

Using the Dietary Inflammatory Index for Assessing Inflammatory Potential of Traditional Cuisine from Four Ethnic Groups in Indonesia

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Abstract Various studies have shown that chronic low-grade inflammation is associated with increased risk of chronic degenerative diseases such as type 2 diabetes mellitus (T2DM), coronary heart disease (CHD), and some cancers. Dietary factors have been shown played an essential role in this condition. The Dietary Inflammatory Index (DII)TM is a literature-derived population-based dietary score to assess the inflammatory potential of an individual's overall diet. Traditional cuisine from four ethnic groups majorities in South Tangerang, Indonesia, have variabilities in preparing and cooking the dishes even though the ingredient were similar. The current study aimed to compare the DII scores across four different simulated 2100 kcal/day traditional menu for Sundanese, Javanese, Betawis, and Minang diets. The Sundanese diets showed less proinflammatory DII scores (DII = +1.81) in comparison to other diets. The higher intake of fresh vegetables and lower consumption of saturated fat in the Sundanese diet influenced the more antiinflammatory DII score than other diets.

Keywords: dietary inflammatory index, traditional cuisine, Indonesia

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1. Introduction

Inflammation is an underlying pathophysiological process in chronic diseases, such as obesity, type 2 diabetes mellitus (T2DM), cardiovascular disease, atherosclerosis, and some cancers [1,2]. Multiple factors contribute to this inflammatory process, including age, gender, physical activity, smoking, the use of certain medications, and diet [3]. Dietary factors can contribute as a major determinant of inflammation. The Mediterranean-style diet is believed to be the best diet for preventing chronic degenerative diseases. It is partially attributed to the anti-inflammatory properties of some of their foods, such as fruits, extra-virgin olive oil, red wine, nuts, and some of their bioactive components such as polyphenols. The observational cohort study, as well as preventive interventions, have shown a negative association between the Mediterranean diet and cardiovascular risk. [4,5,6] The Dietary Inflammatory Index (DII)TM, created by Shivappa et al., is a tool used to assess the inflammatory potential of a diet consumed by individuals. [7] A meta-analysis by Zhong et al. showed that individuals with the highest category of DII were associated with increased risk of all-cause mortality, cardiovascular

mortality, cancer-related mortality, and CVD than the lowest DII score. [8] In the HELENA study (the Healthy Lifestyle in Europe by Nutrition in Adolescents), a cross-sectional study, diets with higher DII scores associated with increased levels of various inflammatory markers. [9] Ramallal et al. [10] found an increased risk of cardiovascular incidents (myocardial infarction, stroke, or death from cardiovascular disease) with an increase in the DII quartile in the SUN (Seguimiento Universidad de Navarra) cohort study in Spain involving 18,794 subjects with a median observation of 8.9 years. Dietary Inflammatory Index is calculated on 28 food parameters obtained from FFQ data with 136 types of food. Researchers found that the hazard ratio for cardiovascular incidents was 2.03 when compared between the highest quartile of DII and the lowest quartile.

2. Material and Methods

2.1. Study Design

In this study, we designed a simulated one-day intake for each of the different menus based on the traditional cuisine of Javanese, Sundanese, Betawis, and Minang ethnic groups residing in South Tangerang, Banten

Province, Indonesia. Focus group discussions (FGD) were held to arrange a one-day menu. These FGDs involving 6-10 people from 4 ethnic groups. All of the FGDs participants were housewives who usually prepare food for their families every day. Authors have made five alternative daily menus based on the traditional cuisine from these ethnic groups previously. The total calories for each one-day menu have set up around 2100 kcal/day, with the same amount of steamed white rice as the staple food of most Indonesian people. The FGDs participants decided the most appropriate menus that would be used as a menu model according to ethnicity. They also choose the recipes used to prepare the food dishes. The recipes then input into the Nutrisurvey software to get the nutrients composition of the respective dishes. Previously, the Nutrisurvey database was added and supplemented with nutrient composition from the USDA and the ASEAN Food Composition Table. The composition of fatty acid and vitamin D in Indonesian foods were also added from the study held by Neufingerl et al. [11]. Then, we compared the DII values across the four diets.

