs was based on the standard portion required to provide optimal nutrition even though the portion is above subjects' habitual dietary patterns. Therefore, the compliance to meet the recommended potion for vegetables will take some time for behavior change to establish.

This finding emphasized that FBRs should be based on current scientific evidence on nutritional requirements and diet-related diseases on the one hand and local dietary patterns and culinary practices on the other hand. Key concepts in developing FBRs include addressing dietary patterns, practicality, cultural acceptability, and local availability of foods.[29] Previous studies showed that most people do not adhere to nationally prescribed dietary guidelines,[15,21] because of incompatibility between the guidelines and local conditions, especially established dietary patterns within the region.

The study found that promotion of the optimized FBRs had an impact on intakes of energy and typical problem nutrients, especially PUFA, MUFA, and dietary fiber. It also improved the intakes of iron and zinc, which are commonly problem nutrients in women of reproductive age. Although promotion of the FBR was not specifically aimed at reducing energy intake, a decrease in energy intake was observed in the FBR group, in line with a decrease in total fat and carbohydrate intake. During the intervention, we emphasized the portion size of each recommended food to obtain a balanced intake of nutrients. For example, the serving size of staple foods such as rice or other sources of carbohydrates should be one quarter of the dinner plate. Vegetables and fruits should occupy half of the plate and protein side dishes the other quarter. This recommendation was intended to promote the message of balanced nutrition for Indonesians[18] and to have a positive impact on reducing energy intake and increasing nutrient density in food consumption.

Positive impacts of the intervention on the intake of unsaturated fatty acids is in line with the improvement in the consumption of fish and soybean protein in the daily subject's diet. Compared to the respective RNI,[30] the intakes of PUFA and MUFA had fulfilled the needs of subjects in the FBR group at the end of the intervention, whereas those in the non-FBR group had still not met the recommendations. An increase in PUFA intake improves the P/S ratio, which is recommended for dyslipidemia. After the 12-week intervention, the P/S ratio in the FBR group reached 0.68, getting closer to the ideal ratio of around 0.8 to 1.1. In the non-FBR group, the P/S ratio was still around 0.49, which is considered an atherogenic ratio.[2]

Although the intake of energy from total fat is still within the recommended limits, the intakes of unsaturated fatty acids remained high in the two groups. This study found that promotion of FBR had not reduced saturated fat consumption significantly. Both groups had a saturated fat intake of about 12% of energy, exceeding the recommended amount for people with dyslipidemia.[20,31] This is probably due to the consumption of fatty foods, especially fried foods, in the daily diet. Increased consumption of food sources of protein, especially fish and soy protein, is very good for increasing the intake of unsaturated fatty acids. However, most of protein side dishes were cooked with deep fat frying that also contribute mostly for increasing the intake of saturated fatty acids.

Recommending changes in eating patterns and nutrient intakes through a population-based approach is a primary preventive measure for dyslipidemia.[32] Increases in the consumption of high-unsaturated foods such as sea fish and soy protein and high-fiber food such as vegetables, fruits, and potatoes were especially positive results and may help women of reproductive age to control their lipid levels.[33–37] A systematic review of fat intake and prevention of selected nutrition-related diseases concluded that a reduced intake of total and saturated fat as well as a larger intake of PUFA at the expense of SFA convincingly reduces the concentrations of total cholesterol and LDL cholesterol in the plasma.[38]

Problem nutrient intake in both group at the end of the intervention, especially for Zn and Dietary fiber only met 50% of RNI, while people with dyslipidemia is recommended to increase their fiber intake. This is in line with the information obtained at the planning stage of the FBR, that with the current recommendations, LP analysis identified zinc and fiber as absolute problem nutrients which means there is limitation on the existing food basket for sources of zinc and fiber. Therefore, additional effort is needed to expand the current food basket by introduction of more zinc and fiber rich foods.