2.2 The Dietary Inflammatory Index (DII)TM

The DII is a literature-derived population-based dietary score that was designed and developed by Shivappa et al. based on an extensive review of 1943 articles published from 1950 to December 2010. [7] The literature search was limited to articles that assessed the association of one or more of 45 food and nutrient parameters with six well-established inflammatory biomarkers: CRP, IL-1 β , IL-4, IL-6, IL-10, and tumor necrosis factor (TNF)- α . The inflammatory potential for each food parameter was scored +1, -1, or 0 if it increased, decreased, or had no effect respectively on these inflammatory biomarkers.

The first step to calculate the DIITM is by subtracting the amount of each food or nutrient consumed with the "standard global mean"; then, this value is divided by the standard deviation. To minimize the effect of "right skewing", this value was converted to a centered percentile score. Then, each percentile score is multiplied by 2, and 1 is subtracted to achieve a symmetrical distribution with values bounded between -1 and +1. The centered-percentile value for each food parameter is then multiplied by its respective "overall food parameter-specific inflammatory effect score" to obtain the "food parameter-specific DIITM score". Lastly, all of "food parameter-specific DII scores" are summed to calculate the "overall DII score". A more positive DII score is representing more pro-inflammatory diets. In practice, the DII score was computed from dietary intake assessment using a validated food frequency questionnaire (FFQ) or 24-hour dietary recall/records.

In this study, the calculation of DII includes 38 out of 45 foods and nutrients used by Shivappa et al. [7] These include energy, carbohydrate, fat, protein, alcohol, cholesterol, saturated fat, monounsaturated fat, polyunsaturated fat, trans fatty acid, omega-3 fatty acids, omega-6 fatty acids, fibre, vitamin A, beta-carotene, vitamin D, vitamin E, vitamin C, thiamin, riboflavin, niacin, vitamin B6, total folate, vitamin B12, magnesium, iron, zinc, selenium, caffeine, garlic, ginger, onion, pepper,

turmeric, saffron, rosemary, thyme/oregano, and green/black tea.

3. Results and Discussion

The foods and portion size used to model a one-day menu of the four different diets are presented in Table 1. Total daily calorie intake is the same on all four menus, which is around 2100 kcal/day. White rice, as the staple food of all diets, is made in equal portions at every meal. However, in the Minang diet, the portion size of the side dish is made less than the usual portion to get the same total number of calories as the menu for other diets. It happens because, in Minang cuisine, coconut milk that contain saturated fatty acid were often taken part as a component of dishes.

Table 2 showed the DII scores of all four simulated menus and also the sum of 38 food and nutrient parameters used in this study. From this table, it appears that Sundanese menus have the most negative DII scores compared to menus from other diets. One of the reasons is because the characteristics of the Sundanese menu often contain fresh vegetables (it called *lalap* in Indonesian) that usually consumed with *sambal*. Sundanese menus are relatively simple in terms of seasoning and processing compared to other menus. Besides being consumed fresh, vegetables in the Sundanese menu are usually boiled or sauteed. The amount of fiber content was highest in the Sundanese menu, which is 10.93 grams. However, this amount is still lower than the recommended daily intake of fiber, which is 25 grams in women, 38 grams a day for men, or 14 grams for every 1000 kcal in children and the elderly. [12]

The characteristic of the Javanese menu is its sweet taste because of almost all recipes use sugar as a part of spice. One of the typical Javanese food is *gudeg*, made from young jackfruit that long boiled with herbs and brown sugar until soft and purplish brown. Javanese menu rarely contain fresh vegetables. The Betawis menu shows the most positive DII, which means the most potential for pro-inflammation compared to other menus.

Based on Table 2, we could see that all menus have a positive DII value. As a consequence, the diet of these ethnic groups has the potential to increase the risk of low-grade inflammation conditions. The study by Vahid et al. have found that subjects who consumed a more pro-inflammatory diet were at increased risk of pre-diabetes compared to those who consumed a more anti-inflammatory diet. [13] For this reason, it is necessary to improve or modify the diet through various methods.