In comparison with dietary guidelines for dyslipidemia, current intakes of energy and nutrients in the FBR group still need to be improved. For those with dyslipidemia, the percentage of energy from SFA should be less than 7%, and the percentage of energy from carbohydrates should not exceed 60%.[20,31] This requires special attention, because the main source of SFA is oil used in food preparation, which is rooted in the culinary practices of the Minangkabau people. A cultural approach is needed to change these habits, especially in optimizing how to cook with minimal use of oil. In addition, excessive intake of carbohydrates, especially from refined grains, also promotes dyslipidemia. Some studies document that excess carbohydrates are closely related to increased levels of serum TG.[39,40] Also, although significant improvements were observed, as compared to RNI[30,41] the intakes of linoleic acid and fiber in the diet were still below the recommendations. We found that these were typical problem nutrients in the diet of Minangkabau women of reproductive age, and higher intakes of these nutrients have a positive impact on lipid profiles.[42,43]

To the best of our knowledge, the present study is the first to evaluate the effectiveness of optimized FBRs in improving dietary practices and intakes of typical problem nutrients related to noncommunicable disease risks among women of reproductive age. We found that the optimized FBRs using locally available food were more effective and easily adopted than the standard dietary guidelines commonly used in nutrition services in the health care setting. To provide a more complete picture of the impact of interventions on dyslipidemia, other outcome of this study on nutritional status and lipid profiles are available and will be published elsewhere. However, we identify some potential limitations of this study. First, the subjects were not individually randomized into the FBR or non-FBR groups but were assigned on the basis of their cluster. This may have led to the difference observed at baseline for some characteristics such as nutritional status and LDL level that might affect the outcome.

Second, we were unable to provide a true control group because of ethical considerations. We may have underestimated the effect of FBR promotion on dietary practices and nutrient intakes because respondents in the comparison group received similar messages from standard primary health programs.

Conclusion

Promotion of the optimized FBRs using locally available foods was more effective than standard nutrition care from health center programs in improving dietary practices and nutrient intakes among Minangkabau women of reproductive age with dyslipidemia. In current dietary practices, intakes of some typical problem nutrients such as n-6 and fiber still could not achieve 100% of the RNIs, whereas the intake of SFA still exceeded the recommended intake. Further approaches are needed to promote behavioral change to address established cultural food habits, such as using cooking oil in food preparation and lack of vegetable consumption

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CONFLICT OF INTEREST AND FUNDING DISCLOSURE

The authors declare no conflict of interest.

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Table 1. Final FBRs and recommended portion formulated for Minangkabau WoRA with dyslipidemia

No	Recommendations	Recommended portion
1	Consume 2–3 main meals and 2 snacks in a day	1 serving of rice milled=100 g (dry weight)
2	Consume at least 2 servings/day of meat, fish, or poultry, including	
	a. 2-4 servings/week of egg	1 serving of egg=45 (wet weight)
	b. At least 5 servings/week of sea fish	1 serving of fish=60 (wet weight)
	c. 2-3 servings/week of poultry	1 serving of poultry=40 (cooked weight)
3	Consume at least 7 servings/week of soybean products (tofu or tempeh)	1 serving of tofu=50 g (wet weight) 1 serving of tempeh=50 g (wet weight)
4	Consume at least 2 servings/day of vegetable, including 5 servings/week of dark green vegetables such as cassava leaf, spinach, kale, etc.	1 serving of vegetable=100 g (wet weight)
5	Consume at least 1 serving/day of fruit such as guava, banana, papaya, watermelon, sweet orange, etc.	1 serving of fruit=100 g (wet weight)
6	Consume at least 5 servings/week of potato (e.g., small potato in chicken rendang, potato pure with eggs, etc.)	1 serving of potato=50 g (wet weight)
7	Limit fried foods or foods cooked with coconut milk to a maximum of 2 servings/day	1 serving of fried foods or food cooked with coconut milk could absorb 5–7 g oil or about 30 g of coconut milk (in one portion of curry)

[†]WoRA

Table 2. Intervention package to improve dietary practice among Minangkabau WoRA with dyslipidemia

Intervention components	Description
Activity platform	FBRs promotion through weekly home visit and monthly group meeting for 12 weeks intervention
Key messages	Key messages were constructed based on the optimized FBRs and input from TIPs, related to dietary risk factor for dyslipidemia, combined with messages in Indonesia balanced dietary guidelines. Key messages include: 1. Consumption frequency and portion size of starchy staples and snack foods 2. Consumption frequency and portion size of animal food sources rich in unsaturated fatty acids (PUFA) such as fish, eggs and chicken 3. Consumption frequency and portion size of plant foods, sources of protein and unsaturated fats, especially processed soybeans such as tofu and tempeh 4. Consumption frequency and portion size of fiber-source foods, especially locally available fruits and vegetables such as cassava leaves and other green leafy vegetables. 5. Consumption frequency and portion size of foods processed using oil and coconut milk 6. Clean and healthy life behaviors such as regular exercise, body weight control, personal hygiene and food sanitation
Delivery platform	Using community-based approach, FBR promotion consisted initial subject meeting, weekly home visit, and monthly group meeting within 12-weeks intervention. Interpersonal approach and individual motivation by trained educators to improve dietary practices related to dyslipidemia.
Initial subject meetings	Persuasion before intervention. Messages includes: - Dyslipidemia among women and its consequences - The important of lifestyle change, especially dietary change to overcome the diseases - Reinforcement and build on subjects' personal reason for making dietary change - Desire to support the subjects and assist with change - Strengthen benefits for dietary change and weaken the cons - Introduce key messages in the FBR
12 weeks Regular Home visits by trained educators	- Explain and discuss design of intervention program - Re-introduce key messages in the FBR in relation to dyslipidemia status - Motivating subjects to practice FBR messages, building commitment and self-confidence to improve dietary practice, setting target to change - Encourage subjects to make a specific plan using small, achievable steps - Building skill on each FBR messages for dietary and lifestyle change (counselling, practices) using educational materials and tools such as weekly menu planning form, self-assessment form, recipe book and "my meals plate" - Weekly monitoring and progress check-up, discuss obstacles and solution - Encouragement to cycle back to recommended diet right away and use experience as an opportunity for learning rather than discouragement - Maintenance, congratulate to the success
Monthly group meeting	- Monitoring and evaluation of the progress and achievement - Discuss barrier and solution - Support, encouragement, and review plans for relapse prevention - Congratulate to the success, provide reward
Monthly study team meeting	- Sharing experiences, problem identification and solution in delivering intervention - Team energizing
Promoters	Trained educators (having nutrition education background) assisted by voluntary health worker (cadres)
Tools	Printed educational materials, food recipes, Self-monitoring form, The " my dinner plate" aid, food stuff and gift

Table 3. Selected demographic and socioeconomic characteristics, lipid profile and nutritional status of the study subject at baseline