Table 3 below is an example of a diet modification of the four Indonesian ethnic groups to reduce the value of DII or make the value of DII more negative. From Table 3 it appears that if the fiber intake is increased to meet the recommendation of 14 grams per 1000 kcal, the DII value decreases considerably. Increased intake of fiber derived from vegetables or fruit, will automatically increase the intake of various micronutrients, including folate. The DII value will then be more negative, for example, by reducing the portion of rice intake, increasing the intake of Selenium-sourced food by two times, or by increasing the intake of green or black tea.

Table 1. A One-day Simulated Menu for Sundanese, Javanese, Betawis, and Minang Diets

	Sundanese Diet	Javanese Diet	Minang Diet	Betawis Diet
Breakfast	1 small portion of steamed white rice (100 g) 1 portion fried tempeh (50 g) 1 sunny side up (60 g) 4 slices of raw tomatoes (50 g) raw cucumber (50 g) raw lettuce (30 g)	1 small portion of steamed white rice (100 g) 1 cup black tea with sugar (200 ml) 1 portion <i>semur ayam</i> (50 g)	1 small portion of steamed white rice (100 g) 1 omelet (50 g) 2 pcs eggplant <i>balado</i> (50 g)	1 small portion of coconut rice (100 g) 2 tbs sliced omelet (30 g) 2 tbs peanut sauce (20 g) 2 tbs <i>Orek tempeh</i> (30 g) Two tbs fried vermicelli (30 g)
Lunch	1 medium portion of steamed white rice (200 g) 3 tbs mixed raw vegetables with peanut sauce/ <i>Karedok</i> (50 g) 1 fried chicken (50 g) 1 fried <i>tempeh</i> (50 g) 1 tbs raw <i>shrimp paste sambal</i> (10 g) 1 portion of fried salted fish (10 g)	1 medium portion of steamed white rice (200 g) 1/4 bowl mixed vegetables cooked with coconut milk (60 g) 1 Fried mackerel (50 g) 1 portion <i>bacem</i> tempeh (30 g) 1 tbs raw <i>shrimp paste sambal</i> (10 g)	1 medium portion of steamed white rice (200 g) 1 portion sour and spicy fish stew (60 g) 3 tbs young jackfruit curry (50 g) 1 prawn cracker (5 g) 3 tbs fried potato <i>balado</i> (50 g)	1 medium portion of steamed white rice (200 g) 1/2 bowl mixed vegetables sour soup (125 g) 2 tbs chili sauce (20 g) 1 portion of fried tempeh (50 g) 1 portion of sweet chicken stews (50 g) 1 prawn cracker (5 g)
Dinner	1 medium portion of steamed white rice (200 g) 1 portion carp fish pepes (100 g) 1 fried tofu (40 g) 2 sliced cucumber (30 g) 1 tbs raw basil leaves (10 g) 3 tbs raw lettuce (30 g) 4 tbs raw cabbage (40 g) 1 raw round eggplant (50 g)	1 medium portion of steamed white rice (200 g) 2 tbs <i>gudeg</i> (30 g) 1 portion of chicken stew in coconut milk (50 g) 1 portion <i>bacem</i> tempeh (30 g) 2 tbs spicy cattle skin/ <i>Krecek</i> (20 gr) 1 sliced papaya (90 gr) crackers (3 gr)	1 medium portion of steamed white rice (200 g) 1/2 bowl cassava leaves curry (100 g) 1 portion of beef <i>rendang</i> (50 g) 2 crispy shrimp crackers (100 g) 2 tbs green chili sauce (30 g) 1 portion of papaya (90 g)	1 medium portion of steamed white rice (200 g) 1/2 bowl Betawi meat soup (125 g) 1 potato patty (20 g)
Snacks	1 banana <i>molen</i> (40 g) 4 dumplings with peanut sauce (120 g)	1 spring rolls (45 g) 1 chocolate and banana rolls (40 g)	1 savory <i>martabak</i> (40 g) 1 pancake with sweetened coconut milk (50 g)	1 crispy fried banana (30 g) 1 portion mixed pickled vegetable salad (90 g)

Note: *bacem tempeh*: fermented soybean that cooked with palm sugar and spices then deep-fried; *balado*: sauce made from stir-fried ground chilly; *semur ayam*: chicken stewed with sweet soy sauce; *opor ayam*: chicken stewed with coconut milk and turmeric; nasi uduk/coconut rice: steamed rice cooked with coconut milk; *orek tempeh*: small sliced-fermented soybean (tempeh) cooked with palm sugar or sweet soy sauce.