Parameters	Group		*p* value[†]
	FBR (n=48)	Non-FBR (n=54)	
Demographic and Socio-economy characteristics			
Age, years median (min-max)	39.5 (22-44)	35.5 (21-44)	0.049[*]
Age category, n (%)			
20-34 years	14 (29.2)	25 (46.3)	
35-44 years	34 (70.8)	29 (53.7)	
Education, n (%)	12 (6-15)	12 (0-15)	0.178
No schooling	0 (0.0)	1 (1.9)	
Elementary	3 (6.2)	6 (11.1)	
Junior high school	10 (20.5)	8 (14.8)	
Senior high school	27 (56.2)	38 (70.4)	
Tertiary	8 (16.7)	1 (1.9)	
Occupation, n (%)			
Housewife	41 (85.4)	49 (90.7)	0.474
Government Employee	1 (2.1)	0 (0.0)	
Small trader	3 (6.2)	1 (1.9)	
Others	3 (6.2)	4 (7.4)	
Marital status, n (%)			
Single	2 (4.2)	2 (3.7)	0.313
Married	44 (91.7)	52 (96.3)	
Widow	2 (4.2)	0 (0.)	
HH number, median (min-max)	5 (2-8)	4 (3-8)	0.636
Parity, median (min-max)	2 (0-6)	2 (0-6)	0.428
Per capita income,1000 IDR median (min-max)	525 (200-3.000)	500 (180-1.466)	0.183
Physical activity, MET min/week	1242 (329-4617)	1257 (329-4518)	0.407
Lipid Profile			
Total cholesterol, mg/dL mean ± SD	221±28	207±36	0.022[*]
Low Density Lipoprotein, mg/dL mean ± SD	149±27	135±32	0.010[*]
High Density Lipoprotein, mg/dL mean ± SD	44.7±6.1	46.2±7.0	0.153
Triglycerides, mg/dL mean ± SD	137±57	127±63	0.121
Nutritional Status			
Body weight, kg mean ± SD	67.6±11.7	64.7±12.2	0.283
Height, cm mean ± SD	153.3±6.2	151.3±5.3	0.089
Body Mass Index, kg/m^2 mean ± SD	28.7±4.3	28.1±4.6	0.693
Waist Circumference, cm mean ±S D	90.9±9.2	89.8±10.1	0.634
Abdominal obesity, n(%)	41 (85.4)	41 (75.9)	0.230

[†]Significant difference between the two groups, Man Whitney analysis (for not normally distributed continuous data) or Chi-square analysis (for categorical data), [*]$p<0.05$.

Table 4. Effect of FBR promotion on subject's compliance

Dietary (Compliance score)	Units	Group		*p* value between group[†]
		FBR (n=48)	Non-FBR (n=54)	
Baseline	mean±SD	52.7±12.8	49.2±14.4	0.128
End line	mean±SD	67.2±18.8	56.2±14.9	0.001[**]
Change[‡]	mean±SD	14.5±22.4	7.1±19.6	0.004[**]
p value within group[§]	-	<0.001[***]	0.008[**]	

[†]Significant difference between the two groups: Independent t-test analysis baseline and end-line.
[‡]ANCOVA test, adjusted for baseline compliance score, income and age for between-group differences on change from baseline to end-line.
[§]Significant difference between baseline and end line within group: Paired t-test (for normally distributed continuous data), or Wilcoxon analysis (for not normally distributed data).
[*]$p<0.05$, [**]$p<0.01$, [***]$p<0.001$.

Table 5. Changes in dietary practice from baseline at 12-weeks intervention by intervention group