Table 2. Dietary Inflammatory Index Scores, Nutrients, and Dietary Factors for A One-Day Simulated Menu

Food Parameters	Sundanese Diet	Minang Diet	Javanese Diet	Betawis Diet
Energy (kcal)	2108.2	2137.32	2135.78	2142.1
Carbohydrate (g)	275.06	288.13	298.54	280.42
Total fat (g)	69.18	89.61	71.78	83.28
Protein (g)	97.86	52.56	69.86	76.83
PUFA (g)	23.81	13.5	14.9	18.32
MUFA (g)	27.68	23.06	15.99	23.31
Saturated fat (g)	26.43	33.8	45.47	23.91
n-3 Fatty acids (g)	1.23	0.48	0.57	0.41
n-6 Fatty acids (g)	13.24	11.68	10.18	9.54
Cholesterol (mg)	391.4	307.25	130.3	195.74
Fibre (g)	10.93	9.98	5.59	10.27
Vitamin A (RE)	543.03	1324.27	453.7	783.78
β-Carotene (μg)	4297.28	5122.46	16667.12	1523.34
Thiamin (mg)	1.07	0.57	0.54	0.67
Riboflavin (mg)	1.3	1.02	1.01	1.09
Niacin (mg)	26.38	19.43	24.01	23.45
Folic acid (μg)	237.08	153.45	145.33	162.64
Vitamin B ₆ (mg)	1.4	1.13	1.13	1.29
Vitamin B ₁₂ (μg)	2.18	1.95	0.95	1.41
Vitamin C (mg)	46.7	112.67	82.16	49.39
Vitamin D (μg)	10.41	6.22	6.15	0.52
Vitamin E (mg)	7.46	5.06	3.17	4.76
Alcohol (g)	0	0	0	0
Caffein (g)	0	0	0	0
Fe (mg)	18.54	12.9	11.96	18.3
Mg (mg)	345.44	220.45	438.47	287.35
Se (μg)	32.52	26.66	44.81	29.39
Zn (mg)	10.27	6.78	7.15	9.71
Trans fat (g)	1.84	0.34	0.9	0.39
Garlic (g)	6.9	6.9	3.2	6.8
Ginger (g)	0	2	0.3	0.7
Onion (g)	7.1	22.6	5.9	11.5
Pepper (g)	0	1.5	0.3	1
Turmeric (mg)	320	360	100	0
Saffron (g)	0	0	0	0
Green/black tea (g)	0	0	0	0
Thyme/oregano (mg)	0	0	0	0
Rosemary (mg)	0	0	0	0
DII SCORE	1.81	3.36	3.55	4.23

Table 3. Modification Intake to Alter DII score

	Initial DII	If Fiber Intake 14 g/1000 kcal	plus intake selenium doubled	plus black tea 2 g/d	plus lowering white rice intake	plus double intake vitamin E	plus double intake of folate
Betawis diet	4.23	3.00	2.97	2.50	2.29	1.71	1.34
Javanese diet	3.55	2.27	2.18	1.71	1.38	1.33	1.02
Minang diet	3.36	2.13	2.07	1.60	1.32	0.63	0.30
Sundanese diet	1.81	0.60	0.40	-0.08	-0.28	-0.96	-1.32

4. Conclusion

This paper highlights the potential of implementing assessing the quality of diet using DII score on various Indonesian menus. The Sundanese diets showed less proinflammatory DII scores (DII = +1.81) in comparison to other diets. The higher intake of fresh vegetables and lower consumption of saturated fat in the Sundanese diet influenced the more antiinflammatory DII score than other diets.

Abbreviation

Coronary Heart Disease (CHD, Dietary Inflammatory Index (DII), Type-2 Diabetes Mellitus (T2DM).

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Conflict of Interest

The authors declare no conflict of interest.

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