Food groups/food items†	Recommendation (servings /week)‡	FBR group (n=48)				Non-FBR (n=54)				*p*-Value between group		
		Baseline	End-line	Change	*p*-Value within group§	Baseline	End-line	change	*p*-Value within group§	Baseline¶	End-line4	Change††
Staple food	14-21	16.7±3.4	17.4±3.1	0.67±4.0	0.288	16.3±3.8	17.2±3.4	0.8±4.6	0.086	0.597	0.494	0.736
Snacks	7-14	7.6±5.3	6.2±3.4	-1.4±5.2	0.040*	9.0±5.1	7.7±4.7	-1.3±6.3	0.150	0.144	0.104	0.225
Protein sources												
Eggs	2-4	3.2±1.9	4.1±1.9	0.9±2.5	0.016*	4.0±2.2	4.0±2.4	0.0±2.6	0.920	0.057	0.624	0.417
Sea Fish	≥5	6.0±3.3	8.5±2.3	2.5±3.5	<0.001***	6.2±3.1	6.2±2.4	0.0±2.9	0.460	0.847	0.000***	0.000***
Poultry	2-3	2.0±1.6	2.8±1.6	0.8±1.6	0.034*	2.0±1.9	2.0±1.7	0.0±2.3	0.908	0.547	0.010**	0.002**
Tempeh/tofu	≥7	6.0±4.5	7.9±3.1	1.9±5.0	0.013*	5.9±4.6	6.4±1.6	0.5±4.6	0.377	0.800	0.014*	0.005**
Total Vegetables	≥14	9.3±6.4	11.6±3.9	2.4±6.5	0.005**	6.1±3.7	7.5±3.7	1.4±3.6	0.004**	0.007*	<0.001***	0.000***
Dark green leafy vegetables	≥5	5.1±4.1	7.1±3.6	2.0±4.5	0.003**	3.4±2.7	4.8±2.8	1.4±3.2	0.002**	0.074	0.002**	0.011*
Fruits	≥7	7.5±4.8	9.5±4.2	2.0±4.8	0.015*	6.5±2.2	7.3±2.1	0.8±2.4	0.021*	0.578	0.002**	0.004**
Potato	≥5	2.9±3.6	5.0±4.2	2.0±5.1	0.003**	2.4±2.6	2.6±2.3	0.2±3.1	0.567	0.479	0.001**	0.001**
Total fatty foods	<14	14.2±4.9	13.5±4.9	-0.7±6.6	0.387	14.0±5.6	14.5±5.5	0.5±6.7	0.735	0.929	0.438	0.444
Fried foods	n.s	10.3±4.4	9.2±4.1	-1.2±5.5	0.092	10.9±5.6	10.3±4.7	0.6±5.9	0.477	0.754	0.275	0.772
Curry foods (w/ coconut milk)	n.s	3.9±2.2	4.3±2.9	0.5±3.6	0.309	3.1±2.7	4.1±2.9	1.1±4.2	0.068	0.042*	0.756	0.581

†Refers to food item/group mentioned in FBRs.
‡Refers to recommended servings in FBRs, n.s= not specified.
§Significant difference within groups, paired T-test (for normally distributed continuous data) or Wilcoxon test (for not normally distributed continuous data).
¶Significant difference between the two groups, Independent T-test (for normally distributed continuous data) or Man Whitney analysis (for not normally distributed continuous data) at baseline and end-line.
††Changes were adjusted for baseline, income and age using ANCOVA.
*p<0.05, **p<0.01, ***p<0.001.

Table 6. Changes in selected nutrient intakes from baseline to 12-weeks intervention by intervention group

Selected nutrient intake[†] (mean SD)	RNI[‡]	FBR group (n=48)				Non-FBR (n=54)				*p*-value between group		
		Baseline	End-line	Change	*p*-value within group[§]	Baseline	End-line	change	*p*-value within group[§]	Baseline[¶]	End-line[¶]	Change[††]
Energy (Kcal)	2150	1918±408	1735±150	-183±447	0.035*	1816±252	1862±276	46.5±323	0.217	0.398	0.044*	0.006**
Protein (g)	54-81	65.9±25.2	68.0±14.2	2.0±28.9	0.601	61.9±17.8	67.4±18.7	5.4±24.2	0.044**	0.828	0.635	0.974
Energy from protein (%)	10-15	13.7±3.6	15.6±2.8	1.9±4.3	0.003**	13.8±3.4	14.4±3.0	0.6±4.3	0.137	0.959	0.031*	0.074
Fat (g)	48-72	53.9±25.2	49.3±17.5	-4.6±33.4	0.552	59.6±27.6	58.1±19.1	-1.4±29.1	0.708	0.432	0.010*	0.028*
Energy from fat (%)	20-30	23.9±7.6	24.4±7.5	0.54±11.3	0.649	28.1±10.0	27.2±8.1	-0.88±11.6	0.536	0.103	0.069	0.142
Carbohydrate (g)	268-322	293.9±51.9	259.7±35.8	-34.3±57.9	<0.001***	258.4±41.9	269.3±53.3	10.9±61	0.223	0.004**	0.283	0.000***
Energy from carbohydrate (%)	50-60	62.4±8.3	60.0±8.0	-2.4±12.0	0.209	58.2±10.5	58.1±8.9	-0.1±12.0	0.976	0.110	0.317	0.000***
PUFA (g)	14-26	10.1±9.1	16.04±5.5	5.9±10.9	<0.001***	12.6±10.3	13.78±7.8	1.2±13.2	0.274	0.118	0.060	0.085
n-3 (linolenic acid)	1,1	1.8±3.6	3.1±2.0	1.3±4.2	<0.001***	1.8±3.4	3.1±2.1	1.3±3.9	0.997	0.776	0.952	
n-6 (linoleic acid)	12	2.2±1.9	7.9±4.7	5.8±4.9	<0.001***	2.9±2.1	5.9±5.5	3.0±6.4	0.003**	0.054	0.020*	
MUFA (g)	22	11.9±9.2	21.6±7.7	9.7±12.1	<0.001***	15.0±10.5	17.7±8.4	2.8±14.3	0.083	0.025*	0.032*	0.003*
SFA (g)	23	25.6±9.4	25.6±8.2	-0.03±12.6	0.874	26.2±8.9	30.5±8.5	4.2±11.6	0.030*	0.785	0.002**	0.098
Energy from PUFA (%)	6-11	4.4±3.1	7.8±3.1	3.4±4.9	<0.001***	5.9±4.3	6.9±3.1	1.0±6.3	0.217	0.041*	0.133	0.044*
Energy from MUFA (%)	4-14	5.2±2.8	10.6±4.4	5.3±5.7	<0.001***	7.2±4.4	9.0±4.5	1.8±6.9	0.070	0.004*	0.062	0.008**
Energy from SFA (%)	≤10	12.0±3.9	12.6±4.9	0.52±6.1	0.902	12.9±4.1	15.1±4.1	2.2±6.1	0.028*	0.360	0.001**	0.191
PUFA/SFA (P/S) Ratio	0.6-1.1	0.43±0.39	0.68±0.31	0.25±0.49	0.001**	0.48±0.34	0.49±0.32	0.01±0.48	0.928	0.068	0.002**	0.003*
Iron, mg	13	9.8±9.0	12.1±16.1	2.3±18.3	0.251	10.7±15.0	9.1±3.9	-1.6±14.5	0.032*	0.970	0.743	0.296
Zinc, mg	13	6.4±2.44	6.58±2.06	0.17±3.25	0.845	6.37±2.44	6.29±1.71	-0.08±2.5	0.955	0.340	0.875	0.620
Dietary fiber, g	30	12.3±4.8	15.6±5.5	3.2±6.2	0.001*	11.2±4.0	13.7±5.4	2.5±5.9	0.005*	0.398	0.022*	0.158

SFA: saturated fatty acids; MUFA: monounsaturated fatty acids; PUFA: polyunsaturated fatty acids; RNI: Recommended Nutrient Intake.

[†]Intake was the average of 2-day nonconsecutive 24-hr dietary recalls.

[‡]Recommended Nutrient Intake; for energy and most nutrient refers to Indonesian RNI for WoRA,[30] fat and fatty acids refer to or calculated from FAO recommendation for fat and fatty acids intake.[44]

[§] Significant difference within groups, paired T-test (for normally distributed continuous data) or Wilcoxon test (for not normally distributed continuous data)

[¶]Significant difference between the two groups, Independent T-test (for normally distributed continuous data) or Man Whitney analysis (for not normally distributed continuous data) at baseline and end-line

[††]Changes were adjusted for baseline, income and age using ANCOVA test.

*p<0.05, **p<0.01, ***p<0.001.

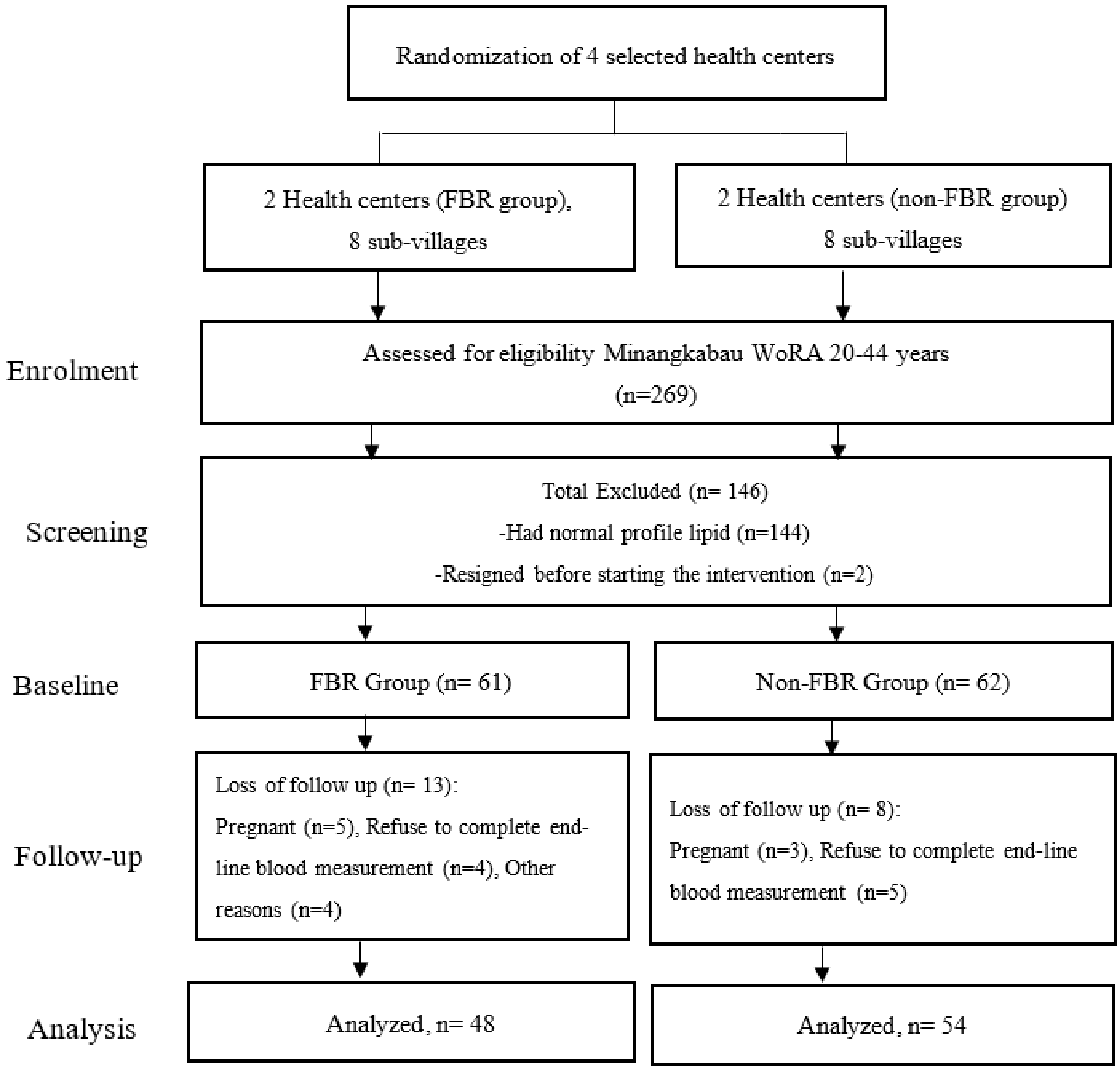

Figure 1. Adapted CONSORT diagram of the trial. WoRA: xxx

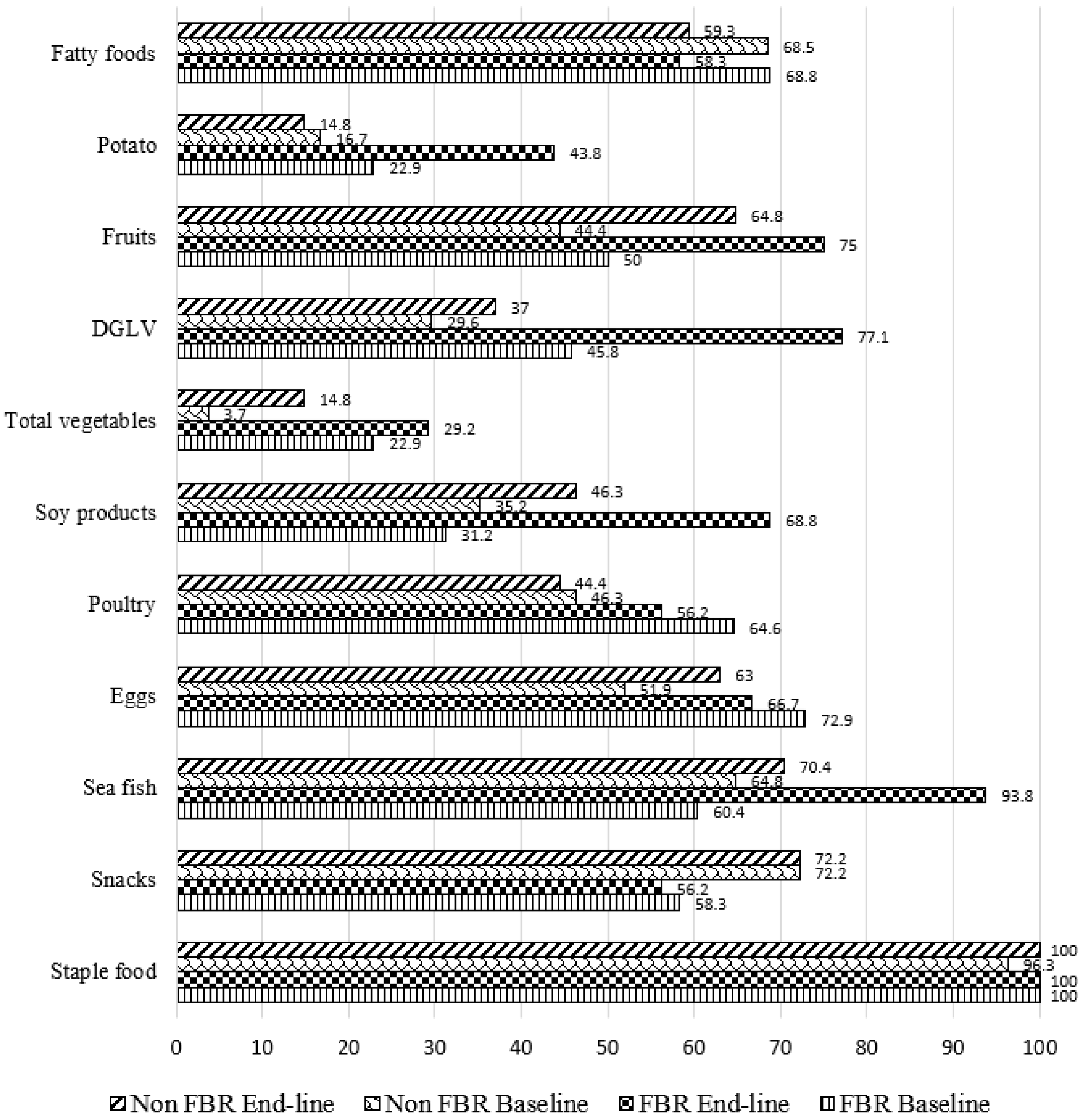

Figure 2. Baseline and end-line percentage of subjects who comply with the recommendations. DGLV: dark green leafy vegetable; FBR: Food-based recommendation